IMPROVING THE REGULATORY FRAMEWORK OF FLOODPLAIN DEVELOPMENT AND MANAGEMENT IN THE UNITED KINGDOM

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Thank you all.

Dedication

I would like to dedicate this research to my mother

List of Abbreviations

ABI	Association of British Insurers
CCC	Committee on Climate Change
CRED	Centre for Research on the Epidemiology of Disasters
CSR	Corporate social responsibility
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EU	European Union
IDB	Internal drainage board
IPCC	Intergovernmental Panel on Climate Change
LLFA	Lead Local Flood Authority
PPG	Planning Practice Guidance
PPS	Planning Policy Statement
POST	Parliamentary Office of Science and Technology
RFCC	Regional Flood and Coastal Committee
RIBA	Royal Institute of British Architects
UNECE	United Nations Economic Commission for Europe
UNISDR	United Nations International Strategy for Disaster Reduction
WHO	World Health Organisation

Abstract

The Flood Risk Management Framework is a means through which flood risk management is achieved with the aim of mitigating the impact of flooding on communities. Within the United Kingdom, this is achieved through a mixture of legislation, directives, regulations and guidance notes. Flooding is set to increase in the future due to factors such as climate change. The damage caused by such natural disasters accounts for an estimated £1.1 billion of annual expenditure in the UK. In response, tools such as insurance, adaptations and funding are used to manage the level of risk. The Environment Agency has a strategy for properties to become resilient by 2050 and works with risk management authorities to achieve this goal. Floodplains are particularly vulnerable to flooding hazards, exposing developments there to risk. This research aims to address this risk by providing recommendations on the regulatory framework of floodplain development in the UK, with the goal of improving resilience measures through the use of regulations and guidelines as part of flood response.

A pragmatic research philosophy has been adopted, with legal research being part of an extensive literature review. This explorative research follows a mixed methodology, utilising a case study and survey-based strategy. This involved the gathering of 101 questionnaire responses from two communities situated on floodplains in the UK, alongside six semi-structured interviews for expert opinion. The research identifies a number of factors, including insurance, a lack of clarity at certain levels regarding flood risk, insufficient resilience measures and funding, which impair the effectiveness of the flood risk management framework. In addition, there is a reactive response towards flood risk that occurs post-disaster, further affecting the development of resilience. These challenges, alongside the growing risk of flooding, aggravate the risk to floodplain developments unless resilience is factored as part of the wider risk management framework. This research therefore recommends that the framework place a greater emphasis on resilience as the ultimate objective, promoting a more holistic view of flood risk management.

Chapter 1: Introduction

1.1. Research Background

The frequency of flooding makes it an important focus for research. Guha-Sapir et al. (2010) identify floods as the most common form of natural disaster, both worldwide and in Europe. The effects of flooding are wide ranging and many communities are likely to suffer them. According to the UK Department for Communities and Local Government (2009), some water flows are natural and result in the promotion of watercourses, while others can be more damaging due to extreme weather conditions. Riverine and coastal floodplains occupy 12% of the area of England and have been populated for centuries, now accounting for 8% of land with property developments (CCC, 2012). Flooding impacts infrastructure such as energy, water and communications (EA, 2009) and disrupts agricultural and recreational activities (Met Office, 2014). Flood damage can be extensive and floodplains are especially prone to this natural hazard. According to the Environment Agency (EA, 2015), floodplains *"would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas"*. In 2009, it was estimated that 2.4 million properties were situated on floodplains (EA, 2009; National Audit Office [NAO], 2014), representing a natural risk of flood damage whose full extent can be determined only post-disaster but which include disruption in the community, damage to structures and the loss of human lives.

The various kinds of natural hazard include earthquakes and tornados in addition to flooding (Rapp, 2011). Such events can cause loss of life, damage to property and disruption of society (UNISDR, 2007). The potential impact of a natural hazard on human beings corresponds to the risk of a disaster. Collins (2014) states that the risk of disaster to an individual or community is linked to the exposure and vulnerability towards an *"emerging or resurgent hazard"*. The increasing frequency and intensity of natural disasters has resulted in a similar increase in the numbers of deaths and of people affected, and in disruption to human life. On average, floods killed over 100,000 people worldwide and caused more than US$ 100 billion in damage each year between 2001 and 2010 (Guha-Sapir et al., 2012). Flooding accounted for 47% of all weather-related disasters from 1995-2015, affecting 2.5 billion people, the majority of whom resided in Asia (UNISDR, 2015). A report by the Centre for Research on the Epidemiology of Disasters (CRED, 2019) indicates that on average, annual floods cause 5,039 deaths. Thus, natural disasters have a devastating impact on society and the environment (Bayrak, 2009;

Brown et al., 2018). To combat these risks, efforts are made to mitigate the impact of flooding. Such mitigation takes the form of disaster management seeking either to avoid or to reduce the potential losses from the hazard. This can take the form of assisting the disaster victims and bringing about rapid response, along with an effective recovery effort (Warfield, 2004). In short, disaster management aims to avoid, adapt or control the effects of hazards. Wisner (2003) states that disasters are a *"complex mix of natural hazards and human action"*. The United Nations International Strategy for Disaster Reduction (UNISDR, 2017) notes that a disaster is composed of a combination of factors and that disaster risk has multiple aspects. Its two principal elements are first, the likelihood of the occurrence of an extreme hazard event, which is caused by natural forces or by a combination of natural forces and human interference, and second, the extent of its effect on something or someone (Holt, 2012). These two elements together form the basis of a disaster risk.

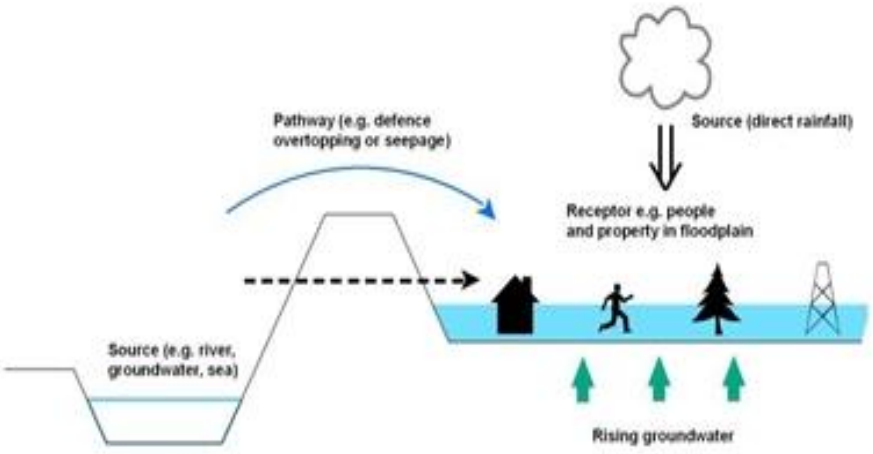

Figure 1: Sources of flooding *(Source: Ogunyoye and Filkweert, 2009)*

Flooding is a natural hazard that may arise from a variety of sources, such as a river or groundwater, as shown in Figure 1. The United Nations states that, *"flooding can arise from an overflowing river, heavy rainfall over the short period or an unusual inflow of sea water onto land, such as storm surge, tidal flooding, seismic events (tsunami) or large landslide"* (Proverbs and Mambretti, 2012: 156). Floods can impact human life and society and constitute a growing risk to populations, particularly those in floodplain areas. According to the UN (2004), they have the greatest potential for damage among natural disasters and affect a large number of people. Flooding can be defined as the overflow of large quantities of water and its impact on dry land. The associated dangers are manifold and floods are capable of devastating

entire communities. Thus, Fleming (2002) states that, *"floods are a natural occurrence and the risk they pose is wide ranging. However, for society, the main focus is the risk to people and property."* Floodwaters directly harm people, whilst also destroying both residential and commercial properties. The societal impact arises from damage to transportation and communication links, impairment of agricultural assets and also damage to the environment. In addition, the potential aftereffects of flooding include health risks caused by pollution and water-borne diseases (Marriott et al., 1999; Warrel et al., 2010; WHO, 2016). Figure 2 shows that flooding is globally the most common of the natural disasters, accounting for 42% of such events.

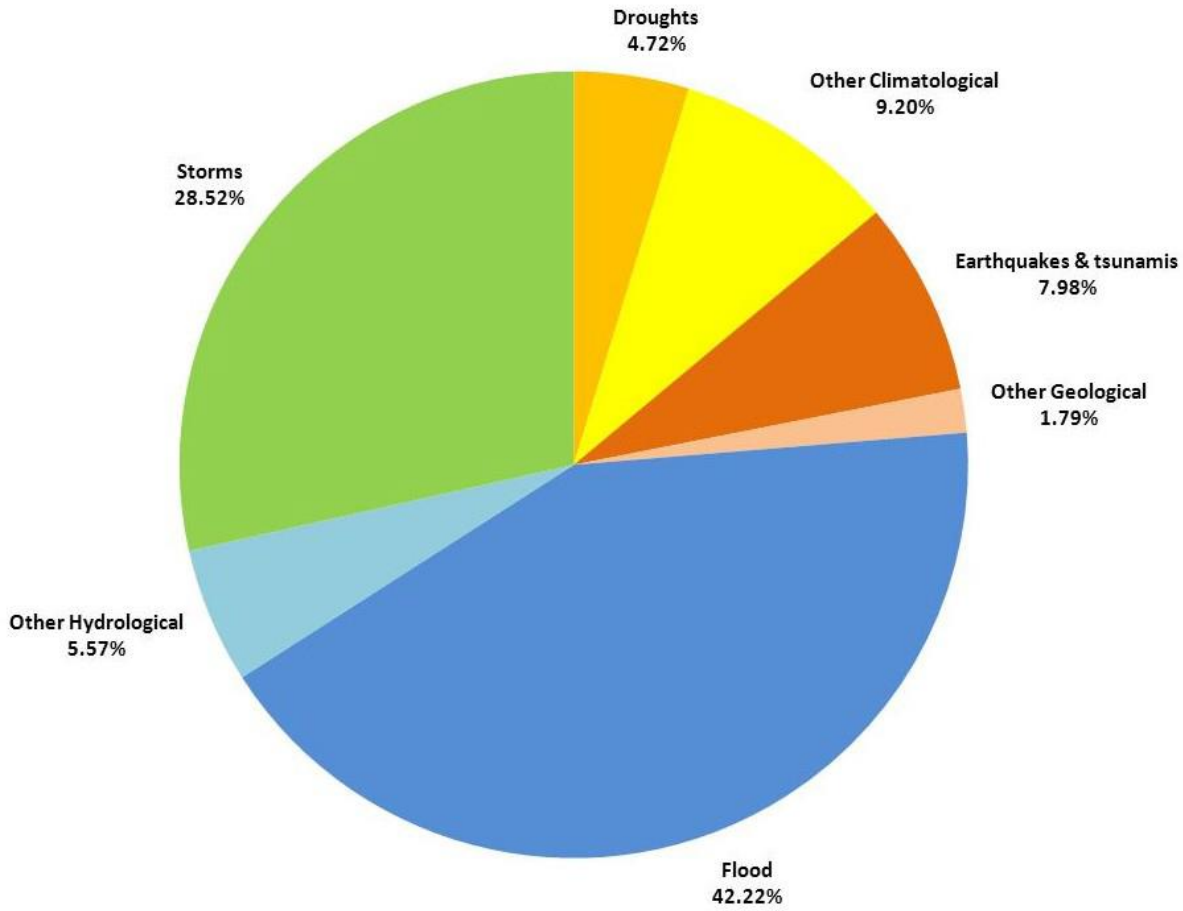

Figure 2: Global occurrence of natural disasters (1993-2012) *(Source: CRED, 2013)*

In response, flood defences have been created to reduce the risk of flooding and so to protect property and safeguard life (NAO, 2001). In the UK, parliament, the regulatory authorities and the courts have recognised the dangers of flooding and attempted to address them through regulatory frameworks. The legal approach adopted was established in the case of Arscott v.

the Coal Authority (2004), where the court found that flooding was as a 'common enemy' that needed to be prevented. This involved taking action both to reduce the likelihood of flooding and to mitigate its impact. The strategic overview and management of flooding lies with regulatory bodies such as the EA and Lead Local Flood Authorities (LLFAs) (Defra, 2014a), which offer guidance to owners on measures to protect their homes. Legislation such as the Flood and Water Management Act (2010) provide the framework for flood management. The regulatory framework, in turn, seeks to create a system of guidance with regard to managing development in floodplains, i.e. areas near bodies of water that are naturally prone to flooding. Ultimately, flooding is not completely avoidable; the general approach is therefore to manage risk (Schanze, Zeman and Marsalek, 2007). The Royal Institute of British Architects (RIBA, 2009) states that in the UK, the EA operates as the statutory consultee on all new developments on floodplains. It offers guidance and operates as part of the regulatory framework in managing the associated risks. The EA guidance states that the primary means of reducing flood risk is locating property away from floodplains (EA, 2009). It is a requirement that local authorities consult with the EA during planning applications when a proposed development could carry a risk of flooding.

Recent research has revealed a growing risk of flooding as the result of climate change, making an effective flood risk management framework ever more urgent yet difficult to achieve. In fact, figures in government recently stated that the current flood risk management strategies were 'fragmented' (House of Commons, 2016). Thus, a more holistic approach is needed in order to create a more effective risk management framework that would mitigate the effects of flooding. Two available tools are law and policy, the foundation for guidelines on flood risk management. Mehryar and Surminski (2020) highlight the importance of legislation in flood risk management. Thus, this research examines the role of law as a tool in bringing about change to the existing flood risk management framework.

1.2. Justification of Research

In 2012, a report by the Committee on Climate Change (CCC), an independent statutory body advising the UK government, stated that flood damage was expected to increase across the UK in the future (CCC, 2012). Flood damage costs £1.1 billion per year in England (Bennett and Hartwell-Naguib, 2014). In 2000, approximately 10,000 properties in England and Wales suffered from flooding and weather-related insurance claims totalling around £1 billion (Parliamentary Office of Science and Technology [POST], 2001). Within the UK, an estimated

5.8 million properties (nearly 20%) have been found to be at risk of flooding (Defra, 2013). After the 2007 floods, the government implemented the recommendations of the Pitt Review to improve management regulations (Defra, 2012). The review highlighted elements of flood response that hindered effective management of risk and called for improvements to the regulatory framework by consolidating legislation and providing clear guidelines to mitigate flood risk. Among the recommendations were that legislation should encompass all elements of flood risk and that the EA should play a greater role in assessing flood hazards. The recommendations were incorporated into policy, with 43 being implemented whilst a further 46 were progressing, in response to the dangers of flooding that were ever present and set to increase due to man-made developments. In 2009, it was estimated that 2.4 million properties were situated on floodplains (EA, 2009). Three years later, the CCC stated that floodplain development had grown rapidly in the past ten years, noting that although 80% of floodplain developments were in well-protected locations, this left one in five properties built in such areas suffering from a significant flood risk (CCC, 2012). The number of homes built in flood risk areas had risen by a third in 2013 as compared to the previous year (RIBA, 2014). Under the Climate Change Act (2008), there existed a general duty to adapt and mitigate the dangers posed by climate change, with local authorities required to conduct 'active strategies' to achieve this goal. As climate change could increase flooding, these strategies sought to promote a policy of adaptation. Nonetheless, the danger of flooding persisted, with certain areas experiencing it on a more regular basis.

