


# Towards urban flood resilience?

A photograph of a wooden park bench partially submerged in floodwater. The water is murky and rippled, reaching up to the top of the bench's backrest. The bench is made of dark wood with two vertical posts supporting the backrest. The scene is set outdoors, likely in an urban area, during a flood event.

The governance conditions for enhancing  
urban flood risk resilience

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Cover photo: Flood by Martin Katerberg, retrieved from Flickr.

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## Abstract

The surface temperature of the earth has been warmer in the last three decades, than ever before, this is seen as a sign of climate change. Climate change can have severe impacts on nature, animals and human beings. One of these impacts is an increased risk of flooding, due to a sea level rise and more extreme precipitation associated with climate change.

Although the impacts of climate change and the flood risks connected to climate change are high, especially in urban areas, the amount of research on the subject of flood risk governance in urban areas is limited and fragmented. So research on this subject has scientific relevance. Besides, the outcome of a study on good practices in flood risk governance in urban areas has societal relevance, because it can increase the resilience of society towards flood risks.

Therefore, this thesis aimed to give an overview of good practices in urban flood risk governance, these good practices led to recommendations for policy makers. To proceed to this aim, the following research question was answered:

*What governance conditions are necessary for the enhancement of urban flood risk resilience?*

In order to answer this question, the first step was to establish a list of governance conditions from literature for the enhancement of urban flood risk governance. This led to a list of twelve conditions. The presence and importance of these conditions was then tested, using a comparative case study. The comparative case study was based on the eighteen cases studied for the STAR-FLOOD project. The comparative case study consisted of a document analysis of the reports from STAR-FLOOD researchers, on interviews with the STAR-FLOOD researchers, and a comparison of all eighteen cases.

The outcome of the research is a new list of governance conditions to enhance urban flood resilience. Within this list, the first five conditions need attention of policy makers, while the other conditions are more context specific. In general it could be stated that flood risk governance in urban areas does not have a general good practice, there is not a solutions that fits all.

## Keywords

Flood risks, urban agglomerations, flood risk governance practices, resilience, climate change adaptation

## List of abbreviations

ACCCRN: Asian Cities Climate Change Resilience Network

CBA: Cost-Benefit Analysis

EU: European Union

FAS: Flood Alleviation Scheme

FRMS: Flood Risk Management Strategy

FRGAs: Flood Risk Governance Arrangements

GDP: Gross Domestic Product

IPCC: International Panel on Climate Change

LAA: Learning and Action Alliance

LLFA: Lead Local Flood Authorities

MCA: Multi-Criteria Analysis

UK: United Kingdom

ZPP: Zuidplaspolder

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## 1. Introduction

In 2013, The International Panel on Climate Change (IPCC) presented their fifth assessment report. In this report it came forward that the surface temperature of the Earth has been successively warmer in the last three decades than ever before. This is based on measures executed since 1850. The time period of 1983 to 2012 was even the warmest 30 year period witnessed in the last 1400 years (IPCC, 2014). Scientists consider this increase in temperature a sign of climate change. It is also considered that climate change can have significant impacts on nature, animals and human beings. Increases of sea levels and heavy rainfall which can lead to floods in flood prone regions are examples of these significant impacts (ibid).

Considering Europe, water related disasters such as flooding accounted for approximately 81 percent of natural victims in 2013 and was responsible for the largest share of economic damage (Guha-Sapir et al., 2013). This will most certainly intensify in the future, according to Alfieri et al. (2015) the average runoff and inflow of the European rivers will change. For example the annual average discharge and precipitation in north-eastern Europe is expected to increase. In general it is expected that 21 of the 37 European countries will face a significant raise in frequency of extreme weather events (Alfieri et al., 2015). Besides the growing chance of extreme weather events, such as flooding to occur, water related disaster risks are also intensified, because of other trends such as economic and population growth, urbanisation (Hegger et al., 2014), and also soil subsidence (STAR-FLOOD, 2016). Urbanisation intensifies the risks, due to the fact that urbanisation takes place in the direction of river areas, which makes the river areas even more prone and intensifies the losses in these areas, because there is more to lose (Hegger et al., 2014). These losses imply that governments need to increase the resilience of the areas that are prone to flooding.

### 1.1 Problem definition and research aim

As stated above, the losses imply that governments need to enlarge the resilience of urban flood prone regions, so it is expected to be an important topic for governments. Because it is such an important topic, you would expect that urban flood resilience is also an important research topic. Research can inform governments and policy makers on how to protect their citizens from flooding. But when searching for academic literature on resilient urban flood risk governance, in the academic search engine of Scopus, there is a small amount of hits and they are diverse in their outcomes and research objects.

One of the articles is about the Asian Cities Climate Change Resilience Network (ACCCRN). In the article it is discussed that although there are critical actions in order to deal with the impacts of climate change, there are challenges in implementation of the critical actions due to powerful forces that influence decision making and it is challenging to ensure that the decisions are equitable and are in line with incentives of the many stakeholders as well (Brown et al., 2012). Besides a study in Asia, there were studies executed in Africa too. Vedeld et al. (2015) discovered that in the city of Saint Louis, Senegal that adaptation in order to be flood resilient cannot successfully be addressed by local governments alone. Multiple layers of government should collaborate effectively, to combine in some cases competing policy agenda's. Beforehand it was expected that implementing strategies to increase resilience should be done by local governments (ibid). Muller (2007) sheds a different light on urban flood resilience. The author is merely interested in how poor African communities should be able to finance measures, to be more resilient against the impacts of climate change. He comes to the conclusion that the costs should be paid according to the polluter pays principle. There is also a

short notice in the article that a prerequisite of good adaptation practices, leading to flood resilient cities in Africa, communities should be informed and involved (ibid). Furthermore, Europe has also been a research object for the topic of urban flood risk governance. Van Leeuwen et al. (2015) executed an assessment of climate change and water management in 45 cities in the world, mostly focusing on European cities. The outcome of their research is that a positive significant correlation exists between cities with a high City Blueprint, the GDP of a country, voluntarily participation and initiative of local governments in the management of water. Therefore, developing cities as well as regions are more sensitive to and less resilient of flooding (ibid). The last retrieved article is also on flood risk governance in Europe and is part of the STAR-FLOOD project; a project subsidised by the European Union in order to establish resilient and appropriate governance arrangements to deal with flood risks in Europe (STAR-FLOOD, 2016a). In the article five types of Flood Risk Management Strategies (FRMS) are listed. These FRMSs are Flood Defence, Flood Risk Prevention, Flood Risk Mitigation, Flood Risk Preparation and Flood Recovery (Hegger et al., 2014). Resilience will be increased by putting these strategies in place at the same time and adjust them to each other. However, not every FRMS is appropriate in every European country, depending on the Flood Risk Governance Arrangement (FRGAs) that vary from country to country (ibid).

From the above discussed articles it is not possible to give a general conclusion on what the conditions are for strengthening the flood resilience of a region or country and what governments can do to strengthen the urban flood resilience. The small amount of articles and the diversity in the research objectives are the causes for the lack of a general conclusion. Furthermore the research is spread over different regions of the world. The academic articles do not base their outcomes on research conducted at different continents, but usually stay within a continent for their research. Therefore, more research is needed on good governance practices that enhance the resilience of urban flood prone regions, based on evidence from multiple continents. As such, the aim of the thesis will be to give a more detailed, but still general overview of governance conditions that enhance the resilience of urban flood prone regions. This can be utilised by policy makers, to produce policies that better protect regions against flooding and makes urban agglomerates more flood resilient.

## **1.2 Research objective, questions and framework**

The research is conducted with the objective to find the necessary governance conditions that lead to good governance practices in resilient urban flood risk governance. This may lead to recommendations for policy makers, to establish policies to make urban regions more resilient against flood risks. This objective will be achieved by conducting a literature review on urban flood risk governance, based on articles from different continents and on a comparative case study, which combines secondary research on eighteen already conducted case studies, with interviews with the case study conductors (see the methods section for a further explanation). The eighteen case studies are part of the earlier mentioned STAR-FLOOD project, which I will introduce shortly.

The STAR-FLOOD project has been started to enable countries and regions to better deal with the risks of flooding from rivers in urban areas throughout Europe, by explaining, analysing and evaluating, but also for designing policies (STAR-FLOOD, 2016a). Six countries participate in the program; Sweden, Poland, the Netherlands, England, France and Belgium (STAR-FLOOD, 2016b). The magnitude of floods is not the same in these countries, as well as the efforts (by their governments) to broaden their flood risk strategies and they differ in administrative culture and structure (STAR-

FLOOD, 2016c). In every country of the STAR-FLOOD project, three separate case studies have been conducted. Until now connections between the good practices in the eighteen cases are not established. Providing the linkages (if any) will give more insights on the governance conditions which are necessary for enhancing the resilience of urban flood prone areas, together with the outcomes of the literature review.

In order to find the conditions that enhance the resilience of urban flood prone regions, the following main research question will be answered:

*What governance conditions are necessary for the enhancement of urban flood risk resilience?*

Four sub-questions have been established to help answer the main research question. The sub-questions, together with the research framework will be explained below.

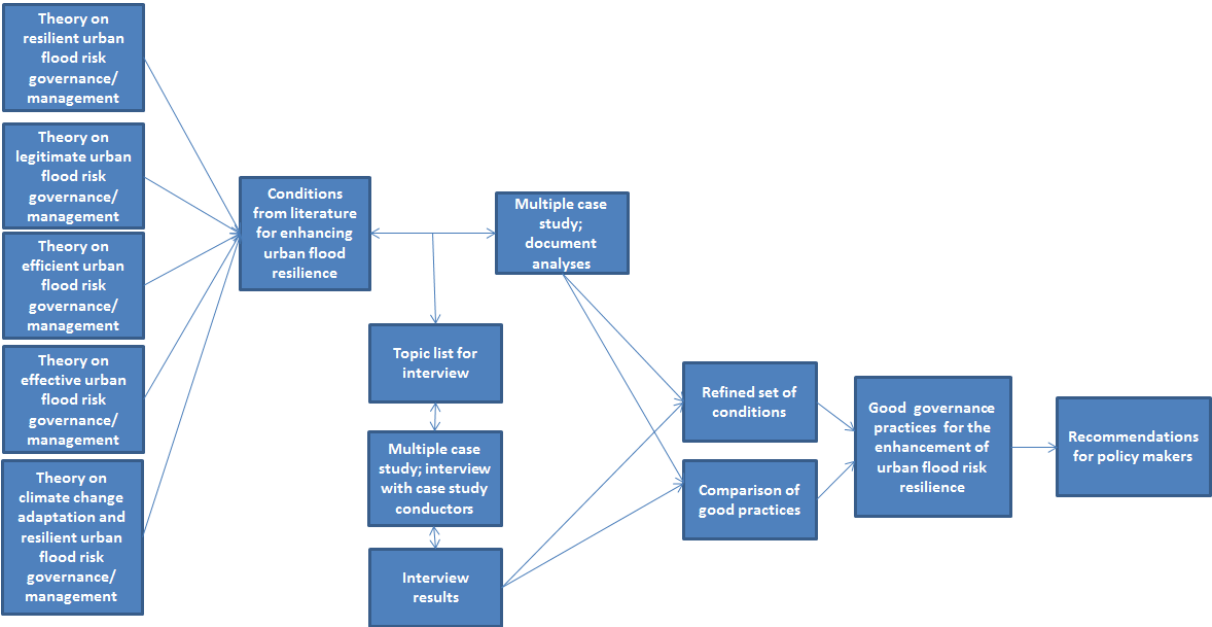


Figure 1.1: Research framework

As illustrated in the representation of the research framework above, the research will start with a literature review on the concepts of resilience, efficiency, legitimacy and effectiveness of urban flood risk management, climate change adaptation and flood risk management. The outcome of the conducted desk research will give insights on the conditions for the enhancement of urban flood resilience from literature. The first sub-question, which is connected to this part of the research, is; *What governance conditions contribute to urban flood resilience according to literature?*

After having set the conditions for enhancing urban flood resilience from literature, a comparative case study on the STAR-FLOOD project will be conducted. The case study is divided in a document analysis (secondary research) and interviews with the researchers of the STAR-FLOOD case studies, as stated above. The first step of the case study is the document analysis of the eighteen STAR-FLOOD case studies. In this document analysis, the STAR-FLOOD case studies will be scored on the presence of the conditions from literature. The STAR-FLOOD case study conductors will score their case(s) on the presence of the governance conditions from literature as well. The conditions from

literature in general (their importance and completeness) and the differences in scores (if) any between the researcher and my observations are the input for the topic list, used during the interviews. This will lead to interview results, which will most certainly give more insights on urban flood risk governance. After conducting the interviews, the STAR-FLOOD case study is finished. For this section of my study, the sub-question is; *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

The multiple case study part of the thesis will be followed by a discussion, in which a comparison of good practices from the case studies will be made. Furthermore, this discussion includes a part about the conditions from literature in general, which will lead to a refined set of conditions. This part of the thesis is guided by the sub-questions; *What conditions of good practices in urban flood risk governance can be retrieved from a comparison of the STAR-FLOOD case studies?*

After answering the last two discussed sub-questions, more substantiated statements can be made on good governance practices for the enhancement of urban flood resilience. This is the aim of the thesis. However, with these good practices it will be possible to inform and give recommendations to policy makers. Therefore my final sub-question is; *What recommendations can be provided for policy makers in order to deal with urban flood risks?*

### **1.3 Scientific and societal relevance**

According to Hegger et al. (2014) governance and legal studies are until now fragmented, scarce and limited in scope on flood risk management. Above it is also mentioned that at this point in time a relatively small amount of studies are conducted on this subject. Furthermore, this small amount of studies is conducted in different regions of the world, the outcomes are too general and there is at the moment not a study based on multiple continents. In short; there is insufficient knowledge on the key governance conditions to enhance the resilience of flood prone urban regions. Therefore this study is scientifically relevant, because it will contribute to the theoretical debate and literature on resilient urban flood risk management.

Considering the societal relevance; it is assumed that the inhabitants of certain regions in the world are most certainly facing flood risks due to climate change. This research and research on good practices in urban flood risk governance in general can lead towards more resilient flood prone regions. What is meant here is that these inhabitants are less exposed to flood risks and are better prepared for a potential flood risk. Furthermore, the societal relevance this topic has can be seen in the fact that there are other projects beside the STAR-FLOOD project which address the problem of climate change and the effects, such as flooding. The C40 Mayors project is an example. The C40 is a network of the megacities in the world, which are devoted to address the problem of climate change. Collaborating and sharing knowledge, so that they can take significant and important action to reduce greenhouse gas emissions and to reduce climate risks is the way in which they want to achieve this aim (C40, 2016).

### **1.4 Outline of the thesis**

The thesis continues with a chapter on the governance conditions for the enhancement of flood resilience in urban areas from literature. The chapter will be concluded with an overview of these conditions. In the third chapter the methods of the thesis will be discussed. This methods chapter starts with the research strategy, followed by an explanation on the data collection. In chapter four, the three STAR-FLOOD case studies that were conducted in the Netherlands will be discussed and

scored on the presence of the conditions from literature established in chapter 2. The scoring is executed through both the findings from the document analysis, as well as by the information retrieved from the interviews. After the discussion case by case, the chapter will compare the Dutch cases and bring forward the opinions of the interviewee(s) on the governance conditions from literature. Chapter five up to and including chapter nine will have the same structure as chapter four; only in every subsequent chapter another country of the STAR-FLOOD project will be discussed. Chapter ten will be a discussion chapter, in which the eighteen cases and different countries will be compared, the conditions in general from literature will be discussed and limitations of my research will be stated. The thesis will end with a concluding chapter, which will also bring forward possible recommendations for policy makers.

## 2. Enhancing urban flood risk governance; perspective from literature

### 2.1 Introduction

In this chapter a literature review is presented on the concepts of resilience, legitimacy, effectiveness and efficiency of urban flood risk management and climate change adaptation and resilient flood risk management. With this presented literature review, insights on the conditions for the enhancement of urban flood resilience retrieved from literature, are given. The sub-question that will be answered in this chapter is the following: *What governance conditions contribute to urban flood resilience according to literature?*

The concepts of resilience, legitimacy, efficiency and effectiveness of urban flood risk governance are chosen as important concepts for this thesis on urban flood risk governance due to their appearance in the earlier mentioned STAR-FLOOD project. In the STAR-FLOOD project it is assumed that regions and cities that are prone to flooding will be more resilient if different Flood Risk Management Strategies are adjusted to each other and are put in place at the same time. Furthermore, it is assumed that adjusting FRMSs to each other and simultaneously implementing them (which makes it resilient) is only possible if the FRMSs and the coordination of these FRMSs is appropriate; meaning they should be legitimate, efficient and effective. So an ideal FRGA leads to both appropriate and resilient flood risk governance, or at least the FRGA is more successful, if the FRGA is more resilient and appropriate (Larrue et al., 2013). When considering other literature on the same concepts, it is easier to merge and compare the outcomes of the literature with the outcomes of the multiple case study on the STAR-FLOOD project. Furthermore, the outcomes of the literature review can narrow down or widen the criteria set by the STAR-FLOOD project.

The literature review is conducted through the academic search engines of Google Scholar and Scopus. In these academic search engines articles were sought by the following key words: “urban flood risk governance” and “urban flood risk management”, which were supplemented, one at the time, with; resilience, legitimacy, effectiveness and efficiency. The terms governance and management are used as substitutes, because they are used simultaneously in literature, due to the fact that enhancing flood resilience is now not only a matter of government, but many times stakeholders are involved, or have the lead in a project. Besides, the amount of academic articles became larger when both governance and management were used as term, instead of only searching for the term governance. It turns out that two of the articles, namely the article of Brown et al. (2012) and the article of Van Leeuwen et al. (2015) are found when searching for either of the key words of governance or management and resilience. Furthermore “climate change adaptation” is added and used as a substitute for “flood risk governance/management”, to find even more relevant academic articles. In Scopus the articles were selected by the amount of citations. Furthermore, the snowball method was used in order to search for academic articles. The snowball method was used in two ways. First, articles were found by checking the references by the already retrieved academic articles. Second, the website of Science Direct, where students are able to download academic articles, offers a function where they show you which articles are also downloaded by other downloaders of the articles. This showed some other interesting and relevant articles as well.

The chapter will start with the concept of resilient urban flood risk governance, because this is the central term in the thesis. In the succeeding paragraphs legitimate, efficient and effective urban flood risk governance are discussed. Due to the fact that there is a small amount of literature on urban flood



risks governance so far, the concept of climate change adaptation is also reviewed, because the term is interconnected with flood governance. In the concluding paragraph an answer on the sub-question stated above will be formulated, in the form of a list of governance conditions for the enhancement of flood risk resilience in urban areas.

## **2.2 Resilient urban flood risk governance**

In the introduction of the thesis it is described that there are not many hits in Scopus if you search for the terms “resilient urban flood risk governance”. When changing the term governance for the term management, a few more academic articles on resilient urban flood risk governance are found. Both resilient urban flood risk governance and resilient urban flood risk management will be discussed. This is done separately so that it becomes clear if there are differences in the conditions from the literature on governance or management. However this paragraph will start with a definition of resilience, because although resilience is widely used, not every academic writer uses the same definition.

### **2.2.1 Resilience; a definition**

Although many articles speak about the concept of resilience, it is not always clear what the definition of the concept is. The ecologist Holling started to use the concept in the 1960s and 1970s. The resilience concept or perspective arose through studies of populations that have interactions with each other, such as predator-prey interactions and the influence from the functional responses of these interactions on theories of ecological stability (Folke, 2006). Resilience was defined by Holling as: *“resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist”* (Holling, 1973, p. 17). This is still a somewhat complex definition. Handmer & Dovers (2009) define resilience a little less complex; they state that resilience is about how large perturbations in an environment can be managed by a system. This means that resilience is all about if relations and structures are strong enough to deal with large changes in the surroundings.

However resilience is as shown in the above definition of the concept by Holling and according to other scholars not only about managing changes, but also about the ability of that system to not only manage large perturbations, but also to recur to the state of the system as it was before the large perturbations. This does not mean that the system should be in exactly the same state as before, because there are multiple stable states possible (Folke, 2006). Folke (2006) adds that these multiple stable states cause surprises and uncertainty. However, more important is that the system is able to absorb shocks, at the same time reconstruct, while change is undergoing, with the result that the system still has the same function, feedbacks, identity and structure (Walker et al., 2004).

In his article Folke (2006) also states what resilience, the multiple stable states and the uncertainty and surprises that come with it means for environmental management. According to him uncertainty and unexpected events are around and we have to manage it, instead of only reacting to it. The population has to be prepared for this uncertainty and surprises and needs to find ways to deal with it and live with it (ibid). As already mentioned, society needs to absorb the perturbations but still keep the same structure, function, feedbacks and identity (Folke, 2006; Walker et al., 2004). It also means that managing our environment gets a different definition. Instead of trying to control the changes which are happening in our environment, we can watch them and see the environment around us coming into a new stable state (Folke, 2006).

### 2.2.2 Resilient urban flood risk governance

In this paragraph multiple articles on resilient flood risk governance will be discussed, which consider the topic from different angles and based on research from different regions in the world. The articles of Muller (2007) and Vedeld et al. (2015) are about flood resilience of urban areas in Africa, while the article of Brown et al. (2012) is about resilient urban flood risk governance in Asia and the article of Larrue et al. (2013) on flood risk policies in Europe. These articles are supplemented with the article of Van Leeuwen et al. (2015) on city blueprints in water management and Hegger et al. (2014) on stability and dynamics in flood risk governance.

According to Larrue et al. (2013), flood resilience of urban areas is enhanced by implementing multiple and diverse FRMSs at the same time and adjust them to each other. This will make sure that society is better able to respond to flooding, but also to recover when a flood has occurred (ibid). This is in line with the above described theory on resilience, where it is also stated that resilience is about recovery after a shock event. Larrue et al. (2013) furthermore state that FRGAs, which empower broadening of FRMSs, can possibly be described as outcome resilience and is a form of delivering resilience. Next to outcome resilience there is also process resilience. In process resilience, the FRGA, which is in place at this moment is able to bear shock events, in the sense that the system will learn and innovate due to the occurrence of a flood and that the innovation and learning assists adaptation and enhances the systems resilience for floods that can occur in the future (ibid). This also in line with the definitions of resilience stated above.

Considering Africa, the city of Saint Luis, Senegal is very prone to flood risks, and therefore the government tried to elevate the flood resilience of the city (Vedeld et al., 2015). The paper implies that the coordination of disaster risk management and climate change adaptation should take place at the local, in this case; city and sub-city levels. This is important because adaptation is bound to a certain region and action should be taken in that region (ibid). However it does not mean that the regional or city level should be the only responsible government layer when it comes to disaster management and climate change adaptation. Effective collaboration across multiple government levels is of importance, vertical as well as horizontal (ibid). In Saint Luis the weak horizontal and vertical coordination was a critical barrier for the flood risk governance, just as the lack of funding from the government level to develop better coordination across government layers (ibid).

Although Saint Luis cannot be considered a resilient city according to Vedeld et al. (2015), they found some ongoing measures that have a positive influence on the flood risk governance in Saint Luis. The most important is that the country decentralised its institutions (ibid). According to Vedeld et al. (2015), the organisational structure with fewer bureaucratic layers, together with committed leadership facilitated active citizen input and coproduction in flood risk management. The active engagement of citizens has led them to take action as well. They demanded that government officials supported reduction of flood risks and drainage. *“Hence, we propose that the arrangement of coproduction within the system of multi-level governance and the way governance was practised were the factors that best explained the relatively successful local adaptation approaches.”* (Vedeld et al., 2015, p. 22). The article of Vedeld et al. (2015) is not the only article that mentions that in order to become more resilient, all stakeholders or local communities should be involved. Muller (2007), who also wrote an article about urban flood resilience in Africa, states briefly that at the moment, there are some challenges for climate change adaptation. In Order to make cities in Africa

resilient, communities should be involved and informed, that is a prerequisite for good adaptation practices.

Not only in Africa, but also in Asia and in the rest of the world, it seems that participation of volunteers and a large role for the local government is also connected to a higher flood risk resilience of a city. In Asia, the Asian Cities Climate Change Resilience Network (ACCCRN) is launched by the Rockefeller foundation. This network tries to mobilise and action, attention and funding to build resilience towards climate change in Asian cities (Brown et al., 2012). The network has analysed vulnerabilities of Asian cities due to climate change and they draw valuable information out of these analyses, from which they were able to identify a list of ten critical actions that need to be considered enhancing flood risk resilience or climate change as a whole (ibid). The enumeration will be described below, but one of these ten critical actions is to engage stakeholder groups; government interventions to enhance the resilience, should not be designed and implemented in isolation (ibid). This also means that the policies should be made in accordance with local level government layers. A way of doing this is to set-up coordination offices for flood risks and climate change adaptation (ibid). These coordination offices should integrate information from multiple government departments and from the local community. Together with these other departments and the local community, actions with priority have to be agreed upon and these actions should be coordinated in an effective manner, together with higher government layers and donors of financial resources (ibid).

Another example that states the importance of participation of volunteers and a large role for the local government is from Van Leeuwen et al. (2015). They executed an assessment of climate change and management of water in 45 cities in the world, but mostly focussing on Europe. To do so, they carried out City Blueprints, which showed that there is a large variety in the management of water across countries. Cities with High City Blueprints scores had a significant and positive relation with participation of volunteers and local government involvement (and also the GDP per person) (ibid). A side note is that they used the voluntary participation index, which is a general index. So it does not mean that those who participate necessarily participate in for example coproduction of flood resilience, which is the kind of participation mentioned earlier.

Besides the outcome that flood resilience should be enhanced by a government that gives more responsibilities to local government layers and to involve all stakeholders, including local communities, there is also an article by Hegger et al (2014), listing five types of Flood Risk Management Strategies (FRMS). Flood Risk Prevention, Flood Recovery, Flood Risk Preparation, Flood Defence and Flood Risk Mitigation are these FRMSs. Preparation, prevention and mitigation strategies focusses on the effects of potential flooding, the recovery strategy focusses on recovery after the occurrence of a flood and the defence strategy focusses on the prospects of flooding. The article states that urban areas become more resilient towards the dangers of flooding if the above mentioned FRMSs are adjusted to each other and are put in place at the same time (ibid). This is also earlier mentioned by Larrue et al. (2013). However, a general manner in which these FRMSs should be adjusted to each other does not exist, so that every urban area in Europe or the rest of the world is more flood resilient. The appropriateness of the adjustment to each other and which FRMSs need to be put in place depends among other factors on Flood Risk Governance Arrangements (FRGAs) through which it is attempted to implement the FRMSs (ibid). FRGAs are the institutional circumstances, emerging because of interaction amid actors and coalitions of actors who are

involved in the policy domains that are relevant for flood risks, their resource base and power, the rules of the game and the dominant discourses of these actors or coalitions of actors (ibid). Disaster management, water management and spatial planning are the policy domains that are meant above (Hegger et al., 2013).

Larrue et al. (2013) elaborate even more on FRGAs, in their article. They established a framework and methodology that assists the assessment of flood risk governance practices, which can lead to design principles for resilient and in their terms appropriate flood risk governance. This can be established by conducting an ex ante assessment of FRGAs. With this ex ante assessment it is according to Larrue et al. (2013) important to explain dynamics or/and stability in the governance of flood risks, there are five factors which possibly explain dynamics and stability. The first one is physical circumstances; trends in climate change, rainfall patterns and their seasonality, elevation, gradient as well as river system and how complex this system is. This factor is of importance, because it determines to some extent the characteristics and nature of flood risk governance. The physical circumstances usually cause stability in FRGAs, because the physical circumstances can generally not be changed (ibid). The second factor is the social and physical infrastructure; for example the existence of dikes, dams, sewer systems, houses, transport networks, energy installations, railways, educational systems and knowledge networks and infrastructures. Due to large investments in all of these networks and infrastructures, but also due to established regulations, these networks and infrastructures are locked in the systems and will not change. Therefore they most likely contribute to stability in the policies and regulations that deal with flood risk governance. Furthermore, established infrastructures can possibly constrain some FRMSs and on the other hand facilitate some FRMSs (ibid). If for example many dikes have been built up, there have been very large investments on these dikes; the focus will be on the FRMS of flood prevention. This can possibly constrain the FRMS of flood recovery, because it is the focus to avert flooding. The third factor is structural factors; the resources and rules in social systems. Examples of structural factors can be building codes, but also the settings where policies are established and this goes further than just the parliament of ministries, but media and universities are also settings, where policies are made. So actually, structural factors are about institutionalising behaviours of citizens. Institutionalising strengthens stability in FRGAs. However, institutionalising can influence behaviours, but not shape behaviours. Furthermore, resources and rules can be changed. Especially in decentralised countries it is easier to change regulations, than in centralised countries. That is because the process of legislation making is usually more complex at the national level, while at the local level, the circumstances are more important (ibid). Therefore, I assume that structural factors could lead to stability as well as dynamics in flood risk governance. The fifth factor is agency; the meaningful actions of agents, which are capable and knowledgeable. The meaningful actions of agents can contribute to change in flood risk governance as well as their actions can resist change in flood risk governance. There are three important types of agency; the change agent, the advocacy coalition and the policy entrepreneur. Change agents are able to make changes in policies, which can lead to changes in legal systems. Policy entrepreneurs are just as change agents engaged in changing policies, but they are involved in the complete process of policy change, in their effort to change policies. The advocacy coalition exists of at least two coalitions in the policy system that has competing beliefs and resources. Beliefs are easier to change and therefore room exists for agents to influence their beliefs. Due to the fact that agents are able to resist or contribute to change, agency can explain stability as well as dynamics in flood risk governance (ibid). The last factor is shock events; an external shock that causes disruption

throughout the interdependent social, economic and ecological systems. Shocks can come from a policy subsystem internally or from outside the subsystem. Focussing events such as flooding is an example of a shock from outside, conflicts within a subsystem of the policy domain is an internal example. These sorts of shocks can lead to dynamics in flood risk governance. There are also shocks that can lead to stability in the governance of flood risks; shocks that occur when small changes in the policy subsystem are already taking place and are being enlarged to considerable change by shock events. So actually a path that is already chosen in the policy subsystem is accelerated, and therefore causes more stability (ibid). As stated these five factors described above can explain stability and dynamics in FGRAs, but it should be noted that these factors should be combined to explain stability or dynamics, it is usually not one of these factors by itself that solely can explain dynamics or stability (ibid). In the report of Larrue et al. (2013) they state that stability and dynamics can coexist and that stability is not by definition better than dynamics and the other way around. It is dependent of the circumstances in a region or country.

In some of the articles authors make an enumeration of multiple important conditions that will most probably enhance the flood resilience or the capacity of a region or a city to adapt to climate change. To start with, Vedeld et al. (2015) formulate some key policy measures that most probably will enhance the flood risk governance in the city of Saint Luis. The first one is that financial resources and powers need to be decentralised to the local city and even sub-city levels. Second, the responsiveness to inequality and to informality among public officials needs to be enhanced. Third, the district level should be provided with resources, a formal mandate and powers, so that they are able to control land development and flood risk governance, which is community based and led. The fourth is connected, to the third; continue to enable even more commitment of (poor) citizens, to participate in coproduction of local planning and relevant services. Lastly, when commitment is enlarged, organisational structures and homes should be established for the coordination of the joint disaster and flood risk management and for the joint climate change agenda's. These should include climate action plans, which are supported on the city-level, and which emphasis risk reduction on the long term instead of short term (ibid). This comes close to the organisational homes that should be established according to Brown et al. (2012). That means that setting up a coordination department to enhance the flood resilience of a city is at least important for Africa and Asia, and might be an important condition for cities on other continents.

The second article that provides a set of conditions is the article of Brown et al. (2012). As discussed the article is about a network of Asian cities that tries to enhance the resilience towards climate change. So the critical actions are not only measures against flooding, but also for other risks related to climate change. They established ten critical actions for the enhancement of the resilience in Asian cities. The first one, which is already mentioned is to engage stakeholder groups, instead of designing and implementing policies on this subject in isolation. To effectively design and implement these policies, a coordination department should be set up (ibid). A second critical measure is to make sure that the urban and land use planning are climate sensitive. Hereby it should be considered if land is developed for, for example infrastructure, as a residential area or for commercial purposes. With this consideration, density should be considered as well, and the interaction between the environment and the area that will be built, which are affected and connected with the changes in the amount of rainfall and heat in a city (ibid). The third is to enlarge the capacity of the drainage system, effective solid waste management and hard and soft flood risk mitigation and response measures. If at least one of them is not implemented, the risks of climate change cannot only cause flooding impacts, but

there can be great risks to health, human life and assets as well (ibid). The fourth measure that is been stated is to invest in conservation systems for the demand of water. Households can for example conserve rain water, which can be used in dry seasons, when the amount of groundwater is low. Another possibility is to restore lakes in the urban area. These lakes can be used when there are water shortages (ibid). A fifth measure is to make sure that there are reliable early warning systems and that there is effective coordination after a disaster. Usually cities already have a disaster management plan, but this should also include how to deal with and manage a natural disaster. Citizens are important for this measure as well, they should be educated about the risks and they should be included for effective coordination (ibid). Sixthly, focus should be built on health systems that are more responsive. Heat stress, drought and flooding have large impacts on human health (ibid). As a seventh measure Brown et al. (2012) state resilient transport systems and resilient housing. This should be incorporated into urban planning. The eighth critical action is to strengthen ecosystem services. Ecosystems have the ability to indirectly and directly reduce the impacts of climate change such as flooding. This is also mostly more cost effective and more affordable, than building infrastructure to enhance the resilience (ibid). The ninth critical action is to protect groups in society that are working in economic sectors that are mostly affected by climate change (ibid). Lastly, Brown et al. (2012) state that capacity building and education of inhabitants is necessary. They also discussed this at the point of waste and drainage, but it is also necessary in general to become more resilient.

It can be argued that not all of the conditions to enhance the flood resilience of a city, which are listed by Brown et al. (2012), are to the same extent important to enhance the resilience for flood risks in general or on other continents. Firstly, because the measures are to reduce the impacts of climate change risks in general, instead of the risks of flooding. Secondly, the conditions are not the same, due to the fact that European cities and cities in Asia are not fully comparable, due to for example differences in structure, culture and resources. Mainly important in Europe will presumably be; land use and urban planning in a climate sensitive manner, policy making in coordination with multiple government layers, departments and stakeholders, early warning systems and effective coordination after a disaster, resilient transport system and resilient housing, supporting ecosystem services and capacity building and education of inhabitants.

One other condition is mentioned to enhance the flood resilience of cities. Muller (2007) suggests in his article on the risks of flooding and other extreme weather events in Africa, that the costs for climate change adaptation measures should be payed according to the polluter pays principle. This is the best way in which African cities are able to afford adaptation measures. Without these climate change adaptation measures the risks of extreme weather events and flood risks are only mitigated, instead of adapting to the risks, which will make the cities more resilient (ibid). However, it can be questioned if this condition is relevant for the enhancement of flood resilience in European cities, because adaptation measures are already in place at this moment, without using the polluter pays principle. But just as with the conditions from Brown et al. (2012), this condition will not be disregarded.

### **2.2.3 Resilient urban flood risk management**

At the beginning of the chapter on resilient urban flood risk governance it is mentioned that both articles on resilient urban flood risk governance, as well as on resilient urban flood risk management are discussed. Two of the articles; Brown et al. (2012) and Van Leeuwen et al. (2015) are found when



searching for either of the key words. So the findings of these articles are relevant for this paragraph as well. Furthermore, the articles of Djordjević et al. (2011) and Van Herk et al. (2011) are discussed in this paragraph.

The first article on resilient urban flood risk management is of Djordjević et al. (2011). The article is about resilience towards flooding in urban areas, within a European Union (EU) project. Their aim is to find measures which enhance resilience in urban flood prone regions; these measures should be cost-effective, adaptable and integrative. The first group of measures to enhance flood resilience that they state is about better planning policies, specifically in the early stages of flooding. These better planning policies are a sustainable drainage system that stores or reuses water flows, and the amount of flows that the system can handle should be enlarged. The system is most effective if it flows as natural pathways (should be considered when building a new drainage system), and if they are maintained in the right manner. Furthermore, flood resilience of buildings should be improved, also with the consideration of natural flood pathways. Besides, the accountability and also the communication across stakeholders should be improved (ibid). The second measure is to a build information system for urban flooding that shows real-time risks of flooding. These information systems are to alarm when precipitation goes beyond an established criterion. However, at that point in time, there is still warning time left, which reduces damages caused by flooding. Furthermore, there is a difference in the sort of information the warning system should give. Citizens just want the information to be clearly and simple, in order to understand what kind of risk they are facing, while the public sector wants more detailed information to coordinate response strategies against the flood risk (ibid). The last condition that the article mentions is resilience measures. What is meant here is that cities should have a “*no regrets*” (Djordjević et al., 2011, p. 869) approach to adaptation and mitigation efforts, in the sense that the resilient approach causes changes in behaviour, changes in policy on urban planning and changes in technology, at all times. Furthermore resilience means that not everybody can be protected from flood risks, especially when they are beyond standard flood defence measures (Djordjević et al., 2011).

