



Kingdom of the Netherlands

A wide-angle aerial photograph of a coastline at sunset. The sun is low on the horizon, casting a golden glow over the sky and the water. The land is visible in the foreground, and the ocean extends to the horizon.

Dutch Risk Reduction Team:
Reducing the risk of water related disasters

DRR-Team Peer review report
Irish Flood-Risk Management

Peer review report Irish Flood-Risk Management

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Summary

This report describes the results of a high-level independent peer review to validate the flood-risk management (FRM) policy in Ireland. The review has the objectives to bench-mark the Irish FRM policy with international best practice, and to identify strengths and weaknesses of any challenges facing Irish national FRM policy and practice, including governance arrangements and resourcing, and indicate key areas that can inform future legislation, policy and resource allocation.

The main finding of the peer review is that *Irish FRM is well on track*. The current policy is formulated in 2004, with the Office of Public Works (OPW) as the lead authority. Since 2004, insight is obtained in the risk profile of the critical hot spots, efficient investments have been made in reducing the flood damage, spatial planning in relation to FRM has been improved and disaster management received a lot of attention. Much progress has been made and the review team is impressed by the results.

The review team concludes that *Irish FRM complies with international best practice*. The international benchmark shows that Irish Flood-Risk Management follows the international best practices. There are many action perspectives in FRM: accepting the risk, preventing the risk to a certain extent by spatial planning, building codes and flood defences, crisis management. It is always important that an appropriate mix of interventions is chosen, and it seems that the chosen mix comes close to international best practice.

However, *there are opportunities to improve Irish FRM*. Despite the strength of Irish FRM, there are ways to strengthen it further. We have found four main directions of improvement:

- Increase investment levels for flood protection. Although investments levels are increased in the past ten years, the level of investment can be increased by at least a factor of 2, from a societal cost-benefit analysis perspective. The review team has observed that the Irish government has taken appropriate actions in 2015;
- A national flood forecasting system is not yet implemented, where all available meteorological and hydrologic knowledge is combined in one information system, and which is based on online measurements. Plans are made for such a system, but funds are lacking until so far. Moreover, output of the information has to be distributed efficiently to all stakeholders, with information on appropriate response actions have to be given, preferably before the flood threat actually occurs;
- There is in every country a tension between efficient FRM and an integrated approach where all relevant sector perspectives are taken into account. Since OPW has the lead in FRM, the pressure to take measures from a flood risk perspective is present, and without such a pressure, is it difficult to reduce flood risk. However, flood risk reduction can be even more improved by combining it with policies from other sectors, for example agriculture, urban design and nature. The review team advises to strengthen an integral system approach, without losing the reins with respect to FRM;
- Coastal flood risk is part of FRM policy, but coastal erosion without inferences with coastal floods can be considered as a local or regional concern. An integrated coastal approach seems here appropriate, with coastal erosion risk as one of the inputs in an integrated plan. Specific knowledge about coastal erosion has to be provided by a national authority, because adequate knowledge in these plans is one of the key success factors.

1 Introduction

1.1 Background

In September 2004, the Irish Government approved the Report of the National Flood Policy Review Group. Since that time, much work has been done, but also a number of very damaging floods have occurred. 10 years later, the Office of Public Works (OPW) decided that, a high level independent peer review would be valuable in order to conclude whether the 2004 policy is still valid, and coincides with the international best practice within the Irish context.

1.2 Objectives

In 2014 the Office of Public Works asked for a high-level independent peer review to validate the policy adopted in 2004.

In the Terms of Reference of the peer review the two main objectives are defined as follows:

1. Bench-mark the Irish national flood-risk management (FRM) policy and compare it with the international best practice.
2. Identify strengths and weaknesses and any challenges facing Irish national FRM policy and practice, including governance arrangements and resourcing, and indicate key areas that can inform future legislation, policy and resource allocation.

1.3 Scope

The scope of the peer review covers three principal areas:

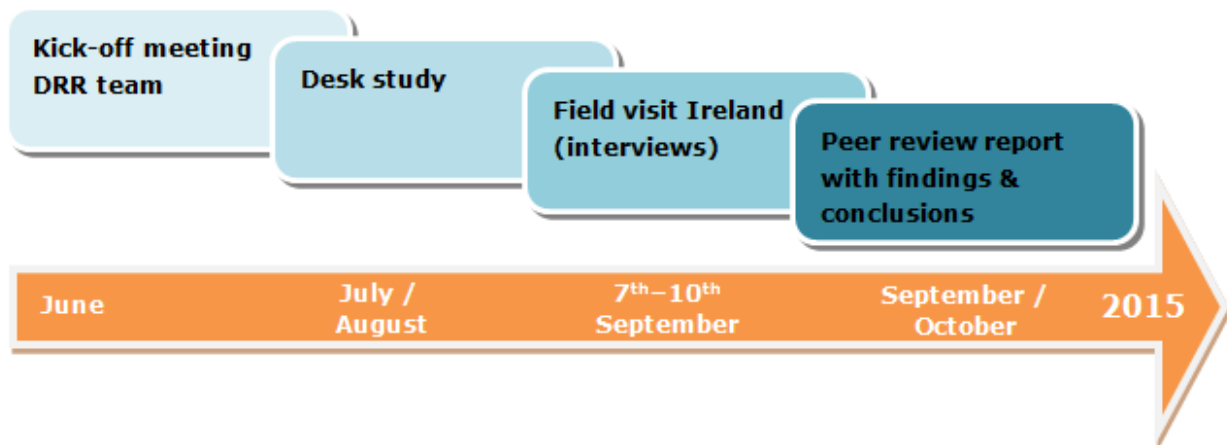
1. Overall Policy and Practice.
In this part the policy and practice of integrated Coastal erosion and Catchment policy is discussed.
2. Governance Arrangements and Resources.
The organisation of Flood Risk policy and available resources are discussed in this part of the review.
3. High-Level Programmes.
A number of High-Level programmes are discussed and recommendations are given with respect to these programs.

The peer review is at a high-level, and examines broad policy, strategy and financial issues, with comparison made to international approaches and safety standards, and take into account statutory requirements and contexts. The review looks at policy and practice overall, including the high-level programmes and resources (human and financial) available to support these programmes. The review does not consider individual projects.

1.4 Process

The OPW asked the Dutch government to be involved in the peer review within the context of Dutch Risk Reduction (DRR) project. The Dutch government organized a project team (the authors of this report) and asked also mr. Robert Slomp (Ministry of Public Works and Spatial Planning) to be involved as a reviewer. Mr. Rob Steijn made a contribution with respect to Coastal Erosion.

The Figure below illustrates the working process of the review team.



Interviews during the field visit have been held with employees of several departments of the Office of Public Works, Dublin City Council, the Environment Agency Protection, Department of Environment, Communities and Local Government, the Office of Emergency Planning and Insurance Ireland.

1.5 Outline

This report presents the findings of the Peer Review Team. In Chapter 2 the focus is on the overall Policy and Practice. Chapter 3 is devoted to Governance, and Chapter 4 focuses on a selected number of high-level programmes.

2 Overall policy and practice

2.1 Introduction

This review assesses the overall Flood Risk Management (FRM) policy and strategy in the Republic of Ireland. This policy and strategy is compared with international best practices.

In this Chapter we first present a rough overview of FRM policy in Ireland. Next, we consider two topics of the FRM policy and strategy: the coastal flooding and erosion policy (Chapter 2.3), and the integrated catchment policy (Chapter 2.4). In Chapter 2.5 we consider the balance, challenges and gaps for future FRM from the perspective of the review team (Chapter 2.5).

2.2 Overview of Irish Flood Risk Management

The Office of Public Works is the lead State body for the coordination and implementation of Government policy on the management of flood risk in Ireland. This role also includes close liaison with a range of local authorities, organisations and stakeholders that also have responsibilities for managing flood risk in Ireland. The aim is to minimise the impacts of flooding on society, households and businesses, through sustainable planning, guidance, information and effective measures for areas at risk from flooding.

There are three pillars to the management of flood risk, namely:

- Prevention - Avoid Creating Flood Risk (Sustainable Planning and Development – planning guidelines).
- Protection - Reduce Likelihood of Flooding (through investment in the Capital Works Programme).
- Preparedness - Preparation and Resilience (Emergency Response: Note that Local Authorities (and not OPW) are Principal Responders)

The OPW funds investment in capital works projects and measures to reduce the likelihood of flooding in areas at risk of flooding. This investment is undertaken both on major urban flood relief projects carried out either by the OPW directly or by local authorities acting on the OPW's behalf and on localised minor flood mitigation works which are undertaken by local authorities with funding provided by the OPW.

However, works that are normally the responsibility of the local authorities such as repair and maintenance of flood or coastal defence structures in the ownership and management of the local authorities will generally not be considered for OPW funding (source: <http://www.opw.ie/en>).

2.3 Coastal protection / erosion policy¹

The Irish coastline spans 4600 km of which is 56% hard rock, 1% soft erodible rock, 39% beaches, 2% muddy coast and 3% artificial coast (source in footnote 2). The resistant headlands with sand and gravel beaches in embayment's, often associated with estuaries, are generally found along the northern, western and south-western coasts. More mobile sediment deposits are found mainly along the east and south-east coast. The coastline of Ireland is relatively long compared to other European countries.

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¹ Based on contribution by mr. R. Steijn (Arcadis)

Table 1 presents an overview of the length of the coastline, the number of inhabitants and the average number of inhabitants per km length of the coastline for Ireland and 5 other European countries. From this Table it follows that the Republic of Ireland has a relative low number of inhabitants per km shoreline compared with the Netherlands, Portugal and United Kingdom (factor 10) and is comparable with Denmark.

This means that it is in general more difficult to generate funds for coastal policy in Ireland and Denmark than in the other three countries, because there is a strong relation between GNP and number of inhabitants.

Country	Length shoreline [km]	# inhabitants [million]	Average [1000 inh/km]
Ireland	4 600 km	4.8	1.0
Netherlands	1 300 km	16.9	13.0
Denmark	4 600 km	5.6	1.2
Portugal	1 200 km	10.8	9.0
United Kingdom	4 300 km	62.3	14.0
France	9 000 km	65.6	7.0

Table 1 Information about length of shoreline for 6 European countries

Some 900 km of shoreline in the Republic of Ireland are reported to be eroding², mainly along the southeast and east coast, with smaller patches of eroding coasts along the southwest and west coast (data till 2001).

Based on historic maps, it appears that most of the erosion is in response to specific storms rather than a gradual retreat (Bell, 2014). A case study for Kilpatrick showed a retreat of 50-100 m in the period of 1973-2000. Similar erosion rates (2-5 m/y average retreat) have been recorded at other locations as well.

The erosion normally doesn't pose a major threat to the hinterland, which is generally located above (high) sea level. However, the erosion undermines infrastructure and buildings located in the erosive zones. Since the nineties, the value of these built assets has risen considerably, which makes coastal erosion a relevant topic for local societies.

The coastal geomorphology at some locations is more complicated than for instance along cliff coast, in particular in and near estuaries. The presence of a sand spit in front of the shoreline, for example at Rosses Point, is an important geophysical element in the coastal resiliency of the area. If during an extreme event the spit breaches for example, or if the volume of the spit is reduced gradually by human actions, then more intense erosion can be expected in the area behind the spit. The morphodynamic response of such coastal systems is less easy to predict and requires an expert's assessment.

The Republic of Ireland faces many challenges with respect to the coastal protection and erosion policy. There are two important hazards along the coast: coastal flooding, and coastal erosion. The first can cause flood damage to infrastructure, buildings, etc., and the second can cause local damage to the properties of land owners. It is recommended to distinguish between these two aspects and follow a different policy for each. Of course, there may be a relation between these flooding and erosion in some of the areas, which has to be taken into account. A practical way of

² EUROSION, 2004. Living with Coastal Erosion in Europe: Sediment and Space for Sustainability, Part II: Maps and Statistics and final report. ISBN 92-894-7496-3.

doing this is to make locations where coastal erosion can lead to flooding problems, part of the coastal flooding policy. Next, we discuss these aspects in more detail.