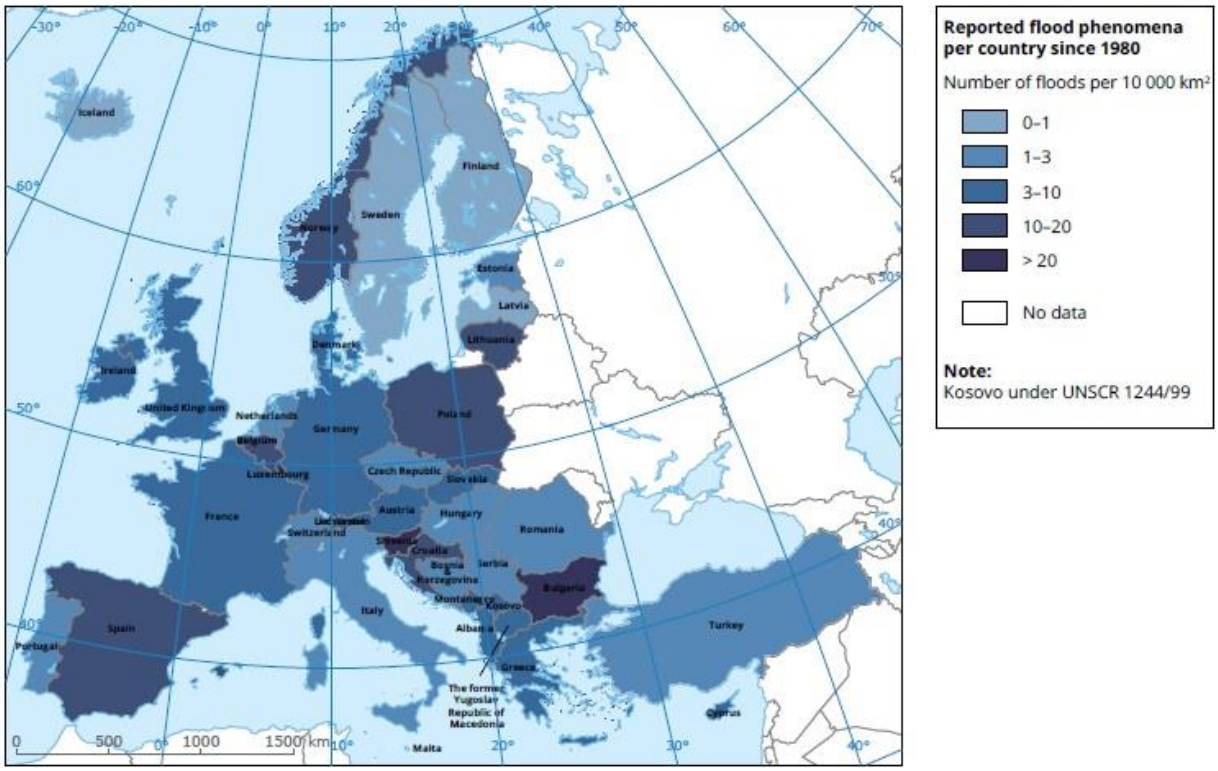

Figure 3: Reported flood phenomena (number of floods per 10,000 km^2) by country (since 1980)
(Source: European Environment Agency, 2015)

As indicated in Figure 3, flooding is a frequent occurrence in the UK, with 3-10 phenomena per 10,000 square kilometres between 1980 and 2015, constituting a regular hazard impacting the country. Flood risk management was identified as a national priority area of development between 2012 and 2017 (HM Government, 2012), because flooding was regarded as one of the worst threats to face the country and the risk would only increase in the future (Defra, 2015). Recommendations from a report in 2007 led to the creation of the Flood and Water Management Act (2010), which applied a regulatory framework to flood risk management policy in England. Mitigation of flood damage was achieved through the implementation of regulations on the management of flood risk, particularly on floodplains, which face an added threat of harm from flooding incidents. According to Hall et al. (2003), the strategy behind flood risk management was to review prior decisions in order to, *"reduce, control, accept, or redistribute risks of flooding"*. As such, it distinguished itself from flood defence, as it sought to mitigate the impact, rather than avoid it entirely, as part of a scheme to reduce flood risk. Flood risk management has been described as moving towards a continuous holistic approach emphasising the need to analyse, assess and mitigate risk on a catchment scale (Schanze et al., 2007; Johnson and Priest, 2008; United Nations Economic Commission for Europe [UNECE], 2009; Sayers et al., 2013). Despite such features, there have been significant cases of damage

to properties as a result of flooding, prompting calls for a more holistic approach to responding to flood risk. In addition, climate change has been identified as increasing the threat of flooding in the future and there exists a duty in legislation to mitigate the effects of this hazard. The Bonfield Report found that sustained rain in 2016 caused extensive damage across the country, with 17,000 properties being flooded and costs expected to amount to £1.3 billion (Defra, 2016). In 2018, Storm Callum was responsible for the worst flooding in Wales for the last 30 years, while 2,000 homes and businesses in Scotland lost power due to breaches in flood defences (BBC, 2018). Further significant flooding in 2019 caused disruptions to travel across the UK (BBC, 2019). In 2019, Storm Dennis resulted in a woman being swept away by floodwater in Worcestershire and over 1,400 properties being flooded across several counties (House of Commons, 2020). Given the considerable impact of flooding, further investigation was evidently needed into the framework of floodplain management in the UK.

Flooding takes a variety of forms, such as overflowing water from rivers/coast or surface water (see 2.2.1 for types of flooding). The response to the hazard was to manage it through policy and legislation, using regulation as a tool to mitigate the ever-present danger of flooding. According to the UK Climate Projections (Defra, 2009), floods were deemed a certainty and were among the extreme events that would affect the country with greater frequency in the future. A formal Climate Change Risk Assessment (Gov, 2012) indicated that the UK was already vulnerable to extreme weather changes, such as those generated by flooding and heatwaves. With regard to flooding, the National Planning Policy Framework provided a set of guidance in relation to floodplain development. It stated that, *"inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere"* (DCLG, 2012: 2). This highlighted the key goal of avoiding developments that could suffer from a flood risk, should they be made in areas designated as being inappropriate due to the natural hazard. However, it also stated that developments could be made so long as safety measures were taken in case of flooding. An Environmental Audit report (House of Commons, 2015: Part 4) noted that the, *"planning system also has a flood defence role to play by minimising development on floodplains and maximising the use of 'sustainable drainage' techniques"*. This shows that there are alternative approaches to flood response which involve management rather than hard engineering-based solutions. Through planning, the framework aims to avoid building in areas of high risk.

Crichton (2012) reported that floodplain development had become easier through a succession of planning policies and that flood defence spending had been reduced. Insurers had sought better control of floodplain development from the government and increased spending on flood defences. This showed that better regulations and guidelines were needed to control flood risk management, including those in the floodplain areas. According to the EA, one in six properties among 5.2 million such residences in England experienced a risk of flooding (EA, 2009; Abbey and Richards, 2016). The expected annual cost of damage to residential and non-residential properties that were at risk from flooding from rivers and the sea was estimated at more than £1 billion (Bennett and Hartwell-Naguib, 2014). The effects of flooding had put 2.4 million properties at risk from rivers or seas, while three million were at risk of flooding from surface water and one million exposed to flood risk from both (Law Society, 2016). This highlights the need for further research into flood risk management. The present research was therefore conceived to provide recommendations towards improving the effectiveness of flood management for developments on floodplains in the UK, in response to the increasing threat of flooding as a result of factors such as climate change. A recent parliamentary report described current strategies as *"fragmented, inefficient and ineffective"* (House of Commons, 2016), although it acknowledged the operation of a number of successful partnerships in flood risk management influencing the effectiveness of the framework, which consists of measures such as mitigation, resilience, response and recovery. This thesis includes a review of legislation, policy, regulations and regulatory bodies, whilst identifying challenges and barriers to the operation of the framework. This research has examined the current flood risk management practices in floodplain regions. Various authors including the Environment, Food and Rural Affairs Committee of the UK House of Commons (EFRAC) have indicated that further research could bring about better management in order to reduce flood risk (EC, 2003; EFRAC, 2008; Koop et al., 2018). Mehryar and Surminski (2020) have also noted that one avenue not yet explored is the role of law in flood risk management. The following section sets out the aim and objectives of this research.

1.3. Aim and Objectives

The aim of this research is to make recommendations for improving the effectiveness of flood management and developments on floodplains in the United Kingdom.

In pursuit of this aim, the research has sought to achieve the following objectives:

- Defining flooding, floodplains and the means by which they are identified.
- Exploring the development of flooding legislation in the UK and offering an overview of duties conferred by the law.
- Examining the regulatory bodies responsible for enforcing the regulations and highlighting their powers.
- Determining the challenges and barriers present within the regulatory framework in relation to flood risk management on floodplains.
- Developing and validating recommendations for improving the flood risk management framework in relation to properties on floodplains.

1.4. Scope of the Study

Given its aim to provide recommendations to improve the floodplain management framework in the UK, the focus of this study is on a particular kind of natural disaster, namely flooding, and more specifically on developments situated on floodplains. By their nature, floodplains are prone to flood events, so properties built on them inevitably have an added risk of flooding. The UK has a framework to manage the threat of flood risk on floodplains, but despite the measures in place, repeated flood events have caused increasing levels of damage in various parts of the country. Such has been their impact that recent cases of flooding have led to calls for a more unified strategy towards flood risk management (House of Commons, 2016). Despite researchers having examined the use of various tools to manage flood risk, including mitigation measures, resilience and recovery measures, taking the form of insurance, adaptation and funding, which have been used to make communities more effective in responding to future flood events, there remain a number of challenges and barriers to their effectiveness.

This study has developed recommendations for improvements to the regulatory framework which are intended to make it more effective. It envisages the implementation of a regulatory framework encompassing law, legislation, policy, guidance and regulations in relation to flooding. The reason for conducting this research was the increasing number of developments on UK floodplains and the recognition that both existing and new developments are exposed to increasing flood risk. Its primary focus is therefore on the floodplains and in order to achieve its aims, it reviews the relevant literature and analyses the experiences of individual participants. The following section outlines the research methodology adopted.

1.5. Research Methodology

Research methodology is the means through which a researcher systematically researches a problem (Kothari, 2009). Goddard and Melville (2004) note that research answers unanswered questions or explores something that did not previously exist. It is the search for knowledge and develops from a certain vision of the world around the researcher. Redman and Mory (1933) define research as the *"systematized effort to gain new knowledge."* This knowledge can come from any research activity, such as theoretical, experimental or observational, but the results have to be substantiated and reproducible (Kennett, 2014). Thiétart (2001) notes that research makes use of certain methods, seeks to produce results and aims at *"predicting, prescribing, understanding, constructions or explaining"*. The use of the different methodologies differentiates types of research and plays a vital role in the overall research strategy (Leedy and Ormrod, 2005). As such, research methodology is the means of resolving a specific research problem. The present study took as its starting point of research design the 'research onion' (Section 3.1, Figure 20), which Saunders et al. (2007) describe as a layered process that aids the researcher in pursuing the aim of the research. A research paradigm was first chosen by considering the respective strengths and weaknesses of the positivist, interpretive and critical paradigms (Mackenzie and Knipe, 2006). For the purpose of this research, interpretivism was chosen on the basis that legal research involves the study of legislation and thus interpretation. Consideration of ontology offered the choice between objectivism and subjectivism (Knight and Ruddock, 2008; Saunders et al., 2009). The interpretive nature of this research was seen to be more closely aligned with subjectivism. A further aspect was pragmatism, which offers researchers flexibility in the means of achieving their objectives (Kelemen and Rumens, 2008). This allowed the researcher a range of options by using the various methodological tools to achieve the research aim. It was decided to take an abductive approach, combining inductive and deductive modes of reasoning (Creswell, 2009; Dawood and Underwood, 2010; Saunders et al., 2012). This was deemed to suit the pragmatic nature of the study, allowing the combination of multiple approaches in order to achieve the research objectives.

In terms of strategy, this research takes an exploratory approach (Saunders et al., 2009), in that it explores the research problem in order to generate recommendations. A further methodological choice is the use of mixed methods, in order to aid the researcher in finding the most appropriate data collection methods and corresponding data analysis techniques. A reason for the adoption of mixed methods was the nature of the study's aim and objectives,

since this methodology allows for the triangulation of various types of data in order to overcome any limitations of a single method. As the goal was to provide recommendations, a qualitative approach was needed, but trends could be better determined through the collection and analysis of quantitative data. A mix of qualitative and quantitative methods was therefore appropriate, providing flexibility in the effective use of both methods of data collection and analysis (Creswell, 2009; Saunders et al., 2012). Saunders et al. (2012) list a variety of research methods, including action research, grounded theory, ethnography and other such strategies. The strategy adopted for the present research was to gather empirical data by means of the mixed survey and case study methods, deployed in parallel with one another. The strategy involved the use of questionnaires and semi-structured interviews as the specific forms of data collection instruments. Their construction and use were based on the literature on flooding, floodplains and floodplain management in the UK. For this research, a target of 10 semi-structured interviews and 150 questionnaires were chosen as a sample base. In total, 101 questionnaire responses were received and seven experts were interviewed, these being deemed acceptable numbers for data analysis. The analysis employed a variety of techniques in order to develop research findings. For the questionnaires, descriptive statistics were used to identify themes from the data, whilst SPSS was utilised to aid in interpreting the results. Similarly, content analysis was used to sift through the interview data and thematic analysis generated common themes among the respondents. This process produced findings that the researcher used in further analysis and became the basis for recommendations for improving the regulatory framework of flood risk management in the UK.

1.6. Thesis Outline

This thesis comprises six chapters with the following content:

- **Chapter 1:** ***Introduction*** – This chapter has set out the nature of the research, provided an overview of the subject matter and offered a justification for the research. A breakdown of the aim and objectives was presented, the scope of the research established and the methodology summarised.
- **Chapter 2:** ***Literature Review*** – The review of relevant literature includes the body of knowledge surrounding natural disasters and flooding, beginning with the definition of terms such as ‘natural disaster’. The second section then details the subject matter of flooding, including flood risk and an examination of the nature of

floodplains. There follows an account of the current UK flood management framework, covering legislation, policy and regulations, as well as the bodies responsible for managing flood risk. These form the basis of flood risk management, as detailed in the fourth section, identifying the regulatory tools utilised by the framework to mitigate flooding. There is then an attempt to identify the major challenges and barriers impeding the effectiveness of the framework and the chapter ends with a summary.