Another article on resilient urban flood risk management is of Van Herk et al. (2011). They state that an integrated approach is better able and more effective to manage the risk of flooding, than large infrastructures that stand by themselves and has the potential risk of a technological lock-in. There should be a shift towards a new path with non-structural and structural responses. The integrated approach is at the moment considered to be most effective in reducing flood risks if it is incorporated in urban planning. This is not only about urban planning for new developments, but also when for example buildings are redeveloped (ibid). So with redevelopment and new development it is possible to reduce flood proneness. However there are quite a few barriers to the integration of flood risk management in urban planning. Examples of these barriers are that flood risk management needs long term perspective, especially compared to the considerations in urban planning, flood risk management is normally not considered to be the most important of service and utility needs and opportunities (ibid). The long term perspective barrier could be addressed by changing from an institutionalised and vertical approach of urban planning, to an interactive and horizontal way of urban planning. This gives more flexibility to deal with complex challenges and it combines democratic legitimacy with spatial quality. Furthermore, short term actions are needed to have short term benefits, these short term benefits can make sure that there are required changes, which cause the delivery of long term plans (ibid). However, there is so much complexity in these urban planning processes that no group of stakeholders has the final say or control on the spatial or urban

developments. This brings forward other barriers; multiple actors complicate adequately addressing flood risks in urban planning, there can be a lack of shared perception and understanding on how effective measures are implemented, which are not standard and this contributes to only using structural solutions, such as increasing flood defence, instead of combining it with non-structural solutions. It thus contributes to technological lock-in (ibid). Integrating flood risk management as a condition to enhance the flood resilience of urban areas is also mentioned by for example Brown et al. (2012). The more horizontal and integrative approach, where all groups of stakeholders are involved, is earlier also mentioned by for example Vedeld et al. (2015). Combining the structural measure of flood defence with other (non-structural) measures is stated in one of the previous parts as well, namely by Hegger et al. (2014).

The by Van Herk et al. (2011) mentioned barriers should be overcome by collaborative and integrative planning. This facilitates complex decision making. Furthermore, interactive decision making, which also means involvement of stakeholders, is expected to bring forward richer policy proposals, it increases effective implementation and therefore increases the democratic legitimacy of the established decisions (ibid). However, stakeholders should be supported, have new skills and competencies in order to achieve this in the way cities are being planned now. The way of doing this is by using a social learning framework. Social learning creates social capital and relational qualities and it also includes capacity building of organisations and individuals. It helps dealing with uncertainty and change, which are essential in flood risk management (ibid). The framework that is mentioned here is the Learning and Action Alliance (LAA). A LAA should be organised to develop and apply knowledge, which contributes to collaborative urban planning. This should be done through the three streams: the process of decision making, addressing the problems and to propose solutions, as well as through the three threads: set ambitions, establishment of facts and the creation of images (ibid). According to Van Herk et al. (2011) the LAA framework should be organised around three groups of activities, with the aim to support the streams and threads: system analysis, a collaborative design and governance. System analysis serves mainly to define and address the problems, and to establish facts. An example of such a fact is stating the definition of flood risk areas. This should be executed jointly by all stakeholders, as this enhances creativity and it makes it more likely that innovative solutions are established. However, the diverse problems and objectives should be balanced by the final decision makers (ibid). The collaborative design aims at proposing strategies and solutions, and also to create images. This usually results in coming up with an urban masterplan, developed jointly by stakeholders. Furthermore, in collaborative design multiple designs are made, not just one preferred design. This can best be done, in an early stage of policy development (ibid). The last activity group; governance, involves discussion of and defining of ambitions from all stakeholders, so that the roles and ambitions can be highlighted. It provides a vehicle for the consideration of the tasks and roles of every stakeholder (ibid). The article of Van Herk et al. (2011) also shows that the LAA framework is used in Dordrecht and the Westflank Haarlemmermeer area, both located in the Netherlands. For both the case studies it turned out that the LAA framework had a positive effect; they had a decisive influence on the policy proposals and masterplans that were established.

### **2.3 Legitimate urban flood risk governance**

This paragraph is about legitimate urban flood risk governance. The paragraph is mainly based on an academic article from Mees et al. (2014), which is supplemented with the academic articles of Bekkers & Edwards (2007), Van Herk et al. (2011) and Lemos & Agrawal (2006).

In quite some countries protection of flood prone regions is seen as a responsibility from the government, because measures to defend regions from flooding are seen as a public good; all inhabitants of the country benefit from it (Mees et al., 2014). However adaptive (or resilient) flood risk governance, as already stated above by for example Vedeld et al. (2015) and Brown et al. (2012) requires more than just the involvement of public actors; it needs other policy sectors and the private sector as well (ibid). When involving stakeholders it should be considered which stakeholders are allowed and what this position offers them, as well as their obligations (Larrue et al., 2013). Besides, the involvement of stakeholders, in order for flood risk management to be considered legitimate, there should also be access to flood risk information and there should be access to a process of appeals (ibid).

With the direct involvement of stakeholders come legitimacy problems. The legitimacy of the state is based on a democratic representation model; in which citizens have an equal right to vote their representatives, which make policy decisions for them (Bekkers & Edwards, 2007). However when stakeholders are directly involved, their interests are merged with the public interests, which might lead to other policies than without involvement of other stakeholders. This brings the legitimacy of the policy in danger. There are not only downsides to the direct involvement of stakeholders; the involvement of stakeholders can lead to network governance, in which stakeholders are able to participate and deliberate in decision making (Mees et al., 2014). This can also increase the support from society for the created policy and assist the implementation of the policy (Lemos & Agrawal, 2006). So it makes the implementation more effective and therefore enhances the democratic legitimacy (Van Herk et al., 2011). Network governance has its own sources for legitimacy and legitimacy issues as well. One of the forms of legitimacy is referred to as input, throughput and output legitimacy (Mees et al., 2014). Input legitimacy is about the equal representation of all interests of stakeholders. An issue for input legitimacy is already existing power relations, which still exist in the governance network and influence the ability of certain stakeholders to have their interest equally represented (ibid). Throughput legitimacy is about the quality of procedures and rules that are used to reach policy decisions and also about the fairness of the whole process. Throughput legitimacy is reached through deliberation and purposeful participation. Here the issue is; are all stakeholders really influencing the decision making process, or is the participatory approach by the government just '*window dressing*' to reach the pre-set and preferred outcome by policy makers (Mees et al., 2014, p: 673). With output legitimacy is meant that authority is accepted and if that authority is able to achieve the goals or solves policy issues. This effectiveness is the perceived effectiveness by the stakeholders, in the sense that the stakeholders accept the outcomes (Mees et al., 2014).

Mees et al. (2014) conducted a research in which they made an analysis of public and private responsibilities and the legitimacy of these arrangements due to the involvement of both public and private parties in adaptive flood risk arrangements. The adaptive flood risk arrangements were studied in Rotterdam (The Netherlands), Hamburg (Germany) and Helsinki (Finland). In order to score the three cases they used an input, throughput and output legitimacy framework. For input they examined the interest representation, for throughput the quality of participation and the quality of deliberation and for output the stakeholders' acceptance (ibid).

Mees et al. (2014) expected that Rotterdam would have high level of input legitimacy, because from the three cases, they are the only one with a public private partnership in their floor risk

arrangements, which represent all key stakeholders, and because they utilised special decision making forums for constructing their flood risk arrangements. However, all three cases scored the same on the level of input legitimacy. Considering the throughput legitimacy, it was also expected that Rotterdam would have the highest level of throughput legitimacy because they had a high quality of deliberation and participation of stakeholders due to the decision making partnership. It turned out that for the level of throughput legitimacy this expectation was correct, Rotterdam had indeed a higher level of throughput legitimacy (ibid). Examining the output legitimacy showed that there were only small differences between the cases. Even though Rotterdam had a higher level of throughput, the acceptance of outcomes was not significantly higher than in the other two cases. Moreover, output legitimacy was quite high in all three cases (ibid). The outcome of the study is that the shift from exclusively public responsibilities in flood risk strategies and arrangements towards shared and divided public-private flood risk governance is pronounced, and that it has its influence on the legitimacy of the established policy, especially when private responsibilities become very dominant. Combined responsibilities can lead to more throughput legitimacy, because it increases the participation and deliberation (ibid). Furthermore the use of network governance does not mean that traditional forms of retrieving legitimacy are no longer in use. In Rotterdam all the established policy documents had to be ratified by the mayor and an alderman (ibid). Lastly, according to the article; *“participatory and deliberative models of democracy do not automatically lead to higher levels of output legitimacy..... legitimacy is gained for hierarchical arrangements under the following conditions: (1) high input legitimacy guaranteed through an extensive process of ratification via elected representatives, (2) clarity of public and private responsibilities, and (3) transparency and continuity in communicating these responsibilities, leading to accountability of both public and private actors”* (Mees et al., 2014, p: 680).

## 2.4 Effective urban flood risk governance

Besides legitimate and resilient flood risk governance, urban flood risk governance should also be effective. The academic articles that are discussed on this topic are; Larrue et al. (2013), Van Herk et al. (2011), Djordjević et al. (2011) and Aerts et al. (2013).

In the article of Larrue et al. (2013), effectiveness is about the degree in which FGRAs are able to use diverse FRMSs and empower the broadening of these FRMSs in flood risks management. Furthermore, flood risk governance is effective if the risks of flooding are eliminated or at least partially eliminated (ibid). Moreover, the report uses Young's (1994) dimensions of effectiveness; problem solving effectiveness, goal attainment effectiveness, behavioural effectiveness, process effectiveness, constitutive effectiveness and evaluative effectiveness (Larrue et al., 2013). Flood risk governance is considered to be problem solving effective if flooding will no longer be seen as a problem (ibid). I assume that this does not necessarily mean that floods do not longer occur. Goal attainment effectiveness is achieved when the goal of a FRGA is achieved. So if the goal is to protect all citizens from flooding, building dikes and dams and their maintenance is effective (ibid). Behavioural effectiveness is about changing the behaviour of humans. A FRGA is considered to be effective in this sense, if they succeed in getting as much people as possible out of an area that will be flooded (ibid). Process effectiveness is achieved when international established laws are implemented at the domestic level in the political as well as the legal system (ibid). An example is to adopt an EU directive in the political and legal system of an individual EU country. Constitutive effectiveness is a different form of effectiveness and it seems to me that it is connected to legitimate urban flood risk governance; however this connection is not stated by Larrue et al. (2013). This sort

of effectiveness is achieved by involving the local community (ibid). Evaluative effectiveness lastly, is about the outcome of the FRGA; is it for example an efficient outcome? This form of effectiveness is connected to legitimacy and efficiency (and this is also stated by Larrue et al., 2013) (ibid).

In the literature above, effectiveness came forward in some of the articles. Van Herk et al. (2011) stated that integrative approaches to urban flood risk management are more effective than using large infrastructures to fight flooding. Djordjević et al. (2011) state that measures to make urban areas more flood resilient should be cost-effective. However they do not mention which of the measures is particularly cost-effective. One relevant source is found on effectiveness and urban flood risk governance. This source will be discussed below.

Aerts et al. (2013) wrote an extensive article about resilience and protection strategies in New York City and the connected cost estimates. According to this article climate change is a challenge that needs to be appointed in planning, regulations and investments of a city. However there are many strategies with different costs and benefits, also over time and this should be considered in flood risk management. To make the cost estimates they define flood risk as a function of vulnerability, exposure and hazard. Furthermore they group adaptation measures into flood management strategies; *“a collection of measures (flood proofing, zoning, barriers, levees, etc.) that is needed to lower flood risks.”* (Aerts et al., 2013, p: 6). Aerts et al. (2013) describe the construction as well as the maintenance costs of two strategies. The first strategy is the Resilient Open City strategy, which is a strategy to lower vulnerability. This is done by enhancement of building codes that can be complemented with local scale measures for flood protection, to protect infrastructures that are not included in policies on building codes. The second strategy is the Storm surge barriers strategy; the aim here is to develop storm surge barriers. This can be complemented with other flood protection measures (ibid).

The Resilient Open City strategy has three alternatives. The first alternative is upgrading of building codes for houses, it includes elevating the base floor of houses in certain flood zones and wet and dry flood proofing. These measures should be applied to both new and existing buildings. The second strategy complements the first strategy with protecting critical infrastructure. Critical infrastructures are for example power plants, the airport, the subway and so on. Protection of these infrastructures should be executed on the local level. The third and last strategy within the Resilient Open City strategy is the Hybrid solution. This strategy anticipates on developments in the future, it keeps all options open and combines this with local level protection measures coming from the surge barrier strategies and the Resilient Open City strategies. The measures include flood proofing of already existing buildings, base floor elevation of new houses, strengthening of beaches via sand nourishments (no-regret measures), protection through levees of low lying areas, protection and enhancement of infrastructure and lastly measures to decrease environmental impact (ibid). The Surge barrier strategy has three possibilities as well, but because these strategies are about where to place a surge barrier in New York City or New Jersey, this is not relevant for this thesis. The outcome of the study by Aerts et al. (2013) is that the Hybrid solution is the best strategy. The reason hereof is that due to the combination of protection and resilience measures, and the fact that this strategy keeps all options open, measures can be upgraded over time, which is less expensive than establishing complete new measures. So there is more flexibility. However, in the future it is possible that surge barriers will become more cost-effective if the risks are increasing in the future (ibid).

## 2.5 Efficient urban flood risk governance

Now that legitimate, effective and resilient urban flood risk governance is discussed, efficient urban flood risk governance will be discussed. This paragraph is mainly based on the academic article of Ocio et al. (2015), and is supplemented with some insights of the article of Larrue et al. (2013).

According to Larrue et al. (2013, p: 72) efficiency is: *“The use of both public and private resources in a resource-efficient manner; based on the ratio of some desired output(s) to some input(s).”* As can be seen, efficiency here is about the efficiency of resource use. Furthermore, in this sense of efficiency, it is important that inputs and outputs are desired, which is determined by actors (Larrue et al., 2013). Taking into account efficiency can lead to better decision making and more transparent decision making, which enhances the legitimacy of certain policies. However, there is also a side note that efficiency can sometimes contradict with for example resilience (ibid).

Besides the notion of efficiency stated by Larrue et al. (2013), there is one article by Ocio et al. (2015) on efficiency and urban flood risk management. The article argues that there is a limited amount of financial resources to deal with natural hazards in general, but also for flood risk management specifically. To make sure that inequalities in flood risk management policies are avoided, these policies should be supported quantitatively. Normally a tool to measure this is a Cost-Benefit Analysis (CBA), but it is very hard to make one for flood damages, the costs cannot accurately be estimated. Ocio et al. (2015) established an approach that can define the best possible strategy to manage flood risks. This approach uses the Multi-Criteria Analysis (MCA). In the MCA, economic costs and benefits are still evaluated as in a CBA, but other relevant criteria, such as environmental impact are also evaluated and are seen as equally relevant.

The assessment should start with studies on the macro scale, in which areas are identified, that have a potential and significant flood risk. This analysis should be executed for example on the basis of previous flood studies and data on the vulnerability of certain regions (vulnerability, considering the potential damage, after which verification should be done with for example historical data) (Ocio et al., 2015). Subsequently, there should be an analysis of the meso scale that should bring forward flood risk and flood hazard maps and eventually prioritise the population that is affected by severe flood risks. In this stage a more detailed analysis is conducted than the analysis at the macro-scale, also involving a CBA, to name one (ibid). In the final stage this data should be used to prepare a reliable flood risk plan. In this flood risk management plan, the risks of flooding should be addressed on the base of structural and non-structural measures. The flood risk management plan is established by for example selecting the level of flood protection that is desired and by establishing which structural measures are best, based on the execution of a MCA (ibid). An outcome of a flood risks management plan can be that an area or region with a high risk of flooding is protected first, and that protection will be postponed for areas or regions with small flood proneness (ibid). This is in accordance with the article of Djordjević et al. (2011) who state that, resilience means that not everybody can be protected from flood risks.

## 2.6 Conclusion

This chapter was guided by the research sub-question: *What governance conditions contribute to urban flood resilience according to literature?* In the previous paragraphs the perspectives from literature on good governance conditions to enhance the resilience of flood prone urban regions are discussed. With this discussion, a list of governance conditions can be set up, that contribute to



urban flood resilience. At the same time, the conditions make urban flood risk governance legitimate, effective and efficient, as the conditions found in literature, for example legitimate urban flood risk governance overlap with the conditions for resilient urban flood risk governance and because most of the articles are found on either effective, efficient and legitimate urban flood risk are also found, when searching for resilient urban flood risk governance.

### *Set of governance conditions*

As shown from literature there are many conditions that are important to enhance the resilience of urban areas towards flooding. Some of the conditions are mentioned by multiple articles and some only by one. In the case where a condition is mentioned by multiple articles, their views are integrated into one condition. Below you can find a list of these important conditions. Next to the condition, it is noted from which articles the condition is retrieved.

- **Collaboration across government layers, with a significant role for the local government** (Brown et al., 2012; Mees et al., 2014; Muller, 2007; Van Herk et al., 2011; Van Leeuwen et al., 2015; Vedeld et al., 2015);
- **Stakeholders are involved throughout the policy process** (Brown et al., 2012; Djordjević et al., 2011; Muller, 2007; Mees et al., 2014; Vedeld et al., 2015)
- **Mechanisms are in place to facilitate learning and knowledge exchange** (Brown et al., 2012; Djordjević et al., 2011; Muller, 2007; Van Herk et al., 2011; Vedeld et al., 2015);
- **Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)** (Aerts et al., 2013; Brown et al., 2012; Hegger et al., 2014; Ocio et al., 2015; Van Herk et al., 2011);
- **Future risks are addressed in long term planning processes** (Vedeld et al., 2015);
- **Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)** (Aerts et al., 2013; Brown et al., 2012; Djordjević et al., 2011; Van Herk et al., 2011)
- **Funding for policy making and implementation is available** (Muller, 2007; Ocio et al., 2015);
- **Flood forecasting is up to date and shows real time risks of flooding** (Brown et al., 2012; Djordjević et al., 2011);
- **Adequate emergency planning is set up to evacuate people in case of flooding** (Brown et al., 2012);
- **Opportunities are created for innovation and experimentation** (Djordjević et al., 2011);
- **Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks** (Djordjević et al., 2011; Ocio et al., 2015);
- **Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding** (Brown et al., 2012; Muller, 2007).

### **3. Methods**

In this chapter the utilised methods for this research will be discussed and elaborated on. First, the success conditions and the research strategy are discussed. This will be followed by elaborating on the data collection. The data is collected by a literature study, which is executed in the previous chapter and a comparative case study. The comparative case study is conducted by doing both a secondary research and interviews, which will be explained below.

#### **3.1 Success conditions and research strategy**

In the previous chapter, governance conditions have been identified from literature, which enhance flood resilience of flood prone urban areas. This has led to a list of governance conditions. The presence of this governance conditions will be tested on multiple flood prone regions. This will give more insights on which conditions are important to enhance flood resilience. This is also one of the aims of this thesis. The other aim is to give recommendations to policy makers, based on the insights retrieved with this research on good practices in flood risk governance.

According to Verschuren & Doorewaard (2010), the decision between an in depth study or a broad study is the first critical choice, when selecting a research strategy. As a researcher you should also make a decision between a qualitative and a quantitative study and if your study is an empirical or desk research. Due to the fact that this thesis has the aim to provide detailed insights on good governance practices in flood risk governance, this study is an in depth study. Furthermore, the research will be a qualitative research, because this is in line with the selection of an in-depth study, to recover detailed insights. Lastly, this study will be a combination of an empirical study and a desk research. With the desk research, a large amount of literature can be compared, which led to a list of governance conditions to enhance flood resilience, from a perspective of multiple continents. Confronting this with an empirical study in the form of a comparative case study (also partly based on desk research); will also make sure that a more detailed analysis is possible. That is why this research will combine the two. The methods of the literature review are already discussed in the previous chapter; therefore the methods section will focus on the comparative case study and the.

#### **3.2 Case study**

In this thesis, the decision is made to combine desk research with an in depth, qualitative empirical study in the form of a case study. Within the case study method there are two variants; the single case study and the comparative case study (Verschuren & Doorewaard, 2010). In this research the comparative case study will be utilised. The reasons for conducting a comparative case study will be elaborated upon below.

As seen in chapter 2, research on enhancing flood resilience in urban areas is done on different continents and regions of the world. In Europe there has even been a research project, called STAR-FLOOD that focussed on this topic. Within the STAR-FLOOD project, there are six different countries that participate; Sweden, Poland, England, The Netherlands, France and Belgium (STAR-FLOOD, 2016a). These countries are different from each other in their administrative culture and structure, the significance of flooding in their country and their attempts to broaden flood risk strategies (STAR-FLOOD, 2016b). In every country scholars conducted three individual case studies. So in total eighteen case studies were conducted.

In this thesis I will identify if the conditions established in chapter 2, are present in these case studies through a document analysis and interviews. Besides, I will compare the eighteen individual case studies with each other. This has not yet been done in the STAR-FLOOD project. This comparison, as well as the assessment of the presence of the governance conditions, will be my own comparative case study, in which these eighteen cases are the research units.

**3.2.1 Document analysis**

As mentioned above the comparative case study that will be conducted on the earlier executed individual case studies of the STAR-FLOOD project, will consist of secondary research in the form of a document analysis in which the written STAR-FLOOD reports are analysed and interviews. In the document analysis, it will be studied if the governance conditions from literature are present in the case studies as well. To do this assessment of the presence of the governance conditions, the table below will be used. A case can score either a plus, plus/minus or a minus on the presence of the governance condition. The scores are justified in the case study chapters. In addition to the scoring on the presence of the condition based on the document analysis, the STAR-FLOOD researcher(s) scored the cases on the presence of the conditions as well. A comparison of the two scores is partly used as topic for the interviews with these researchers.

<b>Governance condition present</b>	<b>+</b>	<b>+/-</b>	<b>-</b>
Collaboration across government layers, with a significant role for the local government			
Stakeholders are involved throughout the policy process			
Mechanisms are in place to facilitate learning and knowledge exchange			
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)			
Future risks are addressed in long term planning			
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)			
Funding for policy making and implementation is available			
Flood forecasting is up to date and shows real time risks of flooding			
Adequate emergency planning is set up to evacuate people in case of flooding			
Opportunities are created for innovation and experimentation			
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks			
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding			

Table 3.1: The scoring table for the presence of governance conditions in the case studies.

**3.2.2 Interviews**

The second part of my comparative case study on the STAR-FLOOD case studies exists of interviews with the conductors of the STAR-FLOOD case studies. The interviews will be on the base of a semi-structured interview lists. The semi-structured interview exists of a comparison of the scores on the presence of the conditions (as stated above) and questions about my established list of governance conditions for the enhancement of flood risk resilience, so that the usefulness of these conditions

can be assessed. For the part of the interview about the established list of conditions, the following questions will be asked:

- Is the list of governance conditions complete? Should conditions be added? Or should conditions be dropped?
- Is every condition important to the same extent?
- Are some conditions more important than others? And if yes, why?

As the comparison of the scoring based on the document analysis and the scores awarded by the researchers can differ from case to case, interview questions will be established for this part of the interviews during the research.

Considering the interviewees, there are multiple researchers involved in the project per country. Some of them focussed specifically on one separate case in these reports, while others were involved in multiple case studies. Therefore, some researchers are interviewed about multiple cases in one country, while some researchers are only interviewed about one case study. The information on which researcher should be interviewed for which case study was partly brought up by my supervisor (and participant of the STAR-FLOOD project); Dr. Carel Dieperink. Furthermore, this information was given by the country coordinators of the project. In appendix 1, a list of interviewees per country can be found.

## 4. Good practices in Dutch flood risk governance

### 4.1 Introduction

This chapter focusses on the enhancement of flood resilience in the Netherlands on the basis of the Dutch STAR-FLOOD case studies. The research question central to this chapter is: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?* The chapter will begin with a short introduction on flood risk governance in the Netherlands. After this introduction, the three case studies will be discussed. In these case study paragraphs, the case studies will be scored on the presence of the governance conditions established in chapter 2. This will be based on a document analysis of the STAR-FLOOD reports and interviews with the STAR-FLOOD researchers that wrote the reports. This will be followed by a case comparison paragraph, which includes the researchers' view of the established governance conditions. The chapter ends with a conclusion.

### 4.2 Flood risk governance in the Netherlands

In the Netherlands there is a long tradition of preventing the country from flooding. A large amount of the country; 26 percent is below sea level and even 59 percent is prone to flooding. From this 59 percent of the country that is prone to flooding, 55 percent is protected by large scale structural measures, dunes or embankments. Within these flood prone regions lies the economic centre of the country, such as the Amsterdam Airport Schiphol and the harbour of Rotterdam, where 70 percent of the GDP is produced. This region is estimated to become even more important in socio-economic terms. Furthermore, it is also the part of the country with the highest population density. Therefore, potential flooding will have enormous consequences for the country (Kaufmann et al., 2015).

Although the probability of flooding is low in the Netherlands, the impact of flooding will be considerable, due to physical characteristics just mentioned. Therefore, the governance of flood risks has a high priority in the Netherlands; it even is the primary focus of the national program for climate change adaptation (Kaufmann et al., 2015). Considering the administrative culture of the Netherlands, the Netherlands is a so called decentralised unitary state. There are mainly, three government layers; the state, the provinces and the municipalities. Besides the decentralisation towards lower government layers, functional decentralisation is important in the Netherlands as well. Functional decentralisation is the transfer of responsibilities from the government (top layer) towards administrative bodies, which are set-up for in order to fulfil these responsibilities. The water boards are a good example of such an administrative body. It also means that the water authorities are for a large part independent of the political parties and that they are specialised in the management of floods (ibid). When looking at the political and administrative culture, the decision making process in the Netherlands is based on dialogue, consensus and compromise between all government bodies and interest groups, which is called the Dutch 'Polder Model'. However, not every plan is open to judicial review, including the management plans for flood risks (ibid).

In terms of Flood Risk Management Strategies, all five of them are visible in the Netherlands, but the most dominant is the FRMS of flood defence. Flood mitigation, preparation and response are found in the concept of Multi-Layered Safety in policy. *"The policy concept describes three layers of FRM: (1) probability-reduction through dikes or river-widening; (2) sustainable urban planning and water-robust construction, and (3) disaster management."* (Kaufmann et al., 2015, p.16). Next to flood mitigation, preparation and response strategies, Multi-Layered Safety also maintains the flood

defence FRMS. Furthermore, the FRMS of adaptation finds its way in policy gradually. Only the FRMS of flood recovery and compensation has a small role and is just partially institutionalised (Kaufmann et al., 2015). Regarding stability and change in flood risk governance in the Netherlands, there is a high level of stability and a large path dependency towards the FRMS of flood defence. However, there is room for diversification of the FRGAs as well as the FRMSs, mainly due to the adjustment of different sub-FRGAs (ibid). Concerning the FRGAs, a shift can be observed from an approach where only one single sector is involved towards a governance arrangement that involves multiple sectors. Within these arrangements especially emergency management and spatial planning are becoming more important. Furthermore, it is observed that there is no shift regarding the multi actor governance. The administrative bodies are mainly responsible for flood protection and not the private sector (ibid).

### 4.3 De Zuidplaspolder

The Zuidplaspolder (ZPP) is situated in the western part of the Netherlands. It lies in the triangle of the cities of Gouda, Zoetermeer and Rotterdam. The ZPP is the deepest polder in the Netherlands. Although the region is very flood prone, the ZPP was chosen in the beginning of the 21<sup>st</sup> century as an urban extension region for the Randstad (Kaufmann et al., 2015). The Randstad is the most densely populated part of the Netherlands and the region with the highest economic value in the Netherlands (CBS, 2016; Kaufmann et al., 2015), on the other hand it is also an area which is to a high extent flood prone (Kaufmann et al., 2015). The ZPP is mainly prone to flooding due to its location by the river Hollandse IJssel, not far from the sea and also to a lesser extent due to pluvial flooding. The area is protected by the Krimpenerwaard storm surge barrier and by dike ring 14, a primary flood defence (Kaufmann et al., 2015).

In the ZPP two independent projects took place; Westergouwe (in the middle of the 1990s) and the development project Zuidplaspolder (started in 2004). The case study in the report mainly focusses on the development project Zuidplaspolder (Kaufmann et al., 2015). With regards to water safety issues, ZPP is an example of adaptive spatial planning. The southern part of ZPP has a high flood risk due to fluvial flooding, and when there is heavy precipitation, also due to its soil type. Therefore, development of this area is not allowed. The northern part of ZPP is not very flood prone, because it lies higher and the soil is better, and because the highway A20 will function as a barrier. Furthermore, it was decided for this area that mitigation measures should be implemented for new developments; floor levels of newly built houses should be raised. Besides it was analysed that channels should be widened, to increase the storage capacity of two areas where the water level is managed (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Zuidplaspolder case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+	+	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+	+
Future risks are addressed in long term planning	+/-	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+	+
Funding for policy making and implementation is available	-	+	+
Flood forecasting is up to date and shows real time risks of flooding	+/-	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	+/-	+/-
Opportunities are created for innovation and experimentation	+/-	+/-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	-	+/-	+/-

Table 4.1: The scores of Zuidplaspolder on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

In Zuidplaspolder the leading actor in water management and also the coordinator of the cooperation process was the province of South Holland (Kaufmann et al., 2015). The municipalities in the Zuidplaspolder have an important role as well. They approved and have committed themselves to the so called Intermunicipal Structural Plan Zuidplas. In other sub-FRGAs, the municipality is a main actor as well, next to citizens, the province and the regional water authority (ibid). At one point in time the regional water authority disagreed on a matter with the municipality, but because the water authority had connections with the State Secretary of the Ministry, they were able to settle the disagreement in their favour (ibid). This shows that multiple government layers are collaborating and that there is a significant role for the local government; at the municipal as well as the province level.

### Stakeholder involvement

During the development project Zuidplaspolder there were multiple conflicting discourses, in order to solve this problem there was a cooperation and communication process in which a solution was found (Kaufmann et al., 2015). Besides this process, a steering group was formed to develop a plan for the expansion of the urban area, which consisted of twenty-three actors (ibid). In the dike strengthening project citizens were actively involved, by 'kitchen table talks' and round table meetings. In the end the citizens did not get the outcome they hoped for. However, interviewees in the case study stated that they had the feeling that they were treated fairly and that it was a good



participation process (ibid). In sum stakeholders were actively involved, citizens as well as public actors.

#### Facilitating learning and knowledge exchange

As stated above, there were conflicting or competing discourses, which were overcome by a cooperation and communication process, in which knowledge was exchanged to get to an agreement (Kaufmann et al., 2015). The case study focused on the development project Zuidplaspolder, before this project, there was the Westergouwe project. The Westergouwe project gave some learning experiences which could be used in the other project. Furthermore, the actors from different government departments made personal connections during the Westergouwe project, which facilitated cooperation (ibid).

#### Hybrid solutions and combined strategies

Zuidplaspolder is traditionally very dependent on flood defence measures; their main goal is to meet the safety standards with their primary flood defence structures (Kaufmann et al., 2015). This traditional approach to flood risk governance, is still the most dominant strategy, but this is now supported by other measures from the other strategies. Pluvial flooding is next to the strategy of flood defence also supported by flood mitigation measures. For fluvial flooding there are next to flood defence measures, also flood prevention, mitigation and preparation measures (ibid). Because the focus is still on flood defence, with a mixture of some other strategies, ZPP can still improve on this condition. According to the interviewee the whole of the Netherlands relies on flood defence; 90% of the flood risks is covered by flood defence, but it is complemented with other strategies, just as you will always find flood prevention. Therefore, hybrid strategies are being used and Zuidplaspolder should score a plus on this condition.

#### Long term planning

In the report on Zuidplaspolder it is not clearly mentioned if the measures taken, are based on long term planning. However, it can be expected that flood defence is built, in order to protect an area for a long period of time. The interviewee told me that all the projects are to address future risks on the long term. This can be seen in for example: establishing dikes, they have a life cycle of 50-100 years.

#### Climate sensitive and resilient spatial planning

The case study report shows that in Zuidplaspolder, the layered approach was used, which facilitated to combine aspects of water management in spatial planning. This in turn facilitated an identification of the context specific functions per location (Kaufmann et al., 2015). They also used a water test, which included floor levels for houses, which means that floor levels are elevated (ibid). This is a good example of resilient housing.

#### Funding

Due to the economic crisis, the development project Zuidplaspolder and also all the flood risk governance strategies are being implemented on a slow pace. Concerning spatial planning measures, they need to be financed by home developers or buyers, because the water authority and the national government use their financial resources for strengthening of the dike and not for these kinds of measures (Kaufmann et al., 2015). So it seems like funding is problematic. The interviewee disagreed. According to her, funding for the project was available from the government, only the strategies to elevate floor levels did not largely take place, because there were not many people that decided to build a house in the ZPP, because of the economic crisis.

### Flood forecasting

In the Zuidplaspolder, exact information on how long it will take for the region to be flooded exists. In that sense the flood forecasting is up to date. However in the report there is no notion of a warning system. The STAR-FLOOD researcher stated that the case study did not focus on flood forecasting, however, the interviewee knows that Rijkswaterstaat monitors the real time risks of flooding and flood forecasting.

### Emergency planning

A research institute conducted research on the possibilities of evacuation. They found out that it is not possible to evacuate all the inhabitants. Therefore they want to use the approach of vertical evacuation; people should move to higher storeys and should be prepared to survive for 72 hours without help. Although evacuation training was carried out, a problem with this form of evacuation is that inhabitants should be aware of the risks and therefore prepare themselves. This awareness is estimated to be low and therefore this form of evacuation might not work (Kaufmann et al., 2015). This shows that ZPP is working on emergency planning, but due to other factors this is not working sufficiently.

### Innovation and experimentation

As already mentioned, research was conducted on evacuation possibilities in Zuidplaspolder, this was conducted by Xplorelab; a laboratory for transdisciplinary innovation. Besides this research they came up with multiple experimental measures. Nonetheless, these experimental measures were not implemented. The main reason for it was that governmental agencies did not have the financial resources to invest in their experimental and sometimes also even more expensive measures (Kaufmann et al., 2015). In this sense there were opportunities in Zuidplaspolder to innovate and for experimentation, but because the outcome was not implemented, they can still improve on this condition.

### Notion by inhabitants that not everybody can be protected from flood risks

There is not really a notion by the inhabitants that not everybody can be protected from flood risks. It is stated in the report that an interviewee argued that citizens pay water tax to the regional water authority, which in turn maintains the dike, and therefore they are responsible for floods not to occur (Kaufmann et al., 2015). There are however some citizens that are aware of the risks. After some research it was calculated that a part of the citizens cannot be evacuated in case of emergency. Citizens were informed about it and they were involved in a project to exercise evacuation. Although this enhanced the awareness there are still many citizens even in the part which will not be evacuated that are not completely aware of the risks. Information campaigns were executed, but there is no information about the successfulness (ibid). Because of the awareness campaign and the evacuation exercise, I scored ZPP a plus/minus on this condition. The interviewee stated that the amount of people that was reached with the exercise and the campaign was so small and because the lack of information on the successfulness, ZPP should score low on this condition.

### Recovery schemes

Recovery is dealt with on the national level, and there is no mentioning of a recovery scheme in the Zuidplaspolder. On the national level, recovery is not considered to be an effective strategy and it does not enhance the resilience in the Netherlands (Kaufmann et al., 2015). This means recovery is not visible in Zuidplaspolder. The researcher stated that recovery schemes are available in the

Netherlands. However, these recovery schemes do not work well all the time and should not be scored with a plus.