Coastal Flooding

The coastal flooding problem is investigated in the CFRAM Programme (see Chapter 4.2), which includes 90 hotspots prone to coastal / tidal flooding. For these areas, the national funding mechanism in CFRAM can be used for the financial resources. In CFRAM, costs for protection (construction, maintenance and monitoring) are related to the assets that are being protected: the higher the value of the assets, the more budget is available to protect it. This practical risk approach provides the methodology to deliver quantitative input for all hotspots, including non-monetary values such as flood risk for individuals, and groups. *The review team concludes that CFRAM uses the international best practice: investments in flood protection are balanced with the assets to be protected to prevent damage (see also Chapter 4.2).*

Coastal Erosion

Investments to prevent coastal erosion can also follow the cost-benefit approach. From a national perspective, investments are only beneficial if benefits are higher than the costs. *The review team recommends developing a regional strategy with respect to coastal erosion, using a national framework where (among others) costs and benefits are included.* Each region should have a strategy about the locations where to maintain the coastline, or not. Perhaps the concept of “sediment cells” can be used to define the regions, because the processes of erosion, transportation and deposition within the coastal margin is largely contained within sediment cells. In order to obtain experience with such a framework, *it is recommended to perform a pilot study with one of those regions.* In such a pilot, an assessment of the risk posed by erosion is made, and proposed measures to manage erosion, if required, within the cell are assessed.

The end result of such a study would be a detailed map with acceptable erosion lines, and proposed measures to manage erosion, if required, within the cell.

From a regional perspective, it might be attractive that the national government provides funding. In Portugal the national government works like this (with help of the EU), but in Denmark the investments against coastal erosion is a completely regional task (with full responsibility of the local land owners). The question is what policy to follow in Ireland. This is a political choice about what to do nationally and what to do regionally. *A suggestion of the review team is to follow the Denmark regional policy for coastal erosion, because the many regional erosion issues in Ireland look comparable with Denmark.* There might be of course other ways to organise measures against coastal erosion.

Coastal erosion policy is part of coastal-zone management, so the question arises whether the control of coastal erosion should be an integral part of a policy on coastal zone management.

In the Netherlands there is a dedicated national policy on coastal erosion, as well as dedicated legislation on flood-risk management and spatial planning. These two policies seem to be independent, but in reality they are not. When the coastal erosion policy was developed in the late Eighties - early Nineties, it was clear that maintaining the shoreline would contribute to the country's flood safety. Later, it turned out that solely maintaining the shoreline was not enough, and compensation of erosion by sand nourishments became a prerequisite for the safety of the low-lying hinterland. This shows that coastal flooding and coastal erosion can be strongly connected.

For the Republic of Ireland, this is in many areas not the case, *and therefore the review team recommends to let coastal erosion be an integral part of Integrated Coastal Zone Management (ICZM). The EC adopted eight principles on good ICZM practice, see OURCOAST website (2012), and it is recommended to take these into account.*

2.4 Integration of catchment management with related policy sectors

Catchment management is important for many stakeholders. The reason for this is that there are many water-related functions and many related policy sectors, such as fisheries, the environment, fresh-water supply and agriculture. These sectors often have their own approach and policy. The CFRAM (Catchment Flood Risk Assessment Management, see Chapter 4.2) program presents insights into the risk profiles of the “hot spots” from the perspective of flood risk. In this programme, measures are developed which will reduce the flood risk in a cost-effective way. These measures can, however, have an impact on other sectors and this impact can be either positive or negative. Measures from other sectors might influence flood risk as well, again in a positive or negative way. An integrated solution therefore seems appropriate, but if all sectors have to agree upon all measures, nothing will happen. It is often very unlikely there are measures that are beneficial for all sectors. One of the solutions for this dilemma is to first identify the practical issues that have to be solved, and then accordingly to develop an integrated plan focussed on these practical issues. These issues have to be identified together with relevant stakeholders, so that these stakeholders can also actively contribute to better understand these issues and subsequently contribute to identifying possible solutions.

At this moment, the CFRAM program focuses on solutions for reducing flood risk. This part of CFRAM is an important step for finding integrated solutions, since in order to find the “best” solution, various alternatives have to be considered. A next step can be to investigate whether more integrated solutions can be found reduce flood risk on the one hand, and which have (additional) benefits for other sectors on the other. These benefits are taken into account within a Multi Criteria Analysis (MCA), so the promotion of additional benefits is embedded into the option appraisal and selection process. *The review team concludes generating alternatives from multiple perspectives is reflective of best practice and that responsibility for Flood Risk reduction remains with OPW as the lead authority.*

The above mentioned approach to catchment management and spatial planning can be found in other countries. An example in Germany along the Elbe River can clarify this approach. Spatial planning uses a range of instruments to control the land use in flood plains, risk areas and flood originating spaces. Spatial planning can secure areas for development in the long term, which is often not possible with sectoral planning measures only. Consequently, there are many practical measures that can be adopted in spatial planning. Figure 1 presents an overview of possible (transboundary) measures along the Elbe³.

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³ Spatial measures often take a lot of time to plan and realise. In 2013 the plans elaborated after the 2003 flood had not all been carried out. Many areas flooded for a second time.



Figure 1 Example of catchment strategy to reduce flood risk (Saxon State Ministry of the Interior, Germany, 2006)⁴

The review team recommends investigating whether the Spatial Planning approach used for the Elbe River, might be helpful for catchments in the Republic of Ireland.

2.5 Balance between the three FRM pillars

Many improvements have been made in the approach of FRM in the Republic of Ireland since 2004. There is now a lead authority, the Office of Public Works (OPW), which is a big step forward. Since 2004, the OPW has been very active in FRM and has obtained significant progress. For example: insight is obtained in the flood risk of the hot spots, much progress is made in the three pillars of flood risk (prevention, protection and preparedness), and flood-reduction measures have been implemented, and are planned to be implemented. However, there are challenges remaining. In this chapter we mention two of them: investments in FRM and the balance between the pillars. Other challenges are presented in Chapters 3 and 4 of this review.

Investments in Flood Risk reduction

In the last decade many investments in the FRM approach and protection measures have been made in order to the reduce Flood Risk in Ireland.

⁴ Saxon State Ministry of the Interior, 2006. Preventive flood management measures by spatial planning for the Elbe river basin ELBE-LABE spatial planning flood management strategy. Results and proposed actions. Published by: Department for State Development, Surveying and State Security, Wilhelm-Buck-Strasse 2, 01097 Dresden, November 2006.

These investments are justified with a sound cost-benefit analysis. However, from the CFRAM program the review team concludes that flood risk in Ireland is relatively high, and that more investments in Flood Risk reduction are, from an economical point of view, justified. For more details we refer to Chapter 3 and 4.

Balance between the pillars of FRM

It is internationally recognized that Modern Flood Protection follows more than one type of measure (in Ireland the different type of measures are called 'pillars'). These pillars are defined differently in the international literature, where we find terms as multi-layer safety (Netherlands), or multiple lines of defence (USA).

Multiple Lines of Defense

The multiple lines of defence against flooding have been worked out for hurricanes along the coast of southeast Louisiana (USA). In the simplest terms, this strategy highlighted in Figure 2 shows how natural features of the coast (such as barrier islands, marshes, and ridges) compliment man-made features (like levees and flood gates) to protect the Greater New Orleans area from hurricanes.

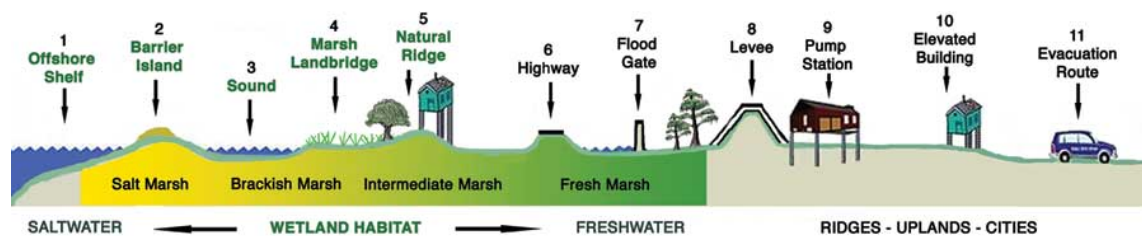


Figure 2 Example of Multiple lines of Defence in Louisiana

In reality, however, the multiple lines of defence as presented in the above Figure are not completely followed: for example the pumping stations and many houses in New Orleans are not built on pillars. But the idea is clear: there is not a single solution to reduce flood risk, but multiple measures combined can reduce flood risk efficiently.

The line of reasoning behind the multiple lines of defence approach is also followed in the Republic of Ireland. Here, three pillars have been defined: prevention, protection and preparedness. Since 2004, the OPW gives attention to these three pillars, often in cooperation with other agencies. A very nice example is the 60-page booklet about preparedness for flood events ("Plan, Prepare, Protect"), see Figure 3. The aim of this booklet is to raise public awareness of the dangers of flooding and the measures that can be taken to minimise the damage that can be caused to persons and properties by the hazards of flooding. It covers all relevant topics, for example how to make a home flood resistant, information about insurance cover, and also the way flood risk is assessed. This makes the booklet complete and useful. Also, each individual section can be downloaded separately. Perhaps some simple, additional flyers might also be helpful, although it is difficult to get the attention of home owners when there is no (imminent threat of) flood.

The balance between the three pillars: prevention, protection and preparedness is not fixed. From an international perspective we see many differences. In the Netherlands for example most attention is given to protection, while in the United States of America much attention is given to preparedness.

This has to do with many factors, such as the nature of the threat and the risk attitude in the country. *The review team concludes that the approach in Ireland is well-balanced overall, but further resources should be invested into protection (more investments into protection) and preparedness (a national flood forecasting system is missing - see also Chapter 4.6).*



Figure 3 Booklet about Flooding for those whose properties are at risk (OPW, 2014)

2.6 Conclusions on overall policy and practice

The overall conclusion with respect to Flood Risk Management in Ireland is that it meets the international best-practice standard. Still, as everywhere, dilemmas in this policy remain. Three of them are mentioned below.

The policy on **Coastal Erosion** is not fully complete yet. Because from a financial perspective it seems not feasible to hold the coast line fixated everywhere in Ireland, it must be clear to everybody where to hold it, and where some erosion is acceptable. These decisions have to be supported by a national framework, so that local decisions seems fair to the local people. Clearly, these decisions are difficult, because they do not always meet the interests of the local people. *The review team recommends to let coastal erosion be an integral part of Integrated Coastal Zone Management (ICZM).*

The policy on **Catchment management** and especially the relation between Flood Risk reduction and other policy sectors (such as fisheries and agriculture) need some further reflection. At this moment, the CFRAM program develops flood-risk reduction measures, and this information is very useful. On a catchment level, attention can be given to a regional spatial plan for the many possible risk-reduction measures.

Remaining challenges in FRM are presented in Chapter 3 and 4. Here we want to conclude that there is a need for **further investment** in Flood protection. The **three pillars** of FRM (prevention, protection and preparedness) are in balance with each other, although there is a need for a national flood forecasting system.

3 Governance arrangements and resources

3.1 Introduction

As part of the high-level review government arrangements, roles and responsibilities were assessed. Recently, the OECD published the Principles on Water Governance⁵. These principles and the considerations behind them have been used by the review team as a guideline.

From: OECD Principles on water governance - Considerations

- Meeting current and future water challenges requires robust public policies, targeting measurable objectives in pre-determined time-schedules at the appropriate scale, relying on a clear assignment of duties across responsible authorities and subject to regular monitoring and evaluation.
- Effective, efficient and inclusive water governance contribute to the design and implementation of such policies, in a shared responsibility across levels of government and in co-operation with the relevant stakeholders to meet current and future water challenges.
- There cannot be a single, uniform policy response to the water challenges worldwide given the diversity of situations within and across countries in terms of legal and institutional frameworks, cultural practices, as well as climatic, geographic and economic conditions at the origin of diverse water challenges and policy responses.

When looking at the roles and responsibilities of different levels of government, subsidiarity is used as a key principle. The subsidiarity principle⁶ is a basic governance principle within the European Union regarding the division of responsibilities between Europe and the member states. This is considered a useful principle as well for the division of responsibilities between national and regional or local governments within EU countries. The subsidiarity principle states that government decisions should be made as close to the citizen as possible. So, higher government should not take on responsibilities or actions which can be taken at a lower level. The lowest possible government level is in general regarded as the appropriate one.

3.2 Governance arrangements

3.2.1 Allocation of responsibilities for addressing and managing different sources of flooding

Within Ireland six sources of flooding can be distinguished: tidal, fluvial, pluvial, as well as flooding from urban storm water drainage, water bearing infrastructure, dams and reservoirs. The possible impact differs in terms of scale: what area can be flooded?, how many people and properties can be affected at the same time? With regard to possible measures, there can be dependencies between cities and counties, such as taking measures within a river basin, or not.

At the moment, roles and responsibilities for addressing and managing the different sources of flooding appear not be entirely clear to all involved. The OPW has successfully picked up the lead role for flood-risk management in Ireland in the last ten years. A lot has been achieved. This might

⁵ OECD, C/MIN(2015)12, Principles on Water governance, May 2015, JT03376779.