- **Chapter 3: *Research Methodology*** – The methodology adopted by the researcher is set out as per the structure of the 'research onion'. The fundamental parameters are dealt with in terms of research design, philosophy, approach, strategy, research choice and time horizon. This is followed by details of the data collection and analysis techniques adopted, before addressing ethical considerations, credibility and the means of verification of the research.
- **Chapter 4: *Research Findings*** – The fourth chapter presents the data gathered from participants, both quantitative and qualitative, and analyses it in order to develop findings.
- **Chapter 5: *Discussion*** – There follows an in-depth discussion of the key themes emerging from the above analysis, which are examined in detail in the context of the literature review in order to identify possible improvements to the current flood risk management framework that could be adopted by the policymakers. There is then an account of the process of verification undertaken to test whether such improvements might make a valid contribution to flood risk management.
- **Chapter 6: *Conclusion and Recommendations*** – The final chapter summarises the way in which the research has addressed its objectives, sets out its contribution to knowledge and makes recommendations to improve the flood risk management framework. It highlights some limitations of the study and ends by recommending lines of future research.

1.7. Chapter Summary

Flooding is the most common of the natural disasters to affect the UK. Its impact is particularly strongly felt in regions prone to flooding, including those areas adjacent to bodies of water, such as floodplains. Flood risk management is achieved through a framework that consists of policy and legislation, whereby regulatory bodies are empowered to mitigate the impact of

flooding. However, despite such a framework being present, the impact of flooding continues to affect society. This impedes the effectiveness of flood risk management, leading to increased vulnerability to floodplain developments. As such, research is needed into the challenges and barriers to the effectiveness of the current regulatory framework. The goal of this research is to offer regulation as a tool in bringing about a more effective flood management framework. To examine the nature of flooding, an extensive literature review has been conducted as part of this research, in order to depict the background to flood risk management in the UK. The findings of the literature review are presented in the following chapter.

Chapter 2: Literature Review

This chapter presents a review of the literature germane to addressing the research question. As stated by Bruce (1994), *"the literature review forms an important chapter in the thesis, where its purpose is to provide the background to and justification for the research undertaken."* In this case, guided by the research objective the review is of literature on flooding, including an examination of the concepts of vulnerability and exposure to hazard, which constitute the elements of flood risk. The chapter then explores the nature of disaster management, followed by an exploration of the nature of flooding. A consideration of the regulatory aspects of flood risk management, including legislation and the bodies that respond to flooding, leads to an exploration of the various management tools used for the mitigation of flood risk. The review begins by defining and examining the concept of disaster.

2.1. Disasters

The word 'disaster' originates from the Latin for 'bad star' and referred to negative occurrences attributed to misfortune or bad luck (Seneviratne et al., 2010; Lonergan, 2011). Killian (1954) notes the social element, in that disasters break with the social order of events and lead people to act outside their normal pattern of expectations (Rodriguez, Quarantelli and Dynes, 2007). In other words, disasters disrupt society from its normal activities. Thus, Wallace (1956) describes a disaster as an, *"interruption of normally effective procedures for reducing certain tensions, together with a dramatic increase in tensions"* (Rodriguez et al., 2007: 6). This definition, however, considers only the disruption that disasters cause to existing patterns, not their full impact. The World Health Organisation (WHO) defines a disaster as *"a sudden ecological phenomenon of sufficient magnitude to require external assistance"* (Noji, 1997). As such, disastrous events are ones so serious that an affected area cannot cope by itself but requires aid from elsewhere. Moore (1958) asserts that whilst disasters do cause disruption to the social order, an essential element of the definition is the consequential loss of life (Rodriguez et al., 2007). Thus, the elements of life are a key component of a disaster, as these events can lead to human deaths. Hutton (2001) notes that disasters do not affect individuals alone; rather, there is an element of collective stress experienced by humanity.

On the issue of the loss of life, Fritz (1961: 655) states that a disaster is *"an event concentrated in time and space, in which a society, or a relatively self-sufficient subdivision of society, undergoes severe danger and incurs such losses to its members and physical appurtenances*

that the social structure is disrupted and the fulfilment of all or some the essential functions of society are prevented" (Miller and Rivera, 2010: xxxviii). This description of a disaster goes further by noting its impact, namely the loss sustained by members of the community. Sjoberg (1962) notes a further characteristic of a disaster, namely that they are both severe and relatively sudden, resulting in unexpected disruption (Rodriguez et al., 2007). This means that disasters are sudden and unforeseen events having an overwhelming effect on the area impacted. This has led to a more modern definition of a disaster as "a hazard event (natural or induced) that seriously disrupts the normal functions of society and causes widespread human, material, or environmental losses which exceed the ability of the affected society to cope using only its own resources" (Park and Allaby, 2017: 119). Thus, these events on a community level tend to affect a large number of people and disrupt the normal operations of the society. The various components of a disaster such as exposure and vulnerability are the basis of risk, as detailed in the following section.

2.1.1. Disaster Components

As noted, disasters can lead to a disruption of society and cause harm to people. However, there are specific elements of a disaster that lead to the creation of risk. According to Kron (2005), the term 'risk' has been understood in many different ways by different people. The disaster literature describes it as a complex combination of hazard and vulnerability (Blaikie et al., 1994; Fielding, 2007; Woltjer and Kranen, 2011). Thus, in terms of context, it can have a range of meanings. Such a view is expressed by Samuels and Gouldby (2009), who state that the meaning of risk depends on its context, varying with the conditions and the nature of the disaster. This variation is seen as a function of probability and consequence (Evans et al., 2004; Samuels and Gouldby, 2009). All of these factors lead to the development of risk that could impact people, infrastructure and the environment. The UNISDR asserts that a disaster is composed of a combination of factors, working in concert with one another to create the element of risk. Wisner (2003) states that disasters are a *"complex mix of natural hazards and human action"*, consisting of the occurrence of an extreme hazard event caused either by natural forces or by a combination of natural forces and human interference. Thus, these elements are various natural disaster phenomena that are not individually considered disasters at a certain point. The following subsections consider these elements, namely hazards, vulnerability and exposure, that lead to the creation of disaster risk.

2.1.1.1. Hazards

Hazards can be defined as sources of potential harm to a community (Coppola, 2015). By itself, hazard does not constitute a disaster, but operates in combination with other components to create the conditions for a disaster to occur. The UNISDR (2017: 17) defines a hazard as *"a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage"*. This definition refers to potentially damaging physical events caused by phenomena or human activities which result in the loss of life, damage to property, disruption in society and impact on the environment (Makoka and Kaplan, 2005). They can come in a variety of forms including natural, technological or intentional hazards. According to Kates (1978), environmental hazards are, *"the threat potential posed to man or nature by events originating in, or transmitted by, the natural or built environment"* (Smith, 2003: 15). Natural hazards can include a range of sources such as earthquakes, tsunamis, volcanic activity, wildfires and flooding. An essential element in any form of disaster management is the identification of the hazard.

2.1.1.2. Vulnerability

The second and subsequent issue is that of vulnerability to the hazard. Timmerman (1981) sees it as the degree of resistance offered by a social system to the impact of a hazard event. This view is shared by Blaikie et al. (1994), who hold that it is how people respond to disasters. This leads to a definition of vulnerability as *"the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard"* (UNISDR, 2007: 30). As such, it encompassed those who have a diminished capacity to anticipate a hazard. Cutter et al. (2008: 599) states that:

> *vulnerability is the pre-event, inherent characteristics or qualities of social systems that create the potential for harm… Resilience is the ability of a social system to respond and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that facilitate the ability of the social system to re-organize, change, and learn in response to a threat.*

Vulnerability can thus lead to an inability to cope, resist or recover from the damage caused by a natural or man-made hazard. The definition covers not only individuals but also groups.

Wisner et al. (2003) describe it as being the likelihood of a natural hazard bringing about harm and as comprising various factors such as poverty, inequality, class, occupation, ethnicity, gender and social capital; in other words, a range of characteristics that can affect the vulnerable people's ability to anticipate, cope, resist and recover from the effects of a natural hazard. There may be a link between vulnerability and situation-specific events, as noted by Field (2007). Thus, vulnerability is created by exposure to aspects of the environment.

2.1.1.3. Exposure

According to Holt (2012), exposure is the potential of harm to affect something or someone susceptible to natural disasters, such as people and property. The exposure to potential harm of people, property, systems, or functions puts them at risk of loss as a result of the hazard, according to Smith (2003), who argues that a hazard without exposure is simply an event of interest. Exposure can be defined as *"the people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses"* (UNISDR, 2009). An alternative definition is that of Dow (1999: 76): *"Exposure is the degree of risk of an event experienced in everyday life, from the probability of a hazard to actual occurrences of events of all sizes"*. As such, hazard exposure is the probability of occurrence of events manifested in certain locations. According to the Intergovernmental Panel on Climate Change (IPCC, 2012), it is the interaction with a hazard event that causes vulnerability to manifest as an element of risk. Thus, exposure is used to indicate those elements-at-risk that are subject to potential losses.

2.1.1.4. Risk

The various components of a disaster serve as the basis of risk. The literature offers no accepted standard definition of risk, which is typically considered a product of likelihood and consequence (Coppola, 2011: 28). As such, the introduction of risk factors can illuminate the underlying vulnerability present. Thus, risk is defined as a function of hazard, exposure and vulnerability (Holt, 2012), referring to exposure to the hazard, the vulnerability conditions and the inability to cope with the negative effects of the disaster event. Alexander (2000: 13) differentiates between risk and vulnerability:

> *Vulnerability refers to the potential for casualty, destruction, damage, disruption or other form of loss in a particular element; risk combines this with the probable level of loss to be expected from a predictable magnitude of hazard (which can be considered as the manifestation of the agent that produces the loss).* (Wisner, 2003: 50)

As such, these various aspects define a disaster that could lead not only to disruption of the social order but also to economic and environmental degeneration (UNISDR, 2007). Crichton (1999: 102-103) defines risk as *"the probability of a loss"* and states that it *"depends on three elements: hazard, vulnerability, and exposure. If any of these three elements in risk increases or decreases, then the risk increases or decreases respectively"*. He adds that the impact of a disaster could include injuries such as mental or physical harm, disease and death, along with damage to property and assets. The various components that comprise a disaster are illustrated in Figure 4.

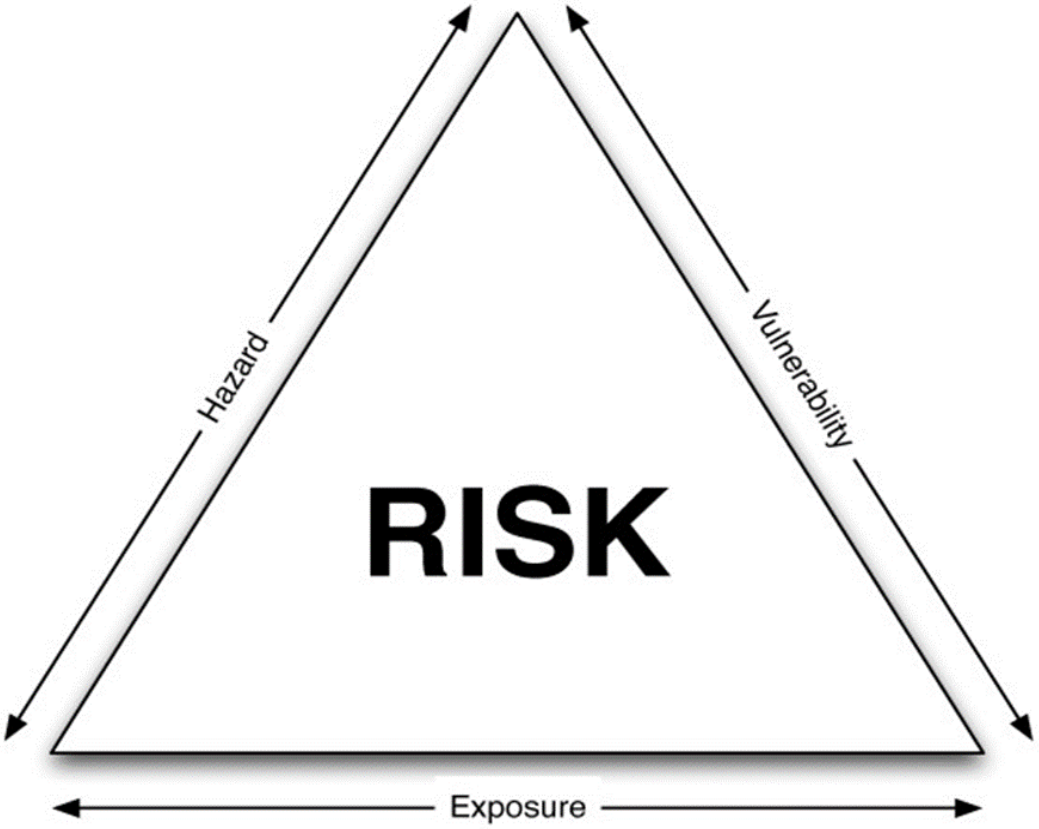

Figure 4: The risk triangle *(Source: Crichton, 1999)*

Risk is generally defined as the expectation of valued losses caused by the hazard. Crichton (1999) refers to the elements of a disaster as forming a 'risk triangle', which Lamond (2011) notes was designed by the insurance industry for catastrophe modelling. According to this risk assessment model, the three elements of risk are hazard, vulnerability and exposure. Wisner (2003) states that disasters are *"a complex mix of natural hazards and human action"*, while the UNISDR notes that a disaster is composed of a combination of factors. Disasters bring about risk when exposure to a hazard brings about vulnerability. The impact of a natural hazard

on human beings creates the risk of a disaster. Disasters are linked to the exposure to an emerging and resurgent hazard that can impact an individual or community (Collins, 2014). Thus, risk consists of the occurrence of an extreme hazard event caused either by natural forces or by a combination of natural forces and human interference. This is followed by exposure to the potential risk, in that that it has to affect something or someone (Holt, 2012). In this way, the three elements of the risk triangle are linked to one another and risk is defined as function of hazard, exposure and vulnerability.