#### 4.4 Nijmegen

Nijmegen is a city situated in the eastern part of the Netherlands, not far from the German border. The city lies where the river Waal has a bottleneck, a branch of the Rhine River. Nijmegen is located on both sides of the river, and has its historical centre south of the Waal River (Kaufmann et al., 2015). Nijmegen is especially prone to fluvial flooding and to a smaller extent pluvial flooding. The fluvial flooding risk is even increased due to its location at a bottleneck (ibid). In 1995 around 250,000 inhabitants of the area close to the Rhine River had to be evacuated, because of a potential dike breach. This was a focussing event for the population of the flood prone region and to the rest of the Netherlands (ibid).

The city of Nijmegen is part of the Room for the River program. Within the Room for the River program, Nijmegen is exceptional; a paradigm shift can be observed here from an approach mainly focussing on dikes and the technocratic engineering of it, towards an approach that is integrated and water-system based (Kaufmann et al., 2015). The Room for the River measures that are utilised in Nijmegen shows this paradigm shift; the dike was relocated inland and at the same time a side channel for carrying water was established. Due to the implementation of the side channel, an island consisting of a flood free area and an area for urban development was established. When floods do occur on the island, there is an extensive emergency plan and escape routes. These measures fall within the FRMSs of prevention, defence, mitigation and preparation. Not within recovery, because this FRMS is handled at the national level (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Nijmegen case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+	+, +/-
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+, +/-	+, +/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+/-	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+	+
Funding for policy making and implementation is available	+	+	+
Flood forecasting is up to date and shows real time risks of flooding	-	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	+/-	+/-
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	-	+/-	+/-

Table 4.2: The scores of Nijmegen on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

According to Kaufmann et al. (2015), actors from other policy sectors were actively involved, informed and consulted during the planning process of the project. When considering the role of the local government, the municipality of Nijmegen saw itself as the leader of the project, as it was setting up the spatial plans for the project. The municipality was even involved in the water system management, which is normally not the case. The central government had a leading role as well, because the measures of the project were financed by the central government. In contrary to the municipality, the province was passive in the project (ibid). This shows that there is a significant role for the local government. The collaboration across government layers was visible, in the sense that actors from different policy sectors were involved. On the other hand the province was passive in the project. According to the interviewee there was enough and good collaboration between the national government and the local government, but she agreed with me that if with collaboration I mean collaboration of every party (including the province), than you could score the case lower on this condition.

### Stakeholder involvement

Actors from different policy sectors were actively involved. They were not only involved, but they were also informed and consulted in the planning process. Besides the actors from other policy sectors, the local community was involved as well. All of them were involved in an integral working procedure. Even before the planning process, numerous and a very broad group of stakeholders was

consulted extensively, and although the government had measures to override the local community they in first instance chose to do not. However, there was resistance by the local community, that appealed, and those appeals were rejected (Kaufmann et al., 2015). Besides the local community, the regional water authority is an actor of importance as well. After completion of the project the regional water authority is responsible for the dike and the water management, however, they are only involved in the project in a passive manner, and were not able to bring their own visions to the project table (ibid). So the stakeholder involvement for the local community was well organised throughout the process of the project. However, although the citizens appealed, these appeals were rejected. Another side note is that they did not involve the expertise of the regional water authority. With a less passive role for the regional water authority, in my opinion this condition was met better.

#### Facilitating learning and knowledge exchange

It seems like decentralisation was a mechanism here that facilitated learning and knowledge exchange, because decentralisation caused that actors from other policy sectors were actively involved, informed and consulted as stated above. Besides involving the other policy sectors, decentralisation also made sure that the local community was very much involved (Kaufmann et al., 2015). Furthermore, the case of Nijmegen shows a new approach on the management of the relationship between central actors and decentralised actors; the establishment of a supervising program management team. The approach of using a program team facilitated the possibilities of learning as well as the ability to adapt (ibid). Due to these multiple mechanisms, in my opinion Nijmegen should score well on this condition. The interviewee found that Nijmegen scored moderately on these mechanisms, but that compared to other cases, these mechanisms were not so strong.

#### Hybrid solutions and combined strategies

The measures of the Room for the River project are categorized as mainly a measure of flood defence. The most important is the relocation of the dike, combined with a newly established side channel. In the past these flood defence measures would only have been technical or structural. However, with the project in Nijmegen they are more integrated and the measures are water system-based (Kaufmann et al., 2015). The other flood risk management strategies can also be found in Nijmegen. There is flood prevention in the sense that there is a prohibition of construction in the flood plain. With the relocation of the dike, a new island, with residential area is established and this is raised. This is a form of flood mitigation. Flood preparation can be identified in flood risk management plans that are established and the flood-free routes that are built in order to reach the inhabitants of the island at the time of an emergency or an evacuation (ibid). As shown a combination of strategies is present here.

#### Long term planning

Relocating the dike seems like a measure that is aimed at long term flood defence. However, in the report it is not mentioned, if this measure is a long term measure, or the assumed time that this measure will protect the citizens of Nijmegen from flooding. Therefore, the case of Nijmegen scores a plus/minus on the condition that future risks should be addressed in long term planning. Just as with ZPP, the interviewee disagrees, because she states that the measures that are taken are for the long term.

### Climate sensitive and resilient spatial planning

As already mentioned above, with the relocation of the dike, a new island was established and raised for urban development. It was raised, so this urban area would not be flood prone. Besides the flood free urban area, flood free roads have been established, in case of emergency or to evacuate the inhabitants of the island (Kaufmann et al., 2015). So with the development they clearly considered that it should be climate sensitive and resilient.

### Funding

The central government funded the project as stated above. In the report of Kaufmann et al. (2015) there is no mentioning of a lack of funding for the project and as the project continued, I assume there was enough financial means to implement the project. Furthermore, it is mentioned in the report that the project most likely stays within their budget (ibid). The condition of funding is met.

### Flood forecasting

In the report there is no mentioning of flood forecasting and because the report states that the government found that there was no need to inform everyone about the situation; inhabitants living outside the dike area had to inform themselves (Kaufmann et al., 2015). Nijmegen therefore scores low on this condition. The interviewee knows that Rijkswaterstaat monitors the real time risks of flooding and does flood forecasting. Due to this Nijmegen should score well on this condition.

### Emergency planning

According to Kaufmann et al. (2015), emergency management has a minor role in the project of Nijmegen. There was only advice on how to set up the island in terms of accessibility and evacuation. Besides, the province, municipality and spatial planners do not consider flood risks explicitly. However, when there will be a dike breach and flooding, there is a disaster management plan in the security region. For this disaster management plan there is an intensive cooperation between the security region and the regional water authority (ibid).

### Innovation and experimentation

Innovation and experimentation in Nijmegen can be found in the new approach of decentralisation and not only technical measures. Furthermore, within the room for the river project, Nijmegen was selected as an exceptional case, where new measures were implemented (Kaufmann et al., 2015). Innovation and experimentation can be found in Nijmegen.

### Notion by inhabitants that not everybody can be protected from flood risks

In Nijmegen there are sporadic information meetings with the inhabitants of the region that is not protected by the dike. There was also a discussion about if there should be a communication strategy that should inform citizens living outside the dike area. However, it was decided that this was not necessary. They had to inform themselves (Kaufmann et al., 2015). This does show that inhabitants were aware that they are not protected against flooding, because that was why they got invited to these information meetings. The notion by citizens that not everybody can be protected is according to the interviewee without doubt a minus, because the mayor of Nijmegen has stated that informing the citizens that they cannot be protected is not necessary, and that the multiple parties point at each other to do this task, without anybody really doing it.

## Recovery schemes

Rijkswaterstaat set up a 'Damage office' for the compensation claims regarding the project. Because of the project around 50 buildings had to be removed and the project affected other private property (Kaufmann et al., 2015). Furthermore, there is no mentioning of any recovery scheme, because a region is flooded. According to the interviewee recovery schemes are available in the Netherlands as a whole; however, these recovery schemes do not work well all the time and should not be scored with a plus.

## 4.5 Dordrecht

Dordrecht is an island in the South-West of the Netherlands, and part of the Rijnmond-Drechtsteden region, which also exist of the city of Rotterdam, some smaller cities and nature and productive agricultural areas. The area is important for the Dutch economy because of the harbour of Rotterdam and the productive agricultural regions (Kaufmann et al., 2015). A large part of the island is protected by a dike ring, but the new houses and businesses and the historical centre lie outside the area that is protected by the dike ring (ibid). In general Dordrecht is very flood prone, because of its location in the middle of the rivers Beneden Merwede, Nieuwe Merwede, Oude Maas, Hollands Diep, Dordtsche Kil and Wantij and because it is located in a tidal area (ibid). Although Dordrecht is very flood prone, evacuation options are limited; there are only two tunnels, three bridges and ship connection to the land (ibid).

A case study was conducted on Dordrecht, because it is one of approximately eighteen pilot projects in which the concept of multi-layered safety is explored within the Delta program. The outcomes of this study can possibly be utilised in the rest of the Netherlands (Kaufmann et al., 2015).

### *Presence of the governance conditions*

The table below shows the scores of the Dordrecht case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.



Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+	+	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+/-	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+	+
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+/-	+/-	+/-
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	+/-	+/-
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+/-	-	+/-

Table 4.3: The scores of Dordrecht on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

In Dordrecht the different sub-FRGAs are connected to each other due to the exchange of information and formal communication. This knowledge exchange and formal communication happens between all involved stakeholders (Kaufmann et al., 2015). The province of South Holland and the municipality of Dordrecht are the important actors, where the municipality has the most responsibilities (ibid). Furthermore, in the Delta Program the focus shifted from representing the interests of your own organisation to cooperation, to find a solution together. To find the solution also non-water managers were involved, such as emergency managers and spatial planners (ibid). In sum the municipality of Dordrecht had a leading role and there was much collaboration between government levels and agencies.

### Stakeholder involvement

As already mentioned all stakeholders were involved in the information exchange and formal communication. Also non-water managers, such as spatial planners and emergency managers were involved in finding solutions (Kaufmann et al., 2015). The municipality played an important role in getting all the stakeholders together, because they have a good connection to all these stakeholders (ibid). Regarding citizens, the municipality was interested in their opinions and when a decision had to be made on measures to strengthen the dike, citizens were consulted and informed by the water authority of the region (ibid). This shows that the municipality even went an extra mile to involve all stakeholders and citizens, more than they had to do. Therefore they score well on this condition.

### Facilitating learning and knowledge exchange

Dordrecht also scores well on this condition. Due to the earlier mentioned formal communication and knowledge exchange, involvement of non-water managers and citizens, but also because of the Delta Program and due to several research programs (Kaufmann et al., 2015). In the Delta Program expertise and new knowledge was developed within the pilot projects. In the research programs a lot of new knowledge and expertise was developed as well (ibid). So because of the combination of good practice in stakeholder involvement and the use of knowledge from the Delta program and research programs, learning and knowledge exchange was facilitated.

### Hybrid solutions and combined strategies

In Dordrecht the concept of multi-layered safety is being tested, in which measures are used that reduce the probability of flooding (i.e. flood defence), spatial planning measures that are sustainable and emergency management measures (Kaufmann et al., 2015). However, the national focus on flood defence can also be found in Dordrecht, but because of the communication between all stakeholders, multiple measures are used and mixed together (ibid).

### Long term planning

It seems like Dordrecht applied a long term vision in their plans, because they developed new safety norms, based on the probability of flooding, as well as the consequences of flooding (Kaufmann et al., 2015). This shows that future risks were taken into account in their plans. However, this is the only evidence found on long term planning. According to the interviewee Dordrecht is applying a long term vision in their plans against flood risks, for example because they are part of the Delta Plan, which is all about long term planning of future risks. So they should definitely score well on this condition.

### Climate sensitive and resilient spatial planning

In the Voorstraat in Dordrecht the regional water authority made it mandatory for the municipality to use movable flood defence barriers. Within the discourse of living with water also other building methods are used, such as; floating houses, escape routes, watertight doors, watertight ground floors and building on stilts (Kaufmann et al., 2015). So multiple examples of resilient housing are being used in Dordrecht.

### Funding

Funding for primary flood defence originates from the national government, while secondary flood defence structures should be financed by the regional water authority. It is not sure that the regional water authority has enough funds to do so, which makes it uncertain if these primary flood defence measures can be implemented (Kaufmann et al., 2015). This shows that funding might not always be available.

### Flood forecasting

The security region has set up a scenario for flood risk, which will have the largest impact on Dordrecht. Within the scenario a warning system is described, and it also states the responsibilities in such a case per governmental organisation (Kaufmann et al., 2015). In the report this is the only mentioning of a flood warning and forecasting system, so it seems that it is in place. However, nothing is stated about if the warning system is effective in real life and up to date. Therefore Dordrecht scores a plus/minus on this condition.

### Emergency planning

In the above condition it is already mentioned that a scenario has been set up about the largest flood impact on Dordrecht in which a division of responsibilities has been established (Kaufmann et al., 2015). There are also areas (un-embanked), where citizens have to organise preparation themselves. The municipality is only practicing emergency situations with inhabitants of the Voorstraat (ibid). Besides, research is conducted on vertical evacuation, but this form of evacuation is still developing and has its weaknesses (ibid). So in Dordrecht they are working on adequate emergency planning, but, some people are not able to profit from it and vertical evacuation should be further developed.

### Innovation and experimentation

The fact that Dordrecht is part of the Delta Program and a pilot case for multi-layered safety means that there is much room for innovation and experimentation. This is further enhanced by research projects such as Mare. Because both were forums that generated knowledge exchange and expertise, which in turn facilitated innovation and change. Moreover, outcomes of research by Mare were also carried out (Kaufmann et al., 2015). There was enough room created for innovation and experimentation.

### Notion by inhabitants that not everybody can be protected from flood risks

Although Dordrecht is prone to flooding and citizens are for example involved in emergency evacuation exercises and have firm conditions for the design and building of their houses due to risks of flooding, the awareness of citizens that not everybody can be protected from flood risks is not present with every citizen. They are even developing alternative measures such as a flood app to raise the awareness (Kaufmann et al., 2015). Due to the high risks of flooding, the involvement in emergency training and the conditions for houses, at least part of the inhabitants should be aware of the risks of flooding. However, this is not the case for everybody and Dordrecht should improve on this condition.

### Recovery schemes

Recovery is dealt with on the national level, and there is no mentioning of a recovery scheme in Dordrecht. On the national level, recovery is not considered to be an effective strategy and it does not enhance the resilience in the Netherlands (Kaufmann et al., 2015). According to the researcher, recovery schemes are available, but if there will be a flood in Dordrecht, almost the whole city is gone, as well as the city of Rotterdam. This means that the damage in economic terms will be so high, that there will not be enough funds for compensation. Furthermore, until now, there have been only five cases in which compensation has been paid in the whole of the Netherlands and it depends heavily from case to case, so it is hard to score a case on this governance condition.

## 4.6 Comparison of Dutch cases

The table below shows the scores of the three Dutch STAR-FLOOD case studies on the presence of the governance conditions from literature. Below the scores will be discussed, as well as the governance conditions in general.

<b>Governance condition present</b>	<b>ZPP</b>	<b>Nijmegen</b>	<b>Dordrecht</b>
Collaboration across government layers, with a significant role for the local government	+	+, +/-	+
Stakeholders are involved throughout the policy process	+	+/-	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+, +/-	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+	+
Funding for policy making and implementation is available	+	+	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+/-
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	+/-	+/-
Opportunities are created for innovation and experimentation	+/-	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+/-	+/-	+/-

Table 4.4: The scores of the three Dutch case studies on the governance conditions from literature. Possible scores were +, +/- and -.

When looking at the table it can be noted that all three Dutch cases score well on the conditions of collaboration across government layers with a significant role for the local government, the mechanisms to facilitate learning and knowledge exchange, hybrid solutions, long term planning and climate sensitive and resilient spatial planning. This shows that in the Netherlands good collaboration between different government layers and departments exist, which enhances learning and knowledge exchange. Furthermore, in the Netherlands future risks are addressed in long term plans, these plans are a mixture of different flood risk management strategies, although flood defence is the dominant strategy. This mixture of strategies is also demonstrated in the fact that spatial planning is included in these strategies. Regarding the presence of climate sensitive and resilient spatial planning, a side note can be made, that although it is present in measures and systems, the Netherlands keeps developing in flood prone areas. So considering the provision of building permits, spatial planning is not so climate sensitive and resilient.

There are also conditions which should be (much more) developed in the Netherlands. These conditions are adequate emergency planning, the awareness of citizens that not everybody can be protected from flood risks and recovery schemes should be established, that can compensate and fund rebuilding in case of flooding. The adequate emergency planning should most probably still be improved, because the Netherlands is quite well protected with flood defence works, which means that disastrous flooding does not happen regularly. The high protection level also leads to low flood risk awareness by citizens, except a little in Dordrecht. The awareness in Dordrecht is present, because the citizens are involved best in flood risk governance in Dordrecht compared to the other cases and also because they have more flood experience. The availability of recovery schemes is

unsure. Recovery compensation is rewarded by a governmental fund, according to the Dordrecht interviewee there are only few examples of actual compensation by this fund. Furthermore, she stated that if for example Dordrecht is completely flooded, Rotterdam will be flooded as well; the economic losses are then so high, that the fund for compensation will not be sufficient to compensate all victims. Moreover, private flood insurance in the Netherlands is not really available.

In the first interview about Nijmegen as well as Zuidplaspolder, the two cases were compared. If we look at the two tables, it seems like Zuidplaspolder scores better on the governance conditions than Nijmegen. The interviewee was surprised when she noticed this. In her opinion, Nijmegen is better protected to the risks of flooding than Zuidplaspolder, and the room for the river project in Nijmegen is a better project than the development project Zuidplaspolder. She states that as someone who is not originally from the Netherlands, it is quite strange to see that we choose to build in the deepest polder of the Netherlands, and in the west of the country which is already flood prone. However, when you consider the policy process from a governance perspective, the governance process was better in the Zuidplaspolder, and because the conditions are mainly about governance, this project scores better. The second interviewee agrees on the fact that there should be no more building in very flood prone regions. This is difficult because regions/provinces want to grow and attract new inhabitants and companies. Therefore this should maybe be dealt with at a national scale, although it is usually better if the responsibility for flood risk governance lies at the appropriate local level, such as at the water boards. She furthermore stated that the risks are better known by Dordrecht and Nijmegen, but it is hard to state which of the cases is better.

Considering the governance conditions, both interviewees mentioned that a lacking condition in the list of established governance conditions is the condition of risk communication by the government towards citizens; informing citizens about the risks they have in a certain region and what they can do to protect themselves. At least in the Netherlands this communication of risks fails most of the time. Dordrecht is according to the interviewee on that case, the only case, and probably the only region in the Netherlands in which risk communication towards citizens is actively been done. Besides the risk communication, the STAR-FLOOD researchers have the opinion that the governance conditions list is complete. However, two conditions should be altered. In the first condition; collaboration between government layers, with a significant role for the local government, the term local government should be changed. In the condition it is not stated which level, so this is not specific enough and there should be a significant role for the appropriate level and this can be a municipality, but also the water boards, or sometimes the national government level as well. The funding condition should also be altered; it is unclear from the condition what is exactly meant with the condition.

The importance of the different conditions is also discussed with the STAR-FLOOD researcher. The first interviewee assumed that collaboration across government layers, with a significant role for the local government is the most important governance condition. It is such an important condition, because without collaboration it is not possible to align different strategies. Stakeholder involvement is to a lesser extent also important. However, stakeholder involvement varies in importance considering the governance system in a country. In a country where flood risk governance is a task of the national government, stakeholder involvement is less important, than in a system where flood risk governance is a task of the local community. Lastly, without funding no project will start, so this has a high importance as well. But in general every condition is important. The second interviewee

argued that every condition is important, because one condition cannot go without the other condition and all the conditions focus on different aspects of resilience and these different aspects are all important. Furthermore, the importance of the conditions depends from area to area. For Dordrecht it is for example very important that emergency planning is up to date, but that is not necessarily the case for every region.

#### 4.7 Conclusion

In this chapter an analysis of the Dutch STAR-FLOOD case studies has been discussed in order to answer the following question: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

In the Netherlands flood risk resilience is enhanced by collaboration between government layers with a significant role for the local government, the mechanisms to facilitate learning and knowledge exchange, hybrid solutions combining structural and non-structural measures, long term planning for future risks and climate sensitive and resilient spatial planning. On the other hand, adequate emergency planning, the awareness of citizens that not everybody can be protected from flood risks and recovery schemes for the compensation after a flood event are not or not enough present in the Netherlands. From a comparison of the three cases it is hard to state which case is best in enhancing the flood resilience. Zuidplaspolder scores well on the presence of governance conditions, because the government process is well established, but the risks are better known by Dordrecht and Nijmegen. However, for all cases it can be stated that development takes place in flood prone areas, which should be limited to enhance the resilience of these regions. When looking at the conditions in general, all conditions are important, however collaboration between government layers, stakeholder involvement and funding might be more important. In the governance condition list, risk communication towards citizens misses. This is also a condition on which the flood prone regions in the Netherlands should improve heavily; it is only to a small extent present in Dordrecht.

In the next chapter the Belgian case studies will be discussed. This will bring about more information on good practices in flood risk governance. It will for example show if the Belgian STAR-FLOOD researcher agrees that risk communication is a lacking condition in the governance condition list and if these condition is as well not present in Belgium.

## 5. Good practices in Belgian flood risk governance

### 5.1 Introduction

This chapter focusses on the enhancement of flood resilience in Belgium on the basis of the Belgian STAR-FLOOD case studies. The research question central to this chapter is: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?* The chapter will begin with a short introduction on flood risk governance in Belgium. After this introduction the three case studies will be discussed. In these case study paragraphs, the case studies will be scored on the presence of the governance conditions established in chapter 2. This will be based on a document analysis of the STAR-FLOOD reports and an interview with the STAR-FLOOD researcher that wrote the reports. This will be followed by a case comparison paragraph, which includes the researcher's view of the established governance conditions. The chapter ends with a conclusion.

### 5.2 Flood risk governance in Belgium

Belgium is relatively small country, located in the North-West of Europe, situated on the North Sea. The country is divided into two river basins; the Meuse and the Scheldt, whereby the Meuse is for the largest part located in Wallonia, the Scheldt is largely located in Flanders (Mees et al., 2015). Due to its location at the North Sea and its low to middle-high elevation, it is a flood prone country. Besides flood proneness due to its location, the Meuse and rivers as the Demer and Dender are rain-fed rivers. This means that the flow of discharge depends largely on the amount of rainfall; therefore most floods are pluvial floods. However, the Scheldt is a tidal river, so that floods can occur from upstream as well as downstream (ibid). When taking into account climate change, it is predicted that Belgium will be even more prone to flooding; there will most probably be an increase in heavy rainfall during summer and in tidal rivers, there will be an increase of floods (ibid).

Considering the administrative culture of the country; Belgium is a federal state, which is composed of regions and communities. These two have competences on different subjects and these competences can only be assigned. There is an overlap in the territorial jurisdiction (Mees et al, 2015). Even though there has been a shift of competences to federal entities, there are still many cases in which the federal level is still the competent authority, such as the competence of coastal waters (ibid). Furthermore, for the subject of flood risk governance, it is important to note that the communities, which are divided into the French, Flemish and German speaking communities have certain competences as well. These competences include spatial planning, environmental protection and water policy. These communities and the federal level are at the same level and are standing above the municipal and province levels (ibid). When looking at the decision making process, this is based on consensus. Concerning decision making on water issues; it is obligatory to consult advisory boards and councils, which represents groups of civil society, by the regional governments (ibid).

Concerning Flood Risk Management Strategies (FRMSs) in Belgium, all five strategies are visible. These five strategies can be found in five Flood Risk Governance Arrangements (FRGAs) (Mees et al., 2015). The first two FRGAs are the Walloon and Flemish Water System Arrangement. These arrangements are based on preventing floods in areas that are built-up. This arrangement is governed at the regional level. The FRMSs within these arrangements are; mitigation, defence and prevention. The Flood Preparation Arrangement is the third arrangement, in contract to the first and second arrangement, this arrangement is governed by the federal level. This arrangement inhibits



the response and preparedness strategies and is focussed on crisis management and emergency planning. The fourth is the Flood Recovery Arrangement. This arrangement has a focus on insurance and related issues and is also governed at the federal level. In this arrangement the FRMS of recovery can be found. The fifth governance arrangement; the Brussels Water System arrangement is not discussed in the report, due to its complexity (ibid). These five arrangements are not so much connected to each other, but are independent from each other, and operate independent from each other in Wallonia and Flanders (ibid).

### 5.3 Antwerp

Antwerp is the largest city in the Scheldt's river basin, it has around 512,000 inhabitants. Downstream from the city, the Scheldt forms a funnel, which narrows nearby the city; therefore it is located on a vulnerable place. However, the city has not faced with river flooding in the past years (Mees et al., 2015). Concerning the potential of flooding, Antwerp is mostly prone to tidal storms, which took place in the city in the years 1953 and 1976. After the last tidal flood, a water barrier was build up, which has protected Antwerp until now. However, it is calculated that this barrier can only withstand a one in 75 year storm. Therefore, the Sigma Plan (the flood protection plan) has been changed in 2005, in order to withstand a one in 1000-4000 year storm. Besides tidal floods, there have been pluvial floods in Antwerp in recent years; 1998 and 2003 (ibid). Considering the economic characteristics of Antwerp, the city is an important logistic centre, with national as well as international highways and the second largest harbour of Europe. Because of this economic characteristics and the amount of inhabitants, there is a relatively large amount of human and financial resources (ibid).

In the STAR-FLOOD case study they wanted to investigate how flood risk is governed in a city that has the potential of flooding, but has a quite limited experience in flooding. Furthermore, the researchers wanted to investigate what the impact is of the Flemish Sigma Plan on the FRGA in Antwerp (Mees et al., 2015).

#### *Presence of the governance conditions*

The table below shows the scores of the Antwerp case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	-	-	-
Mechanisms are in place to facilitate learning and knowledge exchange	+/-	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	+	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+/-	+/-
Funding for policy making and implementation is available	-	-	-
Flood forecasting is up to date and shows real time risks of flooding	+	+/-	+/-
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 5.1: The scores of Antwerp on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

In the report it is mentioned that the FRGA is situated in four government levels; federal, regional, provincial and municipal level. The municipal level is especially leading in the Flood Preparation Arrangement and in Urban Water Management, while the Flood Defence Arrangement is mainly led by supra-local actors. These arrangements are supported by emergency planning by the federal governor of the Department for the province of Antwerp (Mees et al., 2015). So the responsibilities are divided under different government levels. However, it is stated that the competences are fragmented. They tried to reduce the fragmentation, but this is hindered by the interests of the different organisations (ibid). Because of the fragmentation and therefore a hampered collaboration, Antwerp scores a plus/minus on this governance condition. According to the interviewee, Antwerp has a well-established administration that has a great amount of expertise and consults other regions, also in other countries for more expertise. This is better developed in Antwerp than in the other two Belgian case studies. However, maybe compared to other countries such as the Netherlands, the mechanisms to facilitate learning and knowledge exchange are less formalised.

### Stakeholder involvement

The governance of flood risk in Antwerp is almost only dealt with by government organisations. The subject of water management is seen as a very much technocratic subject, where public participation is not desirable. The citizens agree on this view. There is no active group in civil society concerned with the subject of the risk of flooding. Citizens are only active in Urban Water Management,

because they are obliged to implement requirements, which are set by the building code and water assessment (Mees et al., 2015). There is however, a tendency to start sharing responsibilities with inhabitants, such as in crisis management. To achieve this, a cultural change is necessary, because the population is not very aware of the risks of flooding (ibid). This means that stakeholder involvement is not really present.

#### Facilitating learning and knowledge exchange

Due to the fragmentation in flood risk governance, there have been efforts to reduce this fragmentation. Reducing fragmentation is necessary, because fragmentation makes the decision making process more complicated and more input from resources is needed (Mees et al., 2015). These efforts, such as merging of some government organisations have caused that there is more formal and informal coordination between the different organisations (ibid). So there is more coordination, which can enhance learning and knowledge exchange, although this can be improved due to the fact that it is still much fragmented. Furthermore, Antwerp is open to innovation and learning, they have been looking in other cities in Belgium and outside Belgium, for ideas (ibid). In sum, they have tried to facilitate learning and knowledge exchange (although not institutionalised), but fragmentation hinders this.

#### Hybrid solutions and combined strategies

In Antwerp, three sub-FRGAs can be found; Flood Defence, Flood Preparation and Urban Water Management. Because the connection between prevention and protection is not so strong at the local level, in contrast to the national level, the FRGAs differ (Mees et al., 2015). The discourse in dealing with flood risks in Antwerp is a discourse of protection against flooding, which means that floods should be prevented. In order to do so the emphasis lies on flood defence. In the rural areas around Antwerp mitigation is preferred, but for a big city as Antwerp, it is seen as impossible, because due to the building infrastructure, mitigation options on a large scale are restricted (ibid). However, next to the emphasis on flood defence (mainly for fluvial flooding), there are also flood preparation measures for fluvial flooding and flood prevention, preparation and mitigation strategies are being applied to direct pluvial flooding. Flood recovery is dealt with by the national, federal insurance (ibid). As shown every FRMS is present in Antwerp, but because flood risk governance is mainly based on flood defence, Antwerp can still improve on this condition.

#### Long term planning

The city of Antwerp is protected by flooding, with the implementation of the Sigma Plan. When the adjusted Sigma Plan is implemented, it will protect the Scheldt's river basin for a 1 in 1000-4000 years tidal storm and flood, while the protection level at the moment is 1 in 75 years (Mees et al., 2015). Experts claim that the adaptation in the Sigma Plan will be effective for the prevention of floods (ibid). Besides this measure for the long run, climate change is also mentioned in the planning and is taken into account (ibid). Both the adaptation in the Sigma Plan and taking into account climate change too in your flood risk governance measures show that Antwerp definitely addresses future risks in long term planning.

#### Climate sensitive and resilient spatial planning

The case study shows some examples of climate sensitive and resilient spatial planning measures, it seems important for Antwerp. One of them is that the Flemish government has selected some signal areas; areas which are prone to flooding and are not yet developed at the moment. For all of these signal areas a decision needs to be made about the destination of the area. It is possible to restrict

building or let them develop the area under stringent conditions (Mees et al., 2015). Furthermore, due to an expected rise in sea level, Antwerp wants to improve their water infiltration and also for the mitigation of urban heat island effects. They want to achieve this by a revised building code that prescribes green roofs (ibid). According to the interviewee, the effects of these measures in spatial planning are actually diminished by the fact that the government of Belgium assigned the sort of use to every piece of land in the 1970s. Due to lobbying a large amount of land was assigned as building plots. Also pieces of land which are actually not suited to build on, because of flood risk. On a lot of these pieces there has not been built so far, but this can happen in the future, due to the fact that a building plot has more value than for example farmers land. The assigned land use can be changed, but this procedure is very costly, so will most probably not be used.

### Funding

There is lack of funding in Antwerp, especially concerning flood defence and the implementation of the Sigma Plan. There is also a deficit in budget of the local organisations that deal with flood risk governance. In contrast, flood preparation has enough financial resources, as well as human and material resources (Mees et al., 2015). However, in general funding is lacking in Antwerp.

### Flood forecasting

Flood forecasting is been dealt with by the Flemish Environmental Agency and the Hydrological Information Centre in Flanders. The Hydrological Information Centre has a database with real time information of the navigable waterways in Flanders. The environmental agency does the same for the non-navigable waterways (Mees et al., 2015). The information of the two is integrated by the Flemish government on a website. The website publicises a message twice a day to inform if there are expected flood events in the next 48 hours. A warning system sends automatic SMS messages to crisis managers and water authorities, when an alarming level is reached. Citizens can inform themselves through the website, through local authorities and the media (ibid). Flood forecasting in Flanders and therefore in Antwerp is arranged very well, considering the real time information and the fact that they have a warning system. The STAR-FLOOD researcher stated that flood forecasting is, indeed quite good in Flanders. However, it is fragmented, because the water authorities of the navigable and non-navigable watercourses have their own models. They tried to integrate them on a website, but it stays fragmented. Furthermore, the interviewee stated that Antwerp is still developing a flood forecasting system for pluvial floods, which is more important for Antwerp than the already existing fluvial flood forecasting. This means that they are still improving.

### Emergency planning

Antwerp employs a fulltime emergency planning official. The city was one of the first cities/regions to employ a fulltime emergency planning official. The Antwerp official was even a model for the Royal Decree of 2006 that obliged regions/cities to have an emergency planning official (Mees et al., 2015). Furthermore, there have been significant changes in the crisis management of Antwerp. Resources were added, it was professionalised and the communication in the department of Disaster Planning has improved, with a number of communication channels (ibid). Antwerp takes emergency planning serious and scores well on the presence of this condition.

### Innovation and experimentation

In Antwerp opportunities for innovation and experimentation exist. This was not always the case; the flood event brought a window of opportunity to use innovative ideas that were already present by the water managers (Mees et al., 2015). Furthermore, the city administration of Antwerp is open to

innovation and learning, they look for inspiration in other cities and other countries and they participate in European projects. The inspiration and innovation is mainly being used in Antwerp's flood defence arrangement and urban water management (ibid).

#### Notion by inhabitants that not everybody can be protected from flood risks

In the report it is stated that flood awareness is very low among inhabitants of Antwerp. The city believes that awareness campaigns will not raise the awareness, but that awareness can only be improved with financial instruments (Mees et al., 2015). Moreover, governmental actors state that in the future low lying neighbourhoods can no longer be completely protected. Although the governmental actors are aware of this, they do not communicate this with their citizens. On the other hand, citizens expect to be protected from floods by the government, or at least citizens believe that the damage should be mitigated by them (ibid).

#### Recovery schemes

Flood recovery is dealt with on a national scale, with the federal insurance system, which has a very high percentage of uptake (Mees et al., 2015). Furthermore, in Flanders victims of floods that occurred after July 1<sup>st</sup>, 2014 have the opportunity to file a claim, within a three month time frame, at the Flemish disaster fund. The provincial governor decides if compensation is awarded (ibid). So this means that recovery schemes are available, even from two separate agencies.

### 5.4 Lessines

Lessines is a city located in the Walloon region, and just as Geraardsbergen, it is a small city on the Dender River, popular for inhabitants that want affordable building plots located close to larger cities (Brussels and Ghent), but situated in the country side (Mees et al., 2015). The Dender River is a branch of the Scheldt and is a spate river. This means that the discharge of the river is significantly influenced by rainfall. This makes the city of Lessines flood prone. The flood proneness is even enhanced by geographical conditions and spatial developments; naturally flood prone areas are being used for economic activities and housing (ibid).

The last 20 years at least four floods of the Dender River caused damages. In 2010, the most severe flood took place. This was caused by an extreme precipitation event, which victimised multiple districts of the city of Lessines (Mees et al., 2015). Due to the event Lessines improved their flood risk management. Their FRGA is divided into three sub-FGRAs: Flood Preparation, Urban Water Management and River Management. The Preparation strategy aims at minimising the damage by crisis management, River Management focusses on fluvial flood prevention and the Urban Water Management Arrangement has the aim to regulate the impact by means of spatial planning. There is only one important obstacle to effective flood risk governance; thirteen old sluices are located in the Dender, which are a barrier for effective drainage towards the Scheldt. Renovation is necessary (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Lessines case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it

is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

<b>Governance condition present</b>	<b>Document analysis</b>	<b>STAR-FLOOD researcher</b>	<b>Conclusion</b>
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	-	+/-	-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	+/-	-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	+/-	+/-
Funding for policy making and implementation is available	+/-	-	-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	-	+/-	-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 5.2: The scores of Lessines on the governance conditions from literature. Possible scores were +, +/- and -

### Collaboration across government layers and significance of local government

Within River Management, six different waterway managers are active. These managers are from different government layers; the Walloon government, the province of Hainaut and the city of Lessines. They are all responsible for their own watercourse (Mees et al., 2015). Urban Water Management is dealt with by the city of Lessines, because they are responsible for spatial plans and building permits. Besides their significant role in Urban Water Management, they also have a significant role in Flood Preparation (ibid). Lessines can improve on this condition; a significant role in flood risk management is for the local level, but collaboration should be increased.

### Stakeholder involvement

Regarding stakeholder involvement, inhabitants are only consulted in the last phase of the decision making process (Mees et al., 2015). On the other hand in flood risk governance a significant role is for the Committee of Flooded. This committee exists of inhabitants of Deux-Acren, an area that is been flooded before and is a sub-municipality of Lessines. Their aim is to exercise power on the government to raise their flood safety. The mayor of Lessines initiated this committee in order to include inhabitants in the decision making on flood governance (ibid). From the above it seems that some stakeholders are involved, but these stakeholders are only from a previous flooded area.