⁶ Article 5 of the Treaty on European Union.

cause others, including the media, to look at OPW for addressing and managing flood risks that, in terms of good governance, might be better addressed and managed by other parties, such as local governments. The key question then becomes: what should be the role of OPW when looking at the different sources of flooding, and what not?

In general, when the impact is expected to be local and there is no dependence between local authorities, following the subsidiarity principle there seems no justification for an intervention from OPW. Unless maybe critical national assets are at stake, like the Taoiseach's office, electrical key infrastructure, hospitals, etc.

Sources of flooding		Typical impacts, dependences
Tidal	Storm surges combined with high or extreme tides.	Regional or even nationwide. Measures can be interdependent within coastal sediment cells.
Fluvial	Rivers run off and exceed their normal riverbed during or after periods of heavy rain in the catchment area.	Regional. Measures can be interdependent within a catchment area/river basin.
Pluvial	Heavy rainfall does not run off quick enough, typically in urban areas, and leaves water on streets or worse.	Local. Usually no interdependence between cities or counties.
Urban storm water drainage	The urban drainage system overflows with (polluted) water after heavy rains, snow melt or system block.	Local. Usually no interdependence between cities or counties Related to pluvial flooding.
Water bearing infrastructure	Incidents with water bearing infrastructure cause floods, like pipes bursting due to low maintenance.	Local. Usually no interdependence between cities or counties .
Dams	Hydropower or water-supply reservoirs cause floods downstream when water is carelessly released, or dams breach.	Regional, measures can be interdependent within a catchment area/river basin.

Table 2 Sources of Flooding

Conclusions and recommendations:

1. Pluvial floods, and flooding related to water bearing infrastructure and urban storm water drainage systems should in general be addressed and managed by local authorities (with a key role for the owners of water bearing infrastructure and storm water drainage systems), unless maybe there are national critical infrastructures or assets at stake that justify intervention from a higher government level (OPW).
2. The possible impact and the interdependence among cities or counties to take effective measures to address and manage tidal and fluvial floods and flood risk related to dams and reservoirs calls for a higher government level (OPW) to intervene and or take action. With regard to dams, dam operators have of course their own responsibility for dam safety. A role for the higher government level (OPW) exists in relation to dam safety legislation and oversight.
3. It is recommended that, being the lead agency at the national level, OPW takes up roles and responsibilities from a national risk management point of view. That means that the Irish citizens might expect OPW to know the higher flood risks (probability x impact) regardless of the source of flooding and create awareness at the right government level to take action.

3.2.2 Allocation of responsibilities with respect to different stages of the FRM cycle

In assessing the allocation of responsibilities for Prevention, Protection and Preparedness in flood-risk management the review team focused on principle No. 1 from the above-mentioned OECD principles on Water Governance. This first principle is about Effectiveness.

The questions we addressed are:

1. Are roles and responsibilities clear with regard to:
  - Policy making, especially priority setting and strategic planning.
  - Policy implementation, especially financing and budgeting, data and information, stakeholder engagement, capacity development and evaluation.
  - Operational management, especially infrastructure operation and maintenance.
  - Regulation and enforcement, especially standards, monitoring and supervision.
2. Are there gaps, overlaps and conflicts of interest, and is there effective coordination at and between all levels of government?

Based on interviews and desk research our high level findings are presented in Table 3 below. More detail on specific programs can be found in Chapter 4 of this review.

	Prevention	Protection	Preparedness
<i>Policy making</i>	Guidelines on FRM for Planning Authorities in place ⁷ .	CFRAM approach follows international best practice.	Guidelines and procedures are in place both at national and local level (in general).
<i>Policy implementation</i>	Guidelines require a learning curve for local authorities and others, but already promising examples.	Minor works scheduling seems effective and in line with the subsidiarity example. Major works completed within budget, but not within the time. Stakeholder management needs more attention.	The role of flood forecasting including a flood warning system is clearly missing.
<i>Operational management</i>	Not applicable.	Responsibility for maintenance of flood defenses causes much debate (and delay?) in case of multi-level cooperation between governments.	Gap in roles and responsibility with regard to individual property protection and resilience of the public (including emergency measures).
<i>Regulation and enforcements</i>	After six years it is now a good time for a first evaluation round of the 2009 guidelines.	Coherent supervision on maintenance and operation of large constructions upstream (dams and reservoirs) is missing.	Emergency rehearsals with the public and control and audit of emergency measures need more attention.

⁷ The Planning System and Flood Risk Management, Guidelines for Planning Authorities, No. 20, Nov. 2009.

	Prevention	Protection	Preparedness
<i>Effective Coordination</i>	The drafting of the 2009 guidelines is a good example of effective cross government cooperation.	Cooperation with local authorities in protection works is sometimes good, sometimes not.	Effective coordination at the national level (National Emergency Coordination Group). Is the right public reached?
<i>General remarks and recommendations</i>	The drafting of the new National Spatial Strategy offers a new challenge to cross government cooperation and an opportunity for an even more proactive approach f.i. related to catchment planning.	The upcoming protections schemes (following CFRAM) present an opportunity to boost the level of cooperation with local authorities in general. It is advised to solve the debate on maintenance of new flood defenses in general before starting new specific schemes.	Local Authorities have a clear responsibility in emergency planning and action but not always the capacity. Communications should be specific to reach the right people, not part of a general campaign. The flood maps now available make this possible.

Table 3 Findings about roles and responsibilities related to the three pillars of Flood Risk Management
Green = OK; Yellow = improvements are possible; Orange = major improvements are possible.

Conclusions and recommendations:

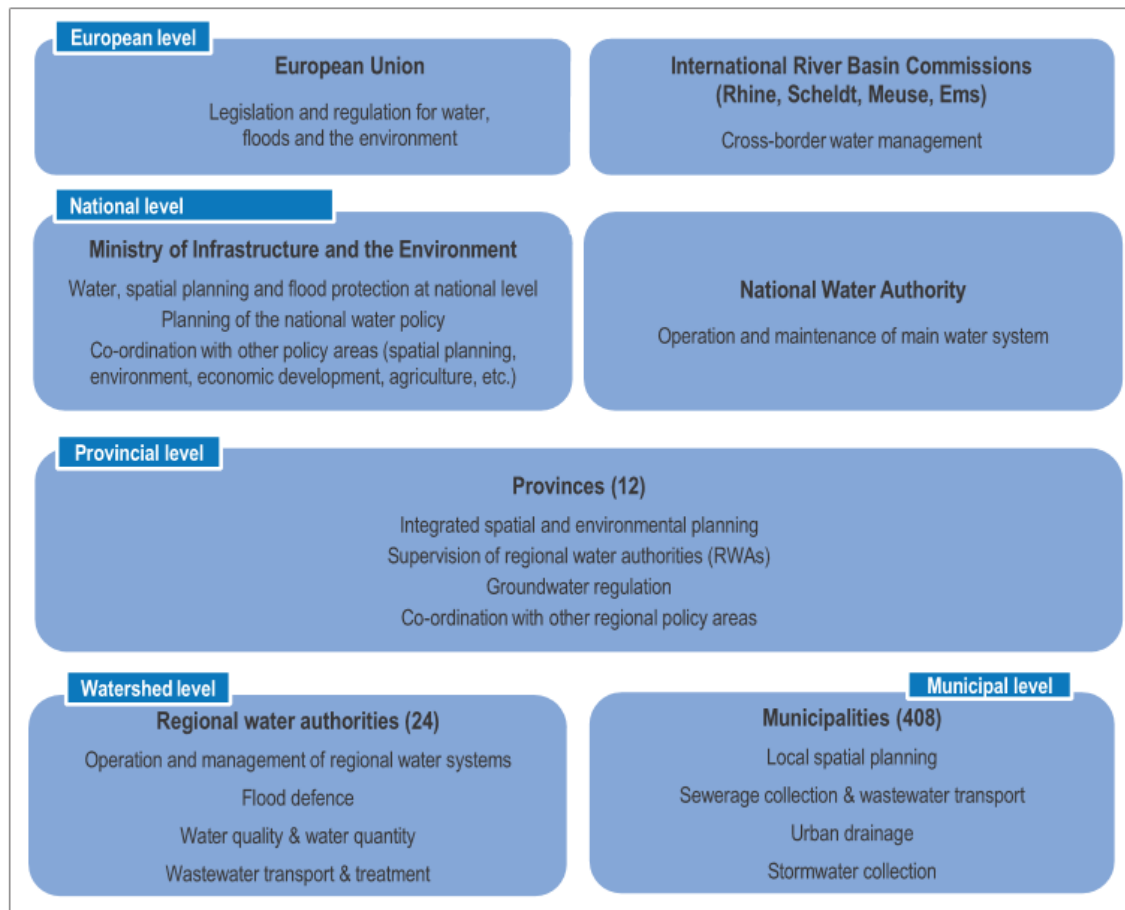
1. Role and responsibilities are clear, effective and there is proper coordination when it comes to FRM policy making.
2. Policy implementation is on its way for both prevention and protection, with regard to preparedness the role of flood forecasting and warning is clearly missing. Lack of funds and human resources is a serious issue in policy implementation.
3. Operational maintenance: in case of multilevel cooperation between governments, roles and responsibilities are scattered, or not agreed on by all involved.
4. Regulation and enforcement: evaluation of the 2009 guidelines is recommended, dams and reservoirs lack coherent supervision in relation to flood risk management.
5. Effective coordination exists within the national government; improvement is possible in coordination between different levels of government.

3.2.3 Allocation of responsibilities with respect to different spatial level and level of Government

In assessing the allocation of responsibilities among governments the review team focused on the OECD Principle on Water Governance No. 2, which talks about *appropriate scale and long term integrated policy and planning*. Appropriate scale is about the scale of the water system; the river basin and catchment area for rivers and the sediment cell for coasts. At these scales, and when it comes to integrated long-term approach cooperation between government levels is always needed. In deciding who should take the lead the principle of subsidiarity applies; what is the lowest possible level (that is closest to the citizen) that can take on the task?

*International example***Water governance in the Netherlands: roles and responsibilities**

Recently, the OECD reviewed water governance in the Netherlands (OECD 2014, Water Governance in the Netherlands - Fit for the Future?). It was concluded that the Netherlands has a robust and adjustable institutional and policy framework. The Figure below shows the roles and responsibilities of different levels of government in the Netherlands.



Barriers for the lowest possible level to take on the task are often a lack of resources and the absence of relevant expertise and experience. This introduces a dilemma.

To reach a level of knowledge compliant with international best practice a certain degree of specialisation and a continuous flow of projects are needed, which calls for centralisation and capacity building at a higher government level (OPW). In case resources are spread out, the required level of knowledge and expertise is at risk.

However, if all knowledge is centralised, and cooperation with lower levels of government is still needed (which very often is the case) this might well be hampered by a gap in knowledge and understanding of flood risk management.

The review team recommends a combined approach to increase effectiveness of multilevel government cooperation. Additional resources are required within OPW to increase effective policy implementation, operational management, regulation and enforcement (see 3.2.2). It is recommended to also strengthen the FRM capacity of a limited number of Local or Regional Government with a substantial FRM challenge.

Compared to other countries Ireland has a compact government with cities and counties as local governments, and the national government. Recently a regional level has been installed to play a more significant role in spatial planning. Experience showed that this level was missing. The review team is also of the opinion that coordination between counties and cities is too weak now or even absent, thus preventing a more pro-active long-term integrated planning approach for the Irish river basins and for the coastal zones.

If the regional level is really going to play an active role in spatial planning *it is recommended that the regions take up a role in drafting long-term integrated river basin spatial plans and integrated coastal zone spatial plans as well.* It is suggested to start with one catchment area as a pilot, for instance the Shannon basin, and with one coastal sediment cell, for instance in Donegal.

3.2.4 Coordination arrangements between different responsible parties and the degree of coordination achieved

When looking at coordination arrangements several degrees of coordination can be distinguished:

- A. Information sharing.
- B. Consultation/representation in larger influential groups.
- C. Joint strategy setting and planning.
- D. Joint financing.

Based on interviews and desk research this high-level review concludes the following:

At the *national level* a high degree of coordination among the government agencies is achieved. We found several examples of *joint strategy setting and planning* related to flood-risk management like joint efforts to draft a plan for a flood forecasting system, a national emergency group with active participation from OPW, joint effort between the Department of Environment, Community & Local Government and OPW to draft and implement planning guidelines related to flood risk management. These are promising examples that show effective governance.

Chapter 3.2.5 focuses on the coordination between OPW and local authorities.