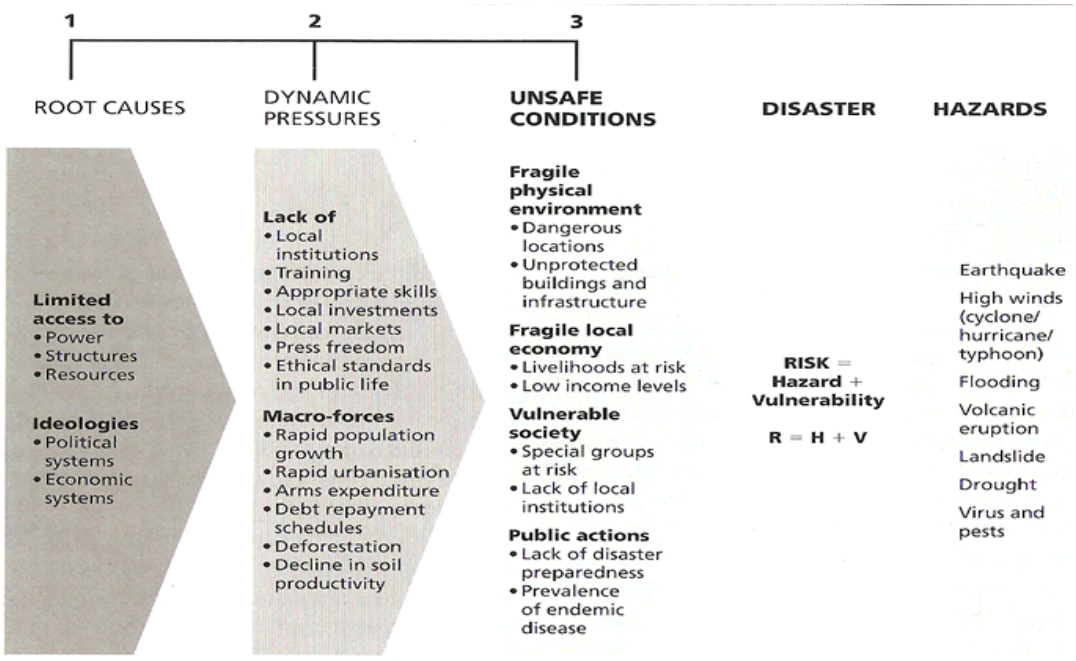

Figure 5: Pressure and release (PAR) model: progress of vulnerability *(Source Wisner, 2003)*

The PAR model detailed in Figure 5 demonstrates how vulnerability is the result of socio-economic pressure and physical exposure to a hazard. As such, it is the combination of vulnerability and exposure that culminate in disaster risk. The model comprises a series of steps that together show the progression of vulnerability. This begins with the two opposing forces of vulnerability and exposure intersecting. Conceptually, the model is said to apply when societal vulnerability is exposed to a natural hazard, creating to the disaster risk, defined as *"potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity"* (UNISDR, 2007: 4). This can lead to harm or damage during a specific period of time. This definition reflects the concept of hazardous events and disasters as having the outcome of continuous conditions of risk. Thus, the only means of reducing risk is to reduce the resultant vulnerability, rather than removing the hazard itself. Risk prevention strategies are produced to combat these threats and to mitigate

vulnerability to natural hazards. In an effort to improve upon measures for managing vulnerability, recent studies have sought to quantify it so that it can be used as a tool of policymaking and planning (Wisner, 2002). The OECD (2006) notes that this effort to reduce the damage can be achieved either through diversification of assets that generate income or insurance that pools risk across multiple agents. Such approaches seed to mitigate damage to incomes and thus reduce the impact on vulnerable people, allowing them to recover more quickly from the hazard.

Natural hazards can include disasters such as earthquakes, tornados and flooding (Rapp, 2011). Such hazards form the basis of risk to those vulnerable to them, with this becoming a danger to individuals being exposed to the disaster. The risk can include harm to persons or impact on infrastructure. These elements form the various components of a disaster. After a disaster, the next stage is that of responding to the incident.

2.1.2. Recovery and Response

The combination of hazard and vulnerability creates risk, making these the elements of a disaster. A vital stage of any disaster cycle is to respond with recovery attempts, many of which seek simply to *"get things back to normal"* (Wisner et al., 2004: 10); in other words, to restore conditions in the area impacted by the disaster to the way they were before it occurred. However, Wisner et al. (2004) warn that these recovery efforts, by merely restoring the state prior to the disaster, fail to consider the vulnerability that created the potential for the disaster to occur in the first place. By acknowledging the vulnerabilities inherent in the area, steps can be taken to rectify the underlying problem and prevent the disaster from having a similar level of impact in the future (Anderson and Woodrow, 1998). Thus, disaster response covers not simply recovery operations, but steps to mitigate the effect in the future. The concept of mitigation forms part of the disaster management cycle. This concept was taken into account in frameworks derived from lessons learnt in combating disasters in the past. Such developments led to the creation of guidelines, policies and laws which were created to respond to disasters.

Disaster response has a history of frameworks to protect the environment, with the first case of this in modern times being Principle 21 of the Stockholm Declaration, part of the Declaration of the United Nations Conference on Human Environment in 1972:

> *States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.* (Sands, 2003: 235)

As such, nations had not only the right to exploit their resources but also a responsibility to do so without damaging the environment. Thus, environmental protection became a factor, although prevention was not necessarily considered. This was later reinforced in 1992 by the Rio Declaration, whose Principle 2 focuses on disaster management. The concept of disaster prevention arose from a growing awareness and recognition of the effects of natural disasters in the 1990s (de Guttry et al., 2012). In 1994, the Yokohama Strategy sought to integrate prevention into a comprehensive strategy towards natural disasters.

Principle 2 of the Rio Declaration states: *"Disaster prevention and preparedness are of primary importance in reducing the need for disaster relief"*. The aim was to reduce the effects of natural disaster by encouraging preparedness. Principle 3 asserts the importance of Principle 2 being part of disaster policy at all levels of preventative strategy. Such a focus on an integrated approach towards prevention is shown in Principle 6: *"Preventive measures are most effective when they involve participation at all levels, from the local community through the national government to the regional and international level"* (Becker, 2014: 45). The need to combat vulnerability is mentioned in Principle 7, which states that it can be reduced through proper design and patterns of development. Principle 9 emphasises the link between environmental protection, sustainable development and natural disaster prevention. Thus, disaster response and prevention have experienced a history of development over the years and into the modern age. The goal has been to combat vulnerability and improve responses to disasters.

The principle of disaster prevention has developed in international law. The International Law Commission declared in 2007 that *"it involves an obligation to act in a setting where the imperative to do so is not necessarily present"* (de Guttry et al., 2012). Thus, a duty of prevention was created, giving rise to response mechanisms designed to recover from the damage resulting from a disaster. Sudmeier-Riuex and Ash (2009) list several reasons for the integration of ecosystems with disaster management: (a) they reduce vulnerability to natural disasters; (b) natural disasters have high costs; (c) it cost less to prevent disasters than it does

to repair the damage caused; (d) populations at risk of natural disasters are dependent on the ecosystem and its services for their livelihoods and (e) natural disasters and the responses to them have a negative impact on biodiversity (Shaw and Tran, 2009). Globally, disasters have affected all corners of the world, as Figure 6 illustrates.

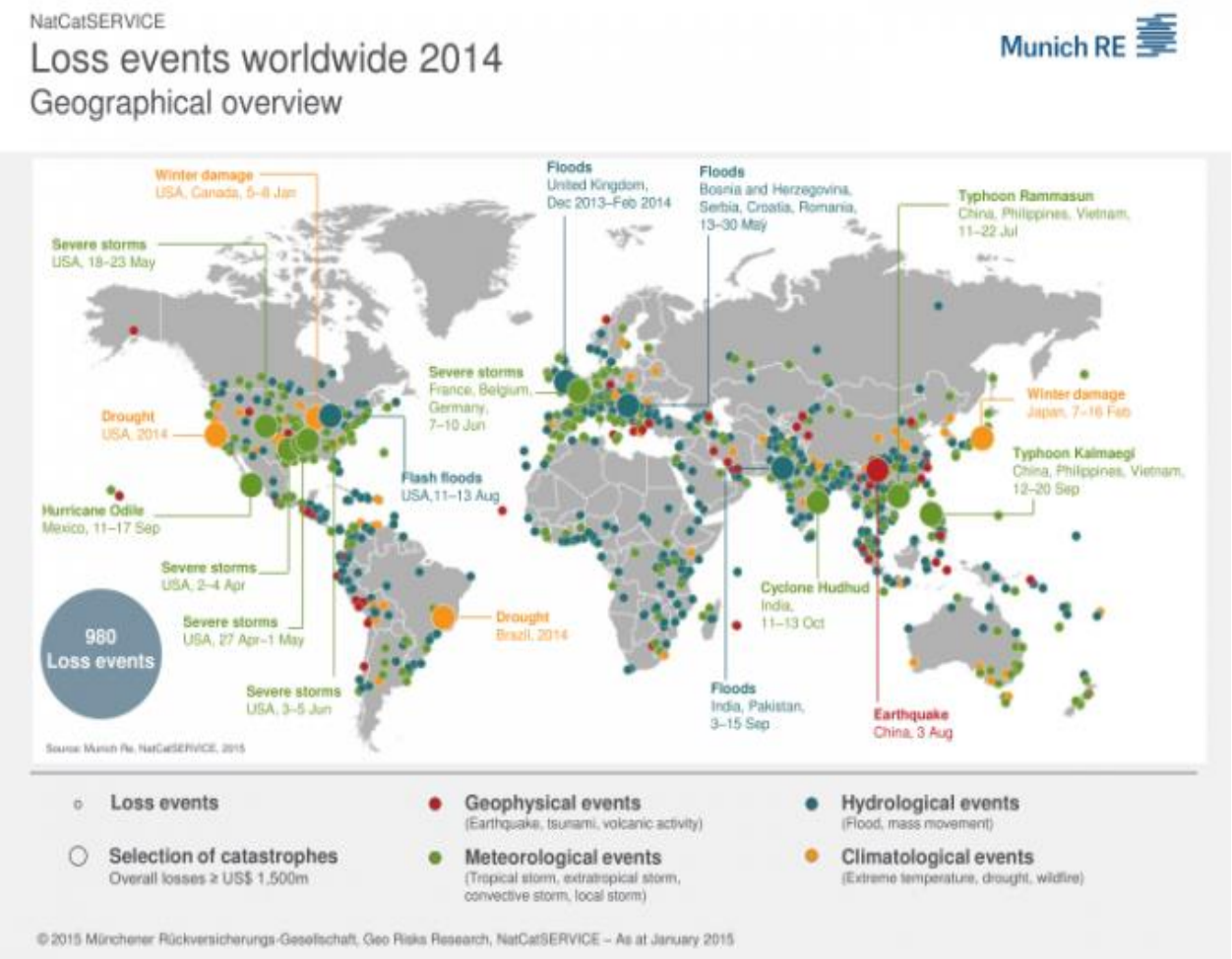

Figure 6: Worldwide losses 2014 *(Source: PreventionWeb, 2015)*

As noted in Figure 6, there were 980 'loss events' affecting the world in 2014 alone. Although their effects were largely negative, disasters can also have some positive results (Statler et al., 2011). According to the UNISDR (2002: 21), *"a disaster with all its negative consequences offers a good opportunity to formulate forward-looking policy concepts pertaining to social development and equity, economic growth, environmental quality and justice, i.e. sustainability"* (Collins et al., 2015). Statler and Penuel (2011) note that 75% of legislation on disaster risk reduction has been created in response to specific events. Generally, natural disaster events cannot be prevented as such, but the impact and damage they inflict can be reduced. Proverbs and Mambretti (2012: 6) cite the UNISDR as describing risk management

as a cycle consisting of *"the systematic process, administrative decisions, organisation, operational skills and abilities to implement policies, strategies and coping capacities of the society and communities to lessen impact of natural hazards and related environmental and technological disasters."* It is this chain of events that has led to disaster risk management using methods such as disaster risk reduction, which is the practice of reducing disaster risks through the use of analysis and management of causal factors. The aim of this approach is to lessen exposure to hazards and reduce the vulnerability of people and assets, whilst making effective use of land and better preparation for further adverse events (UNISDR, 2009). An alternative to disaster risk reduction is climate change adaptation, which involves alterations to natural or man-made systems in response to actual or expected climatic changes or their potential effects. The aim is to moderate the harm caused by climate change or possibly to make use of any beneficial opportunities (IPCC, 2007), thus creating preventative systems designed to reduce the harm caused by disasters.

To combat disasters, a further strategy is that of disaster reduction, defined by the UNISDR (2007: 10) as *"the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessen vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events"*. As such, this consists of efforts designed to address the factors that bring about the hazard and lessen their impact as a result. Field et al. (2012) note the need to understand vulnerability in order to manage risk effectively. In fact, by understanding a disaster event, the response could be better prepared in combating the disaster. As such, following a disaster event, knowledge must be gleaned on how to mitigate such damage in future occurrences. A report by the World Bank (2010) concludes that (1) disasters expose the implications of earlier decisions; (2) prevention is often possible and cost-effective; (3) private and public measures must work well together to bring about effective prevention and (4) exposure to hazards will rise in cities, but this does not necessarily mean an increase in vulnerability. There were indications a decade ago that the rate of occurrence of disasters and disaster risk had increased in the previous five decades (Munich Re, 2011). Tools such as flood warnings, forecasting, effective land management, community preparedness and evacuation planning were seen as being as essential as engineered river and coastal defences in combating the threat of flooding (Warrell, Cox and Firth, 2010). Climate change predictions now suggest that hazards such as droughts, intense flooding and severe storms will become more prevalent and widespread with decaying base conditions only increasing the impact of

these disasters (Collins et al., 2014; Mehryar and Surminski, 2020). Among the notable types of natural disasters is flooding, which has had an impact across the world. The basis for this research is that flooding is globally among the most frequent and destructive of natural hazards. The aim of mitigation strategies is to reduce the cost in terms of life and damage done by the hazard. The following section examines the nature of disaster management, as this research aims to provide recommendations to improve flood risk management in the UK.

2.1.3. Disaster Management

Since the 1930s, there have been numerous studies into the nature and phases of disasters (Neal, 1997). This has slowly and steadily improved understanding and generated a large body of literature on the subject. According to Noji (1997), it was thought that disasters often occurred as cycles. Mohamad et al. (2007) state that each disaster follows a general pattern of development. Such patterns are often repeated in nature and can be divided into various phases, such as impact, rescue and recovery. This can mean that existing infrastructure suffers as a result of the cyclic nature of natural disasters, as structures are weakened by disasters and need reconstruction in order that defences avoid further damage which might otherwise render them ineffective. In other words, weak mitigation efforts may lead to existing defences being overwhelmed by subsequent disasters. McDonald (2003) cites a number of reasons for the increased occurrence of disasters, such as increased population moving into vulnerable areas, economic decisions that delay or cancel essential maintenance of infrastructure and mankind's influence over the environment, which can potentially increase risk (Rapp, 2011). The growth of the human population increases the potential risk, with a greater level of exposure to hazards. Then, when a disaster occurs, it impacts the larger human population. Management of disasters is a key tool when examining the factors of risk (Coppola, 2011). To combat the above danger, a number of responses have been developed over the years with the aim of mitigating the damage caused by natural disasters. These stages are referred to as disaster risk management.