### Facilitating learning and knowledge exchange

In the report, no statement is explicitly or implicitly being made on learning and knowledge exchange. The interviewee stated that a group of stakeholders was brought together in order to facilitate knowledge exchange and learning. However, the participants had the feeling that nothing really came out of these conversations. Therefore, the researcher agrees with me that Lessines should actually score a minus on this condition.

### Hybrid solutions and combined strategies

In Lessines, under water managers, the discourse of 'room for the river' appeared. A result of the change in discourse was that flood control areas were implemented (Mees et al., 2015). Furthermore, water management relies on flood defence works. Water managers are aware that these flood defence works alone are not sufficient to solve the problem of flooding. According to them, flood defence should be supplemented with crisis management and spatial planning measures (ibid). However, flood defence is dominant, all strategies are visible in Lessines, but there are not really linkages between the strategies and the strategies are mainly working independently from each other (ibid). So a combination of strategies is apparent, however flood defence is dominant and the strategies should be better aligned.

### Long term planning

Due to the floods of 2010, initiatives were taken in order to enhance the protection of the Dender River basin. The University of Liege conducted research and the decision was made to construct a flood control area at a branch of the Dender and to build a dike at Deux-Acres, which will be implemented in 2016 (Mees et al., 2015). Even though the project will be implemented in 2016, it turned out that the flood control area would only on a limited scale increase the flood safety and the dike would only secure 20 to 40 ha of ground (ibid). On the one hand it shows that Lessines made an effort to address future risks in long term planning, by involving the University of Liege, but the actual flood safety did not increase significantly. So they can still improve on this condition. According to the interviewee, in Flanders there has been a study to consider different scenarios for long term planning, such a structured study has not been executed in Wallonia and therefore, Wallonia scores less on this condition.

### Climate sensitive and resilient spatial planning

The flood events of 2010 led to the decision by Lessines not to allow any further construction in areas that are flood prone. Already in 2013, this decision was reversed to allow no construction in high risk zones only, and to set up conditions for construction in medium and low risk zones. An example of such a condition is that a person who applies for a building permit should state which measures are taken to mitigate the vulnerability towards floods (Mees et al., 2015).

### Funding

Concerning River Management, since the 2010 flood, water managers in Wallonia and Flanders received additional financial resources. This was also the case for the province of Hainaut; the province that Lessines is located in. Only the water managers of city of Lessines did not receive an increase of budget (Mees et al., 2015). In flood preparation, the actors have the feeling that financial and human resources are lacking (ibid). This shows that funding is available at the provincial level, but it should be increased on the local level. The interviewee disagrees, stating that there is large underinvestment in some of the strategies.



### Flood forecasting

In Wallonia, flood forecasting is been done by their hydrological department. They use two tools to predict floods; one that predicts expected flood plains and water levels and one that assesses the discharge level from the Meuse and its most important branches (Mees et al., 2015). The hydrological department receives messages from stations that go beyond alarm level every hour. When a pre alarm is necessary, the National Crisis Centre and water authorities are alerted (ibid). In Wallonia the hydrological information is also placed on a website, but this website is not being updated all the time (ibid). As well as flood forecasting in Flanders, flood forecasting in Wallonia and therefore Lessines is apparent.

### Emergency planning

Due to the Royal Decree of 2006, an emergency planning official was appointed in Lessines, the city is developing an emergency plan for flooding and a safety cell is established. Before the flood of 2010, the emergency planning was not up to date and during the flood of 2010 crisis response failed. With the new developments it is expected that Lessines' emergency planning will be effective, but this still needs to be demonstrated during a real event (Mees et al., 2015). Because the city of Lessines developed their emergency planning and it is expected that it will be effective, the city scores well on this condition.

### Innovation and experimentation

Besides the fact that the University of Liege was involved in the implementation of new measures, to enhance the flood resilience in Lessines, no other mentioning of innovation and experimentation can be found in the report. The researcher agrees with me, that on the city level, there is actually no experimentation and innovation, so that Lessines should score a minus on this condition.

### Notion by inhabitants that not everybody can be protected from flood risks

Although Lessines experienced flood events, it seems that the notion that not everybody can be protected from flood risks is not present in Lessines. The citizens of Lessines regard the government as responsible for protecting them against floods and expect them to act accordingly. They are not willing to establish self-reliance (Mees et al., 2015).

### Recovery schemes

Flood recovery is dealt with on a national scale, with the federal insurance system, which has a very high percentage of uptake (Mees et al., 2015). Furthermore, it is previously stated that in Flanders victims of floods have the opportunity to file a claim at the Flemish disaster fund. The report states that in Wallonia a similar system exists (ibid). So this means that recovery schemes are available, even from two separate agencies and with the flood of 2010, prove exists that compensation is really provided.

## 5.5 Geraardsbergen

The characteristics and cases of Lessines and Geraardsbergen are very similar. Geraardsbergen is a city located in the Flemish region, and just as Lessines a small city on the Dender River, popular for inhabitants that want affordable building plots located close to larger cities (Brussels and Ghent), but situated in the country side (Mees et al., 2015). The Dender River is a branch of the Scheldt and is a spate river. This means that the discharge of the river is significantly influenced by rainfall. This makes the city of Geraardsbergen flood prone. The flood proneness is even enhanced by

geographical conditions and spatial developments; naturally flood prone areas are being used for economic activities and housing (ibid).

The last 20 years at least 4 floods of the Dender River caused damages. In 2010, the most severe flood took place. This was caused by an extreme precipitation event, which victimised multiple districts of the city of Geraardsbergen (Mees et al., 2015). Due to the event Geraardsbergen improved their flood risk management. Their FRGA is divided into three sub-FGRAs: Flood Preparation, Urban Water Management and River Management. The Preparation strategy aims at minimising the damage by crisis management. River Management focusses on fluvial flood prevention and the Urban Water Management Arrangement has the aim to regulate the impact by means of spatial planning. There is only one important obstacle to effective flood risk governance; thirteen old sluices are located in the Dender, which are a barrier for effective drainage towards the Scheldt. Renovation is necessary (ibid).

### *Presence of the governance conditions*

The table below shows the scores of the Geraardsbergen case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	+/-	-	-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+, +/-	+/-	+/-
Future risks are addressed in long term planning	+/-	+/-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+/-	+/-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 5.3: The scores of Geraardsbergen on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

The city of Geraardsbergen is the principal actor in the Urban Water Management Arrangement, because they are responsible for providing spatial plans, to issue building permits and to provide building codes. They are also the principal actor in flood preparation (Mees et al., 2015). River management is a very fragmented arrangement, where multiple government layers are responsible for different waterways. Collaboration between them should be improved (ibid). This shows room for improvement in collaboration mainly; the local government is already significantly involved.

### Stakeholder involvement

Regarding stakeholder involvement, inhabitants are normally only consulted in the last phase of the decision making process. However, in Geraardsbergen direct citizen participation was arranged after the flood of 2010. Most citizens had the feeling that their concerns were taken seriously and that their proposals were included. Only the citizens committee was dissatisfied with the fact that the water manager did not involve them further in the decision making process (Mees et al., 2015). Furthermore, there are two active civil society groups in Geraardsbergen. The first one is the committee of Overboelare, existing of inhabitants that were greatly affected by the 2010 flood. This group was set up to assist each other within the community with the claims towards the insurance company. They became a pressure group to stimulate the government to take measures against flooding. The other one; Omer Wattez is an environmental organisation that wants the natural flood plain to be restored, therefore they appeal against all the building permits that Geraardsbergen

issues in these flood prone areas (ibid). This shows that the stakeholder involvement is moderate in Geraardsbergen. However, the Belgian researcher states that the City of Geraardsbergen was very effective in involving stakeholders, but the water manager; W&Z is a closed organisation and they are not open to stakeholders. Therefore, stakeholders were not involved during the policy process, and the score on the presence of this condition should be low.

#### Facilitating learning and knowledge exchange

The most important notion of facilitating learning and knowledge exchange is that Geraardsbergen has appointed a new official, which is responsible for the coordination of the integration of water policy and management, together with a special appointed alderman. They should coordinate all efforts that are made to enhance the resilience of Geraardsbergen and make sure that during the integration learning and knowledge exchange are supported (Mees et al., 2015). This shows that learning and knowledge exchange is present in Geraardsbergen.

#### Hybrid solutions and combined strategies

The Flemish government established a flood risk management plan. For this plan research was executed to find the best mixture of strategies. In the region of Geraardsbergen, spatial planning and flood resilient building were seen as important protection strategies (Mees et al., 2015). Furthermore, water managers use a discourse of multi-layer water safety and according to them; there should be a greater focus on flood risk prevention in order to make Geraardsbergen less flood prone (ibid). Lastly, all strategies are visible in Geraardsbergen and compared to Antwerp and Lessines, those strategies are aligned best in Geraardsbergen (ibid). So combined strategies and hybrid solutions are being used in Geraardsbergen and these strategies are aligned better than in the other cases, which means that they should score higher than the plus/minus awarded in the other cases. On the other hand, water managers state that flood prevention should be enhanced. Therefore, a full plus is too high. The interviewee agreed with me on the point that alignment is better in Geraardsbergen. However, she explained that the sentiment in Geraardsbergen is that the city can only be protected by flood defence measures. They do not believe that much in projects such as more room for the river. Besides this sentiment, it is stated by citizens that the municipality approves that houses were built in the area and therefore the government should protect them (with flood defence measures) against flooding.

#### Long term planning

Geraardsbergen build a dike at Overboelare, which was supposed to prevent flooding for a longer time span. However, the height of the dike was calculated with the maximum water level present at the time of implementation. Therefore, it turned out that the dike is not able to endure a severe flood (Mees et al., 2015). On the one hand it shows that Geraardsbergen made an effort to address future risks in long term planning, by building a dike, but due to an outdated water level calculation, the actual flood safety did not increase significantly.

#### Climate sensitive and resilient spatial planning

The government in Flanders selected seven areas in Geraardsbergen that are very flood prone and not yet developed. After screening, only one of the seven regions was selected as an area where construction should be prevented (Mees et al., 2015). Furthermore, the city subsidises the construction of rainwater tanks in order to make houses more flood resilient (ibid). Therefore, Geraardsbergen is active in climate sensitive and resilient spatial planning. According to the

interviewee the same applies as for Antwerp; the effect of the measures is diminished by the assigned use of pieces of land.

### Funding

Concerning River Management, since the 2010 flood, water managers in Wallonia and Flanders received additional financial resources (Mees et al., 2015). The water managers find that they get enough financial resources from the government. However, the public argues that the Dender area gets too little funding, because it is not such an important waterway in economic terms (ibid).

### Flood forecasting

Flood forecasting is been dealt with by the Flemish Environmental Agency and the Hydrological Information Centre in Flanders. The Hydrological Information Centre has a database with real time information of the navigable waterways in Flanders. The environmental agency does the same for the non-navigable waterways (Mees et al., 2015). The information of the two is integrated by the Flemish government on a website. The website publicises a message twice a day to inform if there are expected flood events in the next 48 hours. A warning system sends automatic SMS messages to crisis managers and water authorities, when an alarming level is reached. Citizens can inform themselves through the website, by local authorities and the media (ibid). Flood forecasting in Flanders and therefore in Geraardsbergen is arranged very well, considering the real time information and the fact that they have a warning system.

### Emergency planning

Like Lessines and Antwerp, due to the Royal Decree of 2006, Geraardsbergen established a general Emergency and intervention plan; they employ an emergency planning official and have an operational safety cell. Besides, the city has a crisis response structure, which is well developed (Mees et al., 2015). This shows that emergency planning is well developed in Geraardsbergen.

### Innovation and experimentation

Geraardsbergen shows that the city creates opportunities for innovation and experimentation. In the aftermath of the 2010 flood, they improved their response towards flooding by some innovative measures; citizens could get a subsidy of max €250 in order to install their own innovative measures to protect themselves against flooding. Besides, a SMS warning system was introduced for citizens (Mees et al., 2015).

### Notion by inhabitants that not everybody can be protected from flood risks

With the subsidy for citizens to come up with their own innovative flood protection system, Geraardsbergen tried to stimulate their citizens to be more active in flood risk management. However, the inhabitants of Geraardsbergen see flood risk management as the responsibility of the government. Furthermore, they state that when they are allowed to build in a certain area, the government should protect them in this area (Mees et al., 2015).

### Recovery schemes

Flood recovery is dealt with on a national scale, with the federal insurance system, which has a very high percentage of uptake (Mees et al., 2015). Furthermore, in Flanders victims of floods that occurred after July 1<sup>st</sup>, 2014 have the opportunity to file a claim, within a three month time frame, at the Flemish disaster fund. The provincial governor decides if compensation is awarded (ibid). Considering Geraardsbergen individually it should be stated that the flood victims of 2010 were

completely compensated (ibid). So this means that recovery schemes are available, even from two separate agencies and with the flood of 2010, prove exists that compensation is really provided.

## 5.6 Comparison of Belgian cases

The table below shows the scores of the three Belgian STAR-FLOOD case studies on the presence of the governance conditions from literature. Below the scores will be discussed, as well as the governance conditions in general.

Governance condition present	Antwerp	Lessines	Geraardsbergen
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	-	+/-	-
Mechanisms are in place to facilitate learning and knowledge exchange	+	-	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	+	-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	+/-	+/-
Funding for policy making and implementation is available	-	-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+/-	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	-	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 5.4: The scores of the three Belgian case studies on the governance conditions from literature. Possible scores were +, +/- and -.

The table shows that Belgium scores especially well on the presence of the governance conditions of emergency planning and recovery schemes. The presence of adequate emergency planning can be explained by the Royal Decree of 2006, which obliged Belgian regions to employ an emergency planning official and to establish an emergency plan. Recovery schemes are available due to private insurance, which has a great uptake in Belgium. If Lessines, the only Walloon case study is not considered, Belgium would also score well on mechanisms to facilitate learning and knowledge exchange and opportunities for innovation and experimentation. A problem with the Walloon region of Lessines is that the region is not decisive enough and learning is underdeveloped.

In general Belgium scores low on the conditions on funding for flood risk management and the awareness by citizens that not everybody can be protected from flood risks. In Belgium a culture exists of looking at the government for protection by citizens and expecting this protection, while on the other hand the government wants citizens to be more responsible themselves. So Belgium

should improve on these conditions, to enhance their resilience. At the moment the resilience in Belgium is not optimal. However, in general the regions in the country are trying to become more resilient on different elements. For example there has been a lot of progress on the flood forecasting in both Wallonia and Flanders.

When comparing the three Belgian cases studies, Geraardsbergen scores best of the three cases in Belgium on the presence of the governance conditions, according to the evaluation of the STAR-FLOOD researcher, and in my own evaluation. In the interview it came forward that an important reason behind this is the fact that Geraardsbergen experienced flooding regularly, while Antwerp does not. So in Geraardsbergen the awareness is higher and therefore, more efforts are made to make the city more flood resilient. The researcher thinks that you could say that in general regions that experience floods more often are more aware, more motivated to take action and therefore more resilient than other regions. On the other hand, the municipality of Lessines is less decisive than Antwerp and Geraardsbergen and learning is also less developed in this municipality, while this is an important condition for resilience. These are the main reasons why Lessines' scores are lower, than Antwerp and Geraardsbergen. Antwerp is in the middle of the two regarding their scores. It should be noted that Antwerp has the best developed emergency planning. Emergency planning is best developed in Antwerp, because the city has a lot of resources and expertise and a large harbour, which makes emergency planning in general already very significant for the city. It should be mentioned that although Lessines and presumably more regions in Wallonia are less resilient than Flemish regions (e.g. due to less resources), these regions are more positive about the role of government and water authorities than in Antwerp, Geraardsbergen and other regions of Flanders. This may be caused by the fact that in Wallonia they have sub-basin stakeholder platforms and therefore, the Walloon regions have a greater feeling that the water managers actually consider what they bring to the table, while water managers in Flanders are closed for the public.

Considering the governance conditions in general, a condition that should be added, according to the interviewee, which is partly retrievable in the innovation and experimentation condition, is that regions should learn from a disaster and evaluate what should be improved. The most important conditions are funding and long term planning. However, funding will only make a region more resilient if the investments of the funds are spread over multiple strategies. For example investment in preparation measures should not mean that investment in flood defence can be repealed. Less important is the use of hybrid and combined strategies, because it is more important that different alternatives are considered and that the best strategy/strategies are chosen for a certain region. The process of selecting a scenario should be a collaborative process.

There are also some conditions that should be altered according to the Belgian STAR-FLOOD researcher. First, with the condition that inhabitants should have the notion that not everybody can be protected from flood risks, it seems like inhabitants can be protected from flood risks, while others cannot. In her opinion it should be that citizens cannot be protected from every natural disaster/flood. Besides, emergency planning should not especially be set up for evacuation, because evacuation is not necessary in every region, but it is more important that the actors responsible for emergency planning know exactly what to do at what moment. Furthermore, not only government layers, but also government organisations should collaborate. Furthermore, it is also not crucial that there is a significant role for the local government, but more importantly a significant role for the



most appropriate government layer, so at the most adequate level. An example of a reason behind this is that municipalities sometimes lose the bigger picture, which can lead to short term solutions.

## 5.7 Conclusion

In this chapter an analysis of the Belgian STAR-FLOOD case studies has been discussed in order to answer the following question: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

In Belgium flood risk resilience is enhanced by adequate emergency planning and the availability of recovery schemes that can compensate victims of flooding. When only considering the Flemish regions, flood risk resilience is also enhanced by mechanisms to facilitate learning and knowledge exchange and opportunities for innovation and experimentation. On the other hand Belgium scores low on the presence of funding for flood risk management and the notion by citizens that not everybody can be protected from flood risks. Comparing the three case studies, shows that Geraardsbergen scores best on the presence of the governance conditions. This high score can mainly be explained by their flood experience. Antwerp is in the middle, but has the best developed emergency planning. Lessines is last, mainly because they are governed in a less decisive manner. However, there is more trust in the government regarding flood risk in Wallonia, than in Flanders. When looking at the conditions in general, it should be added that regions learn from natural disasters. Besides, some conditions should be altered. In terms of importance, funding and long term planning are deemed as most important conditions, while using combined strategies is less important.

In the next chapter the Swedish case studies will be discussed. This will bring about more information on good practices in flood risk governance. It will for example show if in Sweden flood risk resilience is also enhanced by adequate emergency planning and the availability of recovery schemes.

## 6. Good practices in Swedish flood risk governance

### 6.1 Introduction

This chapter focusses on the enhancement of flood resilience in Sweden on the basis of the Swedish STAR-FLOOD case studies. The research question central to this chapter is: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?* The chapter will begin with a short introduction on flood risk governance in Sweden. After this introduction the three case studies will be discussed. In these case study paragraphs, the case studies will be scored on the presence of the governance conditions established in chapter 2. This will be based on a document analysis of the STAR-FLOOD reports and an interview with the STAR-FLOOD researchers that wrote the reports. This will be followed by a case comparison paragraph, which includes the researchers' view of the established governance conditions. The chapter ends with a conclusion.

### 6.2 Flood risk governance in Sweden

In Sweden, the risk of flooding varies from region to region. Most of the floods are fluvial floods along lakes and rivers, with the highest flows during spring, when snow is melting. Next to fluvial floods, pluvial floods due to heavy precipitation are occurring more often in recent years. It is expected that the frequency of pluvial and fluvial floods will increase, resulting from climate change (Ek et al., 2015). The waterways in Sweden are important for producing hydroelectric power and are regulated accordingly. The dams for the provision of hydroelectric power can either reduce the probability of a flood event, or increase the probability; water can be stored, but these reservoirs can also get too much water during heavy precipitation and dam failure is possible as well (ibid).

Until now Sweden has been relatively lucky regarding the consequences of flood events. There have been thirty-six floods from 1950 to 2015. Most of the time, these floods led to damages in infrastructure and properties, but very rarely led to casualties; only seven times, compared to globally 5400 on average annually (Ek et al., 2015). From the 1990s onwards, flood risk management nevertheless became an issue on the political agenda. This was caused by the occurrence of some more significant flood events and due to discussions on climate change. However, flood risk management does not have its own policy domain at the national level, flood risks are embedded in other policy areas. Besides, flood risk governance is mainly dealt with on the local level, which is effective due to the great variety in flood risks from region to region. It also means that now alignment can be found between the different strategies (ibid). Four categories of measures can be defined: protection, prevention, preparation and recovery. Flood prevention exists in the form of spatial planning and climate sensitive/resilient systems, which is emerging. Flood defence exists mainly by dams and dikes, although these are not purposefully part of flood prevention. Preparation is highly institutionalised in the form of emergency management. Lastly, recovery is ensured by governmental grants and an insurance system (ibid).

Concerning the administrative culture of Sweden, it is characterised by a central form of government, which is changing to a more decentralised form of governance since the 1970s (Ek et al., 2015). Furthermore, the country is a democracy with a representative and parliamentary government and municipal self-government. The national government is assisted by administrative agencies, which are independent to a certain degree. Municipalities are responsible of public interest matters on the

local level. The municipality is elected and makes decisions on local taxes, its organisations and procedures, their budget, goals and guidelines (ibid).

### 6.3 Karlstad

Karlstad is a city located on a delta of the river Klarälven and by the lake of Vänern. It is a very flood prone urban area, due to flooding of the Klarälven River and the Vänern Lake. These floods mainly occur during fall, due to heavy precipitation and in spring, when snow is melting (Ek et al., 2015). Especially the floods from the Klarälven River affect many people, because the landscape around the Klarälven River is flat. Furthermore, in the case of dam failure, Karlstad will be reached in about 26 hours after the dam failure and will affect around 23,000 inhabitants of Karlstad (ibid). The risk of flooding is higher in Karlstad, than in most of the other Swedish municipalities, which will be increased by climate change.

In 2006 a local flood management program was initiated by the city of Karlstad. They came up with this local flood program due to significant flooding in 2000/2001 and because a national investigation took place identifying great risks and vulnerabilities related to climate change, which identified the vulnerability of Karlstad (Ek et al., 2015). The aim of the program is to address present and future flood risks. This will for example be achieved by: technical adaptation measures to prevent flooding, improving the drainage of Lake Vänern and to plan the expansion of Karlstad on the basis of risk assessment (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Karlstad case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	-	+/-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	-	+/-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	+/-	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 6.1: The scores of Karlstad on the governance conditions from literature. Possible scores were +, +/- and -

#### Collaboration across government layers and significance of local government

The flood management program was mainly developed by the Municipal Management Offices and the Technical Services and Property Management Committee, with the involvement of some other organisations (Ek et al., 2015). Besides Karlstad, along Lake Vänern other municipalities are located as well. These municipalities cooperated in order to involve and to notify the national government about the flood problems, and to come up with financial and technical solutions to reduce the water level and thereby the risk of flooding (ibid). As expected, due to the fact that flood risk governance is dealt with on a local level, the local level has a significant role and the local level cooperates with each other, however collaboration with higher government levels should be increased.

#### Stakeholder involvement

Regarding Stakeholder involvement, Karlstad is active in trying to increase the flood awareness among their inhabitants (Ek et al., 2015). Besides it is a requirement in the national legislation that citizens should be able to participate in the policy making process, they have the right to appeal and to access information. However, citizens seem not interested in these rights and do not participate in discussion on new flood risk management measures. Participation only increased when a flood event has occurred (ibid). So even though Karlstad tries to involve the stakeholders, their involvement can be improved, but this should be done by the stakeholders themselves.

### Facilitating learning and knowledge exchange

Karlstad employs a municipal flood risk manager, to coordinate the task in order to reduce flood risks. This Flood risk manager is part of the Technical Services and Property Management Committee, which is one of the main responsible organisations for the Karlstad flood management program. Coordination takes place between different departments of the municipality and supports knowledge exchange between the departments (Ek et al., 2015). Besides knowledge exchange within the Karlstad municipality, inter-municipal learning also takes place within the Lake Vänern municipalities, as shown in the collaboration condition (ibid). Lastly, representatives of different municipal departments and companies established the Delta-group. The group meets twice a year to exchange experiences and discuss issues related to flood risks (ibid). This shows that there are multiple examples of learning and knowledge exchange in Karlstad.

### Hybrid solutions and combined strategies

At the moment recovery and preparation are institutionalised strategies, while the others are emerging. This is enhanced by a discourse shift from technical solutions towards combined measures. This means that; now preventive and defensive measures are also incorporated, as well as flood mitigation, but it just recently gained interest (Ek et al., 2015). The above shows that multiple strategies are combined.

### Long term planning

The only time that long term planning is mentioned in the report is about the local flood program. For this program the aim is to prepare Karlstad for present and future floods (Ek et al., 2015). The interviewees state that there are enough structural measures, which will protect the city in the long term. Considering non-structural measures; floating houses are an example of long term measures. However, because the city wants to densify, long term planning is not their biggest concern.

### Climate sensitive and resilient spatial planning

Climate sensitive and resilient spatial planning is visible in Karlstad, but can still be improved. To start with, the municipality applies provisions on the minimum flood levels in buildings and on the placement of important infrastructure. The municipal housing company constructed floating houses and the pedestrian and cycle path was planned, that would also protect the central hospital from floods (Ek et al., 2015). On the other hand, a conflict between developing attractive waterfront properties and reducing flood risks can be witnessed. Furthermore, it is been stated that there is a deficiency in the knowledge of the municipality; they often provide building permits for pieces of land that are significantly in risk of flooding (ibid). The STAR-FLOOD researchers state that they were a bit too harsh when scoring this condition. There are indeed efforts to make spatial planning more resilient and climate sensitive, but densifying the city is the main aim in spatial planning. Besides, the efforts are mainly plans on paper, instead of actual implemented measures. Although they stated this, they agreed on the scoring on the basis of the document analysis.

### Funding

Karlstad has a relatively high budget for investments to reduce flood risks. However, according to Swedish law, funding of defensive measures should be done by the responsible body, which in this sense means that it should be funded through taxes and/or the individual property owner. This results in a limited support in funding for defensive measures (Ek et al., 2015). Another channel for funds is the Civil Contingencies Agency at the national level, which can provide grants. This agency is

absent at the local level according Karlstad (ibid). In sum, the budget for measures is high, but there are some obstacles to get funding.

### Flood forecasting

The warning system in Sweden is provided by the Meteorological and Hydrological Institute. They also provide estimates on river flows, which can be used on the local level, to assess flood risks (Ek et al., 2015). On the local level, the City Planning Department and the Technical Services and Property Management Department developed flood risk maps. If necessary, these maps can be connected to the GIS-system of the municipality. This system is used daily by the emergency services and the city planners (ibid). Flood forecasting is up to date and shows real time risks of flooding with the GIS-system.

### Emergency planning

Emergency and crisis management can be identified. First, because municipalities are obliged to perform vulnerability assessments and risk analysis, on the basis of this analysis, an emergency plan should be developed. Secondly, the rescue services have developed two plans for the occurrence of flood events: one how to prepare the municipality, so that the consequences are minimised, the other focusses on how to deal with the disruption of essential social services, due to a flood event. Lastly, the flood risk maps, connected to the GIS-system of the municipality can provide support to emergency services (Ek et al., 2015). Emergency planning is visible, great improvements are not necessary.

### Innovation and experimentation

Besides knowledge exchange and learning, the cooperation between the different municipalities along Lake Vänern, also brought innovation and experimentation, when searching for new and improved technical solutions (Ek et al., 2015). In addition, Karlstad University developed the Centre for Climate and Security, a multidisciplinary research centre, supported by the municipality. The research centre is important in flood preparation and focusses their research on societal risks connected to flooding (ibid). This shows that innovation and experimentation is supported by the city of Karlstad. The interviewees agree that there are opportunities for innovation and experimentation, only these opportunities are not being exploited.

### Notion by inhabitants that not everybody can be protected from flood risks

Due to the fact that Sweden is not very flood prone, citizens perceive that the occurrence of large flood events is not very likely, and they are not concerned, that such an event will happen (Ek et al., 2015). According to inhabitants Swedish authorities are responsible for rescuing and helping citizens during flood events. They rely on the government (ibid). The government in their turn sees citizens as unaware of flood risks, and they are afraid that because of this unawareness and the reliance on the municipality for protection, individuals are not prepared in case of a significant flood (Ibid). This shows that the awareness should be improved, regarding the protection against flood risks.

### Recovery schemes

According to Swedish law, individuals have their own responsibility to protect their property and themselves and to finance necessary measures in order to mitigate the consequences of an emergency and the measures to prevent an emergency from happening (Ek et al., 2015). Furthermore, flood recovery in Sweden is been dealt with via private insurance. If citizens as well as the municipalities will not improve their mitigation and preparation efforts (which they should do by

law), it is possible that the premiums will be significantly increased, to maintain the same level of coverage that is applied now (ibid). This shows that recovery schemes are available in Sweden and also in Karlstad, due to insurance, however to keep the same coverage as today, measures should be implemented.

## 6.4 Gothenburg

Gothenburg is located on the Swedish west coast. Within the area, the Göta River flows into the sea. The sea is called Kattegat. Gothenburg is especially prone to fluvial, pluvial and coastal floods. Furthermore, the main soil type in the river valley of the Göta is clay, which makes the region, besides flood risks also vulnerable to landslides (Ek et al., 2015). Coastal flooding is a concern, due to the rising sea levels as an outcome of climate change. Tidal variation is low, so this does not bring concerns forward (ibid). Furthermore, in Gothenburg, the metropolitan area is very prone to fluvial flooding. Within this metropolitan area; a Natura 2000 area, a water protection area, an emergency service centre, a nature reserve and a polluted land area are located. The most disastrous event will happen, if at the same time the sea level will rise significantly and the waterway will have high flows (ibid).

Flood risk governance mainly got the attention from the municipality of Gothenburg through the Gudrun storm in 2005, Garda flood in 2008 and heavy rainfall in 2011. Due to its flood proneness and the flood experience of the city, the municipality is considered to be prominent in flood risk knowledge and management (Ek et al., 2015).

### *Presence of the governance conditions*

The table below shows the scores of the Gothenburg case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.



Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	-	-	-
Stakeholders are involved throughout the policy process	-	-	-
Mechanisms are in place to facilitate learning and knowledge exchange	-	+/-	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	-	+/-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-, -	-	-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	-	+/-
Opportunities are created for innovation and experimentation	-	-	-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 6.2: The scores of Gothenburg on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

The responsibilities or at least the perceived responsibilities for certain flood risk related tasks have been shifted at the local level. This has contributed to flood risk being handled at the complete municipality, instead of only in certain municipal sectors (Ek et al., 2015). Nonetheless, there is an increasing need for coordination and cooperation between different sectors. In addition, the regional level should have a more important role in flood risk management. This is difficult, because the municipal and regional level do not agree on most flood management issues. It is also stated by the municipality that the national level is not 'on board' yet in flood risk management (ibid). This shows that there is a significant role for the local government, but collaboration is lacking, especially with higher government layers.

### Stakeholder involvement

Regarding Stakeholder involvement, Gothenburg is active in trying to increase the flood awareness among their inhabitants (Ek et al., 2015). Besides it is a requirement in the national legislation that citizens should be able to participate in the policy making process, they have the right to appeal and to access information. However, citizens seem not interested in these rights and do not participate in discussions on new flood risk management measures (ibid). So even though Gothenburg tries to involve the stakeholders, their involvement can be improved, but this should be done by the stakeholders themselves.

### Facilitating learning and knowledge exchange

In the report on Gothenburg, it is not stated if there are mechanisms to facilitate learning and knowledge exchange, it is only discussed that Gothenburg is prominent in knowledge about flood risk management in Sweden. The STAR-FLOOD researcher stated that in Gothenburg, a lot of conflicts exist between the municipality and the regional government layer. However at the municipal level, efforts are being made to facilitate learning and knowledge exchange via collaboration between different municipal departments and companies.

### Hybrid solutions and combined strategies

A diverse set of flood governance strategies are visible in Gothenburg, recovery by insurance, emergency planning and crisis management are available. However, flood defence measures are the dominant strategy in Gothenburg. This is mainly so, because hydroelectric dams provide non-purpose flood defence and because the city wanted to develop densely and central constructed areas, which should be protected by flood defence (Ek et al., 2015). It seems like development of the central areas is more important, than combining different strategies, although most strategies are present in Gothenburg.

### Long term planning

From the report it is hard to assess, if the taken flood risk governance measures are addressing flood risk management on the long term. The interviewees discussed that Gothenburg wants to start some large projects, which addresses future risks on the long term. Furthermore, a study has been executed to calculate the water level in the future, with the occurrence of extreme weather events and climate change.

### Climate sensitive and resilient spatial planning

Gothenburg has introduced the comprehensive plan, in which building safely is one of the strategies. In the plan it is stated that new building developments should take into account risks for floods, landslides and soil subsidence and the lowest foundation level for these developments. In many already built-up areas, the lowest foundation level is not been reached (Ek et al., 2015). This shows that a comprehensive plan was established, so that Gothenburg should not score low on this condition. On the other hand the regulations inside the plan are not been met, so high improvement is necessary. According to the interviewees, Gothenburg is aware that for example their drainage cannot bear future flood risks and they made some suggestion to change the system. Nonetheless, these are only suggestions and a new system is not implemented. So there is a difference between planning and executing of spatial planning measures.

### Funding

According to Swedish law, funding of defensive measures should be done by the responsible body, which in this sense means that it should be funded through taxes and/or the individual property owner. This results in a limited support in funding for defensive measures (Ek et al., 2015). In Gothenburg it is mentioned that funding is available, however, these funds are mainly available when a flood has occurred and not beforehand, than it is difficult to find support for funding measurements (ibid). So, funding is available, nonetheless it can be improved, if funds will also be available before a flood event takes place.

### Flood forecasting

The warning system in Sweden is provided by the Meteorological and Hydrological Institute. They also provide estimates on river flows, which can be used on the local level, to assess flood risks (Ek et al., 2015). On the local level, the municipality has been working to build, communicate and update knowledge on the risks of flooding. They even have data models for various areas. Furthermore, they have a combined hydro model, with information on rivers, streams, tunnels, pipe networks, land and sea. Besides, they also have a 3D model, to show how the central areas of the city will be affected due to very high water levels (ibid). So flood forecasting is adequate at the national as well as the local level.

### Emergency planning

Emergency and crisis management can be identified, because municipalities are obliged to perform vulnerability and risk analysis, and on the basis of this analysis an emergency plan should be developed (Ek et al., 2015). According to the municipality, they are capable of managing a crisis correctly. Especially because Gothenburg witnessed several serious floods (ibid). However, this condition might be hampered to the fact that emergency services decided that it was no longer their task to place pumps and barriers in a flood event, because the municipality and land and property owners should protect themselves (ibid). The interviewees state that the emergency services are not really involved with the other actors in flood risk management in general, while the involvement is visible in the other two regions. Furthermore, they believe that Gothenburg is not prepared for evacuation of their inhabitants; however this is very seldom needed. When evacuation is left out of the condition, Gothenburg scores higher on this condition.

### Innovation and experimentation

In the report on Gothenburg, it is not stated if there are opportunities for innovation and experimentation. According to the interviewees, it is indeed true that opportunities for innovation and experimentation are not available in Gothenburg.

### Notion by inhabitants that not everybody can be protected from flood risks

Due to the fact that Sweden is not very flood prone, citizens perceive that the occurrence of large flood events is not very likely, and they are not concerned, that such an event will happen (Ek et al., 2015). According to inhabitants Swedish authorities are responsible for rescuing and helping citizens during flood events. They rely on the government (ibid). It has not been stated how the awareness of citizens is perceived at the local level. This shows that the awareness should be improved, regarding the protection against flood risks. The interviewees state that in Gothenburg awareness campaigns have been executed to inform citizens. In this information, it is stated that citizens should be able to survive for 72 hours, because the government cannot always come to help immediately. Gothenburg therefore scores better on the presence of this condition than the other cases. It is however the question how many inhabitants are reached and have changed in awareness.

### Recovery schemes

According to Swedish law, individuals have their own responsibility to protect their property and themselves and to finance necessary measures in order to mitigate the consequences of an emergency and the measures to prevent an emergency from happening (Ek et al., 2015). Furthermore, flood recovery in Sweden is been dealt with via private insurance. If citizens as well as the municipalities will not improve their mitigation and preparation efforts (which they should do by law), it is possible that the premiums will be significantly increased, to maintain the same level of

coverage that is applied now (ibid). This shows that recovery schemes are available in Sweden and also in Gothenburg, due to insurance, however to keep the same coverage as today, measures should be implemented.