To increase effectiveness of flood-risk management we *recommend aiming at a higher degree of coordination with some parties outside government circles.* It is suggested OPW takes the lead in this. The coordination with the following types of parties is addressed by the review team:

- insurance companies.
- owners of dams and reservoirs.
- construction companies.

Coordination with insurance companies

A process of data and information sharing (degree A), specifically with respect to risk mapping, has started through Insurance Ireland, the intermediate and lobby organisation for insurance companies that offer flood cover to individual properties. As the insurance sector clearly benefits, the review team *suggests to explore possibilities for a joint campaign on individual property protection* (see also Chapter 3.3.4).

Coordination with owners of dams and reservoirs

Irish Water and ESB own dams and reservoirs all over Ireland for producing water or electricity. By their nature, large constructions upstream can induce risks to those who live below stream, if not operated or maintained properly. In that context consistency of dam safety monitoring regimes becomes important. It is *recommended that maintenance and monitoring obligations remain with*

the owners of the dams and reservoir but OPW identifies how best standards can be drafted to provide supervision from a flood risk perspective.

Coordination with the construction sector

Over the last ten years a major public works program has been completed. For the next ten years the number of construction schemes might triple. A strong and high quality construction sector is vital to deliver sustainable flood protection works.

Affected by the economic crisis, relations with the construction sector have worsened both in Ireland and elsewhere. 'Price diving', claims, and arbitration are a fact of life now. Construction management has entered the domain of lawyers. This drains energy and resources on both sides. Coordination seems absent. *It is suggested to start a process of pre-competitive information sharing, within the requirements of public sector procurement, to achieve a more productive way of working together on both sides.* The start of a new round of protection schemes and/or the implementation of new EU laws on tendering might be a good opportunity for a pre-competitive dialogue on how to move forward.

Claims and coffee – Personal experiences of a Dutch Program Director

Highlights from an interview of the review team with Mr. Johan Bakker, MSc, Director of the Flood Relief Works Program at Regional Water Authority Rivierenland in the Netherlands.

Profile and portfolio

Mr. Johan Bakker is Project Director, responsible for a Flood relief capital works program ('Hoogwaterbeschermingsprogramma') at Regional Water Authority Rivierenland with a budget of €430 million over 10 years. The current program reaches its delivery date in 2017. The capital works mainly consist of strengthening dikes and embankments along the many river borders within the Water board's jurisdiction. All projects within the program are now in the construction phase, or finished, see www.dijkverbetering.waterschaprivierenland.nl for pictures of the construction works. The program is on track in delivering the capital works within the initially estimated time line and budget set. The Integrated Project Management Model facilitated this (see Chapter 4.3).

How often do you end up in court with the contractors that work for you?

Nowadays, we end up in court regularly at the start of projects, when we announce the winner of the tender. Number 2 or 3 then challenges the decision. Over the last 10 tenders, we went to court in 3 cases at the start of the project. In 1 case the challenger won. We have come to see these challenges as a fact of life. It is the legal right of the construction companies to do this, so no hard feelings whatever comes out. We just have to make sure we are well prepared and have the right lawyers to help us.

During the projects we rarely end up in court. It is also our policy to prevent that and solve disputes through (high level) dialogue, as that saves time and money for both parties.

Occasionally, we pick a battle and go to court to win to 'show our teeth' to the sector.

As a project director I spend 70% of my time on dialogue, dispute solving and claims with the construction sector. I do drink a lot of coffee! Within the construction sector companies differ a lot in style (fighting or cooperative), scale and capacities. There is no 'one size fits all' approach. Every project is new in that respect.

What type of contracts do you use?

Over the past years we moved away from employer designed construction contracts. All new contracts are now Design and Build by the contractor, and recently we even moved towards a Planning, Design and Build contract. We are very happy with that. There is less detailed debate and fewer variation orders now, as the contractors have more responsibilities. We can now manage our construction projects at a higher level.

Price or quality: what criteria do you use to select contractors?

We now moved towards 'best value for money' (EMVI in Dutch) tendering and don't do lowest bidder tendering anymore. We gained a lot of experience on what criteria to set and how to evaluate, so that our awarding decisions stand up in court. In general, the simpler is the better. The use of independent expert panels to evaluate the quality documents works very well. We also experiment with new types of contracts, to promote innovations. In line with European Law, there are a lot of possibilities you can use. When we do something new, we first talk to the construction sector to exchange ideas and see whether there is mutual interest and enough parties for competitive tendering. For new contracts, we hire the best procurement and tender experts and we also have our own competent procurement staff.

3.2.5 Governance arrangements between OPW & local authorities

Several arrangements exist between OPW & local authorities which differ in the perceived role of OPW. This review addresses both the effectiveness of the arrangements - as far as can be seen from a high level point of view - and whether or not the arrangement follows principles of good governance, including subsidiarity.

Minor works scheme

The review team concludes that the minor works scheme (see also Chapter 4.3) is effective and also a good example of subsidiarity. Local authorities can apply for funds through OPW. The schemes are planned and constructed under the powers of local authorities. OPW sets guidelines to the process. These are practical and not too complex, so local authorities can follow them within their own capabilities or hire expertise generally available to do it for them.

Major works scheme

The capacity of local governments shows great variety. Therefore a flexible approach is needed. The major works scheme over the last ten years illustrates this. From a subsidiarity point of view it is preferred that local authorities plan protection works under local planning powers, to facilitate integration with other policy sectors at local level, and to take the lead in stakeholder management. Lack of funds, lack of capacity or knowledge and the current situation with regard to maintenance responsibilities might prevent local authorities from doing so, which is undesirable. Nice examples of multilevel governance arrangements with a key role for the local authority were found in Dublin. Perhaps more attention could be paid to stakeholder management at an early stage. Discussions on protection works versus views on the river or sea are better settled at an early stage of the project, ideally in a participative approach.

Maintenance responsibilities are best agreed upon before the start. The following recommendation applies for upcoming schemes. *The review team recommends starting a consultation process with the Local Government Management Agency and Board to come up with a joint and general multi-level governance approach on planning, stakeholder management, capacity building and maintenance for upcoming flood protection schemes. See also Chapter 3.2.3 in relation to capacity building. This may require an amendment to the existing legislation.*

Preparedness

Local authorities are responsible for local emergency planning. In general, plans and procedures, including those for floods, are in place. Nice examples were found in Cork.

As there is no flood-forecasting system yet, no specific flood warning can be issued to the people affected. Once there is a flood-forecasting system in place, the question arises who will interpret these forecasts, and what warnings will be issued to which people, and by whom? This asks for a *flood warning decision tree* with allocated responsibilities and (annual) rehearsals to know what to do (and to know where the flood gate keys are when needed for example).

It is clear that in general local authorities lack capacity to interpret forecasts. *It is recommended OPW takes up a role in ensuring a specific flood warning decision tree is in place and in capacity building of local communities on flood warning response.*

3.3 Resources

3.3.1 Level of available funding for the High-Level Programmes & FRM

In countries where flood risk is mainly about the damage or loss of properties and infrastructure (and not about loss of life) the level of available funding for Flood-Risk Management is best to be related to the cost benefit ratio of possible measures. That means that all measures (both capital works and non-structural measures) with a positive cost benefit ratio (1:1 or greater) are wise to take from a societal costs and benefits point of view.

Currently, €45 million per annum is the available budget for flood risk management. The review team expects the costs associated with the current risk level are higher than the budgets needed for taking measures. It is expected a whole range of measures can be taken with a positive cost benefit ratio that lies between the 1:4.5 (the cost benefit ratio of the current major works capital works program) and 1:1. In doing so, the expected costs of loss and repair can be reduced substantially. *More than doubling the budget seems justified.*

International examples: Flood defense funding in England and The Netherlands

Flood defense spending in England

Standard Note: SN/SC/5755, Last updated: 19 November 2014

Author: Oliver Bennett, Sarah Hartwell-Naguib, Section Science and Environment

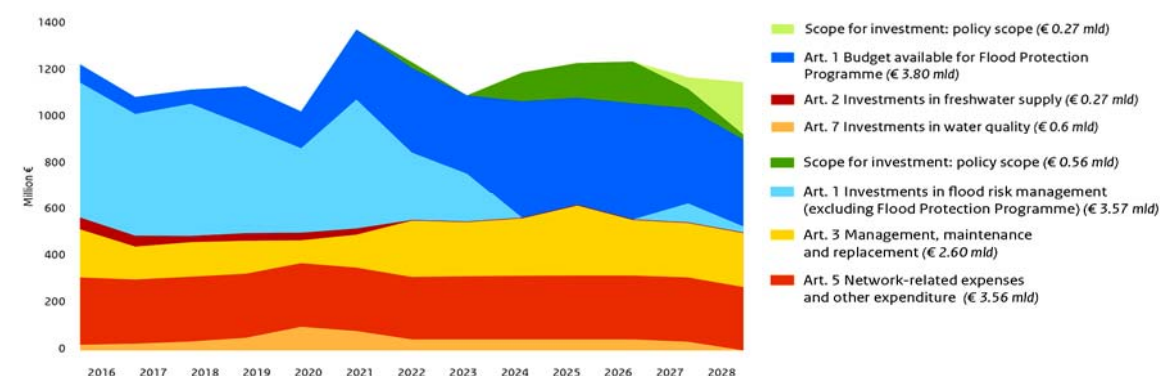


Some 5.2 million properties are at risk of flooding in England. Annual flood damage costs are in the region of £1.1 billion. These costs could rise to as much as £27 billion by 2080. It has been estimated that maintaining existing levels of flood defence would require flood defence spending to increase to over £1 billion per year by 2035. Central Government spending on flood defences will reduce in real terms over the spending review period. The Government has introduced a new flood defence funding system, which it believes will help to meet the shortfall. The new funding arrangements seek to encourage more local investment in flood defences, so that schemes that might not be funded nationally may still go ahead. There are concerns about the extent to which local communities are able to contribute to flood defence funding. While the number of properties at risk of flooding may not rise in the short term, there could be a significant increase in the longer term if current spending levels do not increase.

Flood defence spending Netherlands: Delta Fund 2015 – 2028

In The Delta fund financial resources are reserved for the national (primary) flood defences. As can be seen from the Figure below, more than €1 billion per year is and will be spent.

(for more information: www.english.deltacommissaris.nl)



3.3.2 Funding mechanisms for FRM and coastal erosion activities

Currently the major and minor flood relief schemes and coastal-erosion activities are funded mainly by the national government, with some smaller contributions from the local governments. Co-funding with businesses could be considered in general when they clearly benefit. However, as the attraction of (new) businesses is important for general employment in Ireland it is not likely to happen often. As with local government, to always ask a financial contribution, although small, might be a preferred way of working to enhance local ownership.

Additional local funding seems also suitable when additional goals and objectives can be served outside the domain of flood-risk management, like enhancing tourism by building an attractive footpath along a defense scheme. The topic of prioritization is covered in Chapter 4.2.

The subject of *individual property protection* might deserve more attention and funding. Even when the number of flood relief schemes can be increased, there will still be a lot of locations where no collective flood protection exists, as it is not viable, or affordable yet. Due to the physical characteristics of the country individual property protection has to play an important role in Irish flood risk management. It is *suggested to investigate the possibility to come up with a joint campaign together with the insurance sector for installing individual property protection, similar to campaigns on installing sprinklers against fire, or better locks against theft.*

Specific attention is needed for the 2% of Irish households that have no coverage against floods in their general insurance. In some recently protected areas the number of households without flood insurance coverage can be as high as 30%. Although all over Ireland 98% has flood insurance coverage, these 2% is likely and rightfully going to attract a lot of attention from the media and from politicians. As a lead agency for flood-risk management OPW's credibility could be undermined when a number of heartbreaking incidents occur within a short period of time. There has to be some answer or policy to this in advance. Several ideas came up during this high-level review but this topic needs further investigation as it is very sensitive and the solution should fit well within the Irish context.

3.3.3 Level of human resources available for FRM

Within Ireland a relatively small number of people works on flood-risk management both within OPW, local authorities and other government agencies. Nevertheless, a lot has been achieved over the last decade. The review team met with dedicated people who work hard and passionately to address and manage flood risk within the country and to works towards current international standards.

That only a limited number of people works on flood risk management, does have its advantages. We noticed a strong feeling of ownership, responsibility and personal commitment among the people we met. This is to be cherished.

In a country surrounded by seas and with a lot of rainfall during the year flood risk will remain a continuous factor. Over the next decade the number of projects related to flood protection capital works might triple. Prevention and preparedness also require full attention. As the economy picks up again and (foreign) investments might grow, the acceptance of flooding by the public might be expected to decrease, thus building pressure on government, and especially on OPW as the lead agency in this field to come up with measures.