Disaster management is the organisation and management of resources used in responding to disaster events. Park and Allaby (2017: 242) define it as *"a comprehensive approach to reducing the adverse impacts of particular disasters (natural or otherwise) that brings together in a disaster plan all of the actions that need to be taken before, during, immediately after, and well after the disaster event"*. The goal is to use preparation, response and recovery to mitigate the impact of a disaster. The increasing frequency and intensity of natural disasters results in a

similar increase in the numbers of deaths, people affected, disruption to human life and devastating impacts on the economy, as well as the environment (Bayrak, 2009). In order to combat these risks, efforts are needed to mitigate their impact. Such mitigation takes the form of disaster management that seeks either to avoid or to reduce the potential losses from the hazard. This can take the form of assisting disaster victims and bringing about rapid and effective recovery efforts (Warfield, 2004). Thus, disaster management takes the form of systematic organisation and there is a role for institutions with responsibility for dealing with disasters (Quarantelli, 1988; Wisner et al., 2004; UNISDR, 2009). It operates, in other words, through formal bodies that work to manage the disaster.

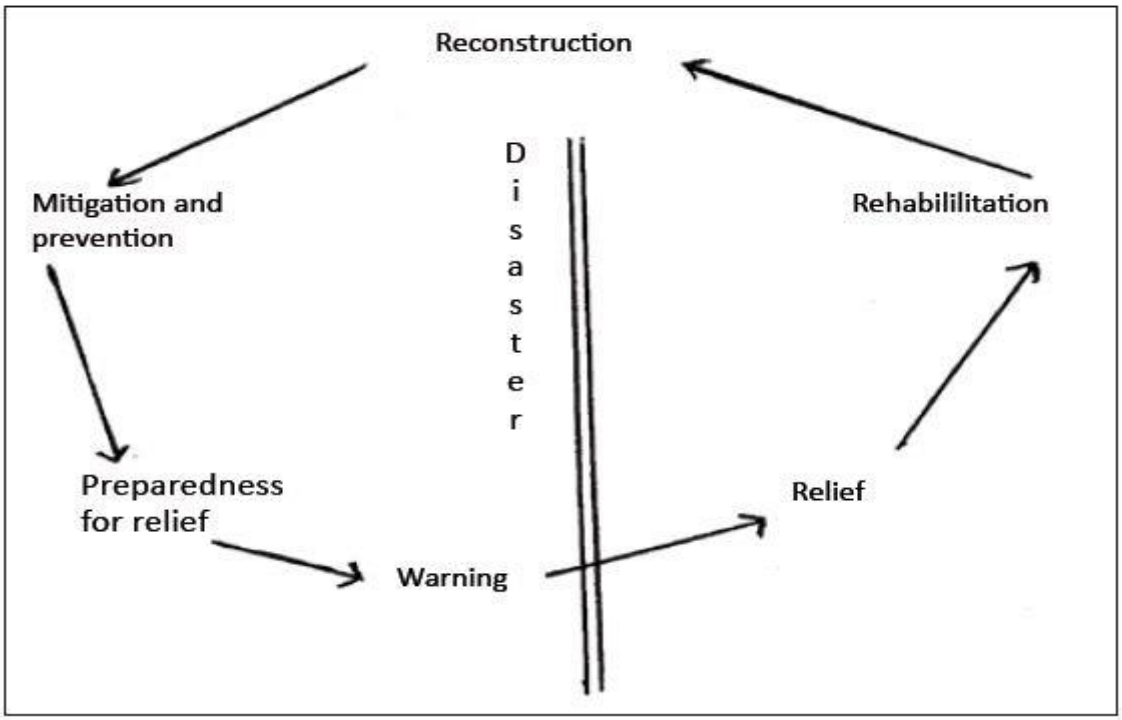

Figure 7: The disaster management cycle *(Source: Baird et al., 1975)*

The disaster management cycle illustrated in Figure 7 represents the means by which society can plan to reduce the impact of disasters. Since the 1970s, it has served as a crucial instrument for the management of disaster events and their effects (Neal, 1997; Baird et al., 1975; Kelman, 2007; Lewis, 2007). As such, it serves as the foundation of response to disasters in the modern age. These responses may occur either during or immediately after the disaster, with steps taken to recover from the damage caused by these events (Clerveaux et al., 2010). The cycle offers greater preparedness, better warnings and reduced vulnerability, or can possibly prevent the disaster during the next event. The disaster management cycle can be divided into four phases,

namely prevention/mitigation, preparedness, response and relief/recovery (Noji, 2005). These may include the shaping of public policy and plans or mitigating their impact on people, properties and the environment. According to Neal (1997), it can be argued that these phases are not mutually exclusive, with the various steps possibly occurring at the same time due to a variety of factors. Although the process is referred to as a cycle, conceptually it can be difficult to separate the phases and they may not be easily distinguishable from each other (McEntire, 2007). Thus, although all disaster cycles are composed of these various phases, they do not necessarily occur in discrete stages.

2.1.3.1. Mitigation

Mitigation consists of efforts made to prevent hazards from developing into disasters. It can be defined as *"the lessening or minimizing of the adverse impacts of a hazardous event"* (UNISDR, 2007). The aim may also be to reduce the effects of disasters when they do occur. Mitigation focuses on long-term measures for reducing or eliminating risk and may include *"any action or sustained effort undertaken to reduce a hazard risk through the reduction of the likelihood and/or the consequence component of that hazard's risk"* (Coppola, 2015: 225). Thus, mitigation involves the implementation of measures intended to prevent a future threat of disaster or to minimise the damaging impacts of unavoidable threats. Hazard risk analysis has a role in the mitigation phase, as it involves the application of strategies to reduce the chances of hazards developing into disasters. It may include engineering techniques, improved construction or environmental social policies and public awareness (UNISDR, 2007). Mitigation efforts include the flood-proofing of homes and the provision of disaster-related insurance. A common measure for combating disasters is insurance that covers the most prominent identified risks. The mitigation phase of the disaster management cycle may include the shaping of public policy. Planning can be used to modify the causes of disaster or to mitigate their impact on people or infrastructure. Effective mitigation can substantially reduce the costs of disaster response and recovery (Godschalk et al., 1999). Importantly, mitigation efforts can take place either before a disaster or following such an event.

2.1.3.2. Preparedness

Preparedness refers to the plans and preparations made to save lives and to aid the response and rescue operations. The UNISDR (2007) defines it as *"the knowledge and capacities developed by governments, response and recovery organisations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current*

disasters" (Ciottone, 2016: 201). The aim is to minimise the adverse effects of a hazard before the disaster manifests itself and impacts the area. According to Godschalk (1991: 136), preparedness comprises *"actions taken in advance of an emergency to develop operational capabilities and to facilitate an effective response in the event an emergency occurs"*. Preparedness thus informs a community's ability to respond to a disaster. Gillespie and Streeter (1987) list the elements of preparedness as planning, resource identification, warning systems, training, simulations and other pre-disaster actions taken to improve a community's safety and effectiveness in responding to disasters. Thus, preparedness constitutes a continuous cycle of planning, organisation and improvement activities to ensure the prevention of the negative effects of natural disasters. Disaster preparedness can take various forms, including hard measures such as building shelters or flood defences or installing early warning systems. Other approaches include planning and preparations made in advance of a disaster to improve upon response measures, such as logistical readiness. Mileti (1991: 215) states that *"preparedness includes such activities as formulating, testing, and exercising disaster plans; providing training for disaster responders and the general public; and communicating with the public and others about disaster vulnerability and what to do to reduce it"*. The goal is to bring governments, organisations and communities to a satisfactory level of readiness to respond to disasters.

2.1.3.3. Response

The response stage is that part of the cycle which follows in the immediate aftermath of a disaster. It can be defined as comprising *"actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected"* (UNISDR, 2007: 10). Thus, efforts are made either during the disaster or afterwards to protect lives or prevent further damage to infrastructure. Coppola (2006) notes that this could involve attempts to prevent further suffering, financial loss or a combination of both. In short, the aim is to reduce or eliminate the impact of a disaster event. The focus of response, otherwise called disaster relief, is primarily on immediate and short-term needs (UNISDR, 2007), which are addressed by implementing existing disaster preparedness measures. While the main focus of the response phase is meeting the basic needs of the affected people until more permanent and sustainable solutions can be put in place, it may continue even when the recovery phase has already started.

2.1.3.4. Recovery

The aim of the recovery phase is to restore affected locations to their state prior to the disaster. Recovery can be defined as *"the restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and 'build back better', to avoid or reduce future disaster risk"* (UNISDR, 2007: 9). It differs from response in that recovery efforts deal with issues or decisions that need to be made to address the vulnerabilities that created the original disaster risk. Typically, it involves the rebuilding and repair efforts of a community. It occurs after a disaster, when an affected population is capable of undertaking measures to restore their lives and the infrastructure that supported them. Thus, properties affected by the disaster in the impacted areas will undergo rebuilding and restoration, involving damage being assessed and the adequate response measures being taken to achieve recovery. According to Coppola (2015: 406), *"the actions associated with disaster recovery are the most diverse of all the disaster management functions"*. The primary aim of these efforts is to return an affected community to its pre-disaster state or indeed to improve upon it. Such measures may be short-term or long-term. This phase involves using the opportunity provided to implement mitigative efforts in order to bring about an effective recovery from the disaster.

2.1.3.5. Aim of Post-Disaster Management

Disaster management is a process that aims to reduce or avoid potential losses from hazards. Thus, it seeks to assure prompt and appropriate assistance to victims of disasters in order to effect rapid and effective recovery. As noted by Pinkowski (2008), the concept of disaster management stems from the idea that disasters can be avoided and managed to lessen the potential loss in terms of people and property. The various phases of the disaster management cycle thus seek to either reduce or prevent disasters. The cyclic nature of disasters can be manifested either in phases or concurrently, whereby the hazard event is managed and lessons are learnt to reduce the future risk of recurrence. As part of the cycle, disaster management may include changes to public policy and the formation of plans to address the causes of disasters, with the intention of mitigating their effect on society and the environment. Among the range of measures put in place to aid in disaster management are detection and early warning systems, hardened shelters, search and rescue teams, local and regional coordinators and so on. National legislatures have a role in creating legal frameworks to guide both

establishing and maintaining such systems. This is done by passing laws, developing national-level organisations, allocating funds and recruiting personnel (Coppola, 2011), to create a framework of institutions and bodies designed to respond to disasters.

The various elements of disaster management include *"mitigation, preparedness, emergency response, recovery, rehabilitation, and reconstruction"* (Park and Allaby, 2017: 242). According to Coppola (2011), comprehensive disaster management is based on just four of these components: mitigation, preparedness, response and recovery. Mitigation is intended to reduce or eliminate the likelihood or consequence of a hazard or both; preparedness involves equipping people to better prepare for the impact of a disaster and providing tools to increase survival and reduce other losses; response is the action taken at the time to reduce or eliminate the disaster's impact; this is followed by recovery relief, comprising the steps taken in the post-disaster period to return the situation to its state prior to the hazard event. As such, an expanded scope for disaster management includes the recovery processes, along with mitigation efforts to reduce the effects of similar such events in the future (Pinkowski, 2008). Thus, it involves not only combating the disaster as it occurs but also enacting recovery and mitigation measures. Alexander (2008) notes that the first problem in disaster risk management is the failure to implement existing knowledge related to the disaster, which can impede mitigation efforts. Quarantelli (1997) describes good disaster management as understanding the difference between the agent and response-generated needs.

This section has examined the many aspects of disasters, one of the most common forms of which to impact the world is flooding. These natural disasters impact the UK regularly and are the focus of this research. The following section therefore begins by describing flooding in general, then considers the topic in some detail, addressing types of flooding, flood mapping, flood disasters and floodplains.

2.2. Flooding

A flood is an event where a significant quantity of water covers dry land during a given period. However, there is no universal definition of what constitutes flooding (WHO, 2013). The reasons for flooding are noted as being complex and dependent on the conditions of a particular catchment or coastal site (Cullingworth and Nadin, 2006). In reality, a wide range of definitions have been applied to flooding and its effects. Ward (1978) defines a flood as *"a body of water which rises to overflow land which is not normally submerged"*, while Fleming (2002) cites a simple dictionary definition: *"a great flow of water, causing overflow and inundation"*. These

authors highlighted the fact that such events often occur after heavy rainfall and are worsened by artificial use of the land, so that flood damage is the consequence of human activity. A definition of flooding by the European Union (EU) is of a body of water covering an area of land that is not normally covered by water (Directive 2007/60/EC). Thus, when flood events occur, they can lead to rivers bursting their banks and the resultant water spilling onto floodplains. Sene (2008) notes that the causes of flooding are primarily atmospheric hazards such as heavy rainfall or geotechnical events including landslides, which themselves are typically created as the result of heavy rainfall connected to river channels, causing them to flood. Floods are normally seen as natural events that simply accompany heavy rainfall. These events may develop quickly or emerge slowly over days or even weeks (Coppola, 2015). Thus, there is an element of unpredictability as to the damage caused by flooding, as noted in the UK during a review of the winter floods of 2013-2014 (House of Commons, 2014). The history of flooding has led to prediction systems being developed to determine the probability of flood events, as illustrated in Table 1.

Table 1: Common flood-related probabilities

Annual probability	Annual probability as a fraction	Example
3.3%	1 / 30	The largest rainfall event for which surface water sewers are designed not to flood
1%	1 / 100	A common design standard for Main Rivers defences
0.5%	1 / 200	The largest flood event for which defences on the tidal Nene are designed to defend against
0.1%	1 / 1000	The largest flood event that the banks of the Whittlesey Washes Flood Storage Reservoir are designed to contain.

(Source: Peterborough City Council, 2015)

Flood predictions operate under a probability system, risk being determined by the probability of flooding and consequences of a flood event. A major outcome of a flooding event is the extent of damage (Penning-Roswell et al., 2003), i.e. the harm done by the disaster. Flood damage and its economic consequences serve as the basis for prioritising structural responses (Messner et al., 2007), which can be either direct or indirect and either tangible or intangible. Direct damage can occur through physical contact with floodwater that impacts human beings or their property, while indirect damage may occur as the result of contact with water, but after the flood event (Buechele et al., 2006). According to the EU, *"floods have the potential to cause fatalities, displacement of people and damage to the environment, to severely*

compromise economic development and to undermine the economic activities of the Community" (Directive 2007/60/EC: L 288/27). As such, their effects are wide ranging and their impact can be devastating to communities. According to Fleming (2002), *"floods are a natural occurrence and the risk they pose is wide ranging. However, for society, the main focus is the risk to people and property."* Floodwaters can destroy both residential and commercial properties, along with key infrastructure such as transportation and communication links, as well as impacting on agricultural developments. In addition, the after-effects of flooding can include health risks caused both by pollution and by water-borne diseases. In 2007, Jakarta suffered from flooding that led to 190,000 people suffering flood-related illness (Vojinović and Abbott, 2012). This demonstrates that there are multiple dangers related to flooding events, as in addition to the damage caused by the overflowing waters, other factors can be present that impact human life. Floods are noted for being the most common of disasters (Ciottone, 2016). The damage they inflict is due to exposure to vulnerability and is affected by whether measures are taken to make the community resilient towards this susceptibility.