## 6.5 Kristianstad

Kristianstad is located in the south of Sweden. The Helge River flows through the metropolitan area of the city, and then flows into Lake Hammarsjön. It then continues towards the Baltic Sea. The lowest point of the metropolitan area lies 2,41 meters below sea level and the area is built on the bottom of a former lake that was drained at the end of the 19<sup>th</sup> century (Ek et al., 2015). Kristianstad is very flood prone, due to the Helge River and Lake Hammarsjön. The River and the Lake can flood when the sea level of the Baltic Sea is high and when the discharge is high. Furthermore, Kristianstad is prone to heavy precipitation. It is expected that climate change will increase the frequency of these flood events (ibid).

Many floods have occurred in the history of Kristianstad. The largest flood event in recent year was a flood event in 2002, caused by heavy rainfall, very high water levels in the Helge River and Lake Hammarsjön. It even almost made the Hammarslund embankment collapse (Ek et al., 2015). In the aftermath of the 2002 flood event, Kristianstad started to expand their flood defences. The built embankment and six pumps are the most expensive and largest flood risk reducing projects in Sweden (ibid).

### *Presence of the governance conditions*

The table below shows the scores of the Kristianstad case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+/-	+/-	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	-	-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	-	-
Funding for policy making and implementation is available	+	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+/-	+/-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 6.3: The scores of Zuidplaspolder on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

As for the rest of Sweden, flood risk management is mainly handled at the local level. The collaboration on the local level is all right, but can be improved (Ek et al., 2015). More interesting, is that flood risk governance is enhanced in Kristianstad by funds from the national level. The national level even recommended that the embankment was not only repaired, but also extended. The national level got involved, when Kristianstad applied for funds to repair the embankment at the Swedish Civil Contingencies Agency (ibid). This shows that the local government has a significant role. Nonetheless, collaboration between different government layers can still be improved, although in this case the national government got involved.

### Stakeholder involvement

It is a requirement in the national legislation that citizens should be able to participate in the policy making process, they have the right to appeal and to access information. However, citizens seem not be interested in these rights and do not participate in discussion on new flood risk management measures (Ek et al., 2015). There is no mentioning of further stakeholder involvement in Kristianstad in the report, besides the national requirements. So stakeholder involvement can be improved. The STAR-FLOOD researchers state that Kristianstad should score all right on this condition, because they were able to involve the national level as a key stakeholder and even received funds from them.

### Facilitating learning and knowledge exchange

Kristianstad encourages collaboration between different departments and municipal organisations; this leads to knowledge exchange and learning between these departments and organisations (Ek et al., 2015). Because this is the only example of facilitating learning and knowledge exchange, Kristianstad can improve on this condition.

### Hybrid solutions and combined strategies

Due to its high flood risks, Kristianstad mainly focussed on flood defence. However, it is stated in the report that Kristianstad has broadened its flood management strategies and is going towards a holistic and adaptive approach to enhance the flood resilience (Ek et al., 2015). This shows that although Kristianstad is focussed on flood defence they are heading towards combined strategies.

### Long term planning

The new flood defence should be able to endure a 1 in 10,000 year flood event (Ek et al., 2015). This means that it will protect the city from flooding at the long term.

### Climate sensitive and resilient spatial planning

The report mentions that flood mitigation efforts, through building requirements are limited. The city developed a comprehensive plan, with measures like flood resistant buildings (Ek et al., 2015). On the other hand new buildings are constructed in the area of the embankment, which may in the long run, although the flood defence is very strong, enhance the proneness of the area (ibid). Climate sensitive and resilient spatial planning is visible, but should be improved. According to the interviewees, spatial planning is worse in Kristianstad, compared to Karlstad and Gothenburg, due to the large embankment.

### Funding

According to Swedish law, funding of defensive measures should be done by the responsible body, which in this sense means that it should be funded through taxes and/or the individual property owner. This results in a limited support in funding for defensive measures (Ek et al., 2015). However, the embankment, a flood defence measure is repaired and extended with funds of the national government, which pays 60% of the total costs (ibid). The above demonstrates that funds are available in Kristianstad. The interviewees state that they scored all the cases all right, on this condition, because in Sweden in general every region has an equal opportunity to receive funds from the government. If these funds are awarded, usually the government funds 50 percent and the region/municipality should provide 50 percent. The only difference between Kristianstad and the other case studies is that Kristianstad received the government funding.

### Flood forecasting

The warning system in Sweden is provided by the Meteorological and Hydrological Institute. They also provide estimates on river flows, which can be used on the local level, to assess flood risks (Ek et al., 2015). On the local level, the municipality retrieves data on the expected water levels in the sea and river, ten days in advance (ibid). It can be stated that flood forecasting is up to date, because of the national warning system and the data available at the municipal level.

### Emergency planning

Emergency and crisis management can be identified, because municipalities are obliged to perform vulnerability and risk analysis, and on the basis of this analysis an emergency plan should be

developed (Ek et al., 2015). Kristianstad has an action program that includes emergencies as well as extraordinary events. Preparedness for crisis is ensured at all times, by the local 'officer on the call' (ibid). Furthermore, as already mentioned the municipality retrieves data on the expected water levels in the sea and river, ten days in advance. Together with the information from the Meteorological and Hydrological Institute a prognosis on the risks can be established (ibid). Emergency planning should be considered adequate.

#### Innovation and experimentation

In Kristianstad, some opportunities for innovation and experimentation exist. Urban Planning in the municipality for example uses retention areas and flood-proof cellars. Nonetheless, these are the only innovative measures, no floating houses or elevated houses are being used (Ek et al., 2015). In the future the Urban Planning Department wants to improve on its innovative measures, by taking a holistic approach and by learning from other countries such as the Netherlands (ibid).

#### Notion by inhabitants that not everybody can be protected from flood risks

Due to the fact that Sweden is not very flood prone, citizens perceive that the occurrence of large flood events is not very likely, and they are not concerned, that such an event will happen (Ek et al., 2015). According to inhabitants Swedish authorities are responsible for rescuing and helping citizens during flood events. They rely on the government (ibid). It is not been stated how the awareness of citizens is perceived at the local level. This shows that the awareness should be improved, regarding the protection against flood risks.

#### Recovery schemes

According to Swedish law, individuals have their own responsibility to protect their property and themselves and to finance necessary measures in order to mitigate the consequences of an emergency and the measures to prevent an emergency from happening (Ek et al., 2015). Furthermore, flood recovery in Sweden is been dealt with via private insurance. If citizens as well as the municipalities will not improve their mitigation and preparation efforts (which they should do by law), it is possible that the premiums will be significantly increased, to maintain the same level of coverage that is applied now (ibid). This shows that recovery schemes are available in Sweden and also in Karlstad, due to insurance, however to keep the same coverage as today, measures should be implemented.

### 6.6 Comparison of the Swedish cases

The table below shows the scores of the three Swedish STAR-FLOOD case studies on the presence of the governance conditions from literature. Below the scores will be discussed, as well as the governance conditions in general.



<b>Governance condition present</b>	<b>Karlstad</b>	<b>Gothenburg</b>	<b>Kristianstad</b>
Collaboration across government layers, with a significant role for the local government	+/-	-	+/-
Stakeholders are involved throughout the policy process	+/-	-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+/-	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+/-	+
Future risks are addressed in long term planning	+/-	+/-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	-	-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+/-	+
Opportunities are created for innovation and experimentation	+	-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	+/-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 6.4: The scores of the three Swedish case studies on the governance conditions from literature. Possible scores were +, +/- and -.

When looking at the table, it is shown that Sweden in general scores well on the presence of the governance conditions of flood forecasting and recovery schemes. Both of these are mainly handled at the national level. Recovery schemes are available due to private insurance, which has a very high uptake. It might be important to state that although recovery schemes are available now, the coverage of today by the insurance companies might not be the same in the future with an increase of the frequency in extreme weather events and climate change. Swedish inhabitants should improve their own protection levels (also stated in Swedish law), to avoid paying significant higher premiums to receive the same insurance coverage as now.

Sweden should improve on the conditions of climate sensitive and resilient spatial planning and the awareness of inhabitants that not everybody can be protected from flood risks. The Swedish cases mainly score low on the presence of the first one, because they suggest different spatial planning measures, but do not implement them. Besides, other motives, such as densifying central areas, or having nice waterfront house get priority above climate sensitive and resilient spatial planning. Regarding the notion that not everybody can be protected, most Swedish citizens rely on the government for protection. Even though in Swedish law property owners are obliged to protect themselves in first instance.

The Swedish cases score modest on the presence of several conditions. One of them is collaboration between government layers with a significant role for the local government. In Sweden, it is not the problem that local governments have a significant role, but rather that they mainly deal with flood

risks by themselves. There is no flood policy domain at the national level. This might have led/leads to bound development of knowledge, because there is less opportunity to learn. On the other hand, according to the interviewees, knowledge about the floods in the region is merely available at the local level. Besides, if a certain region is flooded, it might be fair, if the region funds rebuilding on their own.

Comparing the individual cases, Karlstad scores best on the presence of governance conditions. According to the interviewees it is indeed true that Karlstad has a very broad flood program, which focusses on multiple structural and non-structural measures, so that there is a big diversity in measures. This is accompanied with much collaboration inside the municipal departments. This makes them the most resilient. In comparison, Kristianstad has built an enormous embankment, but all the aspects within flood risk governance do not come together in their flood program, which make them less resilient.

Concerning the general governance conditions, the interviewees stated that the list of governance conditions is complete, because they cover all strategies. Although, the list is complete according to the Swedish STAR-FLOOD researchers, it should be added to the list that problems should be tackled at the right scale; the solution should fit the problem. It also means that the right scale is different in different cases. This could be added to the condition of collaboration between government layers, with a significant role for the local government, so it is not necessary to make this a new condition. Another change in the list of governance conditions according to the interviewees should be that evacuation needs to be left out the adequate emergency planning condition. They state that it is seldom needed to evacuate citizens when a region is flooded in Sweden. They also noted that it is quite hard to score the cases on the governance condition of combined strategies, because it inhibits all the strategies and some are less developed, but they are visible.

Regarding the importance of the conditions, multiple conditions are important according to the interviewees. Future risks should be addressed in long term planning, because addressing risks, without taking into account the long term will not lead to very effective measures. Funding should be available in order to implement measures. Spatial planning should be resilient and climate sensitive, because the consequences of floods are lower, if building in flood prone areas is prevented.

## 6.7 Conclusion

In this chapter an analysis of the Swedish STAR-FLOOD case studies has been discussed in order to answer the following question: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

In Sweden flood risk resilience is enhanced by flood forecasting and the availability of recovery schemes to compensate flood victims. On the other hand, the governance conditions of climate sensitive and resilient spatial planning and the notion that not every citizen can be protected from flood risk are not enough present in Sweden. Furthermore, it should be noted that the Swedish cases score in general quite modest on the presence of the governance conditions and that Swedish flood risk governance is mainly dealt with at the local level, which has some advantages and disadvantages. When comparing the three cases, it turns out that Karlstad scores best on the presence of governance conditions, mainly because their flood program is the broadest of the three regions. Regarding the conditions in general, the interviewees argued that the list is complete, the collaboration condition should be changed towards handling flood risk governance on the

appropriate level. Besides, evacuation is not necessary for emergency planning. Furthermore, some conditions are more important than others according to the interviewees. They stated that addressing future risks in long term planning, funding and resilient and climate sensitive spatial planning are the most important governance conditions for enhancing flood risk resilience.

In the next chapter the Polish case studies will be discussed. This will bring about more information on good practices in flood risk governance. It will for example show if evacuation should be left out of the condition on emergency planning, as is stated by both the Belgian as well as the Swedish researchers.

## 7. Good practices in Polish flood risk governance

### 7.1 Introduction

This chapter focusses on the enhancement of flood resilience in Poland on the basis of the Polish STAR-FLOOD case studies. The research question central to this chapter is: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?* The chapter will begin with a short introduction on flood risk governance in Poland. After this introduction the three case studies will be discussed. In these case study paragraphs, the case studies will be scored on the presence of the governance conditions established in chapter 2. This will be based on a document analysis of the STAR-FLOOD reports and an interview with the STAR-FLOOD researchers that wrote the reports. This will be followed by a case comparison paragraph, which includes the researchers' view of the established governance conditions. The chapter ends with a conclusion.

### 7.2 Flood risk governance in Poland

Poland is a very flood prone country; it is the main natural risk in terms of losses. Most of the floods are river floods caused by rain. These river floods can occur all over the country, but the highest risk of river flooding is around the rivers Odra and Vistula, in the Southern and in the Northern part of the country. In 1997 and in 2010, the most destructive floods occurred. The losses were calculated around € 3 billion for each of them (Matczak et al., 2015). The flood in 1997 caused organisational and legislative reforms in flood risk management, which were finalised in 2001; with the Act on Crisis Management and the Water Act. Besides, multiple flood infrastructure programs were set up regionally. Although the state has an obligation to produce a national flood management program according to the Water Act, this is not completed yet (ibid).

Poland is a unitary state, where the administrative structure has three levels. Besides the central government level, there are sixteen provinces, which are further divided into the local level of 379 counties and 2,478 municipalities. There are elections at the local level to choose the heads of the local government (Matczak et al., 2015). In general Polish flood risk governance is characterised by a dominant role of public administrative bodies; they share some responsibilities with local authorities. Until the disastrous flood of 1997 the dominant measures of these public administrative bodies were flood defence measures. At this moment flood preparation, mitigation, recovery, defence and prevention are all visual, however flood defence is still the main flood risk governance strategy (ibid). Furthermore, due to the level of economic development in Poland, water management is considered to be lacking of funding. However, with the accession of Poland to the EU funds have become available and this resulted in a significant amount of investments for flood risk management infrastructures (ibid).

### 7.3 Poznan County

Poznan County is situated in the Wielkopolska Lake District. The county exists of seventeen municipalities, which are located around Poznan city. The River Warta, the largest river of the county flows through Poznan city. The Warta is the largest branch to the Odra River, and has an even greater basin area (Matczak et al., 2015). The middle part of the river basin is been highly urbanised and is regulated by the city of Poznan (ibid). The water reservoir Kowalski is the only object that has active flood control in Poznan County. This is mainly due to its location on the Warta River, upstream from

the County of Poznan, which means that Poznan County as well as the city are in risk of this reservoir (ibid).

### *Presence of the governance conditions*

The table below shows the scores of the Poznan case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

<b>Governance condition present</b>	<b>Document analysis</b>	<b>STAR-FLOOD researcher</b>	<b>Conclusion</b>
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	-	-	-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	-	-	-
Future risks are addressed in long term planning	-	-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	-	-	-
Funding for policy making and implementation is available	+/-	+	+
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	-	-	-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+/-	+/-	+/-

Table 7.1: The scores of Poznan on the governance conditions from literature. Possible scores were +, +/- and -.

### *Collaboration across government layers and significance of local government*

There are three sub-FGRAs in the County of Poznan. The governance mode within these sub-FRGAs is a mainly centralised governance mode. This is supplemented with a shift in the direction of more decentralised governance. Considering the responsibilities; flood defence is centralised in planning as well as financing, while the structural infrastructure is maintained by the provincial body (Matczak et al., 2015). Concerning efforts to decrease flood risks, government actors are merely competing for

resources, instead of coordinating their efforts to decrease flood risks. The actors are, mainly busy with protecting their own interests. Besides there are some institutional conflicts regarding ownership. River plains, streams, lakes etcetera have multiple owners and managers. Large rivers fall under higher government layers, than streams, which are managed by provincial authorities (ibid). There is however good cooperation in the crisis management sub-FGRA. Within this arrangement the most important actors are the fire brigades and the municipal/county level crisis management centres, which cooperate with provincial and state actors (ibid). This shows that there is collaboration between different government layers, but there is much room for improvement.

### Stakeholder involvement

Flood risk management in Poznan has actor coalitions. There is a very strong coalition that consists of the Provincial Authority of Drainage, Irrigation and Infrastructure and the Regional Water Management Board. This coalition is also partly backed by academia. An opposing coalition exists of actors that are in favour of nature protection and some local citizens (Matczak et al., 2015). The strong governmental coalition criticises the protection of nature and ecology by the non-governmental coalition; they only considered them to hinder the process of policy implementation and the cause for higher investment costs (ibid). Furthermore, when considering open and equal access to information and the right to information for citizens, citizens do not always have access to information and their right to information is seldom being used. There is low engagement of the public in decision making (ibid). However, in the spatial planning sub-FRGA local citizens and the nature protection non-governmental organisations are involved to the highest extent, compared to other regions in Poland and this participation is supported by the municipal administration procedures of Poznan (ibid). Regarding the stakeholder involvement still a lot can be improved, but there is some sign of stakeholder involvement.

### Facilitating learning and knowledge exchange

The only time that knowledge exchange is mentioned in the report is when the report speaks of the crisis management sub-arrangement. Within this arrangement the provincial and local government levels cooperate with the state fire brigades and the municipal and county level crisis management centres. The cooperation is mainly to exchange expertise and information (Matczak et al., 2015). The interviewees state that besides the above, technological knowledge exchange takes place between water managers. Furthermore, regional water boards are obliged to consult citizens; knowledge exchange takes place during this consultation. However, it does not change their policy reports. So it could be argued that it is knowledge exchange without learning, therefore they also scored Poznan low on this condition.

### Hybrid solutions and combined strategies

Poland has a focus on flood defence to cope with flood risks; in Poznan this is not different. The measures that are used for flood defence are mainly embankments and reservoirs. The government administration is aware that these flood defence measures will not completely protect the County of Poznan. However, the city is considered to be a safe city in terms of flooding. Furthermore, next to the flood defence measures, a growth in flood preparation is observed (Matczak et al., 2015). Due to the lack of combined strategies and the dominance of flood defence, Poznan scores badly on this condition.

### Long term planning

As mentioned above, flood defence is the main flood risk management strategy, which is supplemented with preparation. The government agencies are aware that this is not enough to completely protect the city (Matczak et al., 2015). Therefore, it can be stated that long term planning for flood risks is not present in Poznan. According to the interviewees, Poznan is already well protected towards floods and because of this reason, planning is not really executed in Poznan. The researchers also score Poznan a minus.

### Climate sensitive and resilient spatial planning

Flood prevention is in general lacking in Poland. The main reason is that spatial planning is poorly developed and implemented. The local government layer deems economic development as its main priority, which leads to approving investments in flood prone areas (Matczak et al., 2015). Flood mitigation measures are still being developed and are in pilot phases. At this moment, there are no mitigation measures (ibid). Climate sensitive and resilient spatial planning still needs to be developed.

### Funding

Concerning funding, although there is more funding since the accession to the European Union, funding is lacking in Poznan. Institutions that are responsible for flood risk management have small liquidity and at the same time there are delays in projects and investments caused by complicated administrative proceedings (Matczak et al., 2015). The interviewees state that funding is in general quite hard in Poland. However, when reading governmental and assessment reports, it seems that funding is available, but that spending the funds is not efficient or effective, as well as the channelling from the funds from the national to the local level.

### Flood forecasting

Flood preparation has become more important on a national scale after the disastrous event of 1997. The central government is the financier of flood forecasting. The Institute of Meteorology and Water Management is responsible for flood forecasting (Matczak et al., 2015). Sirens as a warning system are abandoned, but at the same time a warning system through mobile phones is introduced at the local level (ibid). This shows that flood forecasting is visible in Poznan and in the rest of the country as well, but it can still be improved.

### Emergency planning

As shown above at the previous condition, flood preparation has become more important. Besides the flood forecasting part of the preparation strategy, the strategy also exists of flood crisis management. Here the County's Crisis Management Centre is responsible for emergency planning (Matczak et al., 2015). In 2010 and 2014 a significantly high level of water in the Warta River made it possible to assess the capacities of this Crisis Management Centre. It turned out that they were able to successfully manage the high water levels (ibid). Poznan scores well on emergency planning; especially because they have shown that the Crisis Management Centre was able to successfully manage the high water levels in 2010 and 2014.

### Innovation and experimentation

Due to the fact that the risk of flooding is quite low in Poznan, there is no urgency for rearranging the FRGAs or to use innovative flood risk management measures (Matczak et al., 2015). There are only some incidental projects in order to re-naturalise the rivers, which comes forward out of the



disagreement between the government coalition and the environmentalist coalition (ibid). In general opportunities for innovation and experimentation are scarce.

#### **Notion by inhabitants that not everybody can be protected from flood risks**

It was previously mentioned that Poznan is considered to be a flood safe county and city; therefore there have not been so many changes to the flood risk management in Poznan (Matczak et al., 2015). Citizens state that protection from flood risks is the task of the government. At the same time citizens have a passive attitude and are not interested in flood risk management (ibid). In the report it is stated that this attitude is a barrier for societal resilience. From this it can be concluded that the notion that not everybody can be protected from flood risks is not visible in Poznan.

#### **Recovery schemes**

The strategy of flood recovery is dealt with at the state level. There has been a plan to set up an insurance system, but this effort failed (Matczak et al., 2015). However, an insurance system based on private companies, which relies on a combination of policies, is slowly developing independently from the other flood risks management strategies (ibid). Besides the insurance for citizens there are also governmental mechanisms, such as a budget reserve by municipalities to assist with flood recovery. Nonetheless this is not a coherent system, and therefore when a flood is occurring ad hoc decisions should be taken in order to recover (ibid). In sum the above demonstrates that flood recovery is available on a small scale. Poznan can still improve on this condition.

### **7.4 Slubice City**

The city of Slubice is located at the border of Poland and Germany and on the bank of the Odra River. The city is very flood prone due to the fact that it lies below the level of the Odra and close by the estuary of the Warta River. Embankments are used along the Odra River, however with heavy rainfall, flood risk is present. Besides, due to a rise in groundwater levels the risk of urban flooding is present as well. Lastly flooding can occur due to many lowlands in the northern side of the city, which are separated by small water streams (Matczak et al. 2015).

Like Poznan, Slubice is dominated by the flood risk strategy of flood defence and nature conservationists are here in conflict with the supporters of the flood defence strategy as well. Moreover, just as the flood risk management at the national level, spatial planning is underdeveloped (Matczak et al., 2015). Slubice has a unique characteristic as well; transboundary cooperation takes place with the city of Frankfurt an der Oder in Germany, which is located on the Odra River as well. This cooperation is intensified and has caused more engagement and social capital since the disastrous flood of 1997 (ibid).

#### ***Presence of the governance conditions***

The table below shows the scores of the Slubice case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

<b>Governance condition present</b>	<b>Document analysis</b>	<b>STAR-FLOOD researcher</b>	<b>Conclusion</b>
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	-	+/-	-
Mechanisms are in place to facilitate learning and knowledge exchange	-	-	-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	-	-	-
Future risks are addressed in long term planning	-	+/-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	-	-	-
Funding for policy making and implementation is available	-	-	-
Flood forecasting is up to date and shows real time risks of flooding	+/-	+/-	+/-
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	-	-	-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+/-	+/-	+/-

Table 7.2: The scores of Slubice on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

With the flood events of 1997 and 2007, the centralised form of governance was reinforced and the focus on the flood defence measures was reinforced as well (Matczak et al., 2015). In contrary to this centralised form of governance, cooperation between Frankfurt and Slubice improved with these floods. This cooperation is also considered to be productive (ibid). Cooperation is also present in flood risk preparation; effective cooperation takes place between the fire brigades, the police, city guard and the border guard. This is supported by the administration on county level, which allows effective cooperation (ibid). Furthermore, local government has a significant role in flood risk management, especially the Provincial Authority of Drainage, Irrigation and Infrastructure and the Regional Water Management Board (ibid). Mainly because of the effective cooperation in flood preparation and with the city of Frankfurt in Germany and the significant role of local level government layers in flood risk management in Slubice, the city scores well on this condition.

### Stakeholder involvement

Concerning stakeholders, there are coalitions of actors in Slubice. The provincial Authority of Drainage, Irrigation and Infrastructure works together with farmers in some cases. Besides, the water management sector is represented by the Regional Water Management Board and another coalition exists of the National Park and an environmental non-governmental organisation (Matczak et al.,

2015). The coalitions of the water management sector and the coalition that includes the Provincial Authority are very much focussed on flood defence, are heavily institutionalised and have a dominant position. The National Park and the environmental organisation try to change this focus on flood defence. However, they are not able to reach local decision makers and the local community (ibid). Besides the fact that not every stakeholder is being heard in Slubice, the local citizens are for example consulted in spatial planning decision making, but their participation is low (ibid). The above shows that stakeholder involvement should be improved heavily in Slubice. The researchers of STAR-FLOOD state that stakeholders are involved to some extent. However the involvement is not so much visible in the outcome and this should be improved. They agree that Slubice should score a minus on this condition.

#### Facilitating learning and knowledge exchange

Learning and knowledge exchange especially takes place between the city of Frankfurt and Slubice. The two cities exchange information, with each other on crisis management and this is considered to be valid. This cooperation started due to previous flood events (Matczak et al., 2015). Besides the learning and knowledge exchange between Frankfurt and Slubice, no evidence was found on this governance condition and therefore Slubice scores badly on this condition.

#### Hybrid solutions and combined strategies

The city of Slubice also relies heavily on the strategy of flood defence to protect the city from flooding. The dominance of the flood defence is even greater in Slubice, than nationally. The flood experiences from the past even enhance the use of flood defence and other options are almost not considered (Matczak et al., 2015). However, flood defence is supplemented with the developing preparation strategy. Some other strategies are getting more attention, but still play a small role in flood risk governance in Slubice (ibid). Due to the fact that flood defence has a very dominant role in the flood risk governance of Slubice and that flood defence is even enhanced by previous flood events, means that the city of Slubice scores badly on this condition.

#### Long term planning

As mentioned before, Slubice relies mainly on the strategy of flood defence. This was enhanced by previous flood experiences, and because Slubice did not have dramatic losses in the flood of 1997. Therefore, the city chose to modernise the embankments and to construct a new dike (Matczak et al., 2015). However, the constructed dike did not meet safety criteria due to the fact that the foundation was constructed geologically unfavourable. Other options were possible that would meet the safety standards, but these options were abandoned (ibid). The above demonstrates that future risks are not addressed in long term planning, because although other options were available Slubice made the decision to favour flood defence above meeting safety standards with other optional measures. According to the interviewees, Slubice has implemented new defence measures, which means that they are more dealing with future risks, than for example Poznan.

#### Climate sensitive and resilient spatial planning

Flood prevention is in general lacking in Poland. The main reason is that spatial planning is poorly developed and implemented. The local government layer finds economic development its main priority, which leads to approving investments in flood prone areas (Matczak et al., 2015). When considering climate sensitive and resilient spatial planning in Slubice, the city allows new development in flood prone areas and the city even has an economic zone which is located directly on the bank of the Odra River. On the other hand very flood prone regions are depopulating, but this

is not because of spatial planning efforts, but because a lot of residents move to newly built areas (ibid).

### Funding

Concerning funding, the provincial authorities dealing with flood risks are considered to be institutions with sufficient resources. However, the provincial office provides poor financial support for flood risk governance in Slubice (Matczak et al., 2015). This shows that funding is lacking in Slubice.

### Flood forecasting

Flood preparation has become more important on a national scale after the disastrous event of 1997. The central government is the financer of flood forecasting. The Institute of Meteorology and Water Management is responsible for flood forecasting (Matczak et al., 2015). Sirens as a warning system are abandoned, but at the same time a warning system through mobile phones is introduced at the local level (ibid). This shows that flood forecasting is visible in Slubice and in the rest of the country as well, but it can still be improved.

### Emergency planning

Flood preparation is the first used strategy in Slubice next to flood defence. Emergency plans and exercises are organised by the cities' Crisis Management Office. The office has good contacts within the local community and therefore, with the flood risks of 1997 and 2010, local citizens were very much willing to help with the evacuations (Matczak et al., 2015). Furthermore, good effective and productive cooperation takes place between the border guard, state fire brigades, the police and the city guard, as well as between the city of Slubice and Frankfurt in Germany (ibid). Lastly, the state fire brigade in Slubice has gained importance during flood events in the past, they are the only mobile force, that is dealing with the risks of flooding in Poland and they are very well equipped (ibid). Emergency planning in Slubice is well established; therefore the city scores well on this governance condition.

### Innovation and experimentation

In the whole case study of flood risk governance in Slubice, innovation and experimentation is not mentioned. According to the interviewees it is correct that Slubice is not active in innovation and experimentation. This is mainly due to their geographical location, which makes flood defence the most important strategy. Other solutions are because of the risks not considered.

### Notion by inhabitants that not everybody can be protected from flood risks

As mentioned above, resilient spatial planning is not taking place, because the awareness of flood risk is not present by the citizens of Slubice. They only want to rely on flood defence measures (Matczak et al., 2015). So there is no notion that not every citizen can be protected against floods. The interviewees disagree on this assessment. They state that Slubice experienced some heavy flood events in the past, although the city is protected by flood defence. Therefore, the citizens and the administration are aware of the fact that not everybody can be protected, even though there are flood defence works.

### Recovery schemes

As discussed in the Poznan case, the strategy of flood recovery is dealt with at the state level. There has been a plan to set up an insurance system, but this effort failed (Matczak et al., 2015). However,

an insurance system based on private companies, which relies on a combination of policies, is slowly developing independently from the other flood risks management strategies (ibid). Besides the insurance for citizens there are also governmental mechanisms, such as a budget reserve by municipalities to assist with flood recovery. Nonetheless this is not a coherent system and therefore when a flood is occurring ad hoc decisions should be taken in order to recover (ibid). So just as Poznan, Slubice can still improve on this condition.

### 7.5 Wroclaw City

The city of Wroclaw is located in a section of the Odra that is channelized. The Olawa, Sleza, Widawa and the Bystrzyca rivers flow into the Odra River or through the city of Wroclaw. The Wroclaw city area is part of the drainage area of the Odra River (Maczak et al., 2015). Besides the location of the city near the rivers, the city is also located on lowland. The combination of the two makes the city very flood prone. Because Wroclaw is also one of the largest cities in Poland, flood risks can cause losses of more than €700 million (ibid).

Mainly due to the two disastrous floods, more effort was needed from the government to deal with flooding. The needed change in flood risk governance can be observed (Maczak et al., 2015). The development of change was not only enhanced by the flood events, but also because of the accession to the EU, which gave a boost to the funds, but also due to EU legislation and policy (ibid). In 2001 the Program for the Odra River 2006 was launched, with a focus on the protection of Wroclaw. The program was a window of opportunity to improve the flood risk management at the local scale and to improve bargaining and cooperation mechanisms (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Wroclaw case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+/-
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+/-	+/-	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	+/-	+/-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	-	-	-
Funding for policy making and implementation is available	+	+	+
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+/-	+/-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+/-	+/-

Table 7.3: The scores of Wroclaw on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

As earlier mentioned flood risk governance in Poland is in general very centralised, although a shift towards decentralisation is visible. All three sub-FRGAs in Wroclaw depend on funding from the national government, which shows the centralised governance. On the other hand local administrative bodies play an important role in flood risk governance in Wroclaw (Matczak et al., 2015). Cooperation between different government layers and government bodies was also enhanced by the Program for the Odra River 2006. Especially consensus was easier to reach between the different bodies due to the program; the different bodies were not only focussed on their own interests anymore, which was the case before. However, the program was terminated in 2015, because of criticism about the incoherence of the program (ibid). So, although collaboration between different government layers exist and the local government has a significant role, Wroclaw can still improve on this condition.

### Stakeholder involvement

Concerning the actors, an important role in flood risk management is for the local administrative boards, stakeholders are involved as well. Only the impact of non-governmental organisations is quite small (Matczak et al., 2015). The impact of the non-governmental organisations is however changing. Government actors slowly start to see them as relevant actors. The more significant role for the non-governmental organisations can be seen in the fact that they are now even able to propose other optional measures (ibid). This shows that the stakeholder involvement is increasing.

### Facilitating learning and knowledge exchange

Learning and knowledge exchange mainly took place in the Program for the Odra River 2006. However as stated above, this program was terminated due to a lack of coherence in the program (Matczak et al., 2015). The flood of 1997 caused the establishment of social networks in the flood risk governance of Wroclaw. Within these social networks knowledge was exchanged, also due to new input by the environmental organisations, which lead to more innovative solutions and alternative flood risk measures (ibid). Learning and knowledge exchange are facilitated in Wroclaw and also way more facilitated than in Slubice and Poznan. However, there is still room for improvement on this condition.

### Hybrid solutions and combined strategies

In Wroclaw, as well as the other case studies, and the rest of the country, flood risk management is based on flood defence. However, the flood defence strategy in Wroclaw has been re-established. Re-establishment was necessary because the dikes and drainage system could not handle anymore floods. The Program for the Odra 2006 came with two new flood defence measures: refitting the Wroclaw water junction and to structure a dry flood control reservoir. Due to the flood in 2010, an additional dike was constructed as well (Matczak et al., 2015). Next to flood defence, flood preparation is the second strategy and this preparation strategy is still improving. Furthermore, due to the social networks discussed earlier in this chapter innovative measures are developed. However, spatial planning and the prevention strategy cannot be considered proactive, but are rather reactive (ibid). As shown, Wroclaw is also a flood defence oriented city; however the city uses innovative measures. So improvement, especially in spatial planning and prevention is necessary.

### Long term planning

Due to the re-establishment of the flood defences and the use of innovative measures for flood risk management, Wroclaw scores a plus/minus on this condition.

### Climate sensitive and resilient spatial planning

Flood prevention is in general lacking in Poland. The main reason is that spatial planning is poorly developed and implemented. The local government layer finds economic development its main priority, which leads to approving investments in flood prone areas (Matczak et al., 2015). Considering Wroclaw, spatial plans are based on attracting developers and on urban sprawl. As mentioned spatial planning is not proactive, but rather reactive (ibid). Therefore, Wroclaw scores low on this condition.

### Funding

In general funds for flood risk management are available in Wroclaw, due to the accession into the EU and because the floods in Wroclaw were big news items, funding became available. The only problem is funding for the maintenance of flood defence works. Wroclaw focusses more on new investments, rather than maintenance (Matczak et al., 2015). So in general Wroclaw has funds available for flood risk management. The only side note is that they should also fund maintenance of flood defence works.

### Flood forecasting

Flood preparation has become more important on a national scale after the disastrous event of 1997. The central government is the financer of flood forecasting. The Institute of Meteorology and Water Management is responsible for flood forecasting (Matczak et al., 2015). Sirens as a warning system



are abandoned, but at the same time a warning system through mobile phones is introduced at the local level (ibid). This shows that flood forecasting is visible in Wroclaw and in the rest of the country as well, but it can still be improved.

#### Emergency planning

For crisis management, the state fire brigades cooperate with the crisis management authorities of Wroclaw. This is assisted by the state and municipal police. Because of the earlier flood events, this cooperation has had several tests already and the cooperation is regarded as highly effective (Matczak et al., 2015).

#### Innovation and experimentation

Above in the chapter it is mentioned that environmental organisations have got more influence in flood risk management in Wroclaw and that a social network is created which brought new and innovative measures to flood risk management in Wroclaw (Matczak et al., 2015). This shows that there are innovative measures for flood risk governance, however much improvement is still needed.

#### Notion by inhabitants that not everybody can be protected from flood risks

In the report no mentioning is being made about the flood awareness of the inhabitants of Wroclaw. However, due to the fact that Wroclaw experienced heavy flooding and they were repeatedly in the news because of it, it seems that the awareness that not everybody can be protected from flood risks is evident in Wroclaw. According to the interviewees, Wroclaw should score the same on this condition as Slubice. The reason behind this, is that just as Slubice, inhabitants experienced flood events, but on the other hand flood defence is increased. Citizens rely on these flood defence measures.

#### Recovery schemes

As discussed in the Poznan and the Slubice cases, the strategy of flood recovery is dealt with at the state level. There has been a plan to set up an insurance system, but this effort failed (Matczak et al., 2015). However, an insurance system based on private companies, which relies on a combination of policies, is slowly developing independently from the other flood risks management strategies (ibid). Different from Poznan and Slubice is the fact that Wroclaw was already able to recover from large flood losses and even returned to its previous state. The funds came mainly from the state and because the flood losses were presented to a large extent in the media. This also enhanced the flow of financial resources (ibid). The case of Wroclaw scores well and better than Slubice and Poznan on this condition, because they have shown they were able to recover from flood losses. The STAR-FLOOD researchers state that a real recovery strategy was not available, only after the flood events funds were found. Therefore, Wroclaw should not score well on this condition.