Is it evident that more human resources are needed within the field of flood-risk management to fully meet international standards of good water governance. The review team recommends that

the expertise of OPW is expanded also in relation to public procurement and contract management (see also Chapter 4.3).

3.4 Overall conclusions on governance

With regard to flood risk management in Ireland effective **policy** is in place that meets international standards both for prevention, protection and preparedness. Good cooperation between the relevant government agencies and departments at the national level has enabled this. The next round of the national spatial strategy offers another opportunity for cooperation, also with regional planning bodies. The review team *recommends to aim at an even more pro-active approach with regard to catchment spatial planning and integrated coastal zone planning.*

Implementation stays behind, mainly due to a lack of funds and a lack of enough qualified staff. The lack of a flood forecasting and a national warning centre illustrates this. *From a governance point of view a multilevel governance approach for capital works is preferred, where flood-relief schemes are planned under local planning powers.* The flood-relief schemes in cooperation with Dublin City Council are good examples of this.

In **operational management**, there is a gap in the responsibility for enhancing the resilience of the public and individual property protection (including emergency measures). *The review team suggests investigating the possibilities of a joint campaign in cooperation with the insurance sector.*

With regard to maintenance *the review team recommends that a new general principle on maintenance of flood relief works is to be agreed on beforehand with the Local Authorities.*

Regulation and enforcement:

- *The 2009 Guidelines on flood-risk management and planning could be evaluated.*
- *The review team recommends that OPW takes up a role to identify how best Ireland can deliver coherent supervision of dams and reservoirs related to flood risk.*
- *Based on CFRAM flood maps specific messages to the public can now be issued and rehearsals planned.*

In general, the governance principle of subsidiarity is important to bear in mind. The Minor Works program is a good example of this. The review team sees no role for OPW in managing and addressing pluvial floods and flooding from urban storm-water drainage and water-bearing infrastructure.

4 High-level programmes

4.1 Introduction

The Terms of Reference ask the review team to pay special attention to six high level programmes within Irish flood Risk Management:

1. The national CFRAM programme.
2. Capital Works.
3. Maintenance of watercourses.
4. Prevention.
5. Flood forecasting and warning.
6. Resilience.

A brief outline of each high-level programme is given, and recommendations for the near future are presented. The recommendations are illustrated with examples of international best practice.

4.2 The national CFRAM Programme

4.2.1 Brief outline

The National Catchment Flood Risk Assessment Management Programme (CFRAM) was initiated to implement key recommendations of the Report of the Flood Policy Review Group (OPW, 2004). The CFRAM Programme is currently being undertaken, in line with the European Directive on the Assessment and Management of Flood Risks (2007/60/EC) and Irish Law (Statutory Instrument No. 122 of 2010)⁸.

The scope of the CFRAM is to address the flood hazards and risks, including both those that currently exist and those that might potentially arise in the future, as a result of for example, climate change. The risk-management measures, options and management plan should address both existing and future hazards and risks.

The National CFRAM Programme consists of three phases:

- Phase 1: Preliminary Flood Risk Assessment, (Completed 2011).
- Phase 2: Preparation of Flood Maps (2013 - 2015).
- Phase 3: Preparation of Flood Risk Management Plans (2015 - 2016).

The outcomes of Preliminary Flood Risk Assessment (PFRA), phase 1, are the identification of 300 areas that are most at risk, these areas are addressed as “Areas for Further Assessment” (the AFAs) in phase 2 and 3. In phase 2, the flood maps are produced in detail for these AFAs, according to Article 6 of the “EU Floods Directive” (available online at www.maps.opw.ie/fhrm). In

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⁸ Directive 2007/60/EC on the assessment and management of flood risks entered into force on 26 November 2007: This Directive now requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. This Directive along with the Report on the Flood Policy Review Group resulted in the introduction of *Statutory Instrument (S.I.) 122/2010 – European Communities (Assessment and Management of Flood Risks) Regulations 2010*. The S.I. addresses items such as “The preparation of schemes of flood risk management works and measures”, “Designation Orders”, “Powers of the Minister” and “the costs of flood risk management”.

phase 3, the Flood Risk Management Plans (FRMPs) develop a long-term strategy with defined and prioritised measures to reduce and manage flood risk.

The stated objectives of the CFRAM studies are as follow:

Assess flood risk, through the identification of flood-hazard areas and the associated impacts of flooding;

- identify viable structural and non-structural measures and options for managing the flood risks for localised high-risk areas and within the catchment area as a whole.
- prepare a strategic Flood Risk Management Plan (FRMP) and associated Strategic Environmental Assessment (SEA) that sets out the measures and policies that should be pursued to achieve the most cost effective and sustainable management of flood risk.

At present, phase 3 is being carried out, where the FRMPs should include a set of prioritised studies, actions and works (structural and non-structural) to manage the flood risk in the area in the long-term. The prioritisation of options for flood-risk management measures is done by MCA (multi-criteria analysis) scores on 18 pre-defined objectives relating to technical issues and economic, social, environmental and cultural heritage risk. The preparation of the FRMPs will consider the “3P” approach (Prevention, Preparedness and Protection) according to the recommendations in the EU Floods Directive. Those measures with the greatest overall benefit relative to cost measures will be prioritised.

No.	Objective
1.a	Ensure flood-risk management options are operationally robust.
1.b	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options.
1.c	Ensure flood-risk management options are adaptable to future flood risk, and the potential impacts of climate change.
2.a	Minimise economic risk.
2.b	Minimise risk to transport infrastructure.
2.c	Minimise risk to utility infrastructure.
2.d	Minimise risk to agriculture.
3.a.i	Minimise risk to human health and life of residents.
3.a.ii	Minimise risk to high vulnerability properties.
3.b.i	Minimise risk to social infrastructure and amenity.
3.b.ii	Minimise risk to local employment.
4.a	Support the objectives of the WFD.
4.b	Support the objectives of the Habitats Directive.
4.c	Avoid damage to, and where possible enhance, the flora and fauna of the catchment.
4.d	Protect, and where possible enhance, fisheries resource within the catchment.
4.e	Protect, and where possible enhance, landscape character and visual amenity within the river corridor.
4.f.i	Avoid damage to or loss of features, institutions and collections of architectural value and their setting.
4.f.ii	Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.

Table 4 Criteria in MCA

Future scenarios

Two possible indicative future scenarios for climate change, land movement, urbanisation (case by case) and forestation are incorporated in the National CFRAM Programme: the Mid Range and High End Future Scenarios.

The CFRAM Programme has adopted an adaptive approach with respect to incorporating future scenarios, since these future scenarios are not fixed for a certain time horizon.

Future scenarios in the Netherlands

Flood risk assessments in the Netherlands are carried out for a certain time horizon; generally 2050 or 2100. Four climate scenarios are available as indicative future scenarios 2050 and 2100 to take uncertainty into account:

- Increase of mean sea level rise +25 – 60 cm till +45 – 80 cm.
- Increase of the mean amount of precipitation in Winter from 4.5% till 30%.

The approach to climate change in the Netherlands, regarding flood risk assessments, is less flexible compared to Ireland. In the Netherlands the use of climate change scenarios are directly linked to financial schemes, the way subsidies are given for flood relief works in the HWBP Program (Dutch National Flood Protection Program).

Community engagement

Community engagement is being facilitated by informal consultations with various governmental organisations⁹ and a public consultation process at various stages of each of the CFRAM Studies, where all interested parties and stakeholders are invited to view and comment the draft maps and the draft plans, outcomes and the process. The PCD events, that are held in most of communities being assessed in detail, are well-publicised in the local media and advertised locally.

Further information is provided through Project Websites, Newsletters, and Ad-hoc meetings and consultations.

4.2.2 Discussion and recommendations

The review team concludes that the National CFRAM Programme is a very extensive, well outlined (from screening phase to detail assessment of areas) project for the development of FRMPs on a catchment level. The amount of research and studies related to flood-risk management so far is impressive. The quality of the CFRAM studies in terms of flood-risk analysis, cost/benefit analysis is high, and is appropriate to international standards.

The FRMPs will be finalised at the end of 2016. The development of the River Basin Management Plans (RBMPs) that are required for EU Water Framework Directive (2000/60/EC) has been extended till 2017. There are opportunities to adjust the RBMPs to the FRMPs.

There are 300 areas assigned to be at most significant at risk and are researched in more detail in the CFRAM studies. Since funds for flood-relief schemes are limited, prioritisation of schemes for these 300 areas needs to be set. The MCA approach is very useful to prioritise the flood-risk

⁹ Dept. of Agriculture, Fisheries and Foods, Dept. of Environment, Community and Local Government, Environmental Protection Agency, ESB, Geological Survey of Ireland, Health Service Executive, National Roads Authority and Waterways Ireland.

management measures. The current prioritisation is based on the most beneficial options relative to cost.

The review team recommends exploring additional prioritisation methods from a nationwide perspective:

- *Highest risk:* flood-relief schemes for areas with the highest flood risk have priority.
- *Highest probability:* flood relief schemes for areas with the highest flood probability have priority.
- *Win-win:* flood-relief schemes that can be combined with other functions in time (road renovation, urban development) can be planned ahead in time.
- *Showing progress:* relatively small schemes that can be rapidly delivered have priority.

4.3 Capital Works

4.3.1 Brief outline

The Capital Works Program consists of multiple implementation methods:

- Flood relief major work schemes implemented by OPW.
- Flood relief major work schemes implemented by Local Authorities with funding of OPW.
- Flood relief minor work schemes implemented by Local Authorities with funding of OPW.

Since 1995, approximately 36 major schemes have been completed by the end of 2015, with 5 schemes at construction stage at the start of 2016 and a further 27 currently at various stages of design or approval. The completed schemes have cost approximately €325 million in total, provide protection to approximately 7 000 properties and have an overall benefit-cost ratio of 4.5:1.

Flood relief major work schemes implemented by OPW

The Amendment of the Arterial Drainage Act 1995 provided the OPW the legal power to implement flood-relief schemes to provide flood protection to local communities, as opposed to catchment-wide schemes aimed at improving agricultural production.

As with the Arterial Drainage Schemes, the OPW has a statutory duty to maintain these flood relief schemes.

Flood relief major work schemes implemented by Local Authorities with funding of OPW

Some major flood-relief schemes have been implemented under local authority powers. This route is taken when the local authority powers are seen to be more suitable, but funding and/or technical advice is generally provided by the OPW in the preparation and implementation of such schemes.

The practice in relation to the maintenance of these schemes varies and it is envisaged that going forward maintenance would generally be done by the Local Authorities with funding provided by OPW.

Flood relief minor work schemes implemented by Local Authorities with funding of OPW

The Minor Flood Mitigation Works and Coastal Protection Scheme was introduced in 2009 for straightforward cases where a solution can be readily identified and achieved in a short time frame. Applications from Local Authorities for the Minor Work Programme are considered by OPW, when the measures cost no more than €0.5 million per scheme. OPW has available funding up to 90% per project, besides the study cost. The remaining cost need to be funded by other parties. This scheme has proven to be very successful with approval given over 500 projects and expenditure of

€29 million to the end of 2015 to provide benefits to approximately 5000 properties. The provision for the minor works schema in 2016 is approximately €2.5 – 3.0 million.

A simplified CBA assesses the cost and benefits of minor work proposals. Proposals need to meet a minimum benefit to cost ratio from 1.5:1 to qualify for funding. Minor work schemes do not require an Environmental Impact Statement (EIS) but must have regard to all necessary environmental consents.

Past, current and future Government expenditures on flood relief

The Government's Capital Investment Programme for 2012-2016 provided €225 million for flood relief measures, so on average €45 million per year. The revised or updated Capital Investment Framework for 2016 – 2021 was published in September 2015 and provides a total capital envelope of €430 million for flood risk management over the period of the plan or €72 million per annum on average. The capital plan provides for available funding to increase from €45 million per annum currently to €100 million per annum by 2021. The completion of the Flood Risk Management Plans of the CFRAM study will set the future Flood Relief Capital Investment Programme. OPWs ambition is to speed up the delivery of major work schemes, in line with the significant increase in capital funding. *The review team supports OPWs ambitions with respect to the delivering of flood relief projects, and the increase in the Government's Capital Investment.*

4.3.2 Discussion and recommendations

Cost effectiveness

Under the current Capital Works Programme many flood-relief schemes are delivered. These schemes are all economically viable, with benefit to cost ratios varying from at least 1.5:1 for minor work schemes to 4.5:1 for the major work schemes. It is possible to construct more flood-relief schemes to further decrease the flood risk. *The review team thinks that it is justified to double at least the number of flood relief schemes, until the benefits equals the costs (B/C-ratio of 1:1), based on these B/C-ratio Figures.*

Community engagement

As the media are of growing importance for governments around the globe to exchange views with the public, the review team was glad to be presented with some nice examples of information sharing with and through the media, like the Eco-Eye television program.