Flooding is the most wide-reaching and commonly occurring natural hazard in the world, affecting on average around 70 million people each year (UNISDR, 2011). As such, flood events have impacted numerous locations around the world. In the UK, flooding is recognised as the most damaging and costly of the natural hazards (Brown and Damery, 2002). It has been described as a major threat to the economy and to the wellbeing of five million people in the country (EA, 2009; House of Commons, 2016). Flooding has a long history of affecting the UK and of shaping response mechanisms towards it. The great Sheffield flood in 1864 is counted among the worst floods to have affected the country and resulted in several hundred deaths (Sheffield City Council, 2009). In 1998, the English Midlands suffered from the most extensive flooding of the 20th century (Acreman, 2002). In 2000, the autumn was the wettest recorded in the UK and one result was disruption to transportation services. In addition, 10,000 properties in England and Wales suffered from flooding, and weather-related insurance claims totalled around £1 billion (POST, 2001). In 2002, the Glasgow floods killed around two hundred people (Foresight, 2004). A further flooding incident which occurred in 2007 greatly affected the country (EA, 2007). In 2009, Cumbria suffered from a major flooding event (Cumbria County Council, 2010). Around the 2013-2014 period, the UK was affected by severe winter storms that brought coastal damage and widespread flooding (Met Office, 2014). In 2015, storms Desmond and Eva flooded 16,000 homes in England (BBC, 2016). In 2018, Wales suffered from the worst flooding in 30 years as a result of storm Callum, with 2,000

homes and businesses being affected in that year (BBC, 2018). In 2019, two separate flood events impacted the UK as a result of storms Dennis and Ciara. A woman was swept away by floodwater in Worcestershire and over 1,400 properties were flooded across several countries (House of Commons, 2020). This brief account suggests that the danger of flooding is likely to remain pervasive. Indeed, flood events and the risk of flooding are projected to increase in time, due to factors such as climate change (IPCC, 2018; Mehryar and Surminski, 2020). Such flooding can come in a variety of forms, as detailed in the following subsection.

2.2.1. Types of Flooding

Flood damage is typically caused by the overflowing of large rivers, flash floods from tributaries, runoff after intense localised rain, rising sea level, ground water flooding or a failure of artificial systems to keep water at bay (Bloch et al., 2012). In other words, flooding arises from a variety of sources. The flood risk is created by exposure, namely whether people or objects are within range of flood waters (UNISDR, 2004; Holt, 2012). It is this element that makes human beings vulnerable following exposure to a flood risk. Floodwater may come from a variety or combination of sources, such as rainfall, tides, overflowing rivers, surface water, impermeable surfaces, groundwater, escaping sewage or obstructions that prevent water from draining (EA, 2009; Samuels, 2015). Combinations of these various sources will tend to increase the level of flood risk. Thus, during times of flood, these hazard sources can operate either independently or in combination with one another, resulting in a wide-ranging effect (EA 2010). Fleming (1999) notes that the process of flood management includes the identification of the source of the flooding, its pathway and the receptor impacted by the floodwater (Holt, 2012). Identification of flood risk is a key element of flood response. Ward (1974) offers various definitions of flooding and lists the different kinds of flood. Others recognise four main types of flooding according to their causes, namely river flooding, coastal flooding, surface water flooding and groundwater flooding (Defra, 2007). An alternative fivefold typology is shown in Table 2.

Table 2: Five types of flooding

Pluvial flood	caused by insufficient drainage from local topographical lows
Fluvial flood	caused by too much water in a watercourse
Coastal flood	caused by storm surge, tsunami, land subsidence or sea level rise
Groundwater flood	caused by groundwater rising and reaching the surface
Breaching flood	caused by water breaching natural or man-made retention barriers

(Source: Becker, 2014)

Each of these five types of flooding has distinguishing characteristics leading to different hazard conditions. Thus, the identification of the varying kinds of flooding have an important role in emergency planning. The preferred typology for the purposes of this review, however, recognises four types: flash floods, coastal floods, local floods and river floods. These are explained as follows.

- ***Flash Floods***

Flash floods occur when water levels rise very quickly in a relatively small area. Sene (2008) notes that the term has varying definitions across different countries, although all share similar concepts: such floods rise over a short period of time, with a relatively high peak discharge (UNESCO/WMO, 2007; EA, 2008). For example, heavy rain may cause an empty or near empty riverbed to fill with fast-flowing water. The rapid onset of rain may saturate the soil or run off dry soil with poor absorption capacity. Borga et al. (2010) state that flash floods are often associated with high rainfall rates over a short time and originate locally. The rainwater collects in areas with steep slopes and flows downhill, rushing at high speeds along riverbeds. Areas affected by flash floods are typically not very large and damage is concentrated in a confined region. As the water level rises rapidly, it flows over the riverbanks and floods the area. Flash floods can develop very quickly and without warning as a result of high intensity rainstorms in a short time (Coppola, 2015). A common characteristic is the involvement of deep and fast-flowing water which is capable of carrying away heavy objects (Sene, 2008). Flash flooding can be particularly deadly because of the speed at which water levels rise (Ohl and Tapsell, 2000). Sene (2008) notes that it is these elements, along with the short time to respond, making it very difficult to do so effectively, which increase the risk to people and property. Flash floods may end just as quickly as they have started, leading to short-lived high flow velocities (Holt, 2012).

- ***Coastal Floods***

Coastal flooding is the result of inundation of coastal areas over a greater extent than is normally expected from tides (WHO, 2013), so that an area of normally dry land becomes flooded by seawater. Such floods are typically the result of a surge formed by severe storms, associated with very low atmospheric pressure, causing sea level to rise. Watson and Adams (2010) note that this form of flooding affects coastline and shore areas. Such storms are responsible for generating winds that push the water up, creating high waves. The flood event will start when these waves move inland on an undefended coast or overtop or breach the

coastal defences, having assaulted them wave after wave. A tidal surge, wave action or a combination of wave and surge can often overtop or overflow the shoreline boundary (Sayers et al., 2015). The water level falls and rises with the tide during such events. Once the sea defences are breached, the seawater enters quickly, but slows down as it spreads over a large area of land.

- ***Local Floods***

Local flooding develops as a result of high surface runoff that exceeds the local drainage capacity (Holt, 2012). Such floods can damage urban developments when heavy rainfall leads to drainage networks being unable to remove the excess water sufficiently quickly (Sene, 2008). Sewer flooding can result from overwhelmed or blocked sewers (Hamill, 2011). Urban flooding may be due to inadequate drainage facilities in an urban setting. Because there is relatively little exposed soil, most of the precipitation has to be transported to surface water or through sewer systems. During high rainfall, the sewage system of the city and draining canals begin to overflow. As they fill to capacity, flooding occurs because there is insufficient space to drain away the water. This can result in water entering the drains in one place and emerging elsewhere, such as on the city streets.

- ***River Floods***

River flooding or fluvial flooding is the result of rivers spilling onto floodplains (Hamill, 2011; Sayers et al., 2015). This occurs when the river runoff volume exceeds the local flow capacity (Holt, 2012). Riverine flooding occurs during rainfall over an extended period of time that could cause major rivers to overflow their banks. The resulting floodwater may cover enormous areas of land, with downstream areas possibly also being affected. Such processes tended to be slow developing, as the rainwater enters the river in many ways. Some may flow off the surface of saturated or hard soil, entering small streams that feed larger rivers, which are in turn tributaries of even greater rivers. As the water collects, the rivers gradually rise and the water eventually flows downstream to the sea. Watt (1989) and Andrews (1993) note that river flooding is primarily driven by hydro-meteorological conditions that operate either independently or in combination with one another (Whitfield, 2012). As these are slow events, officials often have time to decide on response measures such as the evacuation of people before the river overflows. An issue of concern is that flooded areas can be so large as to isolate entire communities.

2.2.2. Flood Mapping : Forecasting and Modelling

Since the various types of flooding discussed above can affect communities, it is important to understand the nature of the hazard in order to better prepare for its effects. This is a factor in responding to flooding, which requires flood events to be predicted by mapping the hazard. Mapping allows the forecasting of future flooding and the modelling of flood events to determine the likely extent of damage. There are two kinds of flood mapping: flood hazard maps, which depict inundation areas with maximum depths and velocity at every point in the region, and flood risk maps, which project damage and losses in those areas affected by the flooding (European Council, 2007; Tsakiris et al., 2009). Flood forecasting depends on a number of sources of data, including hydrological, meteorological, topographic, structural and social data. According to Serban and Askew (1991), *"the heart of any flow forecasting system is a hydrological model"*. This provides an estimate of the future hydrological phenomenon including flow rate, cumulative volume, stage level, area of inundation or mean flow velocity in a particular location or flow in a channel section. In terms of event prediction, hydraulic models have been specifically designed to determine flood inundation (Horritt and Bates, 2002). Hydrological models serve as simulations of surface runoff from rainfall, whereas hydraulic models describe the structural controls of the river system (Mark et al., 2004). An alternative means of determining flooding uses historical data to produce direct flood hazard maps covering the various return periods and involving an appropriate statistical process (Jha et al., 2012). This allows one to determine flooding based on past events being factored into prediction models.

Flood forecasting plays an important role within the framework of flood management. It plays a part in planning and development strategies that seek to address occupation on floodplain regions where non-structural means could be used to respond effectively to flood risk. This allows flood management measures to consider whether to use temporary defences such as movable flood gates, or whether domestic protection measures such as sandbags are more appropriate. Real-time flood forecasting models are a useful tool for early warning and disaster prevention. Reed and Robson (1999) stress that many problems regarding flood estimation arise at ungauged sites due to the lack of flood peak data recorded in the UK Flood Estimation Handbook (Dawson et al., 2006). The Handbook, issued by the Centre for Ecology and Hydrology, contains information on river catchments in the UK, including data on rainfall frequency estimations and descriptors of catchments. The Environment Agency maintains several interactive web-based services for monitoring flood risk, constituting its Flood

Information Service (EA, 2013). There are thus several means of predicting flooding, which is a natural disaster affecting communities on a global scale.

2.2.3. Flood Disasters

Flooding can be seen as an inevitable and natural part of the environmental cycle (Cullingworth and Nadin, 2006). As such, there exists no means of completely eliminating the risk of flooding. Its impact depends on a combination of factors, both natural and human-made (Holt, 2012). Thus, both elements of the natural environment and human influence can affect the likelihood of flood disasters. According to Hogan (2007), floods account for more than half of all natural disasters and more than three quarters of all disaster-related deaths worldwide. They cause enormous damage every year around the world. The damage caused by flooding will vary greatly, depending on the area affected and the origin of the flood itself. A flood may affect either an entire region or limited areas and its speed may vary from slow and steady to sudden and violent. Numerous health-related problems, such as toxic ingestion, can occur during flooding events and these become increasingly likely with prolonged exposure. A further danger is the greater risk of infectious diseases as a result of breakdowns in sanitation and water quality (Hogan, 2007). This can bring about increased risk and exposure to new potential hazards. Floods often result in the disruption of services, such as water purification and sewer disposal systems. In addition, waste sites may overflow or dislodge toxic chemicals, exposing people to further risk (Noji, 1997). It is this complex set of interrelated factors that make floods among the most devastating of natural hazards facing humankind (Ohl and Tapsell, 2000). Askew (1999) estimates that floods cause one third of all deaths, of all injuries and of all damage among natural disasters (Holt, 2012). Their potential impact includes loss of life, disruption to society and damage to infrastructure. Flood risk management is therefore of extreme importance in areas at significant risk of flooding.

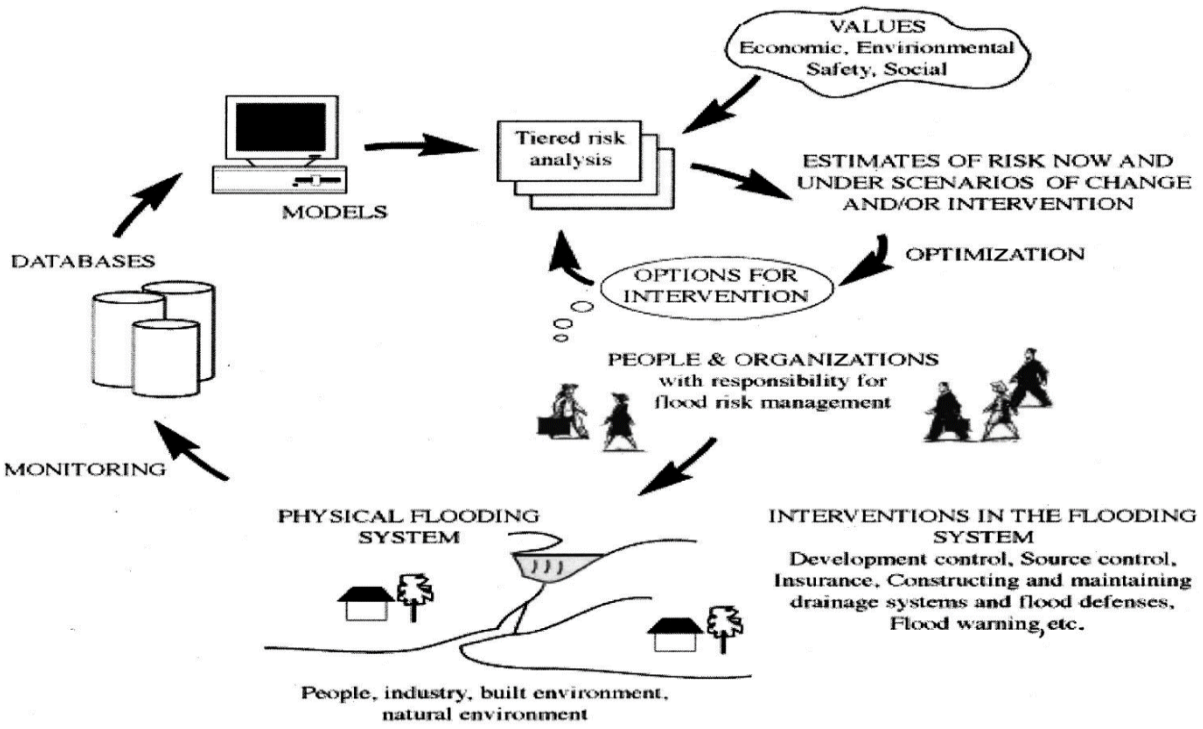

Figure 8: Flood risk management model *(Source: Hall et al., 2003)*

Figure 8 illustrates the flood risk management cycle, which serves as a means of responding to this natural disaster and managing its impact on society. It shows that monitoring of flooding is collated into databases which are used to generate models of risk, with these in turn influencing intervention tools to mitigate the risk. Despite flooding being seen historically as a natural hazard that has always existed and will continue to exist (UNESCO, 2007), the conclusion drawn by modern scholars and practitioners is that flood damage itself is an artificial creation, in that the human element of interference causes or exacerbates the hazard, which can therefore be prevented or reversed by human intervention (EC, 2003). It is for this reason that governments have invested in disaster risk reduction policies in response to the severity of the disaster threat from natural events such as storms, floods and heatwaves. These policies are seen as essential to protect vulnerable populations and avoid large-scale economic losses (UNISDR, 2009). Ultimately, flooding is not completely avoidable; instead, the general approach is to manage the risk. This involves taking action to reduce the likelihood of flooding and to mitigate its impact. Flood defences are designed to protect human lives and limit any damage to property. In the UK, the Environment Agency offers guidance on the measures for owners to protect their homes. As noted by Fleming (2002), it is not practicable or economically feasible to eliminate all flood risk, with the most suitable approach being to best manage it. As such, flooding could be viewed as not being a preventable issue but rather an