## 7.6 Comparison of Polish cases

The table below shows the scores of the three Polish STAR-FLOOD case studies on the presence of the governance conditions from literature. Below the scores will be discussed, as well as the governance conditions in general.



<b>Governance condition present</b>	<b>Poznan</b>	<b>Slubice</b>	<b>Wroclaw</b>
Collaboration across government layers, with a significant role for the local government	+/-	+	+/-
Stakeholders are involved throughout the policy process	+/-	-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	-	-	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	-	-	+/-
Future risks are addressed in long term planning	-	+/-	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	-	-	-
Funding for policy making and implementation is available	+	-	+
Flood forecasting is up to date and shows real time risks of flooding	+	+/-	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	-	-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+/-	+/-	+/-

Table 7.4: The scores of the three Polish case studies on the governance conditions from literature. Possible scores were +, +/- and -.

Regarding the table above, the three Polish cases score very well on the presence of the condition of adequate emergency planning. When considering the amount of flood events Poland has already witnessed, and will most probably witness in the future, this is not surprisingly. Furthermore, the Polish cases score relatively well on collaboration and flood forecasting. Collaboration can be improved, if cooperation is enhanced between different departments. The lowest scores for Poland are on climate sensitive and resilient spatial planning. The most important reason for these low scores is that economic development has the main priority for local governments. The result is that investments are allowed in areas, which are very flood prone. Thus, in Poland it is very much needed to include spatial planning into flood risk governance, or set up an insurance system.

Considering the government conditions in general, the interviewees stated that collaboration between government layers, as well as between departments and different government organisations is deemed crucial to enhance the resilience. In Poland collaboration exists mainly between government layers and should be enhanced between departments. Furthermore, collaboration is not possible at all times, because in some cases, the national government may not be involved. This is also the time when the local government should have a significant role. Moreover, a combination of different strategies, funding and long term planning and stakeholder involvement are also very important. Stakeholder involvement is important because, involvement is for example needed for adequate emergency planning. However, side notes can be made for the use of different strategies and funding. In some cases different strategies are not possible or not most effective, due to discourses, funding, or because of geographical characteristics, flood defence is the best option to protect a region against flooding. Funding can be problematic, because it might enhance path

dependency in the already existing strategies. Besides, because of funds for recovery, citizens are still willing to live in flood prone areas. If an insurance system is in place with high risk premiums for very flood prone areas, citizens may reconsider living in these areas. Furthermore, the condition of future risks should be altered, because it is not clear what is meant with future risks. If these future risks include that policy or measures should take into account climate change. In Poland for example climate change is not taken into account, with the implementation of new measures. The new measures are based on previous flood events and do not consider that flood events can be intensified by climate change.

Since stakeholder involvement is deemed important, this condition should be improved as well. According to the interviewee, the problem with stakeholder involvement is that, although stakeholders are involved, the involvement is usually quite late in the policy making process. So the effect of the involvement is rather small. So this should be changed. As combined strategies are deemed important as well, Poland should improve on this condition as well. Flood defence is a very important strategy in Poland, because of the significant flood proneness. Besides, it is the discourse in Poland that the most effective way to protect regions from flooding is with flood defence. This can be found in regulations as well; they do not support other measures. So for flood defence to become less dominant or at least be combined with other strategies, a discourse shift is needed, which should be backed up by a change in policy and regulations.

When comparing the three cases, Wroclaw has the highest scores on the presence of the conditions and accordingly it can be suspected that Wroclaw is the most resilient of the three regions. The interviewees stated that indeed Wroclaw is the most resilient region of the three, mainly, because Wroclaw has enormous flood experience. Other reasons are the fact that of the three cases, Wroclaw diversified their flood risk strategies most; Wroclaw was active to enhance public participation and because policy entrepreneurs came forward after the flood of 1997 that advocated changes in flood risk governance and started large projects.

## 7.7 Conclusion

In this chapter an analysis of the Polish STAR-FLOOD case studies has been discussed in order to answer the following question: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

In Poland flood risk resilience is enhanced by adequate emergency planning and to some extent by collaboration between different government layers with a significant role for the local government and flood forecasting. On the other hand climate sensitive and resilient spatial planning is not enough present. Besides, stakeholder involvement and using combined strategies, with structural and non-structural solutions should be improved in Poland. Together with collaboration, stakeholder involvement and combined strategies are seen as the most important governance conditions to enhance flood risk resilience according to the Polish STAR-FLOOD researchers. Funding can be an important condition as well, nonetheless funding can also weaken the resilience of a region. Regarding the conditions in general, the interviewees stated that the condition that future risks should be addressed in long term planning should be altered. In this condition it is not clear whether climate change is part of the future risks. Lastly, a comparison of the three cases was conducted. In this comparison it came forward that Wroclaw scores best on the presence of the governance

conditions, mainly because of the city's flood experience, their diversified flood risk strategies, the enhancement of public participation and the emergence of policy entrepreneurs.

In the next chapter the English case studies will be discussed. This will bring about more information on good practices in flood risk governance. It will for example show if the English interviewee agrees on the importance of using combined strategies in order to enhance the resilience of a region.

## 8. Good practices in English flood risk management

### 8.1 Introduction

This chapter focusses on the enhancement of flood resilience in England on the basis of the English STAR-FLOOD case studies. The research question central to this chapter is: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?* The chapter will begin with a short introduction on flood risk governance in England. After this introduction the three case studies will be discussed. In these case study paragraphs, the case studies will be scored on the presence of the governance conditions established in chapter 2. This will be based on a document analysis of the STAR-FLOOD reports and an interview with the STAR-FLOOD researcher that wrote the reports. This will be followed by a case comparison paragraph, which includes the researcher's view of the established governance conditions. The chapter ends with a conclusion.

### 8.2 Flood risk governance in England

England is a flood sensitive country, from multiple different sources. It is even estimated that around one out of six commercial and residential properties face the risk of coastal, fluvial or surface water flooding (Alexander et al., 2015). Exposure to coastal flooding is for example worsened by coastal erosion, subsidence and sea level rise. Surface water flooding increases due to increased urbanisation, land use change and drainage infrastructure, which is aging (ibid). Furthermore, population growth and new development in flood prone areas, due to the population growth enhance flood risks as well. It is also suggested by the Foresight Future Flooding project that within the United Kingdom (UK), fluvial, coastal and surface water flood risks will increase under different climate change scenarios, with an increase in precipitation and sea level rise (ibid).

English flood risk governance is characterised by a comprehensive approach and complexity. The change in flood risk governance was incremental, which has led to large overlap with multiple policy domains. This also means that flood risk governance has a large amount of actors and rules, which resulted in different and mixed governance modes (Alexander et al., 2015). Furthermore, in line with the previous there has been a rise in the emphasis of local scale flood risk management, empowerment and engagement of the local community, partnerships and cost-sharing arrangements. This is recently been supplemented by the uptake of measures on the property-level (ibid). When looking at the flood risk management strategies in England, it is acknowledged that floods cannot be prevented by flood defence works; structural as well as non-structural measures are necessary. In contrary to the other flood risk countries, all five of the flood risk strategies are present in the national FRGA and their sub-FGRAs (ibid).

Considering the legal landscape, the national FRGA and the sub-FRGAs are formed by numerous rules, which include legislation, policy and informal rules systems. The primary legislation is the Flood and Water Management Act 2010, together with the Flood Risk Regulations 2009. The last one transfers the Floods Directive of the EU into domestic law. The Lead Local Flood Authorities (LLFAs) and the Environment Agency are the competent authorities (Alexander et al., 2015). Risk Management Authorities are also important within flood risk governance. These authorities have various statutory duties; however the Risk Management Authorities exercise permissive powers. In England there is no legislation on standards of protection and also no legal right on levels of flood protection. Furthermore, responsibilities in flood risk governance are organised through common

law. Owners of properties lying on shores have the right to protect their land against flood risk, but also have the legal duty to make sure the use of their land does not increase the risks of flooding at neighbouring land (ibid).

### 8.3 Hull & Haltemprice Catchment

Kingston-upon-Hull is situated in Northern England, on the East coast. It lies in the county of Yorkshire. The city is located at the junction of the Humber Estuary and the River Hull, where it is developed on reclaimed marshland. The city lies in a naturally low basin, in which almost 90 percent of the land lies below the level of high tides and only some metres above sea level. This means that Hull is very flood prone; surface water flooding and tidal and fluvial flooding are the common types of flooding in the city (Alexander et al., 2015).

The STAR-FLOOD research examined how mitigation measures are being integrated in the Hull city approach, which is traditionally dominated by defence strategies, with a focus on the development of Flood Alleviation Schemes (FASs) (Alexander et al., 2015). Multiple FASs are in different stages of design. The project to develop the FAS requires close cooperation between the Hull City Council, the LLFAs and the East Riding of Yorkshire Council (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Hull & Haltemprice Catchment case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+	+	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	+	+/-
Funding for policy making and implementation is available	+/-	+	+
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	+	+
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 8.1: The scores of Hull & Haltemprice Catchment on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

After the summer floods of 2007, an independent review was conducted by the City Council of Hull, which criticised the lack of cooperation and coordination between responsible authorities and agencies. This meant that none of the agencies took the responsibility for the management of flood incidents. As a result the discourse of partnership working is strengthened on a local and national scale. This is shown in the development of FASs in Hull, where different agencies cooperate in the projects (Alexander et al., 2015). Besides the presence of collaboration between different government layers and agencies, a significant role for the local government can be distinguished as well. According to the report by Alexander et al. (2015), The East Riding of Yorkshire Council and the Hull City Council act as LLFAs. This means that they are competent authorities in flood risk governance, in their region.

### Stakeholder involvement

Gaining community support for the FASs was challenging. Hull city centre did not have enough space for the development of the FASs, and therefore it is being constructed in the neighbouring rural areas, which gave concerns to the rural community. The concerns were not so much visible in instances where the FAS reduced the flood probability for the rural area, but they became visible when the rural land was used to protect the urban communities. To address the concerns different participatory activities were organised (Alexander et al., 2015). In general various participation and

public consultation methods were used to enhance the awareness among citizens and to increase the public acceptance of the measures (ibid). So stakeholder involvement is present in Hull.

#### Facilitating learning and knowledge exchange

As stated above, due to the summer floods of 2007, the cooperation and coordination was criticised between different agencies in Hull. After this the discourse of partnership working became apparent, both at the national and the local level, which meant that more collaboration took place (Alexander et al., 2015). Due to this cooperation learning and knowledge exchange was facilitated. Multi agency working and interaction is also facilitated by different actor working groups, such as the Local Resilience Forum and the Integrated Strategic Drainage Partnership. These forums assist with bridging multiple agencies (ibid). Therefore these working groups also facilitate learning and knowledge exchange.

#### Hybrid solutions and combined strategies

As already mentioned, Hull has a flood risk management strategy that relies mainly on flood defence. After the storm surge in 2013, this flood defence was even strengthened with investments in a new flood wall, as well as a raise of 600 metres of already existing defences in the Port of Hull (Alexander et al., 2015). Due to partnership funding, mitigation measures are supported next to flood defence. In order to broaden the flood mitigation strategy, considerable efforts have been made. The main examples are the FASs (Alexander et al., 2015). Besides the effort to broaden the flood mitigation strategy, the River Hull Integrated Catchment Strategy will be established, which will facilitate an integrated approach between Risk Management Authorities (ibid). The above demonstrates that Hull uses hybrid solutions and combined strategies in their flood risk governance.

#### Long term planning

In the city of Hull, future risks are addressed in long term planning. The city itself is completely embanked with a protection level that gives protection for a 1 in 100 year flood event. Furthermore, the Hull Barrier prevents water entering in the river from the Humber Estuary in the events of a storm surge or exceptional high tides and is able to endure a 1 in 200 year flood event (Alexander et al., 2015). However, this amount of protection was not enough. Therefore, the defences in the Port of Hull were raised with 600 metres and a new flood wall was established. It was estimated that if there were no defences, 47,000 properties would be exposed to a 1 percent fluvial flood, which could have risen to 63,000 in the future.

#### Climate sensitive and resilient spatial planning

In the city of Hull research has been conducted to examine different mitigation options. It turned out that within Hull, the LLFAs and the Environmental Agency considered property level measures to enhance the resilience and resistance as less efficient than the large scale projects that they were developing and success of these measures cannot be guaranteed, due to the willingness of the inhabitants to adopt these measures and to adequately use them. Therefore, property level measures have not really been encouraged (Alexander et al., 2015). Nonetheless, some mitigation efforts exist, such as enforcing selected floor heights in properties in very flood prone areas. Another example is that a study is executed to explore the options of multi-functional use of land wherein recreational sites should be developed as small scale flood storages (ibid). The presence of climate sensitive and resilient spatial planning can be improved, mainly if property level measures will be encouraged. The interviewee agrees on this, she argues that in all three of the case studies there are

positive and negative points on spatial planning, such as the uptake of the property measures. Therefore, all three can improve on the presence of this condition, and should score moderately.

### Funding

Funding is not a problem in Hull; the FASs received funding from various sources, such as the National Investment Plan, local levies and the European Regional Development Fund. The only side note that can be made, is that some stakeholders expressed concerns that the national government is more willing to fund new defences, than to fund maintaining the already existing flood defence works (Alexander et al., 2015). Therefore, Hull can still improve on funding, although there is no lack of funds for the new FASs development. The interviewee disagreed on this. She stated that there was some frustration about the bureaucracy in the funding process, but Hull is in some way fortunate with the extreme flood risks; therefore it is not so difficult to get their flood risk projects funded.

### Flood forecasting

Public Weather Services are provided by the Met Office. They offer forecasts of the weather which is free to the public. Besides, a National Severe Weather Warning Service is provided. This warning service gives notice of weather that could potentially disturb public safety. Furthermore, in 2009 the joint venture; Flood Forecasting Centre was established which combines the forecast capabilities of the Environment Agency and the Met Office. The Flood Forecasting Centre provides for all different types of flooding (Alexander et al., 2015). Besides the national flood forecasting, Hull implemented a new flood warning service in 2014. The flood warning service uses new modelling data to increase the precision of the forecasts and warnings are communicated by fax, phone, email or texts (ibid). This shows that flood forecasting is present at the national scale, organised by the Flood Forecasting Centre and that flood forecasting is present at the regional scale of Hull as well.

### Emergency planning

Emergency planning is a national strategy in England, it is organised by the Civil Contingencies Act. Within the legislation two main groups of actors are notable; responders of Category One and Two. The Category One responders are central to emergency response. They have the civil protection duties to advise the public and other responders about the possible risks and to do the emergency planning. Category Two responders should, on a legal basis cooperate with the Category One responders and share information with all responders (Alexander et al., 2015). Besides, Category One responders have to form Local resilience Forums, which facilitate the development of Community Risk Registers and multi-agency emergency plans. At the community level, some Risk Management Authorities might also steer the development of flood action plans (ibid). This shows that adequate emergency planning is present at the national scale of England, and therefore also in Hull.

### Innovation and experimentation

Hull was traditionally a region with flood defence as the dominant flood risk governance strategy. Due to the summer floods of 2007 and their destructive impacts, efforts were made to improve the flood risk governance in Hull. This was being done by institutional learning and coming up with innovative measures to protect the area next to their flood defence works. The development of the FAS was the outcome (Alexander et al., 2015). This shows that innovation and experimentation opportunities exist in Hull, which even led to new flood risk management measures.



### Notion by inhabitants that not everybody can be protected from flood risks

According to the STAR-FLOOD report, public interest in flood risk is lacking, which is a barrier to societal resilience. The public perceives the summer floods of 2007 as a once in a lifetime event, therefore the citizens think that the changes of the occurrence of a new disastrous flood is rather small (Alexander et al., 2015). In addition, the governmental organisations and departments feel that the public does not completely understand responsibilities in flood risk management; citizens expect the state to defend them from flood risks. In Hull this is enhanced by the successful dominance of flood defence in the past, which is considered to be successful in the future (ibid). On the other hand, the report states that when the community is not engaged, the flood awareness in the community will not be high, because the community is engaged as shown in the stakeholder condition above; flood awareness should exist in Hull (ibid). Hull scores a plus/minus on the presence of this condition. On one hand citizens think that the state will protect them with flood defence measures, on the other hand they should be aware of the risks of flooding due to the involvement in public participatory activities. According to the interviewee, there will always be groups in the society that argue that the government should protect them from flooding. However, due to the great efforts in public participation and other public engagement mechanisms, which enhances the awareness of flood risks by citizens, the cases should score well on this condition.

### Recovery schemes

Flood recovery in England is dealt with at a national scale; general household insurance includes flood insurance. Every citizen with a mortgage is obliged to have this insurance under the composite policy, which means that a very large amount of the inhabitants are insured against flood risks. From the beginning, the insurance is provided by private insurance companies. For many years the general household insurance is market based operated, which means that these insurance companies could decide who they wanted to insure and for what price (Alexander et al., 2015). In 2016 Flood Re will be introduced, which is a non-profit reinsurance fund. This fund will limit the insurance costs to households, of properties that have higher risk of flooding, by a premium cap (ibid). Furthermore, local authority functions get compensation for unexpected losses from the Bellwin Schemes, which is funded by the central government (ibid). This shows that recovery schemes are available in England and therefore also in the Hull & Haltemprice Catchment, because of private insurance, which is also available for very flood prone regions due to Flood Re. Besides, local authorities can also get compensated for their unexpected losses by the Bellwin Scheme.

## 8.4 Lower Thames and the River Thames Schemes

The Lower Thames and the River Thames Schemes, is a case study of the 40km area of the Thames River from Datchet to Teddington. This part of the Thames River is referred to as the Lower Thames and is located west of the City of London. The area is one of England's largest developed flood plains. The Lower Thames Catchment is prone to surface water and fluvial flooding and rising ground water (Alexander et al., 2015). Serious flood events have happened in 1947, 1968, 2003 and 2014. Although these events have occurred, there is no formal flood defence in the area. There are some weirs for the navigation depths that have the secondary role to alleviate floods. Besides, the Teddington area is some cases protected from fluvial flooding through the Thames Barrier, which is established to manage tidal flooding for the City of London (ibid).

In order to protect the Lower Thames area from flooding, the River Thames Scheme was approved in 2011, while already being proposed in 1980. The project exists of alleviation channels, increase of

weir capacity and an increase of the capacity from the Desborough cut. Local infrastructure, such as roads and the sewerage system, as well as 15,000 properties and businesses will profit from the River Thames Scheme (Alexander et al., 2015). The Lower Thames and River Thames Schemes case study focussed on the influence of rules, funding and discursive shifts in flood risk management from the moment the proposal was made in 1980 (ibid).

### *Confrontation with the governance conditions*

The table below shows the scores of the Lower Thames and the River Thames Schemes case study on the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

<b>Governance condition present</b>	<b>Document analysis</b>	<b>STAR-FLOOD researcher</b>	<b>Conclusion</b>
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+	+	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	+	+/-
Funding for policy making and implementation is available	+/-	+	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	-	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+	+	+
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 8.2: The scores of Lower Thames and River Thames Schemes on the governance conditions from literature. Possible scores were +, +/- and -.

### *Collaboration across government layers and significance of local government*

The River Thames scheme has adopted a partnership approach in the project. A partnership is formed between the Environment Agency, Department for Environment Food and Rural Affairs, seven local authorities and Thames Water. Within the Scheme, community based alternatives are

used, which are aligned in the governance discourse and the responsibilities for these measures are transferred to the local government. Furthermore, the importance of collaboration between a diverse set of actors and stakeholder is supported by partnership funding (Alexander et al., 2015). This demonstrates that in the Lower Thames area, collaboration between government layers is visible and the local government has a significant role.

#### Stakeholder involvement

Close to the River Thames Scheme, an alleviation channel exists at the Jubilee River. The establishment of this alleviation channel has been a leading example of extensive stakeholder consultation. Since the development of that project, public consultation became much institutionalised within flood risk governance at the national scale (Alexander et al., 2015). Thus also in the Lower Thames region; where stakeholder involvement has been a method to increase the acceptance of the project, but also as a potential to receive contribution to the partnership funding of the project (ibid). This shows that stakeholder involvement is present in the Lower Thames area.

#### Facilitating learning and knowledge exchange

The report states that the River Thames Schemes is recognised as a good practice, considering participation and public consultation. From the beginning of the project, in the design stage already, stakeholders, actors and interest group have been involved and where in dialogue with each other. An example of this is workshops that facilitated knowledge exchange between the groups (Alexander et al., 2015). In general, partnership working is favoured within the River Thames Scheme, facilitating interactions between multiple actors. This led to knowledge exchange and learning, due to the interactions (ibid). The Lower Thames scores well on the presence of this condition.

#### Hybrid solutions and combined strategies

Hybrid solutions and combined strategies are visible in the Lower Thames area. The River Thames Scheme uses a diverse set of flood risk governance strategies to reduce the likelihood of flood events. The alleviation channels within the project are backed up by an effective emergency management response. Furthermore, the alleviation channels are supplemented with protection measures at the property level. Besides, the fact that this broadens the flood risk management, it also enhances the response and emergency preparedness towards future flood events (Alexander et al., 2015).

#### Long term planning

In the Lower Thames area, alternative measures were considered to decrease the likelihood of flooding and at the same time would have a positive cost-benefit ratio. The consideration of alternative measures was backed by flood modelling that included climate change factors. The inclusion of climate change factors caused the diversification of the implemented measures within the River Thames Scheme (Alexander et al., 2015). Furthermore, it is calculated that the new alleviation channels will protect around 9,500 properties, against a 1 in 75 year flood event. This is standard protection (ibid). Considering the alleviation schemes, a 1 in 75 year protection suggests that the alleviation channels should protect the area for a longer time period. However, it is more important that the River Thames Scheme took into account flood models that included climate change factors. This shows that the Scheme addressed future risks in long term planning.

### Climate sensitive and resilient spatial planning

From the previous discussion on the governance conditions, it can be expected that the Lower Thames will score good on this condition, because property level measures are part of the River Thames Scheme. Nonetheless, the area can still improve on this condition. In the report it is stated that although property level measures are part of the River Thames Scheme and could be implemented by 1,600 properties free of charge, only 33 percent of the property owners was interested in adopting the property level measures (Alexander et al., 2015). There are several reasons for the lack of interest by property owners; not every property owner is aware of the risks of flooding for their property, if they are aware, they do not want to acknowledge the risk, because it might have an impact on the cost of their insurance and there is mistrust in government institutions (ibid). The interviewee agrees on this, she argues that in all three of the case studies there are positive and negative points on spatial planning, such as the uptake of the property measures. Therefore, all three can improve on the presence of this condition, and should score moderately.

### Funding

The River Thames Scheme is a very expensive project, which would probably not get funded completely by the national funding system and could not have started without the introduction of partnership funding. Nonetheless, the central government funded the majority of the project and a significant part should be funded at the local scale, with the help of for example partnership funding (Alexander et al., 2015). According to the Environment Agency, partnership funding has its pros and cons; partnership funding leads to a reassessment if the project is realistic and funding can be met. On the other hand the project is progressing on a slow pace, because many efforts are made to get the project funded. Furthermore, although the project is in majority funded by the central government and through partnership funding, it is hard for the Local Authorities to raise their share, and this is a barrier to the project (ibid). This shows that the funding is available for the largest part, because of partnership funding and funding by the national government. However, partnership funding has its downside and the Local Authorities have difficulties with raising the funds for their share. The interviewee agreed that there were difficulties with the funding at the local level. The Lower Thames Scheme shows that partnership funding can have its downsides.

### Flood forecasting

Public Weather Services are provided by the Met Office. They offer forecasts of the weather which is free to the public. Besides, a National Severe Weather Warning Service is provided. This warning service gives notice of weather that could potentially disturb public safety. Furthermore, in 2009 the joint venture; Flood Forecasting Centre was established which combines the forecast capabilities of the Environment Agency and the Met Office. The Flood Forecasting Centre provides for all different types of flooding (Alexander et al., 2015). This shows that flood forecasting is present at the national scale, organised by the Flood Forecasting Centre.

### Emergency planning

Emergency planning is a national strategy in England, it is organised by the Civil Contingencies Act. Within the legislation two main groups of actors are notable; responders of Category One and Two. The Category One responders are central to emergency response. They have the civil protection duties to advise the public and other responders about the possible risks and to do the emergency planning. Category Two responders should on a legal basis cooperate with the Category One responders and share information with all responders (Alexander et al., 2015). Besides, Category One

responders have to form Local resilience Forums, which facilitate the development of Community Risk Registers and multi-agency emergency plans. At the community level, some Risk Management Authorities might also steer the development of flood action plans (ibid). This shows that adequate emergency planning is present at the national scale of England, and therefore also in the Lower Thames and River Thames area.

#### Innovation and experimentation

In the report, there is no mentioning of opportunities for innovation and experimentation. Therefore, the Lower Thames scores badly on the presence of this condition. According to the interviewee, The Lower Thames should actually score very well on this condition, maybe even the best of the three cases. In this area, the flood risk managers struggled many years with achieving a favourable cost-benefit ratio. This meant that they came up with many different solutions, which included very innovative measures that even included flood forecasts on the basis of climate change.

#### Notion by inhabitants that not everybody can be protected from flood risks

In the Lower Thames region, significant attempts have been made in order to engage the local communities, also with the intention to enhance the risk awareness of the local communities. This was achieved, because the Environment Agency recruited community engagement officers, as part of the River Thames Scheme project, in order to strengthen the capacity to respond and the preparedness of the households that are part of the local communities (Alexander et al., 2015). Therefore, the Lower Thames scores well on the presence of this condition. This is completely in line with the statement made by the interviewee about this condition in Hull.

#### Recovery schemes

Flood recovery in England is dealt with at a national scale; general household insurance includes flood insurance. Every citizen with a mortgage is obliged to have this insurance under the composite policy, which means that a very large amount of the inhabitants are insured against flood risks. From the beginning, the insurance is provided by private insurance companies. For many years the general household insurance is market based operated, which means that these insurance companies could decide who they wanted to insure and for what price (Alexander et al., 2015). In 2016 Flood Re will be introduced, which is a non-profit reinsurance fund. This fund will limit the insurance costs to households, of properties that have higher risk of flooding, by a premium cap (ibid). Furthermore, local authority functions get compensation for unexpected losses from the Bellwin Schemes, which is funded by the central government (ibid). This shows that recovery schemes are available in England and therefore also in the Hull & Haltemprice Catchment, because of private insurance, which is also available for very flood prone regions due to Flood Re. Besides, local authorities can also get compensated for their unexpected losses by the Bellwin Scheme.

## 8.5 City of Leeds

The City of Leeds is located in North East England, in the county of Yorkshire. There are multiple main rivers in the area, such as the River Calder in the south, which unites with the Aire River and the Wharfe River in the north. The Aire River flows through the city, and drains around two third of the region. Because of this river and the drains of the river, the City of Leeds is flood prone (Alexander et al., 2015). The most disastrous flood events took place in 1946, 2000 and 2007. If no defence are in place, it is estimated that 4,724 properties are at risk of a 1 in 100 year fluvial flood incident. Besides the proneness to fluvial floods, the City of Leeds is prone to surface water flooding; Leeds is highly

urbanised and situated in a topographic bowl. In addition the economic losses are large, because the city is very important for the economy of the Northern part of the country. Economic development is also key aim of the city. However this aim should be balanced with flood risk governance (ibid).

In order to reduce the changes of a flood event to occur, 249 defence works are along the River Aire. Besides the flood defence strategy, all five strategies are present in the flood risk governance of the City of Leeds (Alexander et al., 2015). The STAR-FLOOD case study on the City of Leeds has focussed on the River Aire Flood Alleviation Scheme. In this Scheme, movable weirs are used. It is the first time that movable weirs are used for flood governance in the UK, so this is a very innovative project. Furthermore, the City of Leeds is deemed to be a good practice regarding their spatial planning initiatives to reduce flood risks (ibid).

### *Confrontation with the governance conditions*

The table below shows the scores of the City of Leeds case study on the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

<b>Governance condition present</b>	<b>Document analysis</b>	<b>STAR-FLOOD researcher</b>	<b>Conclusion</b>
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+	+	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+	+/-
Funding for policy making and implementation is available	+	+	+
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+	+	+
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 8.3: The scores of the City of Leeds on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

Collaboration, with a significant role for the local government is present in Leeds. Leeds is a very pivotal city for the economy of the Northern part of England; therefore the national government sees the importance of protecting the city. The visible importance of the city at the national scale, for example led to the allocation of funds from the national Regional Growth Fund (Alexander et al., 2015). An example of the significant role for the local government and the collaboration between the local government organisations can be found in spatial planning. The City Council of Leeds is at the same time the LLFA and the Local Planning Authority. There is a good relationship and collaboration within the flood risk governance departments and the planning staff, as well as the staff of the Environment Agency (ibid).

### Stakeholder involvement

In the City of Leeds various public participation methods have been used to engage the local community and businesses. With these public participation measures the awareness of the River Aire FAS was raised and it gave the opportunity to the local community to state their opinions and criticise the Scheme. These opinions and critique were taken seriously; some aspects of the regime were revised with the knowledge from the local community. Eventually this led to a high public acceptance of the Scheme (Alexander et al., 2015). So, stakeholders were involved in the project and their opinions and knowledge was seriously taken into account.

### Facilitating learning and knowledge exchange

In the previous condition it is mentioned that Leeds used multiple methods of public participation. This resulted in the revision of the Scheme in some aspects, due to the knowledge retrieved from the local community (Alexander et al., 2015). Furthermore, the Leeds City Council convenes a scrutiny board periodically, in order to review implementation of the flood risk management strategies at the local level. This is open to the press and the public. The Leeds City Councils sees this as a good opportunity to improve the strategy and enhance the resilience on the local level, by learning from this open scrutiny board (ibid). This demonstrates that facilitating knowledge exchange is present in the City of Leeds, and that there are multiple examples of this facilitation.

### Hybrid solutions and combined strategies

The City of Leeds scores well on the presence of hybrid solutions and combined strategies. As been stated at the beginning of the paragraph, all five strategies are visible in the City of Leeds. There are already 249 defence works along the River Aire, besides the innovative use of movable weirs is applied, as well as spatial planning measures, for the mitigation, such as 'hard landscaping' in the city (Alexander et al., 2015).

### Long term planning

That future risks are addressed in long term is shown in the fact that the City of Leeds uses very innovative measures and a very broad flood risk management strategy. The innovative River Aire FAS can even be modified to provide flood protection, when floods get worse due to climate change. Furthermore, the River Aire FAS will protect households in the city centre with a 1 in 75 year flood event protection level (Alexander et al., 2015). This means that the city is well prepared for the risks of flooding, even if these will be worse due to for example climate change. The interviewee agrees on this point. She argues that the movable weirs that can be modified in case of more extreme flood risks due to climate change, is a very good example of addressing future risks in long term planning.



### Climate sensitive and resilient spatial planning

Spatial planning in the City of Leeds is considered to be effective. The Local Planning Authority in Leeds takes into account the advice on flood risk standing and relevant specific planning applications from the Environment Agency. There is even no example of a situation where the Local Planning Authority ignored the advice of the Environment Agency. In addition, the LLFA comments on the risk assessments of floods within planning and assists with understanding flood risk matters (Alexander et al., 2015). There are also many examples of how flood risk is reduced by the use of spatial planning conditions in redevelopment (ibid). The above demonstrates that climate sensitive and resilient spatial planning is present in Leeds. As mentioned in the other two cases, the interviewee argues that in all three of the case studies there are positive and negative points on spatial planning, such as the uptake of the property measures. Therefore, all three can improve on the presence of this condition, and should score moderately, so Leeds as well.

### Funding

Similar to the River Thames Scheme, a diverse range of funds has facilitated the implementation of the River Aire FAS project. Pivotal to the allocation of the funds was the important economic position the City of Leeds has in the Northern part of England, which was recognised at the national scale. Combined with active lobbying, this led to the allocation of funds from the Regional Growth Fund. This meant that although, partnership funding is implemented in England, the River Aire FAS was mainly funded by the state (Alexander et al., 2015). So, funding was available in the City of Leeds for the River Aire FAS. It was even mainly funded by the state, which might be easier than partnership funding.

### Flood forecasting

Public Weather Services are provided by the Met Office. They offer forecasts of the weather which is free to the public. Besides, a National Severe Weather Warning Service is provided. This warning service gives notice of weather that could potentially disturb public safety. Furthermore, in 2009 the joint venture; Flood Forecasting Centre was established which combines the forecast capabilities of the Environment Agency and the Met Office. The Flood Forecasting Centre provides for all different types of flooding (Alexander et al., 2015). This shows that flood forecasting is present at the national scale, organised by the Flood Forecasting Centre.

### Emergency planning

Emergency planning is a national strategy in England, it is organised by the Civil Contingencies Act. Within the legislation two main groups of actors are notable; responders of Category One and Two. The Category One responders are central to emergency response. They have the civil protection duties to advise the public and other responders about the possible risks and to do the emergency planning. Category Two responders should, on a legal basis cooperate with the Category One responders and share information with all responders (Alexander et al., 2015). Besides, Category One responders have to form Local resilience Forums, which facilitate the development of Community Risk Registers and multi-agency emergency plans. At the community level, some Risk Management Authorities might also steer the development of flood action plans (ibid). This shows that adequate emergency planning is present at the national scale of England, and therefore also in the City of Leeds.



### Innovation and experimentation

With the 2000 flood, the flood proneness of the City of Leeds was highlighted, with the absence of defence works. This motivated the design of the River Aire FAS, which includes the establishment of movable weirs that replaced old fixed weirs (Alexander et al., 2015). In the initial design stage of the River Aire FAS, movable weirs were not part of the project. The movable weirs were applied, when the FAS was revised in order to maximise the cost-benefit ratio and because of the adaptation of lower protection standards, partly due to objections to the initial project by the community. This was a very innovative measure, because until then, this form of protection did not exist in England (ibid). This shows that there are opportunities for innovation and experimentation visible in Leeds.

### Notion by inhabitants that not everybody can be protected from flood risks

The City of Leeds scores well on the presence of this condition. The main reason is that the city has made significant effort to enhance the public awareness of the risk of fluvial flooding. Besides the awareness was raised on the River Aire FAS in general and thereby the necessity of the project (Alexander et al., 2015). The only side note that could be made is that the establishment of a flood defence work, such as the movable weirs, could increase the perception of flood safety, which could possibly increase social vulnerability (ibid). However, as stated above, the English cases score well on this condition, because of the efforts to engage the local community in flood risk management through for example public participation.

### Recovery schemes

Flood recovery in England is dealt with at a national scale; general household insurance includes flood insurance. Every citizen with a mortgage is obliged to have this insurance under the composite policy, which means that a very large amount of the inhabitants are insured against flood risks. From the beginning, the insurance is provided by private insurance companies. For many years the general household insurance is market based operated, which means that these insurance companies could decide who they wanted to insure and for what price (Alexander et al., 2015). In 2016 Flood Re will be introduced, which is a non-profit reinsurance fund. This fund will limit the insurance costs to households, of properties that have higher risk of flooding, by a premium cap (ibid). Furthermore, local authority functions get compensation for unexpected losses from the Bellwin Schemes, which is funded by the central government (ibid). This shows that recovery schemes are available in England and therefore also in the Hull & Haltemprice Catchment, because of private insurance, which is also available for very flood prone regions due to Flood Re. Besides, local authorities can also get compensated for their unexpected losses by the Bellwin Scheme.

## 8.6 Comparison of the English cases

The table below shows the scores of the three English STAR-FLOOD case studies on the presence of the governance conditions from literature. Below the scores will be discussed, as well as the governance conditions in general.

<b>Governance condition present</b>	<b>Hull</b>	<b>Thames</b>	<b>Leeds</b>
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+	+	+
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+
Future risks are addressed in long term planning	+	+	+
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	+/-	+/-
Funding for policy making and implementation is available	+	+/-	+
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+	+	+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+	+	+
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 8.4: The scores of the three English case studies on the governance conditions from literature. Possible scores were +, +/- and -.