The review team noticed within the programme several delays on proposed schemes related to discussions with the public. An example is the discussion about the view from a house across the sea, which can be disturbed by a flood defence. Formal and timely public consultations are in place. *The review team suggests to involve stakeholders at an early stage in optioneering and experiment with more participative approaches together with strong involvement on a political level.*

International example: The IPM Model for the delivery of Public Works in the Netherlands

Many governments in the Netherlands, such as the national Rijkswaterstaat and the Water Boards have in recent years adopted the so called Integrated Project Management (IPM) Model as a dominant way of working in delivering Public Capital Works.

The philosophy behind the model is that a successful project requires attention to different roles and perspectives at the same time to deliver a product within budget and on time. In general, a project manager and his assistant cannot be successful in all roles at the same time. Also different personal qualities might be required to be effective in different roles.

The IPM model distinguishes five major roles and responsibilities:

- Project manager : overall responsibility and first point of escalation
- Process manager : risks, finance, planning, progress reports
- Contract manager : procurement plan, tendering, contract manager
- Technical manager : technical requirements, MCA, design
- Stakeholder manager : communications, public consultation

Experience shows that an effective project requires roughly about the same amount of time for each role, but that depends of course on the type of project. Roles can be combined of course. In general, staff's personality and qualifications allow for a combination of process manager and technical manager or contract manager, or for a combination of project manager and stakeholder manager.

4.4 Maintenance of watercourses

4.4.1 Brief outline

Maintenance works are necessary to improve the quality of the land for agriculture by providing free outfalls for land drainage, and also to reduce the risk of flooding.

OPW is the Lead Agency of flood risk management. Since the 1945 Amendment Act, river drainage and flood relief has been OPW responsibility. Where the Commissioners of Public Works have completed a drainage scheme under the Arterial Drainage Acts, 1945 and 1995, there is a statutory requirement to maintain the drainage works forming part of the Scheme. An annual programme of maintenance is compiled to maintain the drainage works which are prioritised based on the rate of deterioration and the increase of risk. In any one year, approximately one-fifth of the watercourses are maintained.

The Report of the Flood Policy Review Group (2004) identified, among other things, that:

- There are a substantial number of watercourses for which no State authority has legislative responsibility for flood management.
- The lack of maintenance of watercourses and their associated defences and structures is potentially a major cause of flooding.

Therefore the Arterial Drainage Maintenance & High Risk Channel Designation Draft Programme (2011 – 2015) has been set up. This Programme covers two sets of activities:

1. Arterial Drainage Maintenance:

The Office of Public Works is the body through which Central Government exercises its statutory responsibilities with respect to river drainage and flood relief. It derives its statutory authority from the Arterial Drainage Acts, 1945 and 1995 and the European Communities (Assessments and Management of Flood Risk) Regulations 2010. The OPW is responsible for the maintenance of 11 500km of channel, 730km of embankments, some 18 500 bridges and 750 ancillary structures such as sluice gates, pumping stations and tidal barrages. The Act uses the terms “proper repair and effective condition”. The performance criteria relate to the design standard of the original Scheme works, its condition and performance of the various watercourses, embankments etc. The maintenance cycle varies per channel embankment or structure from annually to once every twenty years, but is on average once per five year.

2. High Risk Channel Designation:

The Flood policy review report recommended that a system be put in place to “designate” high-risk channels and give permissive powers of maintenance to the central authority (OPW). The general objective of ‘Designation’ is to ensure that potentially high-risk channels or defences are maintained to reduce the flood risk that may otherwise arise. This system is intended, however, *only to be applicable to channels or defences that pose a significant risk, or that are of strategic importance.*

No legal mechanism is yet in place to allow the Commissioners to designate particular channels or other structures.

The report also recommended that an asset register be developed to aid in identifying and prioritising watercourses and structures for ‘Designation’.

The annual budget for maintenance works is €17 million.

4.4.2 Discussion and recommendations

The recommendations of the flood policy review group of 2004 were to designate channels at high-risk, and give permissive powers of maintenance to the central authority (OPW). This is in line with OPWs role as leading agency of FRM. The Arterial Drainage Maintenance & High Risk Channel Designation Draft Programme of 2011-2015 agreed with these recommendations.

Based on the interviews of the review-team with OPW it seems that the responsibilities of maintenance are still scattered and not in line with OPWs lead role. *The review team recommends defining a more coherent system for the roles and responsibilities with respect to maintenance works of arterial drainage schemes and flood relief schemes.*

For the process of designation “high-risk” channels, the review team suggests to define the definition of the term “high-risk”. Next, a legal mechanism can be devised to organize the designation process.

The review team remarks that it is an opportunity to set up a national asset register with all channels, embankments, bridges and ancillary structures. For each asset collect data about the

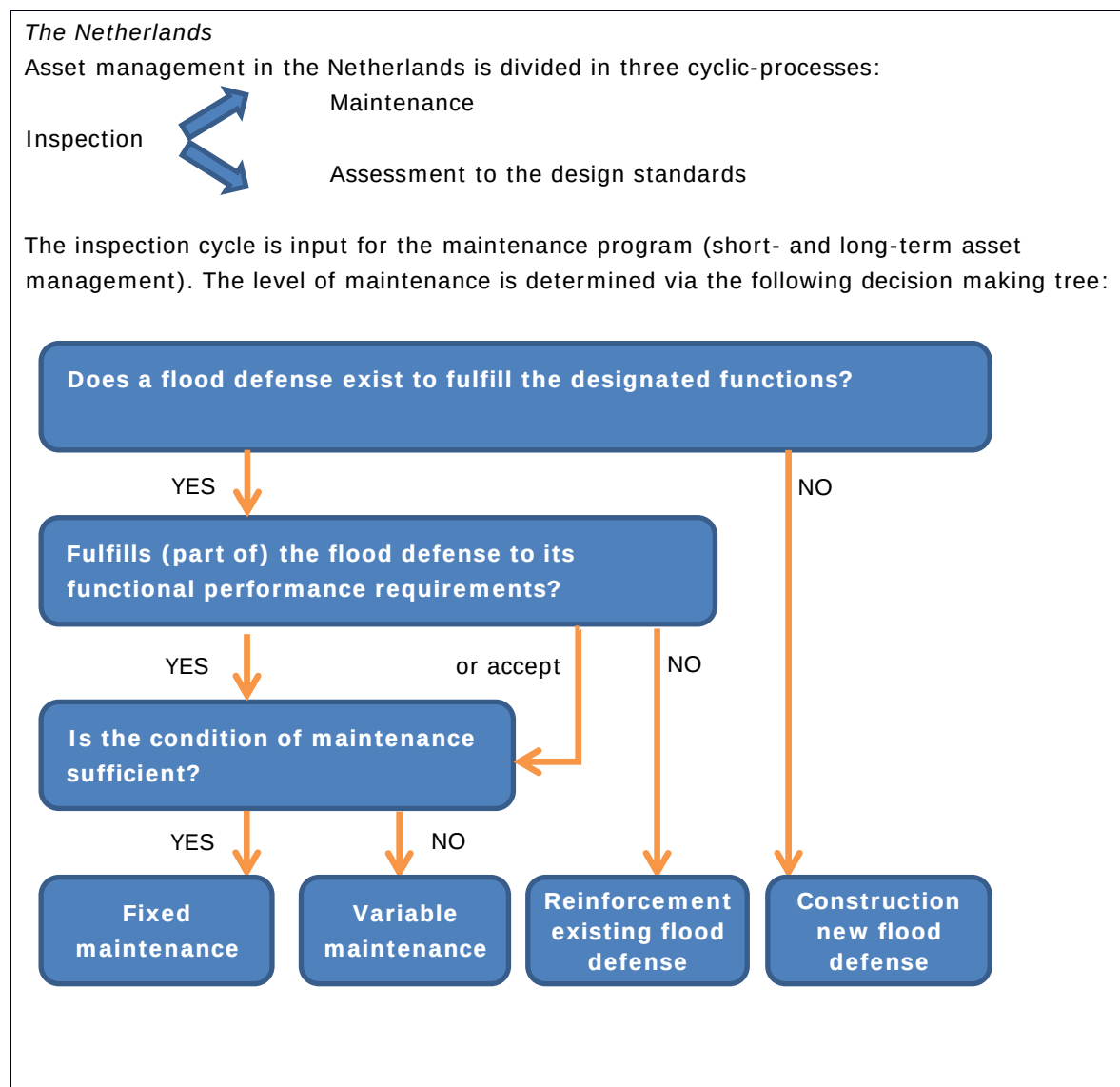
- Dimensions of flood profile, structure, etc.
- (Risk-based) service levels according to type of asset.
- Performance indicator.

The OPW is currently setting up the Defence Asset Database under the CFRAM Programme / Arterial Drainage Maintenance Programme, wherefore part of above asset data has been collected already or is under preparation. *The review team supports this and recommends the OPW to set up an annual “audit-system” where the status, technical and functional performance of the arterial drainage scheme or flood relief scheme is assessed: which assets still meet the required design standard and which not.* This is input for the short- and long-term (risk-based) asset management plan. Examples of performance indicators are: condition and performance of the various watercourses (f.e. minimum required flow profile), embankments (f.e. conditions of the revetment), bridges (f.e. conditions concrete structures /fatigue) and ancillary structures (f.e. reliability of the closing process of sluice gates and pumping stations).

The review team concludes that the OPW should have the “Check”-role, in case the maintenance works area carried out by Local Authorities.

4.4.3 Best practice

There are many models for asset management. This chapter gives an overview of possible methods to carry out the asset management, based on practices in the Netherlands.



Two types of maintenance are used:

- *Fixed in time maintenance* = year around maintenance;
Annual maintenance works such as mowing, small repair works on the slope/toe of the embankment etc.
- *Variable maintenance* = extensive maintenance;
Largescale maintenance works aiming to strengthen the flood defense according to its design standards; heightening the dike level, enlarging the dike width etc. These intervention works are carried out based on the 6-year safety assessment of the flood defenses, in case the Water Boards assessment is insufficient.

Responsible authority for maintenance works of flood defenses

The primary flood defenses are maintained by the responsible Water Boards (direct hydraulic load from sea, large rivers or large lakes). The maintenance works for regional flood defenses and remaining flood defense are scattered: i.e. local authorities, riparian owners and leaseholders.

Asset management perspectives

There are many ambitions and objectives thinkable that can be followed by planning asset management. Here are some perspectives:

- Flood defense always needs to fulfill its functional performance related to flood safety.
- Maintenance of flood defenses will be carried out plan based to be effective and efficient.
- Reachability is at any time guaranteed.
- Asset management will be adjusted to the ecological potential value.

4.5 Prevention

4.5.1 Brief outline

The Report of the Flood Policy Review Group (FPRG), published in 2004 following Government approval of its recommendations, including the decision that the OPW should pro-actively manage flood risk; in particular the need to avoid or minimise potential future increases in risk.

The OPW advises government in relation to policy development and legislative requirements for flood risk management, and develops, coordinates and implements programmes and measures to reduce the national level of flood risk.

The Guidelines on the Planning System and Flood Risk Management were published in 2009, after the recommendations of the Flood Policy Review Group of 2004, by the Minister of the Environment, Heritage and Local Government under Section 28 of the Planning and Development Act 2000. The purpose of these Guidelines is that they should be implemented by Planning authorities, to ensure that, where relevant, flood risk is a key consideration in preparing development plans and local area plans and in the assessment of planning applications.

The core objectives of these spatial planning Guidelines with respect to flood risk are:

- Avoid inappropriate development in areas at risk of flooding.
- Avoid new developments that increase flood risk elsewhere, including those with negative impact on surface water run-off.
- Ensure effective management of residual risk for development permitted in floodplains.
- Avoid unnecessary restriction of national, regional or local economic and social growth.

- Improve the understanding of flood risk among relevant stakeholders.
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood-risk management.

The long-term objective is to manage flood risk, ensuring that communities can develop in a sustainable manner so that potential future increases in flood risk are minimised. Development in flood-prone areas can create flood risk, for example, by locating houses and other properties in areas where they may be flooded, or by worsening the flood risk to properties up- or downstream. Development in areas outside of the floodplain can also increase flood risk to existing development downstream through increased runoff rates and volumes.