obstacle that one has to live through. Thus, it could be argued that alternative strategies need to be developed in order to mitigate the scale of the impact caused by flood incidents. Although flooding is an inevitable reality, Watts (2007) notes that preparedness can mitigate some of the resultant health and economic damage. Elements of flood defence include early warning systems designed to alert coastal populations, allowing them the chance to evacuate a danger area, and zoning codes that keep people from building in flood-prone areas. These systems have been used throughout the world in an effort to mitigate the damage caused by flooding. Flooding has impacted communities across the globe and the extent of damage it can cause poses a danger to people. The following section looks at the worldwide impact of floods.

2.2.3.1. Flooding in a Global Context

According to Kron (2005: 58), *"In most parts of the world, flooding is the leading cause of losses due to natural phenomena and is responsible for a greater number of damaging events than any other type of natural hazard."* Indeed, this hazard affects to some extent most countries in Europe and around the world. Among the natural hazard events, flooding is the most prevalent in the world, affecting all continents (EM-DAT, 2012; Lamond and Penning-Roswell, 2014). On average, flooding affects around 70 million people each year (UNISDR, 2011). In the United States, for example, flash floods are among the leading causes of death from natural hazards (Noji, 1997). They are ranked as the primary cause of death among natural disasters in that country, with the majority being the result of drowning (Ohl and Tapsell, 2000). An estimated 46 million people around the world were at risk of flooding as the result of storm surges (Rostron, 2013). Floods are seen as the most common of the natural hazards and can occur anywhere around the world. Coppola (2015) notes that each year, an average of 20,000 deaths occur as the result of flooding, with 75 million people affected. Over a period of 30 years, it was estimated that 2.8 billion people had been affected by flooding around the world (Doocy et al., 2013). Thus, more people are killed annually as a result of flood events than by any other natural disaster. The Association of British Insurers (ABI, 2005) reports that worldwide floods are the second costliest catastrophe after windstorms, while Whitfield (2012) indicates that the cost of flood damage globally in the period 1991-1995 amounted to €170 billion. A report in 2013 indicated that 9,819 people had been killed in the preceding year as a result of flooding. This was held to be the highest death toll of the decade, with storms being the second most deadly events. These findings indicate that deaths due to floods accounted for almost half (45.4%) of global natural disaster mortality (CRED, 2013). Such deaths may occur in almost any country, although in this case, 70% of flood-related deaths occurred in

Bangladesh and India (Noji, 1997; Hogan, 2007). Jha and Stanton-Geddes (2013) reported in the same year that Asia and the East Pacific had accounted for 40% of worldwide floods over the past 30 years. This demonstrates the impact of flooding across the world, which is tabulated in Table 3.

Table 3: Loss events worldwide 1980-2014

10 Costliest Floods ordered by Overall Losses					
Date	**Event**	**Affected area**	**Overall losses in US$ m original values**	**Insured losses in US$ m original values**	**Fatalities**
1.8-15.11.2011	Floods, landslides	Thailand: Phichit, Nakhon Sawan, Phra Nakhon Si Ayuttaya, Pathumthani, Nonthaburi, Bangkok	43,000	16,000	813
27.6-13.8.1996	Floods	China: Guizhou, Zhejiang, Sichuan, Hunan, Anhui, Jiangxi, Hubei, Guangxi, Jiangsu, Fuijan	24,000	450	3,050
27.6-15.8.1993	Floods	USA: MS, MO, IA, IL, ND, IN, MN, WI, KS, NE, SD	21,000	1,270	48
June-September 1998	Floods	China: Hubei, Hunan, Chongqing, Jiangxi, Anhui, Sichuan, Yunnan, Jiangsu, Zheijang, Guangdong	20,000	300	3,600
12-22.8.2002	Floods	Germany, Austria, Czech Republic, Hungary, Moldova, Switzerland, Slovakia	16,500	3,400	39
24.7-18.8.1995	Floods	North Korea	15,000		68
May-September 1991	Floods	China: Anhui, Jiangsu, Hubei	13,600	410	2,630
30.5-19.6.2013	Floods	Austria, Czech Republic, Germany, Hungary, Poland, Switzerland	12,600	3,100	25
21.6-20.9.1993	Floods	China: 10 Provinces Affected	11,000		3,300
June 2008	Floods	USA: IA, IL, IN, KS, MI, MN, MO, WI	10,000	500	24

(Source: Munich, 2015)

The table lists the ten costliest floods recorded, demonstrating the unpredictability of the timing of flooding in a given region and of the financial cost of damage incurred. As to the cost in human lives, China suffered a devastating flooding disaster in 1887 that saw 900,000 killed (Gunn, 2008). In Canada, Brooks et al. (2001) note that in the last century flood damage in the country exceeded $2 billion and led to the loss of over 198 human lives (Whitfield, 2012). Since the 1900s, floods in the United States have resulted in the deaths of more than 10,000 people (Holt, 2012). In Asia, many countries suffer from a major threat of flooding (Maskey, 2004). In 1931, another flooding event in China caused the deaths of 2,500,000 to 3,700,000 people. This is regarded by the US National Oceanic and Atmospheric Association (1999) as among the most extreme weather-related disasters of the 20th century. In Japan, urban flooding

in 1947 heavily impacted the economy and people when tropical storm Kathleen affected 1.6 million in the Tokyo Metropolitan Area (Graaf and Hooimeijer, 2008). The North Sea storm of 1953 led to the deaths of over two thousand people across the United Kingdom and in Northern Europe (HR Wallingford et al., 2006). In 1974 and 1999, floods in Bangladesh and Venezuela accounted for 30,000 deaths (Sene, 2008). In Bangladesh, widespread flooding caused by tropical storm surges caused the deaths of hundreds of thousands of people in the years 1970, 1985 and 1991 (Askew, 1999; Holt, 2012). In 2007, approximately half of African countries suffered from floods caused by heavy rainfall that affected more than 100 million people (Sene, 2008). In Australia in 2011, flooding in the city of Brisbane and throughout Queensland led to 19 people being killed (Shrestha et al., 2014). Also in 2011, Thailand suffered from floods that caused $46.5 billion of damage and losses, obliging the government to allocate 5% of its annual revenues to recovery (World Bank, 2012; Jha and Stanton-Geddes, 2013). Flooding has been estimated to be directly or indirectly responsible for 90% of damage in Nigeria (Adeoye, Ayanlade and Babatimehin, 2009; Holt, 2012). These examples illustrate the pre-eminence of flooding among the different natural disasters for its impact on human society.

Europe has been severely affected by flooding for centuries (Maskey, 2004). The annual average losses due to flooding are stated to have been greater than wind-related losses, amounting to $8-$10 billion and $3 billion respectively (ABI, 2005). Within Europe, a series of major flooding events have impacted various countries in recent decades. According to a CRED report, between 1900 and 2006 there were an estimated 415 major damaging flood events in Europe (Ashley et al., 2007), where floods are the most common of the natural disasters (WHO, 2013). Major floods in Europe have increased in average frequency, from one per year between 1900 and 1974 to 15 per year between 1993 and 2001 (Dlugolecki, 2008; Wedawatta and Ingirige, 2012). In 1953, the Netherlands suffered its worst case of flooding when strong winds and tides led to the death of 1835 people (UN, 2007). Rostron (2013) notes that in 1997, floods of a severity that should normally be expected to occur once a century affected countries including Germany, Poland, China, the USA and Canada. Floods were the costliest events in terms of economic damage, costing €7 billion in 2002 (Whitfield, 2012). In 2013, flooding in South and East Germany was estimated to have caused $12.9 billion of damage, making it among the costliest natural disasters of the year (CRED, 2013). This demonstrates that flooding has a considerable impact on society, both financially and in terms of lives lost.

In fact, the danger has increased, as Milly et al. (2002) have shown that there was a substantial increase in the frequency of flooding during the 20th century (Whitfield, 2012). CRED (2013) reports that 9,819 people were killed as a result of flooding during 2013, this being the highest number for a decade, representing the largest share of natural disaster fatalities. The findings indicate that floods accounted for 45.4% of global fatalities resulting from disasters, with storms accounting for 39.7%. According to CRED Director Guha-Sapir, floods and storms were expected to become more frequent and severe in the future for Europe (UNISDR, 2009). Floods and tropical storms were expected to continue to be prominent sources of disasters (The World Bank, 2010). The number of flood events is likely to continue to rise and possibly even accelerate in the next 50 years (Jha et al., 2011; Holt, 2012). An increase in vulnerability is predicted by Johnstone and Lence (2009), due to continued settlement on coastlines and floodplains and to climate change (Holt, 2012). The Asian Development Bank (2012) and World Bank (2012) have predicted that vulnerability will increase in Asia, with 410 million people suffering from the risk of coastal flooding by 2025 (Jha and Stanton-Geddes, 2013). Climate change is also reported to have made many North African cities more vulnerable to extreme weather patterns. In fact, it is expected that floods will become more frequent and severe, impacting densely populated and economically important coastal cities (UN-HABITAT, 2014). Despite this, some analysis of flood data suggests that evidence for an increased risk in the future is not conclusive (Hall et al., 2014).

As to causes, Viglione and Rogger (2015) note that disasters and particularly floods are the result of a number of unfortunate factors. They cite Blöschl et al. (2013) as asserting that contingency matters in combating the dangers posed by such disasters. Kumar (2011) urges that unforeseen possible events need to be explored to the same extent as probable events. The European Environment Agency (2012) predicts that a lack of additional adaptation measures could see between 775,000 and 5.5 million people being affected annually by coastal flooding in the EU by the end of the 21st century. Similarly, river flooding has been estimated to affect 300,000 people each year within the EU by the 2050s, rising to 390,000 by the 2080s. All in all, flooding has been shown to be a present danger likely to increase in severity, with adaptation being a key tool in matching the dangers posed by this hazard. Given the scope of the present research, the following subsection examines in particular the threat posed by flooding within the UK.

2.2.3.2. Flooding in the UK

Flooding which causes loss of life and widespread damage is said to be a rare occurrence within the UK (Gov, 1998; Acreman, 2002). However, it remains a hazard affecting the country, with a long history of impacting the population. In 1607, the southwest of England and Wales suffered some of the worst flooding in the history of the country, causing the deaths of around 2,000 people (Morgan, 2015). In 1864, the Great Sheffield Flood was among the severest floods to affect the UK, with several hundred dead as a result (Sheffield City Council, 2009). In 1947, extensive areas of the country suffered catastrophic snow-melt flooding which severely affected Wales, the South-West, the Midlands and the Thames Valley (Gardiner and Matthews, 2002). In the 1990s, flooding was given greater priority among critical issues facing the country (Cullingworth and Nadin, 2006). In 1998, the English Midlands suffered from the most extensive flooding of the century (Acreman, 2002). More than 1,500 people had to be evacuated, five were killed and insurance claims totalled £500-£700 million (POST, 2001). Bye (1988) reports that in some places, the Easter floods of 1998 exceeded those of 1947. They also led to a review of flood guidance and planning development (Cullingworth and Nadin, 2006). The Bye Report (1998) commissioned in wake of the Easter flooding, indicated that improvements were needed in the communication system with regards to flooding (Gov, 1998). This included the use of flood warnings, weather monitoring and the incorporation of flood reports. In the aftermath, a ten-year strategy began to improve flood warning systems within the UK. The autumn of 2000 was the wettest in UK records and saw disruption of transportation services. In addition, 10,000 properties in England and Wales suffered from flooding and weather-related insurance claims totalled around £1 billion (EA, 2001; POST, 2001). Floods in Glasgow in 2002 killed around two hundred people (Foresight, 2004). A further flooding incident in 2007 greatly affected the country (EA, 2007). In that year, the impact of flooding was notable and led to many changes in terms of flood awareness and management.

The summer flooding of 2007 was severe and widespread, affecting many areas of England, including South Yorkshire, Hull, Gloucestershire, Worcestershire and the Thames Valley (Pitt, 2008). Locations such as South Yorkshire, Humberside and Gloucestershire experienced unprecedented levels of flooding. During this time, 48,000 homes were flooded across England (Smith, 2009). Heavy downpours caused as many as 55,000 properties to be flooded (Defra, 2009; Jha et al., 2012). In 2008, intense rainfall in Morpeth led to flooding that seriously damaged around 1,000 properties (Parking, 2010). In 2009, Cumbria suffered from a particularly severe flooding event (Cumbria County Council, 2010) which impacted the town

of Cockermouth, leading to an estimated 900 properties being flooded and 1,400 people affected in the town (BBC, 2013). Around the 2013-2014 period, the UK was affected by severe winter storms that brought coastal damage and widespread flooding (Met Office, 2014). In the 2013 surge event, over 2,800 properties were flooded and 10,000 people were evacuated in areas protected by flood defences (Wadey et al., 2015). In 2015, storms Desmond and Eva flooded 16,000 homes in England (BBC, 2016). Indeed, across the Christmas and New Year period of 2015-2016, the UK faced three major storms, designated Desmond, Eva and Frank, which broke rainfall records. These caused massive damage and harmed communities, particularly in northern regions of the country. Storm Desmond is estimated to have cost £5 billion (EFRAC, 2016). The Bonfield Report states that sustained rain in 2016 caused extensive damage across the country, with 17,000 properties being flooded and costs expected to amount to £1.3 billion (Defra, 2016; POST, 2016). In 2019, Storm Dennis resulted in a woman being swept away by floodwater in Worcestershire and over 1,400 properties being flooded across several counties (House of Commons, 2020). Such events are indicators of future severe floods by 2070 (EA, 2016). As such, flooding in the UK has had a great deal of impact on society, as illustrated in Figure 9.