When looking at the table it is shown that England in general scores well on the presence of almost all of the governance conditions from literature. However, in the interview it came forward that the best established conditions in England are; collaboration between different government layers with a significant role for the local level, stakeholder involvement and public participation, flood forecasting, emergency planning and recovery. The presence of some of these conditions, such as emergency planning is increased due to the exposure to flood events. Furthermore, a remark should be made that most of these conditions are handled at the national level, such as flood forecasting and emergency planning. It is considered to be a good practice that flood risk governance at the national level is very much intertwined with local flood risk governance. Regarding recovery, this is also handled at a national scale, and is considered to be well established in England, because of the Bellwin Scheme and insurance, which is supported by Flood Re and has a very high penetration among citizens. According to the interviewee, a side note to insurance is that insurance can lead to a form of resilience, where everything will return to normal. However, the interviewee argues that in order to be resilient it is more important to be able to adapt. These adaptation measures are not always supported by the insurance companies and as also stated above; property owners are afraid to implement adaptive measures, because this might have an impact on the costs of their insurance. So insurers can have a more important role in encouraging property level adaptive measures. Which also means that when you see resilience as returning back to normal, recovery is well developed in England, when you see resilience as adapting, recovery can be improved in England. Next to the best established conditions in England, it should also be noted that the strategies in England are very much diversified. There is and should be a balance between different strategies; areas that can be protected by flood defence will get flood defence works, but is important to have other mechanisms

backing failure. This diversification is necessary in England, because they are aware that flood risks cannot always be prevented from happening.

The lowest scores of the English cases are on climate sensitive and resilient spatial planning, which is also lacking in more STAR-FLOOD countries, according to the interviewee (and as could be noted in the previous chapters). The problem with climate sensitive and resilient spatial planning is that incentives are missing to implement these spatial planning measures. This means that the measures should for example be connected to recovery and compensation, through for example insurance. Opinions exist in England, that there should be no development on flood plains. However, the interviewee argues that this is not realistic; for one development already exists on flood plains, these houses will not be destroyed, secondly there is limited space available for the development of new houses, while this is necessary with the population growth and housing shortages in the UK, besides economic development is desired. Furthermore, the presence of funding can also be improved. In the Lower Thames region, it was shown that partnership funding can have its downsides, which leads to a lack of funding, or at least makes it harder to gather funds. On the other hand, funding can disincentive the local government or people to act adaptively, because they will just wait for, for example the central government funds to appear and then built some flood defences or other measures. With partnership funding, the changes are bigger, that adaptive measures are implemented; besides it is more realistic than just relying on for example government funds.

In the interview with the STAR-FLOOD researcher, the three cases are compared. When looking at the initial scores that are awarded through the document analysis, it seemed that the City of Leeds scores best on the presence of the governance conditions from literature, and would therefore be most resilient against flood risks. According to the interviewee, it is at least clear that the Lower Thames has the most problems in their flood risk management and is therefore, also less resilient than the other two cases. The City of Leeds has indeed for example very innovative and adaptive measures in their scheme. However the city is prone to flooding for quite some time already and you could question, why it took so long for them to develop their alleviation scheme. Only with the 2007 floods, the realisation appeared in Leeds that there are no formal flood defences and that they should come up with flood risk management measures. So in Leeds they were very proactive. On the other hand, Hull had to be the most creative due to their unfavourable location, in a bowl. This leads to significant flood proneness and the lack of space to build flood defences. Hull was very active in their search for creative measures, and is therefore the front runner of the three cases.

Regarding the importance of the conditions, the STAR-FLOOD researcher of England states, that adaptive spatial planning is a very important condition that should be present, especially in the future, because it could enhance the societal resilience. In addition she stated that stakeholder involvement and collaboration (as in her alteration of the condition), are important as well, but the most important is adaptive spatial planning. Furthermore, considering the general conditions, the interviewee argued that the conditions are complete. However, some of the conditions miss some nuances and should be altered because of that. The first one is the condition of collaboration between government layers with a significant role for the local government; the interviewee agrees that horizontal and vertical collaboration enhances resilience; however a significant role for the local government is not always necessary, and it is not only about collaboration between government layers, because flood risk management is at this moment managed with multiple actors. For some aspects of flood risk management a more centralised strategic approach is needed, in which there is

a helicopter view on the matter. So, different government layers are appropriate for different aspects of flood risk governance. Connected to this is the view that the scale on which a problem is managed should fit with the problem. So in flood risk governance, the problem should fit the hydrological scale. This means that the condition should be altered to the following condition: horizontal and vertical collaboration between the multiple actors in flood risk governance, where the problem of flood risks should be managed at the appropriate (hydrological) scale. In the second condition, it should be mentioned how stakeholders should be involved. The last condition that should be altered is the condition on the notion of inhabitants that not everybody can be protected from flood risks. From this condition it seems like citizens should know that not everyone will equally be protected. However, it is more about taking responsibility at the individual level for flood risks, as they might occur. Especially in England this is important, because there is no statutory standard protection level for citizens. So this means that the condition should be altered to: citizens should have the notion that protection against flood risks cannot be guaranteed.

## 8.7 Conclusion

In this chapter an analysis of the English STAR-FLOOD case studies has been discussed in order to answer the following question: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

In England flood risk resilience is enhanced by almost all established governance conditions, but mainly through: collaboration between different government layers with a significant role for the local level, stakeholder involvement and public participation, flood forecasting, emergency planning and recovery. Most of these conditions are managed at the national scale, which is considered to be a good practice. Furthermore, the presence of some of these conditions is enhanced by the exposure to flooding. Recovery is mainly a good practice, because of the Bellwin Scheme and a high penetration of insurance, which is backed up by Flood Re. Next to these conditions, which are very well present and established in England, it is important to note that the strategies are very well diversified in England, and this is a necessity. England scores lowest on the presence of climate sensitive and resilient spatial planning. This is mainly due to a lack of incentives to adopt property measure levels, which can be enhanced through for example insurance. The presence of funding (mainly in the Lower Thames) can also be improved. With this condition, the problem is that partnership funding has its positive as well as its negative sides.

Regarding the rest of the conditions in general, the interviewee stated that the list is quite complete. There are however some conditions that should be altered. Climate sensitive and resilient spatial planning is seen as the most important governance condition. The conditions that should be altered are: collaboration between different government layers, with a significant role for the local government and the involvement of stakeholders throughout the policy process. In the first one, the collaboration should not only be within government layers, but it should also include collaboration with multiple actors, important to flood risk governance. Besides the significant role of the local level, should be altered in the appropriate scale for the flood risk problem. In the second condition it is not clear how the stakeholder should be involved, so this should be included. The last condition that should be altered is the condition of the notion that not everybody can be protected. It should be altered to: citizens should have the notion that protection against flood risks cannot be guaranteed.

In the next chapter the France case studies will be discussed, which is the last STAR-FLOOD country within the research. This will bring about more information on good practices in flood risk governance. It will for example show if climate sensitive and resilient spatial planning is also lacking in France, as the presence of this condition is lacking in the previous STAR-FLOOD countries.

## 9. Good practices in French flood risk governance

### 9.1 Introduction

This chapter focusses on the enhancement of flood resilience in France on the basis of the French STAR-FLOOD case studies. The research question central to this chapter is: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?* The chapter will begin with a short introduction on flood risk governance in France. After this introduction the three case studies will be discussed. In these case study paragraphs, the case studies will be scored on the presence of the governance conditions established in chapter 2. This will be based on a document analysis of the STAR-FLOOD reports and interviews with the STAR-FLOOD researchers that wrote the reports. This will be followed by a case comparison paragraph, which includes the researchers' view of the established governance conditions. The chapter ends with a conclusion.

### 9.2 Flood risk governance in France

Regarding natural risks, flooding is the most threatening of all natural risks in France. The west and north of the country are at risk of tidal floods, while the south is at risk of flash and pluvial floods, besides a great share of the French cities is prone to urban flooding and along the four main rivers; Loire, Rhône, Garonne and Seine slow floods can occur (Larrue et al., 2015). Although France is prone to flooding, the country did not experience that much significant flood events in the 20<sup>th</sup> and 21<sup>st</sup> centuries, other than floods in the Paris region in 1910. As a consequence, the French see themselves as not being in risk of flooding. However, they do think that they are not well informed about the potential of natural risks. Because flood risk is not considered to be a high threat, it also does not have a high priority for the public policies domain. This means that within the public administration, they are not willing to put in place measures that could cause behavioural changes (ibid).

Although, significant floods did not really occur in the past in France, some minor regular flooding influenced flood risk policy, this policy is characterised by a global and multi-risk approach, just as risk management policy (Larrue et al., 2015). Flood risk governance in France is funded by the state and through the Barnier Fund, which is indirectly through private actors. The state funding is however steadily decreasing, which led to a shift in funding, towards the Barnier Fund, and thus indirectly private actors (ibid). Furthermore, France has six water agencies and six main water basins. The water agencies have an important role in gathering stakeholders at the basin level into a so called Water Parliament. In addition the water agencies levy waste water discharge fees and water abstraction fees, and with the income of the levies, they should finance infrastructures (ibid).

Concerning the administrative culture in France, there is a rather strong tradition of centralisation and therefore the central government is relatively powerful. Nonetheless, its organisations are decentralised through the constitution. There are primarily two types of public authorities that should be noted: state services and local authorities. The state authorities exist of central ministries, deconcentrated services at the departmental and regional level and agencies. The local authorities exist of Regional Councils, Departmental Councils and municipalities (Larrue et al., 2015). Furthermore, it should be noted that there are two powerful trends in public administration; acceleration of decentralisation and strengthening of cooperation in the local/territorial communities.

### 9.3 Nevers

The City of Nevers is a medium-size city in the Bourgogne region, located at the banks of the Loire River and at the junction of the Loire, Allier and the Nièvre (Larrue et al., 2015). The Loire River flows through the middle of the country and is France's longest river. Along the Loire River, the land is flat and has a sandy riverbed, which means that slow floods affect urban expansion areas along the river. In general three types of floods can be distinguished along the Loire. An oceanic flood is the first one, which is the most frequent type and is caused by long periods of rainfall coming from the Atlantic Ocean. The second type is flooding due to violent Mediterranean storms. The last type is a mixture of the two previous types (ibid).

Nevers was originally build on a hill, but expanded to the river banks of the Loire, after World War II, due to population growth. Therefore, the city is also prone to slow floods, as well as the other types (ibid). At the moment 12,000 citizens are exposed to the risk of flooding, although this amount of citizens that face flood risks is quite high, it is much less than the amount of citizens facing the same risk in other major cities along the Loire. For that reason Nevers does not have the main priority for the state when a general flood occurs in the Loire. However, Nevers is the only city on the Loire that faced floods in the last decade, which raised awareness at the local authorities for the potential damage that Nevers might face (ibid).

Concerning flood risk governance, the main problem is renovation of old protection infrastructures. This problem led to the development of a master plan, combining defence and mitigation measures, established by the inter-municipal body (Larrue et al., 2015). Nevertheless, it is not desired to integrate flood risks in urban planning, because of financial stakes and urban pressures. Furthermore, Nevers mirrors flood risk governance at the national scale, with some local adjustments (ibid).

#### *Presence of the governance conditions*

The table below shows the scores of the Nevers case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.

Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+/-	+ (+/-)	+/-
Stakeholders are involved throughout the policy process	+/-	+ (+/-)	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	+/-	+	+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	-	-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+
Opportunities are created for innovation and experimentation	+/-	+/-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 9.1: The scores of Nevers on the governance conditions from literature. Possible scores were +, +/- and -.

#### Collaboration across government layers and significance of local government

Flood risk management has traditionally been a national state matter, which is changing due to the decentralisation movements, which favours a significant role for the local government, especially an important role for the inter-municipal and regional bodies (Larrue et al., 2015). In Nevers, the decentralisation is visible; the involvement of the inter-municipal body and the municipality of Nevers are regarded as noteworthy, which is mainly visible in the Nevers Flood Risk Assessment Study. This study is aimed at addressing flood risks with a broad range of strategies and an integrated vision (ibid). Furthermore, several government layers are for example involved in the defence-mitigation sub-FRGA, which exists of the state, who is responsible for the dikes (on the left bank) and restoration of the riverbed, the Basin Water Board, which manages the dams and the municipality of Nevers, which manages and owns the dikes on the right bank (ibid). So, in Nevers the local government level has a significant role. However, Nevers can improve on the collaboration and therefore scores moderate on the presence of this condition. The lack of collaboration can for example be seen in the fact that the national level adopted a flood management plan for the region of Loire-Bretagne, but the local level was not sufficiently involved in the decision making process of this flood management plan. So after all, the flood policy in the region is still centralised (ibid). The interviewee disagrees with the above and stated that collaboration exists in Nevers, although it is not always very effective, but the role for local government is not significant in Nevers.



### Stakeholder involvement

Stakeholder involvement is moderately present in Nevers and should be improved. Considering stakeholder involvement from an institutional point of view, stakeholders are involved and represented, but when it comes to state planning, local authorities and organisations are insufficiently consulted. Besides, local stakeholders are not able to challenge or appeal the state's decisions (Larrue et al., 2015). In addition it is mentioned that in the FRGAs innovative measures, solutions and processes of environmental organisations are encouraged, however, private individuals are still insufficiently involved regarding the implementation of these innovative policies (ibid). The interviewee stated that institutional stakeholders are involved in the policy process, but the general public is indeed not. This is the case for almost the whole of France.

### Facilitating learning and knowledge exchange

Nevers did not face many flood events until now; therefore, not many lessons are learned. Nonetheless, Nevers is active in developing and searching for knowledge and expertise (Larrue et al., 2015). Furthermore, it is stated in the report that Nevers has shown a good capacity to reorganise themselves regarding flood problems, and are building their knowledge for the future (ibid). This demonstrates that within Nevers mechanisms are present to facilitate learning and knowledge exchange. The interviewee agrees, however she stated that the knowledge exchange and learning in Nevers is not institutionalised, which means that for the future there is no certainty that knowledge exchange and learning will still take place.

### Hybrid solutions and combined strategies

Already since the 12<sup>th</sup> century, the Loire has had large embankments; this is also the case for Nevers, which has several dikes on both the banks of the Loire (Larrue et al., 2015). Although, flood defence has always been a dominant strategy in Nevers, a 'room for the river' project was launched in the 19<sup>th</sup> century. Nonetheless, not until the 1990s flood mitigation measures were back on the flood risk management agenda (ibid). This shows that flood defence is and was the dominant strategy within Nevers, supplemented with some mitigation efforts. However, in 2007 Nevers launched the Nevers Flood Risk Assessment Study, which aims to address flood risks with a great variety of strategies, including; mitigation, protection, crisis management and prevention, and has to be achieved through an integrated approach and vision (ibid). So improvement in combined strategies is visible, but there is still room for improvement.

### Long term planning

Long term planning to address future risks is not completely present yet. One of the reasons is that Nevers, does not see climate change as an issue yet. Furthermore, it is stated in the report on Nevers, that the effectiveness of the measures, which are planned for the long term are limited, due to the problems with funding of maintenance of the dikes (Larrue et al., 2015). On the other hand long term planning improved through the Nevers Flood Risk Assessment Study (ibid). According to the STAR-FLOOD researcher, long term planning exists in France; regions are obliged to make risk plans, which should be connected to urban planning. However, she stated that the plans are not very good.

### Climate sensitive and resilient spatial planning

Some insurers in France believe that, they could play a financial role in supporting mayors and encouraging citizens in the decision to not build in very flood prone areas. In response to this, there have been developments, such as the legal right for insurers to refuse to cover flood risks in very

flood prone areas, if these were built after 2001; the publication year of this legal right (Larrue et al., 2015). Considering climate sensitive and resilient spatial planning at the local level in Nevers, improvements can be made. The Loire Basin Water Board promotes a mitigation strategy, which includes vulnerability reduction measures, at economic stakeholders on the floodplain. In addition, vulnerability reduction measures will be strengthened for existing and new buildings that are situated on the flood plain (ibid). On the other hand, it is stated that in Nevers and surrounding municipalities, the potential role of urban planning is underestimated, especially in terms of risk prevention (ibid). The interviewee agreed that some measures exist, but that it is far from sufficient, so great improvements on climate sensitive and resilient spatial planning are necessary.

### Funding

Funding in Nevers has its strengths and weaknesses and therefore, Nevers can improve on the presence of this condition. Firstly, they make use of financial partnerships, which makes sharing responsibilities easier, but it also causes uncertainty about continuation of funding in the future. Besides, financial partnerships, the state and the water agency are also financial partners in flood risk governance (Larrue et al., 2015). Furthermore, a problem exists with the funding of the maintenance of the dikes in Nevers. Therefore, the main objective for Nevers' Action Program for Flood Prevention is to find partners, to support the funding of the mitigation and defence structures.

### Flood forecasting

Flood monitoring and forecasting is managed at the state level. The state is also responsible for informing about the forecasts along the rivers that are in public domain (Larrue et al., 2015). The state flood monitoring and forecasting service is operated on the local level with twenty-two Regional Flood Forecasting Services. These Regional Flood Forecasting Services provide forecasts at cartographic representations, according to the danger level. The cartographic representations are accessible for the public. Besides, the Regional Flood Forecasting Services can assist public authorities in the form of advice to decide on alerts (ibid). In addition to the state flood forecasting and monitoring services, there are also private flood forecasting services, which cover the rivers that are not monitored by the state. These private companies assist local authorities in their risk management (ibid). This shows that flood forecasting and monitoring is present at the national level. Flood forecasting is also discussed in the Nevers case specifically, stating that flood monitoring, crisis management and alerts are seen as one of the most advanced.

### Emergency planning

In the previous condition, it is already discussed that Nevers has one of the most advanced crisis management system, flood monitoring and alerts of the country. In addition, the Intermunicipal body supports municipalities in the Nevers region in their emergency management. They mainly assist with the Local Safety Plans and with organising the resources to respond to a potential crisis (Larrue et al., 2015). This shows that emergency planning is present in Nevers.

### Innovation and experimentation

In Nevers, opportunities exist for innovation and experimentation, however this can be improved. Nevers, was a pioneer in the 2000s with developing an innovative approach in flood risk governance, which included trips to the Netherlands and the involvement in an Inter-Regional Program (Larrue et al., 2015). Furthermore, innovation was supported by the possible lack of funding for dike maintenance, which meant that adaptive solutions were sought to protect the city. However, Nevers is not active in implementing these innovative measures (ibid).

### Notion by inhabitants that not everybody can be protected from flood risks

From the report on the Nevers' case study it cannot be assessed if the inhabitants have the notion that not everybody can be protected from flood risks. Therefore, Nevers initially scored badly on the presence of this condition. According to the interviewee, a notion that floods can occur and not everybody can be protected is present at citizens of France, due to their flood experience. However, there are indeed citizens who rely on protection of defence works for example, but even they should know that floods occur in France. Nonetheless, citizens of high risk regions are most of the time not aware that they are in a more flood prone region.

### Recovery schemes

The recovery strategy is a national strategy. Although, protection against flooding is not part of the Constitutional law in France, a compensation scheme for natural disasters, with constitutional value is created through extensive case law and interpretation of constituents (Larrue et al., 2015). The Natural Disaster Compensation Scheme is called CAT-NAT, it incorporates the solidarity principle and it relies on compulsory contributions of insurance firms and the insured clients (ibid). In first instance, insurance companies are obliged to cover the risks of natural disaster by a fixed rate set by the state, after which a risk premium is added per insurance contract. The risk premium that is added per contract is set by a Ministerial Decree and is 12 percent since 2009. With this added risk premium, the CAT-NAT is financed. Because insurance is mandatory, the penetration rate is 98 percent, which means that almost everyone is protected and is able to claim compensation (ibid). This shows that recovery schemes to compensate victims is widespread available in France and therefore also in Nevers.

## 9.4 Le Havre

The City of Le Havre is medium-sized, located in the north-eastern part of France, on the estuary of the Seine River, and on the shore of the Channel. The city has an industrial background, which is based on their harbour. This harbour is situated in a vulnerable area and for the development of the harbour; dealing with the preservation of the Seine estuary is required. It should be noted that the Seine, as well as the Harbour of Le Havre are state owned (Larrue et al., 2015). In addition urban development in Le Havre is limited due to natural boundaries. The first limitation is that Le Havre is located between the Channel and the estuary of the Seine, which is a natural area. Conflicts exist between local industries and natural area, although these industries already have to pay compensatory funds. The second obstacle is a cliff on the western side of the city, which is eroding with one meter per year. The last one is a chalk plateau, north of the city, which is used for intensive agriculture (ibid).

Considering flood risks, due to its location on the Channel, Le Havre has a temperate oceanic climate, which means that there are almost no days without wind, and there are many days with rainfall. Four types of flooding exist in Le Havre, the most important one, in the sense of damage is marine submersion. The second important type of flooding is run-offs, which is caused by a combination of high intensity rainfall, with rainfall in a long time period. The next type is a consequence of run-offs; flash floods. The last type of flooding in Le Havre is overflows in the sewerage systems and of rainwater. Because of climate change, these different types can occur at the same time (Larrue et al., 2015). Flood management policy was introduced on the local agenda of Le Havre on the 1980s. This policy focussed mainly on the flash floods at the Chalk Plateau. Later on, good practices in the management of industrial risks were added to the flood risk policies. In the domain of flood risk

governance, two actors are mainly important; the Seine Estuary Major Risk Office and the Intermunicipal Body of Le Havre, which exists of sixteen municipalities (ibid). Furthermore, it should be noted that in Le Havre, the main challenge is to integrate their four main objectives; industrial development, agricultural economy, flood prevention and preservation of environment (ibid).

### *Presence of the governance conditions*

The table below shows the scores of the Le Havre case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. For the case of Le Havre, no interview was conducted; therefore the second column is empty. In the conclusion column the final score is awarded, which is thus only an outcome of the document analysis. Underneath the table it is argued per condition why a certain score is awarded.

<b>Governance condition present</b>	<b>Document analysis</b>	<b>STAR-FLOOD researcher</b>	<b>Conclusion</b>
Collaboration across government layers, with a significant role for the local government	+/-		+/-
Stakeholders are involved throughout the policy process	+/-		+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+		+
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-		+/-
Future risks are addressed in long term planning	+/-		+/-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+		+
Funding for policy making and implementation is available	+/-		+/-
Flood forecasting is up to date and shows real time risks of flooding	+		+
Adequate emergency planning is set up to evacuate people in case of flooding	+		+
Opportunities are created for innovation and experimentation	+		+
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-		+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+		+

Table 9.2: The scores of Le Havre on the governance conditions from literature. Possible scores were +, +/- and -.

### *Collaboration across government layers and significance of local government*

Flood risk management has traditionally been a national state matter, which is changing due to the decentralisation movements, which favours a significant role for the local government, especially an important role for the inter-municipal and regional bodies (Larrue et al., 2015). At the local level, mainly two actors are involved in flood risk policies; the Intermunicipal Body of Le Havre, consisting of sixteen municipalities and seen as the most powerful actor in flood risk governance in Le Havre and the Seine Estuary Major Risk Office. These are seen as cooperative institutions (ibid). In the past

cooperation was also promoted by many institutions, but the solidarity between the institutions disappeared after significant flood crises in 1993, 1995 and 1999 (ibid). Furthermore, the run-off sub-FRGA is handled by the state in terms of land planning, the River Syndicate coordinates mitigation and public information and Intermunicipal Institutions are in charge for local forecasting and warning systems and have built hydraulic works (ibid). Within the marine submersion sub-FRGA, the harbour of Le Havre is an important actor; with its involvement in implementation of the European Floods Directive and because it owns the marine dike, which is an important defence work (ibid). This shows that many institutions have important roles in flood risk governance in Le Havre, and that these important roles are for local institutions as well. However, it seems like collaboration is missing and this should be improved.

### Stakeholder involvement

Stakeholder involvement in Le Havre can be improved. The general public receives information on flood risk governance, but participation processes or joint decision making is absent in Le Havre. Regarding the sub-FRGAs; in the marine submersion almost all stakeholders are present, except for the general public and civil society organisations. This is the same for the Lézarde basin arrangement. The only group of the public that is able to participate are farmers and this group improved the knowledge among decision makers (Larrue et al., 2015). Besides the lack of participation, a lack in transparency exists. Although it should be stated that the decision makers do not have the aim to hide information, but there is no interest in the information. So the policy is more transparent after involvement of other actors (ibid). Moreover it should be noted that in flood management in Le Havre, a lot of technological solutions are adopted, because these solutions are favourable to all parties, including experts, citizens, farmers and local institutions (ibid).

### Facilitating learning and knowledge exchange

Le Havre scores well on the presence of learning and knowledge exchange. To start with, Le Havre has accumulated much knowledge regarding risk management due to the local industries. This has led to feedback towards all five of the strategies. In addition multiple studies have been carried out, as well as flood mapping, this shows that the attitude in Le Havre is that they (want to) learn from previous mistakes and they are open to innovative solutions (Larrue et al., 2015). Concerning these studies, many actors are involved in the gathering of technological and scientific knowledge (ibid). Lastly, knowledge exchange takes places in the decision making process due to the involvement of farmers, especially on the topics of flood mitigation and prevention (ibid).

### Hybrid solutions and combined strategies

In Le Havre, two sub-FRGAs are present; the run-off sub-arrangements, that combines mitigation, prevention and preparation strategies, where the marine submersion arrangement exists of an opposition between defence and prevention (Larrue et al., 2015). In addition it is mentioned that the Action Program for Flood Prevention, which was used to speed up the implementation of a Risk Prevention Plan, diversified the strategies (ibid). Although, the strategies are diversified, technological solutions are preferred by all parties, such as hydraulic infrastructures (ibid). In addition, the sub-FRGAs are not connected to each other. This means that flood risk governance misses some consistency (ibid). So, Le Havre scores moderately on the presence of this condition; all strategies are visible, but lack some consistency, and technological solutions are preferred.

### Long term planning

In the report of Larrue et al. (2015), it is mentioned that flood management is not the main priority in Le Havre, concerning policies. However, sustainable development and climate change are, and Le Havre is very proactive on the matter of climate change, especially compared to the national level. Because flood risk management is not the main priority, Le Havre can still improve on the presence of this condition, but scores moderately, because on the other hand climate change is a priority.

### Climate sensitive and resilient spatial planning

Some insurers in France believe that, they could play a financial role in supporting mayors and encouraging citizens in the decision to not build in very flood prone areas. In response to this, there have been developments, such as the legal right for insurers to refuse to cover flood risks in very flood prone areas, if these were built after 2001; the publication year of this legal right (Larrue et al., 2015). Besides the measures on the national level, the local level implemented measures as well. The City of Le Havre has built a network of retention basins and open air retention basins. Furthermore, the municipality implemented adaptive solutions such as banks, ponds, grass and wetlands. Moreover, practical guidelines are established in order to reduce the vulnerability at houses (ibid). In the marine submersion sub-FRGA, the municipal authority came with a proactive initiative for upper-elevation of urban development in the southern part of the city, close to the sea and dock areas (ibid). So this means that climate sensitive and resilient spatial planning is present in Le Havre.

### Funding

In June 2003 a Risk Prevention Plan for the Lézarde Basin was launched. In order to speed up the process of implementation of this Risk Prevention Plan, two resources were mobilised; an Action Program for Flood Prevention and a national decree, that is established for local run-offs, so they were funded with large amounts of money (Larrue et al., 2015). Nonetheless, considering flood risk governance in general, due to the economic crisis, there is a shortage of funds, which has actually increased the diversification of different strategies (ibid). This shows that funding is moderately present in Le Havre.

### Flood forecasting

Flood monitoring and forecasting is managed at the state level. The state is also responsible for informing about the forecasts along the rivers that are in public domain (Larrue et al., 2015). The state flood monitoring and forecasting service is operated on the local level with twenty-two Regional Flood Forecasting Services. These Regional Flood Forecasting Services provide forecasts at cartographic representations, according to the danger level. The cartographic representations are accessible for the public. Besides, the Regional Flood Forecasting Services can assist public authorities in the form of advice to decide on alerts (ibid). In addition to the state flood forecasting and monitoring services, there are also private flood forecasting services, which cover the rivers that are not monitored by the state. These private companies assist local authorities in their risk management (ibid). This shows that flood forecasting and monitoring is present at the national level. At the local level, some technical hydrological works are being implemented, such as a flood warning system (ibid). This shows that this condition is also present at the local level.

### Emergency planning

The state is the main actor in emergency planning, in terms of resources and discourses and they also coordinate emergency plans. However, the state is transferring the responsibilities of emergency planning to the municipal level, by obliging them to establish Municipal Crisis Management Plans

(Larrue et al., 2015). This is definitely also the case in Le Havre; the city is very much involved in the development of flood preparation plans. Their Crisis Management Plans even stimulates collaboration between different municipal services (ibid). Moreover, risk and emergency management policy are rather strong in Le Havre, because good practices of industrial risk management are transferred towards flood risk policy and this is already happening since the 1970s. An example is that a toxic industrial cloud threatened Le Havre in 1986, and when the warning sounded, several schools evacuated outside. Due to this incident, preparation is strengthened with crisis exercises and better communication (ibid). This shows that adequate emergency planning is present in Le Havre.

#### Innovation and experimentation

Connected to the opportunities for learning and knowledge exchange, opportunities for innovation and experimentation are also present in Le Havre. First, because of its proactive risk management, innovative solutions are used and sought. Furthermore, as seen in the discussion on the condition of hybrid strategies, it is mentioned that technological and engineering innovations are preferred as measures by all parties and are therefore mainly used. Lastly, which is also already mentioned, Le Havre proved to have an attitude open to innovative measures, with significant innovative capacity (Larrue et al., 2015).

#### Notion by inhabitants that not everybody can be protected from flood risks

Concerning the awareness of inhabitants, it is mentioned that the municipality has organised a forum in order to raise the awareness of citizens and businesses on flood prevention measures. Besides, the desire among the local government in Le Havre exists to share information on preparation strategies with the public and came up with measures to raise the awareness under citizens of flood risks, which partly comes forwards from the tradition of industrial risk management (Larrue et al., 2015). On the other hand, it is mentioned that due to infrastructures such as dikes, policy makers and the general public have got the idea that for example a marine submersion event is not likely to take place. Moreover, because there have not been major events in the recent past, policy makers and the public sometimes deny the potential risks and hide after the capacity of engineering (ibid). This shows that although Le Havre is very active in achieving flood awareness by their citizens, this is in part hindered by the technological solutions and a lack of flood experience.

#### Recovery schemes

The recovery strategy is a national strategy. Although, protection against flooding is not part of the Constitutional law in France, a compensation scheme for natural disasters, with constitutional value is created through extensive case law and interpretation of constituents (Larrue et al., 2015). The Natural Disaster Compensation Scheme is called CAT-NAT, it incorporates the solidarity principle and it relies on compulsory contributions of insurance firms and the insured clients (ibid). In first instance, insurance companies are obliged to cover the risks of natural disaster by a fixed rate set by the state, after which a risk premium is added per insurance contract. The risk premium that is added per contract is set by a Ministerial Decree and is 12 percent since 2009. With this added risk premium, the CAT-NAT is financed. Because insurance is mandatory, the penetration rate is 98 percent, which means that almost everyone is protected and is able to claim compensation (ibid). This shows that recovery schemes to compensate victims is widespread available in France and therefore also in Le Havre.



## 9.5 Nice

The City of Nice is located in the region of Provence-Alpes-Côte-d'Azur, at the Mediterranean Coast, which is in the South of France. The city belongs to the basin district of Rhône Méditerranée, where the Var is the main river. Next to the Var, the Paillon is also an important river (Larrue et al., 2015). The municipality of Nice is affected by multiple natural disasters, such as earthquakes, forest fires, landslides and flooding, which is mainly because of its Mediterranean climatic and geographical features. These Mediterranean features can also be found in the flood profile, which includes marine submersion, flash floods and river floods. In general, Nice is very flood prone (ibid). The high level of exposure to various natural disasters such as flood risks is accompanied by very high urban pressures and they are, just as most Mediterranean cities dependent on tourism, housing, transport systems and businesses (ibid).

When looking at flood risk governance in Nice, it should be noted that the old city of Nice was built on the banks of the river Paillon, while the new developments of the city are along the Var River. The two rivers are both at risk of flooding, but due to their history, different solutions and approaches are necessary to govern the flood risks of these rivers (Larrue et al., 2015). Within the case study, one of the focus points is therefore also on the question if these two flood risk management strategies are completely separated or if they are integrated (ibid). In addition, the case study of Nice illustrates how flood risk management and urban development can be integrated, which is exactly what happens on the national level. Furthermore, although it is a trend, that the state is disengaging from the local level, the state intervened in Nice, with a national operation; the Var Plain Operation of National Interest. The aim of this operation is to support flood risk governance and the development of it (ibid).

### *Presence of the governance conditions*

The table below shows the scores of the Nice case study on the presence of the governance conditions from literature. In the document analysis column, the score is based on my secondary research of the written report. The second column consists of the initial scores awarded by the STAR-FLOOD researcher. In the conclusion column the final score is awarded which is an outcome of the comparison in scores during the interview with the STAR-FLOOD researcher. Underneath the table it is argued per condition why a certain score is awarded. In case of a difference in scores between the researcher and my own analysis, this difference is discussed as well and a final score is awarded.



Governance condition present	Document analysis	STAR-FLOOD researcher	Conclusion
Collaboration across government layers, with a significant role for the local government	+	+	+
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+/-	+/-	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+/-	+/-
Future risks are addressed in long term planning	-	+/-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+/-	+/-	+/-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+/-	+
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	+	+/-
Opportunities are created for innovation and experimentation	+/-	+/-	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 9.3: The scores of Nice on the governance conditions from literature. Possible scores were +, +/- and -.

### Collaboration across government layers and significance of local government

Flood risk management has traditionally been a national state matter, which is changing due to the decentralisation movements, which favours a significant role for the local government, especially an important role for the inter-municipal and regional bodies (Larrue et al., 2015). In Nice, the local government also has a significant role and collaboration takes place between different government levels. An example of this collaboration is the fact that the flood risk management projects that takes place in the Nice region are built on strong political coalitions, which consist of the state, and local authorities, which provide the project plans with a broad consensus (Larrue et al., 2015). Furthermore, there is a very strong local coalition in the water sectors, which consists of the Basin Committee, the Water Agency and an ad hoc Intermunicipal Association. Moreover, in the part of the Nice report on the funding of flood risk management in Nice, it is stated that the state is now mainly the provider of regulations, which will change to a role where the state is just one of the involved actors in the bargaining game (ibid).

### Stakeholder involvement

Traditionally the opposition of civil society is weak in Nice. However, this is changing (Larrue et al., 2015). In addition, most projects have a broad consensus, and the decision making process intends to be as consensus based and as inclusive as possible. Nonetheless, environmental organisations state that there is a lack of transparency in the so called Eco-Valley project. The lack of transparency is caused by limited access to information and late delivery of information, which decreases the opportunities to enter the policy process with criticism (ibid). The above demonstrates that,

stakeholder involvement is slightly present, especially because of the broad consensus, but it should be improved by better access to information.

#### Facilitating learning and knowledge exchange

Previous flood events have been input for change and learning in Nice in for example the metropolitan services, especially regarding flood preparation. This means that there is greater attention to training and communication in emergency situations, but also in normal times (Larrue et al., 2015). As this is the only mentioning of learning and knowledge exchange, Nice can still improve on the presence of this condition. The interviewee agreed that Nice can still improve on the presence of this condition; she said that although they have been active in accumulating new knowledge and learn in their risk management, many changes in their risk management cannot be observed. A main reason for this lack of change can be retrieved in the fact that development of the region is seen as most important.

#### Hybrid solutions and combined strategies

All strategies are visible in Nice, just as at the national level, however, the strategies are more intertwined at the local level in Nice, than at the national level. The three main sub-FGRAs are prevention-defence, mitigation-defence and emergency management. The intertwining is demonstrated in the fact that prevention-defence and mitigation-defence both incorporate defence (Larrue et al., 2015). The river contract in Nice had the aim to represent a framework that combined defence and mitigation, but in reality the accent of the framework was to reduce vulnerability. Because of a lack of funds, defence was left on the side. This will most certainly change in the future, because the river contract will expire and the Action Program for Flood Prevention will come in to action, which is mainly used as to finance defence works (ibid). The STAR-FLOOD researcher stated that although all strategies are visible, Nice still heavily depends on structural solutions, and can therefore improve on the presence of this condition.

#### Long term planning

It seems that within flood risk management in Nice, the solutions that are sought need to combine development and flood protection. Development and urbanisation are the driving factors in the local policy (Larrue et al., 2015). Although, a risk factor is included in planning policies, this is mainly seen as a condition for further development. This development is also not questioned, even not by environmental organisations (ibid). This shows us that the planning is mainly to ensure economic development and urbanisation, if this also means that future floods can be protected, it means a win-win situation, but this is not the biggest driver in Nice. The interviewee stated that concerning flooding, it is indeed correct that the planning is more on the short term and development is more important than flood protection.