The FRMP presents an opportunity to identify areas at risk of flooding to avoid inappropriate development in the floodplains, and to inform decisions and risk assessment where development is considered necessary or appropriate in areas of flood risk. The flood mapping provides useful information to support the implementation of these Planning Guidelines, in particular the flood maps that delineate the three flood zones (high, moderate and low probability of flooding) referred to in the Planning Guidelines. There could also be opportunities for partnerships with regard to integrated flood management and development schemes.

Future policy changes regarding spatial planning need to take into account the flood maps prepared by the CFRAM Study and the flood-risk management actions recommended in the FRMP.

At the moment the new national spatial-planning guidelines are under development by DoECLG.

4.5.2 Discussion and recommendations

The review team concludes that the spatial planning Guidelines (2009) with respect to flood-risk management are very useful to integrate spatial-development goals and flood-risk management.

The review team concludes from the interviews that DoECLG actively reinforces the compliance with the guidelines. In two cases, the Minister intervened and spatial developments plans made by Local Authorities were overruled.

The current development of the national spatial planning strategy is an opportunity for OPW to have an influential role in this process. *The review team recommends evaluating the guidelines regularly (every six year to ten years), parallel to the development of the FRMPs.*

The review team also suggests to encourage the Local Authorities within a river basin to work together on flood-risk management. A possible direction is to follow a risk-neutral spatial planning approach within a river basin. This means that flood risk increases downstream in the basin have to be compensated by flood risk decreases upstream in the basin.

4.5.3 International best practice

There are many examples of integrating flood-risk management within spatial planning. Three possible examples on a local scale of Hamburg, Copenhagen and London are shown in this chapter.

Germany - Hamburg:

Hafencity (www.hafencity.com) is a large urban redevelopment area in the old Harbour of Hamburg along the river Elbe. The new urban development is built south of the main Hamburg dike. Hafencity is therefore unembanked and located in a flood prone area along the river Elbe.

The Hafencity will not be protected by dikes, but the urban development is based on the concept of interaction of land and water, with “flood resilient and adaptive” buildings, infrastructure and public spaces, floating waterfront promenades, terraced landscapes.

The total area of the old Harbour is raised 7.5 – 8 meters above sea level, except quays and promenades (4 – 5.5 meter above sea level). All buildings are flood resistant up to a certain design flood level. The residents are provided with waterfront access.

The Hafencity plan is based on the concept of “level changes”: water-to-street with terraces, old-to-new with bridges and stairs.

Five levels of public spaces are under development¹⁰:

- **On the water:** Floating docks are accessible at sea level, which changes twice daily.
- **Waterfront Promenades:** Embankment promenades for walking and cycling are at 4 to 5.5 meters above sea level.
- **Terraces:** provide transition for the public thoroughfares from the waterfront promenades to the street level.
- **Streets:** All streets (and buildings) are built on artificially raised, flood-protected bases at around 7.5 to 8 meters above sea level.
- **Above the streets:** In addition to the street level, there are higher elevations of occupiable space, some public and some private. For example residential units which start at one-story above street level.

¹⁰ <http://www.worldchanging.com/archives/011536.html>

Denmark – Copenhagen:

Copenhagen has set up a Cloudburst Management Plan (2012) after the pluvial flooding of 2011. The Climate Adaptation Plan points to two types of measures which are necessary to avoid pluvial flooding:

- Future-proofing sewerage functions by separating rainwater from waste water.
- Implementing adaptive measures to counteract extreme rainfall events in the city.

A cost-benefit analysis has been carried out to optimise the design standard for the city of Copenhagen.

The measures to manage the flood risk will be prioritised for Copenhagen's 26 water catchment areas, according to four criteria:

- High-risk areas.
- Areas where measures are easy to implement.
- Areas with on-going urban development projects.
- Areas where synergetic effects can be gained.

Action will be given a higher priority in areas with a high flood risk, where measures are easy to implement, and will achieve good synergetic effects with urban development projects or other types of urban planning.

Responsibilities for the Cloud Burst Plan are allocated as follows:

- *Property owners* are responsible for flood-proofing their properties on private soil.
- *Utility companies* are responsible for ensuring that drainage systems meet the service levels. The utility companies are not responsible for protecting privately-owned basements. They also have responsibility to the utility company for implementing adaptive measures in accordance with the new risk dimensioning.
- The *City Administration* , in its capacity of urban planning authority and owner of the utility company, is responsible for ensuring that the adaptive measures are incorporated into the municipal master plans and implemented. The City Administration is also responsible for climate adaptation/redirection of water courses.

Copenhagen considers three methods of financing the Cloudburst Management Plan: private financing, financing by charging revenues, and/or financing by taxes.

UK – London:

The London Climate Change Adaptation Strategy was published by the Mayor in late 2011. The strategy identifies the key climate risks to London, proposes a range of adaptation measures to manage these risks and focuses on where the Mayor is uniquely placed to lead by example and co-ordinate actions with others. Below, the four main parts of the strategy are outlined:

1. Identifying and better understanding climate risk:

The Greater London Authority (GLA) has been working with London's 33 boroughs and the UK Environment Agency to map surface water flood risk in London. The developed map has been used to identify areas where flooding could present a risk to people and property. This has enabled the Mayor to identify and target strategic risks (for example, critical infrastructure) and help each London borough develop their own surface water management plan in coherence with one another.

2. Raising awareness and building capacity:

There are areas of London that have experienced flooding, and where there are limited physical measures to manage flood risk in the short to medium term. The GLA has been working with a number of communities facing higher flood risk to develop Community Flood Plans that are developed and owned by the community. It sets out what the community will do before, during and after a flood to increase its resilience, and how community leaders will work with their local government and emergency services to ensure more effective mutual cooperation.

3. Ensuring to lead by example:

The GLA is undertaking a flood-risk assessment of all of London's emergency services (fire, police and ambulance) to understand the risk to emergency services and how flooding may affect an emergency response.

4. Implementing win-win solutions:

London develops an integrated strategy for the CO₂-reducing ambitions with flood risk.

The project is in its early stages, but it will:

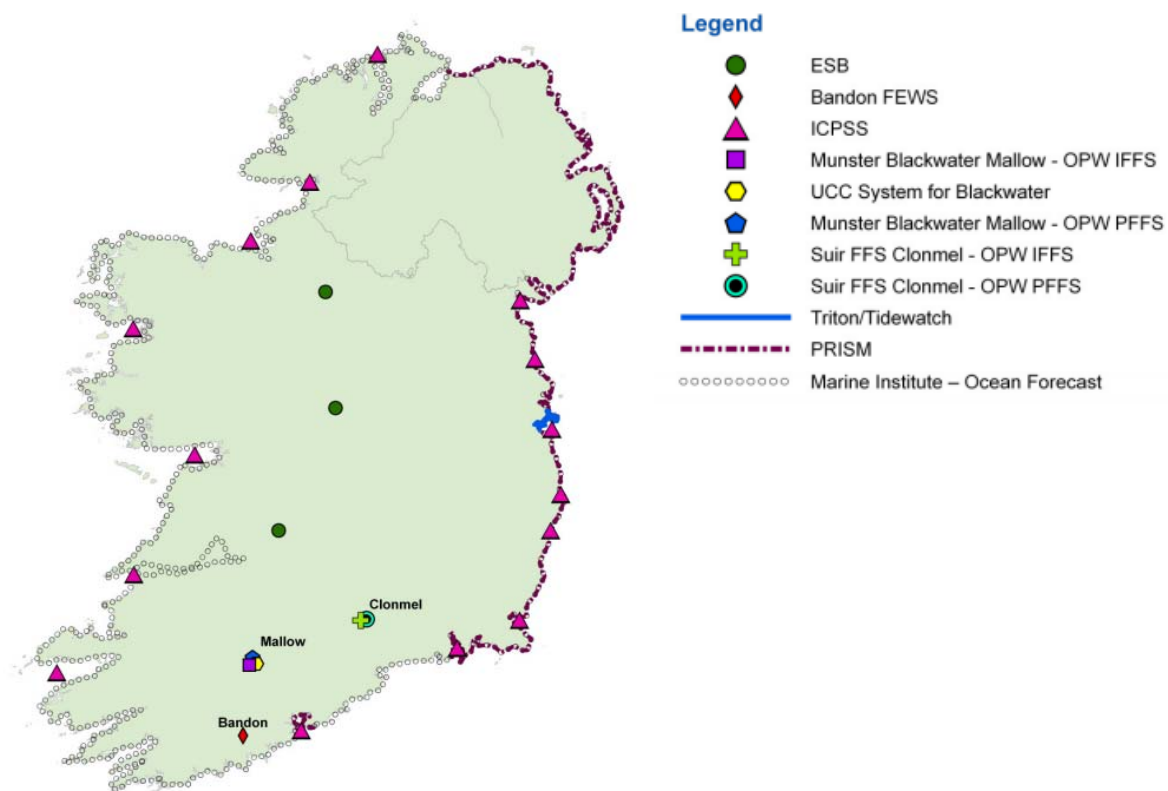
- Divide London into a number of drainage catchments.
- Assess the capacity of the drainage network in each drainage catchment to deal with current challenges.
- Model future challenges to the drainage networks in each catchment from population growth, 'urban creep', and climate change to determine if the current 'headroom' is sufficient to maintain an acceptable level of service, or how much it is exceeded by.
- Identify a range of options for each catchment, including water efficiency (to reduce the volume of sewage), sustainable drainage (to keep more of the rain out of the drains) and flood resilience (manage flood risk where a residual risk still exists) to ensure an acceptable level of risk through the century.
- Develop an action plan to co-ordinate and facilitate the implementation of these measures.

4.6 Flood forecasting and warning

4.6.1 Brief outline

The UNISDR stated in 2004 that flood forecasting is one of the most effective ways is to manage flood risk (UNISDR, 2004). At present, Ireland does not have a *national* flood forecasting system. Ireland is member of EFAS and only receives generic early warnings from the EU, receiving specific messages adapted to the flood prone areas are not possible. The existence of a comprehensive flood forecasting system is essential for professionals (e.g. emergency services) and the public to prepare on a potential flood event, that provides information about the *potential* location of flooding (where), flood extent (area), expected moment of flooding (time) of the forecasted flood scenario.

A number of *individual* flood forecasting and flood-warning systems are running in Ireland, see Figure 5, but these are not coordinated on a national level.



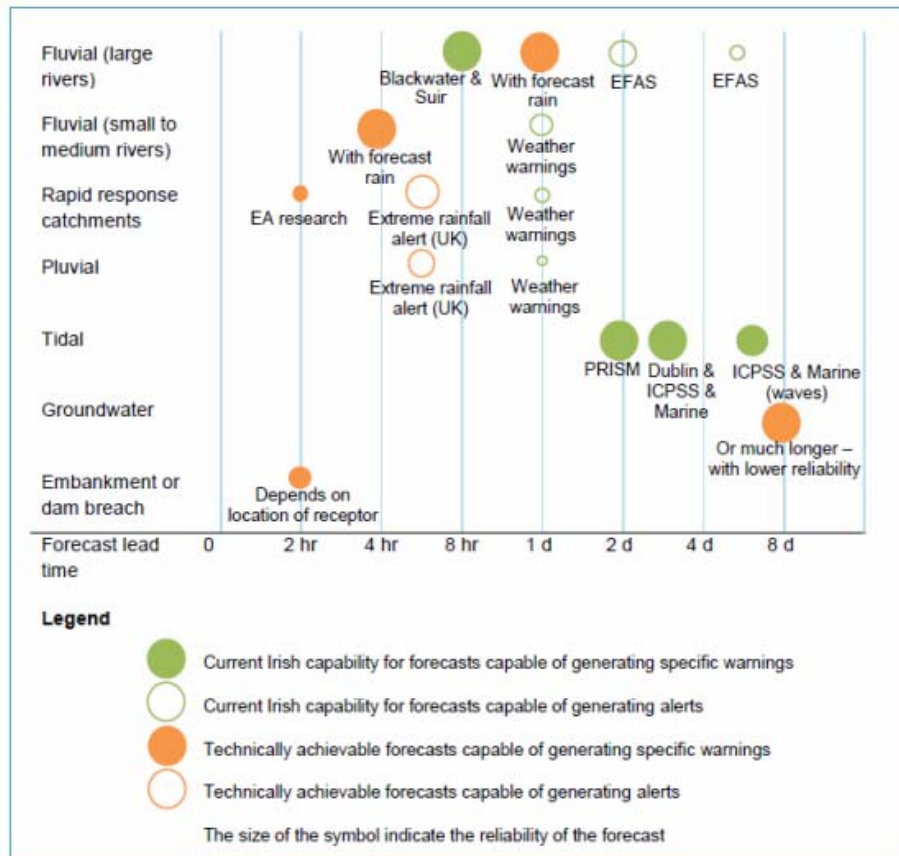


Figure 5 Local Forecast systems in Ireland (Source: STRATEGIC REVIEW OF OPTIONS FOR FLOOD FORECASTING AND WARNING IN IRELAND – Benn et al., 2011)

In 'The strategic review of options for flood forecasting and warning in Ireland' it is mentioned that the large number of locations and their wide geographical spread suggests that any national flood forecasting and warning system will need to have the capacity and robustness to deal with a large number of catchments and locations during the same event.