#### Climate sensitive and resilient spatial planning

Some insurers in France believe that, they could play a financial role in supporting mayors and encouraging citizens in the decision to not build in very flood prone areas. In response to this, there have been developments, such as the legal right for insurers to refuse to cover flood risks in very flood prone areas, if these were built after 2001; the publication year of this legal right (Larrue et al., 2015). Looking at the local level, it can be noted that urbanisation and economic development has a higher priority in the local policies than flood risks; development is not an issue also not for environmental organisations, as stated above. However, it is also stated in the report that the urbanisation will encounter restrictions. One of these restrictions is that the already urbanised areas

will be more compact and more effectively organised, instead of urbanising new areas that are at risk of natural disasters (ibid). This shows that at the local level climate sensitive and resilient spatial planning is moderately present, there are some restrictions to new development, but urbanisation and development are still the main priority in Nice.

### Funding

Concerning the funding for flood risk governance in Nice, this is moderately present. The most important sources of funding are the state and local departments of Nice and the Nice Metropole (Larrue et al., 2015). Besides it is stated that at the moment the river contract is in use in Nice, in which the defence strategy is left a bit on the side. This will change when the river contract will expire and the Action Program for Flood Prevention will come into force, which is mainly used for financing flood defence (ibid). So at the moment not every strategy is fully supported in terms of funding, but this will change in the future.

### Flood forecasting

Flood monitoring and forecasting is managed at the state level. The state is also responsible for informing about the forecasts along the rivers that are in public domain (Larrue et al., 2015). The state flood monitoring and forecasting service is operated on the local level with twenty-two Regional Flood Forecasting Services. These Regional Flood Forecasting Services provide forecasts at cartographic representations, according to the danger level. The cartographic representations are accessible for the public. Besides, the Regional Flood Forecasting Services can assist public authorities in the form of advice to decide on alerts (ibid). In addition to the state flood forecasting and monitoring services, there are also private flood forecasting services, which cover the rivers that are not monitored by the state. These private companies assist local authorities in their risk management (ibid). This shows that flood forecasting and monitoring is present at the national level. There is no mentioning of flood forecasting on the Nice case specific. The interviewee agreed with the above.

### Emergency planning

At the beginning of the case study on Nice, it was mentioned that the Paillon River and the Var need a different approach and measures to be governed against flood risks. In the preparation strategy, the two different management strategies meet, while this is not the case in the defence and preventive actions and solutions. The connection of the two different management systems is safeguarded by the Intermunicipal bodies and the state civil security services (Larrue et al., 2015). Furthermore, municipalities are obliged to adopt a Municipal Safety Plan, but because flood events are rare in the area of the Paillon River, some of the municipalities in the Nice area still do not have Municipal Safety Plans (ibid). On the other hand more attention is available for the training and communication in the case of an emergency event and at normal times. In addition it is mentioned in the STAR-FLOOD report that flood preparation differs from the state arrangement; it is not a mono-strategy, but is shared with a diverse group of actors, such as voluntary groups and Intermunicipal bodies, that all plays an important and increasing role (ibid). This means that adequate emergency planning in the Nice area is moderately present; improvements can be made in for example adopting Municipal Safety Plans in the whole region. The interviewee agreed with the argumentation; Nice can indeed improve on the presence of this condition.

### Innovation and experimentation

Due to the fact that flood defence is not the main strategy and innovative solutions are necessary to make sure that economic development and urbanisation still have priority, while the urban areas are also protected against flood risks, innovative measures and opportunities for experimentation exist (Larrue et al., 2015). On the other hand, it is also mentioned that technological innovations are being developed, but these innovations might not be adequate enough to make the system more resilient (ibid). Therefore, improvements can still be made on the presence of this condition in Nice.

### Notion by inhabitants that not everybody can be protected from flood risks

Nice is busy with raising the awareness of flood risks to its citizens, so that their adaptive capacity will increase. This has mainly been done with new technologies, such as smartphones and websites. Nonetheless, the awareness under citizens, in the sense that they change their behaviour is not yet visible. There seems to be a gap between informing citizens and actual change in behaviour. Furthermore, not everyone is reached with the new technologies (Larrue et al., 2015). So Nice is active in increasing the awareness, but this does not lead to the notion that not everybody can be protected and the change in behaviour that is associated with it. Therefore, Nice scores moderately on this condition.

### Recovery schemes

The recovery strategy is a national strategy. Although, protection against flooding is not part of the Constitutional law in France, a compensation scheme for natural disasters, with constitutional value is created through extensive case law and interpretation of constituents (Larrue et al., 2015). The Natural Disaster Compensation Scheme is called CAT-NAT, it incorporates the solidarity principle and it relies on compulsory contributions of insurance firms and the insured clients (ibid). In first instance, insurance companies are obliged to cover the risks of natural disaster by a fixed rate set by the state, after which a risk premium is added per insurance contract. The risk premium that is added per contract is set by a Ministerial Decree and is 12 percent since 2009. With this added risk premium, the CAT-NAT is financed. Because insurance is mandatory, the penetration rate is 98 percent, which means that almost everyone is protected and is able to claim compensation (ibid). This shows that recovery schemes to compensate victims is widespread available in France and therefore also in Nice.

## 9.6 Comparison of the French cases

The table below shows the scores of the three French STAR-FLOOD case studies on the presence of the governance conditions from literature. Below the scores will be discussed, as well as the governance conditions in general.

<b>Governance condition present</b>	<b>Nevers</b>	<b>Le Havre</b>	<b>Nice</b>
Collaboration across government layers, with a significant role for the local government	+/-	+/-	+
Stakeholders are involved throughout the policy process	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+/-	+/-	+/-
Future risks are addressed in long term planning	+/-	+/-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	-	+	+/-
Funding for policy making and implementation is available	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+	+	+/-
Opportunities are created for innovation and experimentation	+/-	+	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	+/-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+	+	+

Table 9.4: The scores of the three French case studies on the governance conditions from literature. Possible scores were +, +/- and -.

When looking at the table, it is shown that France in general scores well on the presence of the governance conditions of flood forecasting and recovery schemes, and to a certain extent adequate emergency planning and mechanisms to facilitate learning and knowledge exchange. The first two are mainly handled at the national level. Recovery schemes are available due to the CAT-NAT fund, which is financed by premiums from private flood insurance companies. The private insurance has a very high uptake. Adequate emergency planning is mainly present, because municipalities are obliged by the state to establish Municipal Safety Plans. Furthermore, in the case of Le Havre, it is also present, due to their industrial background, which helped them develop their safety and risk plans.

France should improve on the conditions of addressing future risks on the long term and climate sensitive and resilient spatial planning. Concerning climate sensitive and resilient spatial planning, at the moment the focus of the French regions is mainly on urban and economic development, and less about managing flood risks. This is also in part the reason why future risks are not or not sufficiently addressed in long term planning. Besides it came forward that the notion under citizens that not everybody can be protected from flood risks can be improved. This condition is not well present, because some inhabitants still heavily rely on flood defence. Besides, the local governments have tried to increase the awareness among citizens, but this has not yet led to behavioural change among them. Moreover, inhabitants of highly risk areas are usually not aware that their region is particularly vulnerable.

Concerning the general governance conditions, the two French interviewees stated that the conditions are complete in general; only both stated that risk communication towards citizens can be added as a condition, the second interviewee stated that coproduction with citizens in flood risk management should be added, as well, as she believes this is a good practice in England and this increases the awareness of flood risks among citizens. Both the interviewees stated that some conditions should be altered. According to the first interviewee, the condition on collaboration should state that the collaboration is institutionalised and the significant role for the local government should be a separate condition. In the condition of stakeholder involvement it should be mentioned that stakeholder involvement includes involvement of the general public. Regarding the mechanisms to facilitate learning and knowledge exchange, the mechanisms should be institutionalised, to make sure that this is an ongoing process and this should be added to the condition. Furthermore, it is hard to state if emergency planning is adequate, because flood experience is lacking and exercises do not always take place, so it might be better to remove adequate from the condition. The second interviewee stated that the condition of mechanisms to facilitate learning and knowledge exchange is too broad, it is not clear on what level and between which departments this should take place. In addition the first interviewee stated that the most important conditions are that the local government has a significant role (without collaboration) and that opportunities exist for innovations and experimentation. The reason for the importance of the first condition is that the local government is best informed at the local level, can overlook all problems, and should execute flood risk governance. Besides, it enhances the knowledge at the local level if local governments have an important role in flood risk governance. The innovation and experimentation is necessary in order to come up with adaptive measures. However, these two conditions are important, but they are mainly important in France, the relevance of these conditions can be different from country to country. The second interviewee stated that all conditions are important. The first interviewee also made a general remark on the scoring table, it is better to leave out a score of plus/minus, because most conditions can improve, but are present, which will cause that a lot of researchers will give the cases this score.

## 9.7 Conclusion

In this chapter an analysis of the French STAR-FLOOD case studies has been discussed in order to answer the following question: *What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

In France flood risk resilience is enhanced by flood forecasting and availability of recovery schemes to compensate flood victims, and to a certain extent by adequate emergency planning and mechanisms to facilitate learning and knowledge exchange. On the other hand, the governance conditions of addressing future risks in long term planning, climate sensitive and resilient spatial planning and the notion among citizens that not everybody can be protected against flood risks are not enough present in France. Regarding the conditions in general, they are mainly complete. However, risk communication towards citizens can be added, as well as a condition on coproduction with citizens in flood risk governance, as this is seen as a good practice from England. Furthermore, the conditions are better if some are altered. Collaboration should be separated from a significant role for the local government and the collaboration should be institutionalised. In the stakeholder involvement condition, it should be clear that stakeholders include the general public. Furthermore, the mechanisms to facilitate learning and knowledge exchange should be institutionalised, just as collaboration, besides this condition is too broad, it should also state at what level and with whom

learning and knowledge exchange should take place. Regarding the importance of the governance conditions, one of the interviewees stated that a significant role for the local government and opportunities for experimentation and innovation are the most important conditions. However, this might mainly be the case in France; the importance can differ from country to country.

This chapter was the last case study chapter. This chapter brought about more information on good practices in flood risk governance. The next two chapters are the discussion and conclusion of this thesis.

## 10. Discussion

In the table below, the final scores of the eighteen case studies are presented. Underneath the table, it will be discussed, what the outcomes of the final scores actually mean for the enhancement of flood risk governance. Furthermore, in the interviews with the researchers, they were asked about their opinion on the conditions in general; completeness and importance. The second part of the discussion will compare the researchers' view and discuss the conditions in general. After the discussion of this two, my research approach will be commented. Lastly, a connection will be made with other literature.

Governance condition present	ZPP	NIMG	DDT	AWP	LSS	GRB	KLS	GTB	KTS	PZN	SBC	WCW	Hull	TMS	LDS	NVS	LHR	Nice
Collaboration across government layers, with a significant role for the local government	+	+, +/-	+	+/-	+/-	+/-	+/-	-	+/-	+/-	+	+/-	+	+	+	+/-	+/-	+
Stakeholders are involved throughout the policy process	+	+/-	+	-	+/-	-	+/-	-	+/-	+/-	-	+/-	+	+	+	+/-	+/-	+/-
Mechanisms are in place to facilitate learning and knowledge exchange	+	+, +/-	+	+	-	+	+	+/-	+/-	-	-	+/-	+	+	+	+	+	+/-
Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)	+	+	+	+/-	+/-	+/-	+	+/-	+	-	-	+/-	+	+	+	+/-	+/-	+/-
Future risks are addressed in long term planning	+	+	+	+	-	+/-	+/-	+/-	-	-	+/-	-	+	+	+	+/-	+/-	-
Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)	+	+	+	+/-	+/-	+/-	+/-	-	-	-	-	-	+/-	+/-	+/-	-	+	+/-
Funding for policy making and implementation is available	+	+	+/-	-	-	+/-	+/-	+/-	+/-	+	-	+	+	+/-	+	+/-	+/-	+/-
Flood forecasting is up to date and shows real time risks of flooding	+	+	+/-	+/-	+	+	+	+	+	+	+/-	+	+	+	+	+	+	+
Adequate emergency planning is set up to evacuate people in case of flooding	+/-	+/-	+/-	+	+	+	+	+/-	+	+	+	+	+	+	+	+	+	+/-
Opportunities are created for innovation and experimentation	+/-	+	+	+	-	+	+	-	+/-	-	-	+/-	+	+	+	+/-	+	+/-
Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks	-	-	+/-	-	-	-	-	+/-	-	-	+/-	+/-	+	+	+	+/-	+/-	+/-
Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding	+/-	+/-	+/-	+	+	+	+	+	+	+/-	+/-	+/-	+	+	+	+	+	+

Table 10.1: The scores of the eighteen case studies on the governance conditions from literature. Possible scores were +, +/- and -. The names of the case studies are shortened. The first three are the Dutch case studies, followed by the three Belgian case studies, then the Swedish, Polish, English and lastly French case studies.



## 10.1 Final scores

When looking at the table, the first thing that stands out, is that the condition of flood forecasting, which shows real time risks of flooding is present in almost every case. There are only three cases (Dordrecht, Antwerp and Slubice), where this condition is moderately present. Besides, the conditions of adequate emergency planning, to evacuate people in case of flooding and the availability of recovery schemes to fund rebuilding and to compensate victims in case of flooding are also present in a large amount of the case, and otherwise at least moderately present in the remaining cases. This brings us to the question, what it actually means that these conditions are present in a large amount of the cases. Does this mean that these conditions are the most important conditions? Are these conditions essential for enhancing flood resilience? Or are there other reasons for the presence of this condition?

In the interviews with the researchers, the importance of the conditions is discussed. Some of the researchers mentioned that all conditions are important, because the conditions all cover different aspects of enhancing flood resilience. Furthermore, the conditions that were stated as most important conditions were mainly funding for implementation of policies, addressing future risks in long term planning, stakeholder involvement throughout the policy process and collaboration between different government layers. Only the conditions of adequate emergency planning and recovery schemes were both one time mentioned as one of the important conditions to enhance flood resilience. Concerning adequate emergency planning, it was mentioned by one of the Dutch STAR-FLOOD researchers that the presence of this condition can be important for some cases, such as the Dordrecht case, due to its very high vulnerability towards flooding. So this would mean that only in extremely vulnerable cases, the presence of this condition is of great importance. Regarding recovery schemes, it was mentioned by the Polish researchers, that this condition can be important if recovery schemes are funded through private insurance. Private insurance can lead to higher risk premiums for inhabitants of very flood prone regions, which might influence the behaviour of these citizens, in the sense that they are less willing to live in these regions, because of the high costs for insurance. On the other hand, if recovery is state funded, and almost nobody will see the direct link between the taxes they pay and the recovery that is provided, citizens will most likely not change their behaviour, towards living in less vulnerable areas. This would mean that in regions where private insurance is available to fund recovery schemes, citizens will not live in flood prone areas. However, looking at the countries, where insurance is available; this has not led to a stop in development in and of flood prone regions. For example in England urban pressures are too high, to not develop in these regions.

In my opinion essential is very much connected to important, therefore in first instance I would state that either flood forecasting, recovery schemes and adequate emergency planning are not essential conditions to enhance flood resilience. On the other hand, when thinking about the definition and aspects of resilience, it is mentioned by Folke (2006), that a system has multiple stable states, which leads to uncertainty and surprises. Walker et al. (2004) add to this, that the system should be able to absorb shocks, while at the same time reconstruct, with the result that the systems still has the same function, feedbacks, identity and structure. This can be connected to the three most present conditions. It can be stated that flood forecasting makes a region aware of the fact that change is possibly coming; for example if a defence structure proves to not be able to withstand a flood. Due to adequate emergency planning, citizens will survive this shock and with the help of recovery schemes, reconstruction is supported to return the system to the state with the same function,

feedbacks, identity and structure. So these three conditions can be seen as essential conditions in the sense that, if a shock will occur due to multiple stable states and uncertainty and surprise linked to this, at least these conditions make sure that a region is resilient against this shock (flood), as it is able to return to the same system as before.

Regarding other reasons for the large presence of these conditions, it should be reconsidered, why these conditions were present in different regions and countries as a whole. To start with, flood forecasting is present in fifteen cases, except for Dordrecht in the Netherlands, Antwerp in Belgium and Slubice in Poland. This means that this condition is present in all of the cases of Sweden, England and France. In Sweden, at the national level, the Meteorological and Hydrological institute provides warning systems. The national level flood warnings are supplemented with local data, knowledge, flood risk maps and systems. In England, flood forecasting and warning is also done at the national level by the Flood Forecasting Centre. In the case of Hull, this national flood forecasting and warning system is supplemented with a local system as well. The same can be stated about the condition in France; it is present at the national level and supplemented at the local level. Considering adequate emergency planning, it is present in all countries, besides the Netherlands, where it is moderately present as well as for the cases of Gothenburg and Nice. In most countries, the regions are obliged by the national government to establish emergency plans, such as the Municipal Safety Plans in France. In the areas, where this condition is moderately present, it is mainly because the plans are not, or not well established, or because there is too little awareness among citizens to adequately participate in the case of an emergency. For the availability of recovery schemes, sort of the same applies as for the previous two; it is handled at a national scale, in the form of insurance. Recovery schemes are only moderately present in the six cases (two countries; Poland and the Netherlands), where insurance against flood risks does not exist. So one of the reasons why these conditions are so well present in many of the cases is partly attributable to the fact that these conditions are mainly handled at the national scale. Therefore, a possible conclusion can be that conditions, which are handled at the national scale and supplemented and/or executed at the local level, will make sure that the conditions to enhance flood risk resilience are present at the regional and country level. Which than could also mean that policy makers should deal with all these governance conditions on the national scale, and then make sure these conditions are supplemented and implemented at the local scale as well.

Next to the conditions, which are present in almost all cases, two conditions are not or badly present at most of the cases. These conditions are the notion among inhabitants that not everybody can be protected from flood risks and climate sensitive and resilient spatial planning. For these conditions the question does also come up; what does this mean? One of the things this could mean is that these conditions are not important. However, in at least two interviews it was explicitly stated that climate sensitive and resilient spatial planning is an important condition. The Swedish researchers for example stated that if spatial planning is more climate sensitive and resilient, this would mean that houses in flood prone areas are better protected against floods, or flood prone regions would not even be developed for housing and businesses. This would make sure that the consequences of flood events will be less than they are now. In the interview with the English researcher, it is mentioned that the development of flood prone areas is sometimes necessary due to a lack of space for urban development and population growth. It is not realistic to prohibit building in these areas. Therefore, climate sensitive and resilient spatial planning is necessary in the form of property level measures. Furthermore, considering the case studies, it came forward in quite a few cases, that economic

development (in flood prone areas) has a higher priority for a region, than to implement spatial plans that prohibit developing in very vulnerable regions. Therefore, it can be argued that national governments, or maybe even the EU in case of European regions, should establish policies that the local and regional level are obliged to adopt flood risks in spatial planning. If this is not handled at a higher government level than the local level, it probably means that the local levels will always give more priority to development than to flood risks, because it will compete on the development with neighbouring regions. Besides, climate sensitive and resilient spatial planning, it also came forward in the documents of STAR-FLOOD as well as in the interviews that many regions tried to increase the awareness of inhabitants about the fact that floods can occur and the state is not always able to protect its citizens against these floods. That citizens are aware of this is seen as important, because citizens will probably be more eager to implement property level measures, with this awareness, but will also participate more adequately in for example emergency management. The problem with the awareness is in many cases, that citizens have the feeling that the state should and will protect them against flooding. One of the reasons is that citizens argue that they are allowed to live in certain regions, so therefore the state should protect them. Another reason is that citizens feel protected by flood defence measures, which are in place in a large amount of the case studies. Lastly, because citizens did not witness or did not witness many flood events, or they did but think it was a once in a lifetime event and therefore have the feeling that flooding will not occur. In some of the cases government authorities tried to change this laidback attitude, with for example awareness campaigns, but this did not lead to behavioural changes of citizens.

Lastly, there is a great amount of conditions, which score different from case to case. Examples of these conditions are the stakeholder involvement, the use of hybrid solutions, combining structural and non-structural measures and collaboration across government layers with a significant role for the local government. In my opinion, the presence of these conditions differs from case to case, because they are more context specific. This opinion is partly grounded on the basis of statements from the interviewees. For example one of the Dutch interviewees stated that stakeholder involvement is an important condition, but it very much depends on the governance structure of a country. In countries where flood risk governance is mainly handled at the national scale, stakeholder involvement might be less important than when it is a local government matter. Concerning hybrid solutions, combining structural and non-structural solutions, it is mentioned by the Belgian interviewee that it is less important that all strategies are combined, it is more important that the best combination of strategies (might be without using all of them) is chosen for a region. The Polish interviewees added that it is also not always possible to protect regions with hybrid measures, some regions are so flood prone, that defence by itself can be the best solution. Although in my opinion, this should always be supplemented with some other conditions, such as adequate emergency planning, to have a backup, if flood defence fails.

## 10.2 Conditions in general

In chapter 2, a list of governance conditions was established that should enhance the flood resilience of urban areas according to academic literature and research. This was the following list:

- **Collaboration across government layers, with a significant role for the local government** (Brown et al., 2012; Mees et al., 2014; Muller, 2007; Van Herk et al., 2011; Van Leeuwen et al., 2015; Vedeld et al., 2015);

- **Stakeholders are involved throughout the policy process** (Brown et al., 2012; Djordjević et al., 2011; Muller, 2007; Mees et al., 2014; Vedeld et al., 2015)
- **Mechanisms are in place to facilitate learning and knowledge exchange** (Brown et al., 2012; Djordjević et al., 2011; Muller, 2007; Van Herk et al., 2011; Vedeld et al., 2015);
- **Flood prone areas are protected by hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)** (Aerts et al., 2013; Brown et al., 2012; Hegger et al., 2014; Ocio et al., 2015; Van Herk et al., 2011);
- **Future risks are addressed in long term planning processes** (Vedeld et al., 2015);
- **Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)** (Aerts et al., 2013; Brown et al., 2012; Djordjević et al., 2011; Van Herk et al., 2011)
- **Funding for policy making and implementation is available** (Muller, 2007; Ocio et al., 2015);
- **Flood forecasting is up to date and shows real time risks of flooding** (Brown et al., 2012; Djordjević et al., 2011);
- **Adequate emergency planning is set up to evacuate people in case of flooding** (Brown et al., 2012);
- **Opportunities are created for innovation and experimentation** (Djordjević et al., 2011);
- **Inhabitants of flood prone regions should have the notion that not everybody can be protected from flood risks** (Djordjević et al., 2011; Ocio et al., 2015);
- **Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding** (Brown et al., 2012; Muller, 2007).

In the interviews, the interviewees commented on the completeness of this list of governance conditions to enhance urban flood resilience and the importance of the conditions. Most of the interviewees stated that the list was complete. However, it was mentioned by the interviewees on the Dutch cases that risk communication by the government towards citizens; informing citizens about the risks they have in a certain region and what they can do to protect themselves, should be added as a condition. The Belgian interviewee stated that a condition should be added that regions should learn from a disaster and evaluate what should be improved. However, this is and can be part of the condition of opportunities for innovation and experimentation. One of the French interviewees stated that coproduction with citizens in flood risk management should be added, as she believes this is a good practice in England and this increases the awareness of flood risks among citizens. Besides adding some conditions to the list of governance conditions, quite a few researchers felt that some conditions need to be altered. To start with, some researchers commented that a significant role for the local government is not always necessary. It is more important that the appropriate level handles flood risk governance, and that the solution fits the problem. In the condition of future risks, it should be mentioned that climate change is one of these future risks. The condition on emergency planning should be changed, because evacuation is not necessary in every emergency situation. The condition about the notion of inhabitants should be changed, so that it is clear that it cannot be guaranteed that citizens are protected. The way it is formulated now, it seems like there is unequal protection across citizens. Furthermore, it should be added at the collaboration, as well as the learning and knowledge exchange condition, that this should be institutionalised. Lastly, it should be made clear that stakeholder involvement includes the involvement of the general public.

Based on the outcomes of my research, a new list of governance conditions to enhance urban flood resilience is presented below. The list starts with the three conditions that are mostly present in the cases, because these might be the most essential conditions. After these three conditions, the two conditions are placed that scored low on the presence, because it turned out that these conditions are of importance, but that progress on these conditions is still necessary to enhance urban flood resilience. The other conditions might be more context specific, as shown in the previous paragraph, and are therefore randomly placed beneath those five conditions.

- Flood forecasting is up to date and shows real time risks of flooding
- Adequate emergency planning is established for flood risks
- Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding
- Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)
- Citizens should have the notion that protection against flood risks cannot be guaranteed
- Vertically and horizontally institutionalised collaboration across government (layers, departments, etc.) and private parties in flood risk governance and coproduction
- Stakeholders (including the general public) are involved throughout the policy process
- Flood risk governance should be handled at the appropriate (hydrological) scale and solutions should fit the problem
- Institutionalised mechanisms are in place to facilitate learning and knowledge exchange
- Flood prone areas are protected by well-fitting (for the region) hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)
- Future risks (including climate change) are addressed in long term planning
- Funding for policy making and implementation is available
- Opportunities are created (for example, because of learning from a flood event) for innovation and experimentation
- Risks of flooding (and other natural disasters) and information on how to protect yourself against these risks are clearly communicated towards citizens

### **10.3 Connection to other literature**

Now that I have established a list of governance conditions to enhance flood resilience in urban areas, based on my research, the next step is to identify if my list of conditions shows some similarities with other research. The research that I will compare my conditions with, is the report of the OECD on the principles of water governance from 2015. According to the OECD water policy is hindered by governance gaps. Therefore, they have established a multi-level governance framework, with good practices to overcome these governance gaps.

The first similarity that can be found is that the OECD (2015) states that due to its characteristics, the water sector is heavily dependent on multi-level governance, which can also be witnessed in my condition on horizontal and vertical collaboration. Next to this, the report states that because the management of freshwater is a local as well as a global concern, many different stakeholders, including private and non-profit stakeholders should be included in the decision making as well as

the policy making process (OECD, 2015). Furthermore, as mentioned, the OECD established principles of good water governance. The figure below shows a representation of these twelve principles.

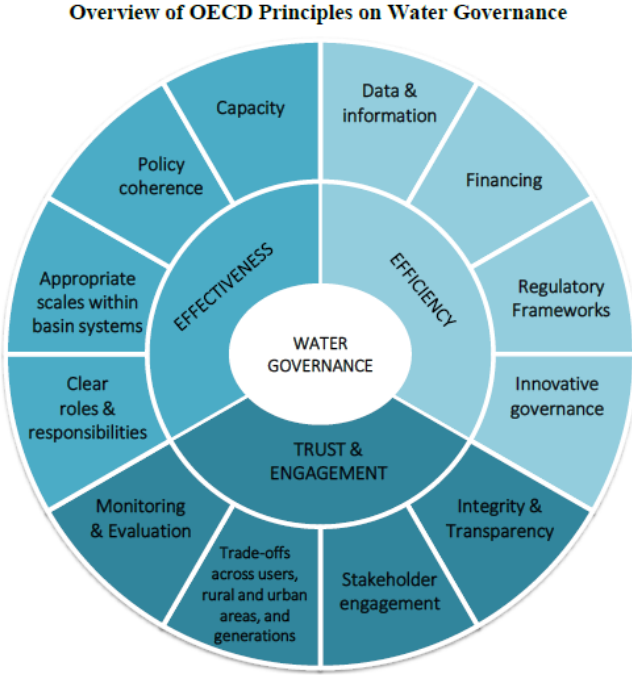


Figure 10.1: The principles on Water Governance of the OECD (OECD, 2015)

There are similarities between my conditions and the Water Governance Principles, in the sense that my conditions can be found in parts of the principles; they are needed to achieve these principles. To start with, the principles to increase the effectiveness, are for example achieved by collaboration across government and private parties, addressing of future risks in long term planning, handling the problem at the right scale and by institutionalised mechanisms to facilitate knowledge exchange and learning (OECD, 2015). The efficiency principles are achieved by for example stakeholder involvement, including the general public, flood forecasting and warning systems (as this is a form of accurate data), the availability of funds for policy making and implementation, the notion by inhabitants that protection against flood risks cannot be guaranteed, risk communication towards citizens and the availability of opportunities for experimentation and innovation (ibid). Lastly the trust and engagement principles should be achieved by stakeholder involvement, including the general public, collaboration across government and private parties and the existence of flood forecasting and warning systems (as this is a form of accurate data (ibid).

Besides the similarities between my conditions and the statements and principles from the OECD report, the OECD also states that in the case of water governance, a solution that fits all challenges globally does not exist. Water governance is rather context specific, which was also argued in the first paragraph of this discussion, and should be adapted to specific countries and regions (OECD, 2015). On the other hand there is also a possible difference between my outcomes and the Water Governance Principles. In the section above it can be noticed that in order to achieve the Water Governance Principles of the OECD, in many cases stakeholder involvement, including the general public, collaboration across government and private parties and flood forecasting and warning systems is needed to achieve the principles. This can possibly mean that the OECD might see these

three conditions as most important conditions or essential conditions, while from these three, only flood forecasting is a possible essential condition based on my research.

#### **10.4 Limitations of the research**

Although it seems that the outcomes of my research are for a big part coherent with the research of the OECD on Water Governance Principles, there are some possible limitations to this research. First of all, due to constraints of being a university student, I did a comparative case study on the STAR-FLOOD project cases, instead of my own new comparative case study. For this reason, my study has led mainly to an enrichment of the STAR-FLOOD project, than to completely new insights based on new material.

Besides the limitation because of the research approach, there might be some limitations to the conducted research itself as well. In order to score the cases on the presence of the conditions from literature, a table was established in which the STAR-FLOOD researchers and I could score all cases a plus, plus/minus or a minus. According to interviewees, it is better to use a scoring table that inhibits four possible choices, but no score in between. The reason is that when there is a possibility to score a plus/minus many people will choose this option. If a score should be awarded on the presence of conditions, this is especially the case, because although conditions might be present, improvements on the presence of these conditions is usually possible. Furthermore, it should be noted, that there was no case in which the researcher(s) of STAR-FLOOD and I awarded exactly the same scores for the presence of all conditions. One of the reasons might be that it can be hard to judge a case by a report. For knowledge on some conditions, it might be better to conduct the case studies yourself. Nonetheless, in the interviews, the differences in scores were discussed, leading to final scores. Here is a limitation as well, in the fact that in the interviews, I mainly focussed on explaining the differences in scores, instead of also discussing, if the scores that were the same for the researcher and me, were also the same in terms of argumentation.

Keeping these limitations in mind, this research is still able to provide some recommendations for policy making and some statements about conditions to enhance the flood resilience of urban areas. Furthermore, new research on enhancing flood resilience of vulnerable regions could use my list of conditions to test them in a complete empirical comparative case study.

## 11. Conclusion

The aim of this thesis was to discover conditions that enhance the resilience of urban flood prone regions and to provide policy makers with recommendation on good practices in flood risk governance. In order to do so, the following main research question was used:

*What governance conditions are necessary for the enhancement of urban flood risk resilience?*

To give an answer to this main research question four sub-question were established and researched in this thesis. The first sub-question was the following:

*What governance conditions contribute to urban flood resilience according to literature?*

From a literature review multiple conditions came forward that should enhance the flood resilience or urban agglomerations. These conditions were combined, which resulted in twelve conditions (see chapter 2 or the discussion for this list). To see if these conditions were important conditions, a comparative case study was executed, in which the presence of these conditions was scored by researchers of the STAR-FLOOD project and by me in the form of a document analysis. Furthermore, interviews with the researchers, within this comparative case study brought forward information on the governance conditions in general (completeness, importance). In this part of the research the following sub-question was answered:

*What conditions of good practices in urban flood risk management can be retrieved from a multiple case study based on the STAR-FLOOD project?*

This led to more insights on good practices in urban flood risk management on the case study and country level, as well as more insights on the conditions to enhance urban flood resilience. These insights are discussed in chapter 4 up to and including 9.

The third sub-question was established in order to compare the different countries and their cases on good practices in flood risk governance and to compare the insights on the list of governance condition. The third sub-question was the following:

*What conditions of good practices in urban flood risk governance can be retrieved from a comparison of the STAR-FLOOD case studies?*

The answer to this sub-question was discussed in the discussion chapter. It turned out that most of the cases score well on the presence of flood forecasting and warning systems, adequate emergency planning and the availability of recovery schemes. All three of these conditions are present in most cases, because it is handled at the national scale. Furthermore, these conditions can be seen as essential conditions, when linking them to the literature on resilience. The conditions of climate sensitive and resilient spatial planning and the notion by inhabitants that not everybody can be protected against flood risks are not present at most of the case studies. This however, does not mean that these conditions are not important for enhancing flood resilience. Climate sensitive and resilient spatial planning is mainly not present, because economic development and urbanisation have the highest priority at the local level. Many local governments see the flood awareness of citizens as an important condition to enhance resilience. Only their efforts to change the behaviour of citizens on this matter are not yet paying off; citizens feel protected by flood defence and argue that the state should protect them against flood risks. The other conditions score different from case



to case and seem to be a bit more context specific. Although it seems like the OECD at least considers stakeholder involvement, including the general public, collaboration across government and private parties and flood forecasting and warning systems as important conditions.

Besides these outcomes of my research on good practices in urban flood risk governance, my research also led to a new list of governance conditions to enhance urban flood resilience. Within this new list, some previously existing conditions are altered, a new condition of risk communication is added and the condition of collaboration and significant role for a certain level are split. Besides, the first five conditions can be seen as most important. The first three are probably essential conditions, while the fourth and fifth are important conditions, from which the presence should be raised. The importance of the presence of the other conditions is more context specific.

- Flood forecasting is up to date and shows real time risks of flooding
- Adequate emergency planning is established for flood risks
- Recovery schemes are available to fund rebuilding and to compensate victims in cases of flooding
- Spatial planning is climate sensitive and resilient (resilient housing, resilient transport system, sustainable drainage and water demand system, responsive health system)
- Citizens should have the notion that protection against flood risks cannot be guaranteed
- Vertically and horizontally institutionalised collaboration across government (layers, departments, etc.) and private parties in flood risk governance and coproduction
- Stakeholders (including the general public) are involved throughout the policy process
- Flood risk governance should be handled at the appropriate (hydrological) scale and solutions should fit the problem
- Institutionalised mechanisms are in place to facilitate learning and knowledge exchange
- Flood prone areas are protected by well-fitting (for the region) hybrid, structural and non-structural solutions, and combining multiple flood risk management strategies (defence, recovery, prevention, mitigation and preparation)
- Future risks (including climate change) are addressed in long term planning
- Funding for policy making and implementation is available
- Opportunities are created (for example, because of learning from a flood event) for innovation and experimentation
- Risks of flooding (and other natural disasters) and information on how to protect yourself against these risks are clearly communicated towards citizens

Lastly, the thesis had the aim to provide recommendations to policy makers on the basis of these conditions and good practices. The sub-question connected to this part is:

*What recommendations can be provided for policy makers in order to deal with urban flood risks?*

The recommendations to policy makers are that flood resilience can be enhanced with the conditions stated above. Special attention should be awarded to the first five conditions; the first three could be essential and climate sensitive and resilient spatial planning and the notion among inhabitants that protection against flood risks cannot be guaranteed should be raised. These are important conditions, but not enough present. The presence of climate sensitive and resilient spatial planning might increase if this condition is implemented and handled at a national scale. Handling climate

sensitive and resilient spatial planning might be necessary at the national scale, because without the national scale obliging them to implement regulations on spatial planning, the local level will most probably still prefer economic development and urbanisation pressures above for example flood risks. Furthermore, the other conditions should be implemented dependent on the context of a certain region or country. There is no solution that fits all.

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## Appendix 1: List of interviewees

### *The Netherlands*

- Maria Kaufmann for the cases of Zuidplaspolder and Nijmegen
- Willemijn van Doorn-Hoekveld for the case of Dordrecht

### *Belgium*

- Hannelore Mees for the cases of Antwerp, Lessines and Geraardsbergen

### *Sweden*

- Elin Spegel and Susana Goytia Casermeiro for the cases on Karlstad, Gothenburg and Kristianstad

### *Poland*

- Adam Chorynski and Jakub Lewandowski for the cases on Poznan County, Slubice City and Wroclaw City

### *England*

- Meghan Alexander for the cases of the Hull & Haltemprice Catchment, Lower Thames and the River Thames Schemes and the City of Leeds

### *France*

- Lisa Lévy for the case of Nevers
- For the case of Le Havre, no interview was conducted
- Sivia Bruzzone for the case of Nice