There is some evidence (based on a range of data sources and sensitivity tests) that the national annual average flood damage is in the range of €171 million to €195 million with monetized annual average benefits from flood forecasting and warning of at least €8 million (2010 Figures). The benefits mainly occur from removal of property to reduce losses: loss of life or, loss of damage on properties or businesses.

According to the strategic review of options for flood forecasting and warnings in 2011, a national service could eventually require around 120 flood-forecasting models (20 catchments and 100 sub-catchment models) and up to 600 community-focused flood-warning procedures; supported by a network of additional rainfall and river gauges and appropriate staffing to develop and operate the service.

4.6.2 Discussion and recommendations

The review team supports the development and installation of a national flood forecasting and warning system. Authorities on national, regional or local scale can base their decision making on taking flood prevention and emergency measures on the flood forecast.

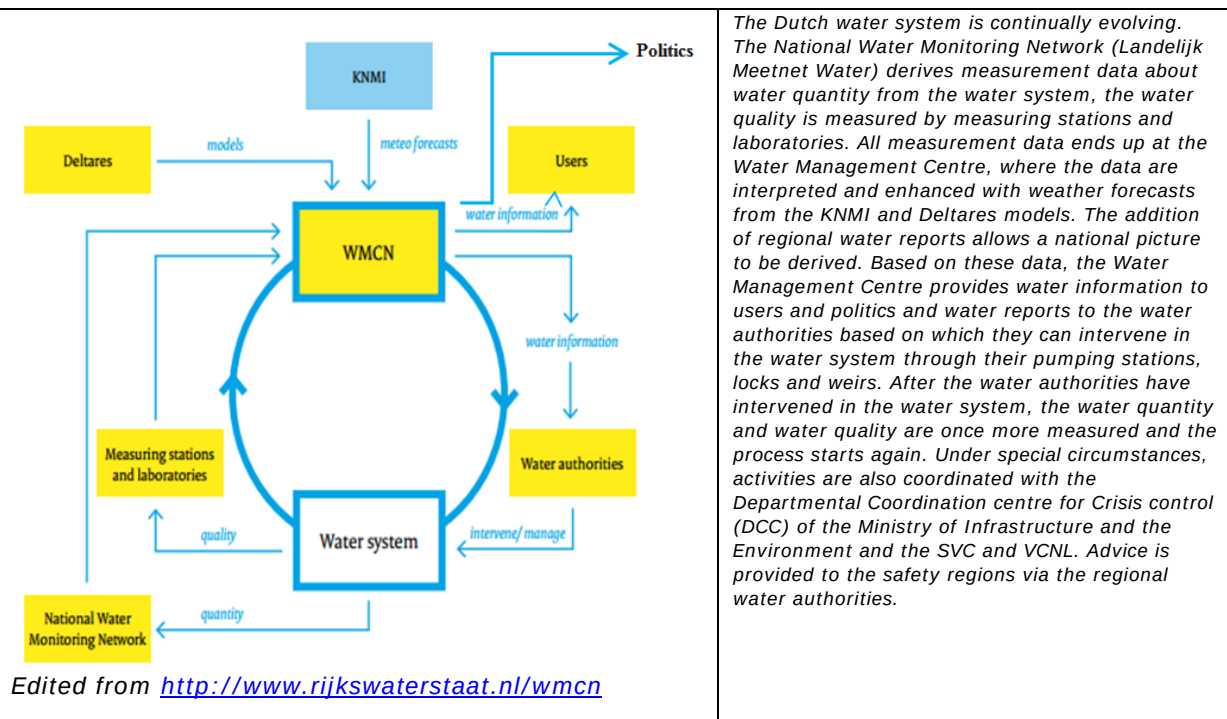
The review team also recommends investing in the performance and effectiveness of the warning system to improve emergency response and public awareness, (i.e. acted upon). The effectiveness of the warning system in terms of reducing the flood risk depends on the effectiveness of the actions being taken by the government and the citizens. Citizens decide how to act, based on their flood-risk perception, their reliance on the warning system (based on performance) and the available forecast lead time (i.e. available time to take flood mitigation measures).

Naturally, the review team also recommends investing in well-qualified high-level staffing, equipment and running costs. Met Éireann seems the most appropriate organization to be responsible for a flood-forecasting system. They have the required knowledge of forecast modeling. But they do not have enough staff. It requires a dedicated core team and also an increase in resources during flood events. Technological expertise is necessary of hydrological models, GIS, databases, websites, contact databases, written procedures and protocols, hydrometric gauges, et cetera.

4.6.3 International best practice

Netherlands

The Water Management Centre provides daily information to users of the Dutch water system, about water levels, flood risks and (bathing) water quality. In extreme situations, including water shortages, water pollution and the threat of flooding, the Water Management Centre provides advice to the national and regional water authorities about the expected conditions of the water. The Helpdesk Water is available to answer questions related to water policy and water management. The Water Management Centre is engaged in promoting the expertise of water professionals through tours, presentations and training.



United Kingdom

The Flood Forecasting Centre (FFC) is a 24/7 hydro meteorological service enabling all 2,500 customers to be better prepared for flooding. The Flood Forecasting Centre went live on 1 April 2009 and is fully operational 24 hours a day, 7 days a week, with a team of highly skilled staff based at the Met Office in Exeter. The centre is jointly staffed by Met Office and Environment Agency employees. England's National Flood and Coastal Erosion Risk Management Strategy supports the FFC to continue its work to develop and improve national flood forecasting.

The FFC is a successful partnership between the Environment Agency and the Met Office. It is steered by directors from both organisations. The FFC also has a Stakeholder User Group (SUG), consisting of representatives from key partners in government, business, the scientific community and emergency responders. The SUG provides valuable feedback to the centre's management team to help shape the future direction.

4.7 Resilience

4.7.1 Brief outline

Resilience can be broadly defined as the 'ability to withstand, recover from, and reorganise in response to crises'. Resilience measures comprise all measures that can be taken in the risk-management cycle, including risk identification, prevention, mitigation, preparedness, response and recovery measures. In this review we consider resilience as a sub-set of the so-called non-structural measures, such as risk communication to the general public, and emergency response planning.

The Report of the Flood Policy Review Group (OPW, 2004) recommended to increase further flood-risk preparedness, response and resilience, besides preventing floods from occurring. The flood policy approach involves 'non-structural' measures, such as:

- Increasing the awareness and preparedness of the public, businesses, farmers and other stakeholders so they know what to do prior to, during, and after flood events to reduce the damages that can be caused by floods.
- Ensuring effective flood-event response planning by the emergency response authorities, so that the response is effective and timely to reduce impacts on people and property.

Work that has been done since 2004 to enhance flood preparedness, response and resilience in Ireland, includes:

- Launch of the 'Plan, Prepare, Protect' initiative in 2005 (www.floodmaps.ie) to provide practical advice to the public on how to prepare for potential flooding (revision issued in 2014).
- Launch in October 2006 of the national past flood event database (www.floodmaps.ie) to promote awareness of flooding.
- Preparation of guidelines and templates for flood event emergency response plans in 2008 by the OPW and Dept. of Environment, Heritage and Local Government (now DECLG) under the Framework for Major Emergency Management (revision issued in 2013).

4.7.2 Discussion and recommendations

The review team concludes that much work has been done to enhance flood preparedness, response and resilience since the Report of the Flood Policy Review Group in 2004. The effect of this work is evaluated in a public survey about resilience, which showed increased flood awareness.

The review team suggests to further improve the effectiveness of flood risk communication to enhance social resilience and so a proactive role of the public in flood risk management. Resilience to floods may be enhanced by building social capacities (see best practice below), through cooperation and interaction between (groups of) individuals and relevant authorities in community groups. The provision of all essential information that promotes flood risk awareness facilitates social capacity building. Information is suggested to be tailor-made (personal), ongoing and on a regular basis be available, e.g. via online platforms, websites, or mobile applications. Examples of tailor-made flood risk communication are: communicate flood maps and water depth information for a given post code, including tips and advice about what to do in case of flooding (how to prepare before flooding, what to do during a flood, where to go and where not, where to stay etc.).

4.7.3 International best practice

Good practices in the EU and abroad

According to the EU FP7 CapHaz-Net project (<http://caphaz-net.org>) social resilience can be improved by building 'social capacities'. Social-capacity building is based on the cooperation and interaction of a variety of individuals and groups of actors. Social capacities are fostered through methods of risk communication and risk education. Since building capacities is a long-term process, risk communication and education should be imbedded in a long-term risk management strategy. CapHaz-Net has defined six principles for social capacity building:

1. Identifying vulnerabilities and prioritizing the needs of the most vulnerable.
2. Making information available.
3. Being participatory and inclusive.
4. Building networks.
5. Starting early.
6. Sharing responsibilities fairly.

Overall goal	Main challenges for communication	Good communication strategies
Prevention Development and implementation of prevention measures (structural, land-use planning, evacuation plans and risk information tools)	• Potential conflicts of interest • Using and integrating different forms of knowledge • Social appropriateness and acceptance of prevention measures	A communication strategy is needed which: • enables dialogue between actors with different amounts of knowledge and with different interests. • involves stakeholders and people at-risk in the pre-assessment of risk and in the planning and decision making on structural and non-structural measures through two-way communication. • informs the general public about decisions and measures. • goes beyond hazard prevention and integrates it with wider issues of sustainable-community development. • targets the affected area (e.g. catchment area, river basin) and the whole of affected municipalities. • provides continuity in that it supports lasting communication networks between actors.
Preparation-Information To trigger protective/preparatory behavior among people at risk	• Raise and sustain awareness and the motivation/interest to reflect on personal situations and to act • Lacking ability or willingness to transfer awareness and knowledge into action	A long-term strategy is needed that pays attention to different communication needs and: • raises awareness and the interest/ motivation to act through connecting people cognitively and emotionally with the issue, and through engaging cues. • builds up knowledge on how to act. • show people how to enact knowledge. • builds up psychological resources to cope with situations of stress and anxiety. • keeps memories alive, sustains awareness, and maintains abilities to act. • combines a) conventional and innovative tools, b) one-way communication and communication with feedback possibilities, and c) one-off, episodic, regular and permanent activities/tools.
Warning • To warn people and to trigger immediate actions	• Different sources of communication • Time constraints • Lack of trust and compliance	A communication strategy would: • combine continuous and up-to-date forecasts with effective warning and alert systems. • introduce people to the warning and alert system and show them how to act upon receiving a warning as an integral part of preparation communication (see above). • include emergency training/exercises (as part of preparation communication, see above). • build trust between the sender and the receiver of warnings through prior long-term communication (integrative part of preparation communication, see above). • integrate local initiatives with official communication, i.e. involve local residents in the development of warning and alert systems and use local networks to disseminate warnings. • use effective one-way communication but also two-way channels that allow for feedback and confirmation.

Netherlands

The Netherlands wants to improve the flood resilience by different media. They launched for example the website and mobile application www.overstroomik.nl. The objective of this website is to improve the flood risk awareness and resilience of the Dutch population. For each given zip code (input), the maximum flood level is given. To improve the preparedness, action perspectives are shown. What to do in case of a flood: stay at home and evacuate vertically, or how to evacuate horizontally to leave the area at risk.

Wat doe jij bij een grote overstroming?

Bij een overstroming zie je niet meer waar je rijdt of loopt. Als je vast komt te zitten op een (snel)weg en het water bereikt je, dan ben je de pineut. Wees je hiervan bewust.



Source: <http://www.overstroomik.nl/tips-voor-weggaan.html>

Another source of information is the website: National Platform for Water and Flooding. This information system contains different maps with essential information about flood risk and preparedness for a flooding. This information is made available for professionals and governmental "Safety regions", the Water Boards (Water Authority) and Rijkswaterstaat. This information is also useful in spatial planning, and for improving resilience.

Integrated maps can be composed of the areas that are at risk (e.g. flood map, available evacuation roads, dry public shelter locations et cetera). This is essential for decision making e.g. whether to stay at home in the area at risk of flooding, or try to evacuate out of the flood-prone area.