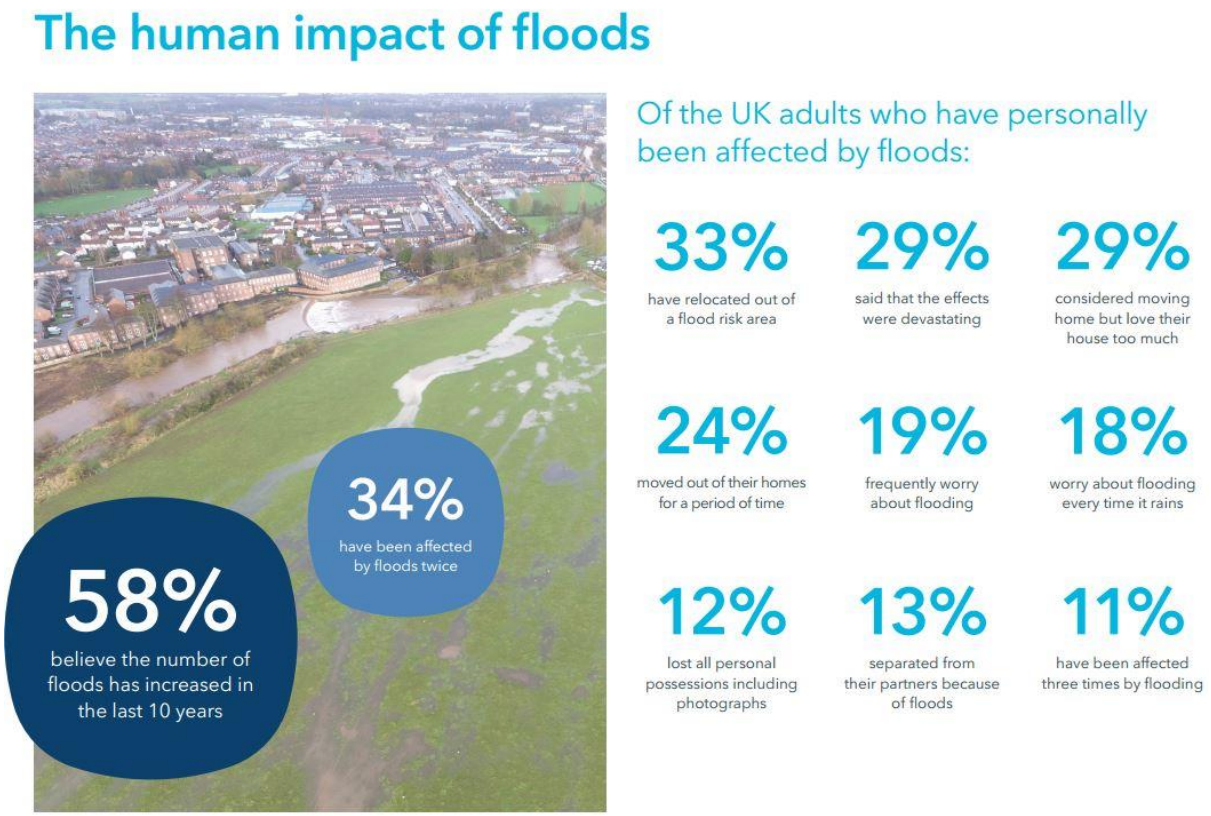

Figure 9: Human impact of floods *(Source: Coop, 2017)*

The above figure shows that the impact of flooding has met with a wide range of responses from communities within the UK. The effects on public perception of the increasing prevalence of flooding includes some of those affected relocating from their homes either temporarily or permanently. The fear of flooding is a notable response among those who have experienced flooding. Parker et al. (2008) note mounting pressure to take responsibility for safety issues and developing improvements to combat disasters. These have included increased pressure for greater corporate responsibility from private enterprises to legal steps to account for safety issues. Professional disaster experts and organisations representing victims have put similar pressure on central government to make improvements in current practices. Sir Michael Pitt (2008) found that this was due to the effects of climate change. In the same year, Walker and King (2008) predicted that river and coastal flooding in the UK would increase by 2080. Earlier, the ABI (2005) had stated that climate change could increase the annual costs of flooding by almost 15-fold by 2080. The Climate Change Risk Assessment (CCRA, 2015) identifies rivers, seas and sewers as contributing the largest increases, while Whitfield (2012) estimates the potential increase at between 2 and 20 times, with annual flood damage rising as a result from £1 billion to £21 billion. Within England, an estimated 5.2 million properties, amounting to one in six, suffer from a risk of flooding (Environment Agency, 2009). Flooding has been widely acknowledged as a growing risk to British properties (Law Society, 2014). In England, the National Risk Register considers flooding to be a major risk (Cabinet Office, 2013; Surminski and Eldridge, 2015). As such, the number of people affected as a result of increased flooding may double from current figures. The Met Office reports studies showing a recent trend for river flows to increase in the winter half-year, along with a tendency for higher flows to occur more frequently (Met Office, 2014). The next subsection considers a type of land that is therefore particularly vulnerable to flooding, namely floodplains.

2.2.4. Floodplains

During times of increased rainfall, rivers are at risk of overflowing their embankments, causing water to flow onto the neighbouring floodplains. These events are known as fluvial flooding or river flooding (Sayers et al., 2015). Such areas are prone to developments being built on them due to a variety of factors. It has been noted that a key cause of flooding is the erosion of floodplains by the building of new developments, this being a major issue for the planning system (Cullingworth and Nadin, 2006). The occupants of such developments are vulnerable to flood hazard and exposed to it during disaster events, which create a risk of flooding. It has been estimated that around seven million people lived in areas of the UK prone to frequent

natural flooding (Acreman, 2012). It is particularly important to define what constitutes a floodplain, as these areas are particularly vulnerable to flood events. Multiple definitions exist, some intended to establish standards for regulatory purposes and others to be useful to geomorphologists.

2.2.4.1. Definition of a Floodplain

Floodplains represent a significant component of riverine landscapes (Meitzen, 2013). A floodplain is an area of land adjacent to a river that is vulnerable to flooding. It is *"the land next to, or hydraulically or ecologically connected to, the flowing river"* (Freitag, 2009). More broadly defined, it is any area of land that is susceptible to being inundated by water from any source. This connection means that there is greater exposure to the water during flooding. Such a definition has been used for planning and regulatory purposes, as enshrined in the UK government's Planning Policy Statement, PPS15. Hartmann (2011) states that a defining feature of a floodplain as that it constitutes potentially submergible riparian land. Floodplains have an important role in naturally storing and conveying additional water flows. As such, they were are likely to suffer from flooding, making it hazardous to develop them for housing, as such developments are particularly vulnerable to flooding events. Marriott (1999) observes that as natural floodplains environments are functional parts of fluvial systems, they are defined by flooding risk. Fluvial or riverine floods occur when excessive rain falls over an extended period of time, causing a river to exceed its capacity (Sayers et al., 2015). Intense rainfall can contribute to water overflowing onto the floodplain. It should be remembered that the concept of a floodplain and its definition are perceived differently by different people, based on their discipline (Marriott, 1999). There exists, therefore, a diverse and ambiguous range of terminology that can serve as a barrier to the classification of floodplains (Kellerhals et al., 1976; Lewin, 1978; Miall, 1985; Graf, 1988; Nanson and Croke, 1992). In short, the definition of a floodplain will vary depending on the author and the system of classification.

Schmudde (1968) shares the view that the definition of a floodplain varies widely depending on the reason for attempting to classify it. According to hydrologists and engineers, a hydraulic floodplain is defined as a surface next to a channel that is inundated once during a given return period, regardless of whether that surface is alluvial or not (Hydraulic Engineering Centre, 1976; Ward, 1978; Nanson and Croke, 1992). Thus, a floodplain is a landform subject to periodic flooding by a parent stream. Geomorphologically, it is a landform composed primarily of unconsolidated depositional material created from sediments transported by a related stream.

Another definition is that of a genetic floodplain: *"the largely horizontally-bedded alluvial landform adjacent to a channel, separated from the channel by banks, and built of sediment transported by the present flow-regime"* (Nanson and Croke, 1992: 460). Schmudde (1968) suggests that a combination of all of these characteristics serve as the essential criteria in defining a floodplain. From a regulatory perspective, Rice (1949: 139) offers a simpler definition, whereby a floodplain is *"a strip of relatively smooth land bordering a stream and overflowed [sic] at a time of high water"* (Leopold et al., 1964). Finally, the Planning Policy Statement PPS25 defines it as *"land where water has to flow or be stored in times of flood"*. A further technical aspect of defining a floodplain is that geomorphologists seek to understand how these regions are formed.

2.2.4.2. Mechanics of a Floodplain

Taking floodplains to be large flat expanses of land lying on either side of a river, defining the most relevant geomorphological characteristics of landforms susceptible to flooding has been recognised as no simple task (Graf, 1988; Nanson and Croke, 1992; Moody et al., 1999; Croke et al., 2016). The relevant distinctions are complex, as floodplains can be composed of several discrete surfaces of differing elevation varying in their frequency of inundation (Woodyer, 1968; Pickup and Warner, 1976; Grams and Schmidt, 2002; Heitmuller et al., 2015; Croke et al., 2016). Floodplains are typically associated with rivers and streams, consisting of stream-deposited sediments that form levels. According to Melton (1936), floodplain structures can be classified on the basis of stream activity. When its embankments are full, the river water overfills and spills onto the floodplain, which may have been formed in one of two ways: by erosion or by aggradation. Thus, Schmudde (1968) writes:

> *"As a topographic category, it is quite flat and lies adjacent to a stream; geomorphologically, it is a landform composed primarily of unconsolidated depositional material derived from sediment being transported by the related stream; hydrologically, it is perhaps best defined as a landform subject to periodic flooding by the parent stream."* (Marriot and Alexander, 1999: 2)

Erosion is the process whereby the earth is worn away by the movement of a floodway. Conversely, aggradation (or alluviation) is the process by which earthen material increases as the floodway deposits sediment. The natural functioning of a floodplain is to store and release floodwaters, with the flood attenuating as it travels downstream (Wheater and Evans, 2009).

This shows that floodplains have an environmental function in managing flooding, in that an element of their lifecycle involves natural flooding.

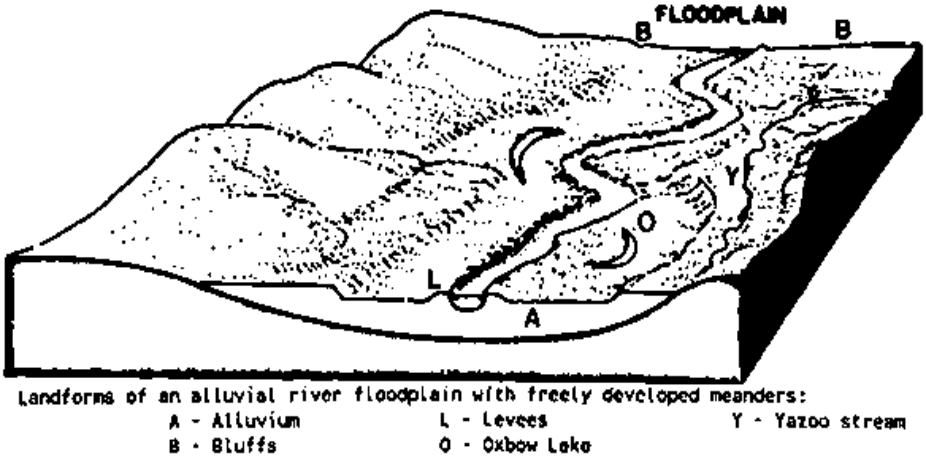

Figure 10: Characteristics of a floodplain *(Source: Strahler and Strahler, 1973)*

Figure 10 illustrates the technical aspects of floodplain formation, much of the basis of which is the erosion process occurring when meanders erode sideways as they travel downstream. The water leaves behind a layer of alluvium or silt in areas where the river breaks its banks. These, over time, build up to create the floor of the resulting floodplain. As such, these plains typically contain unconsolidated sediments that extend below the bed of the stream. Floodplains are thus wide, flat plains formed by the deposited material or alluvium that has built up on either side of the river due to successive flooding events over the years. Floodplains consist of two parts: the floodway, i.e. the main channel of the river itself, and the flood fringe, extending from the outer banks of the floodway. Carey (1969) supplements this account by defining four kinds of floodplain on the basis of river migration and sedimentation action. Historically, they were defined only by a bank-full recurrence interval ranging from one to two years (Wolman and Leopold, 1957; Leopold et al., 1964; Dury, 1973; Croke et al., 2016). Geologists and hydrologists use a mathematical calculation known as the Exner equation to determine the extent of a floodplain.

The UK planning guidelines note that a *"functional floodplain includes water conveyance routes and flood storage areas (sometimes referred to as washlands)"* (Gov, 2009). This characteristic of artificial or officially designated floodplains indicates the inclusion of other constituent elements as part of their design. In their storage role, they serve an important function of conveying additional water flows (House of Commons, 2016). Thus, they constitute

an important aspect of the ecology of flood management. Paron et al. (2014) note that floodplains along rivers and near lakes have long been attractive locations for settlement due to the fertility of the land, as well as the easy access to irrigation water. This has led to them being a common site of development, despite the risk of flooding. Within the UK, there has been a long history of developments on floodplains, for a variety of reasons. The next subsection therefore examines the history of floodplain development in the UK and presents a 'snapshot' of its current operation in the country.

2.2.4.3. Floodplain Development

Floodplains tend to be fertile regions, making them ideal for agricultural development. Rivers and their associated floodplains have long attracted habitation, due to their abundant water supply, fertile soil, access to navigation and flat terrain suitable for building and transportation (Alexander and Marriott, 1999). The flooding of such areas can be seen as desirable or at least tolerable to the extent that it does not adversely impact human life or activity. In the 1940s, the 'common sense' principle was applied in avoiding new settlements on UK floodplains. A consequence of the shortage of building land in towns and cities, along with the availability of freshly-drained flat land deemed unsuitable for agriculture, was that this was used to meet post-war housing demand (Potter, 2013; Stedman, 1958; Werrity, 2006). Freitag (2009) notes that human developments on floodplains can be subject to a quick and deadly response from the river. Such areas are subject to urban development but suffer from extreme flood risk, making them contested regions. Under Article 319, the European Commission stated in 1999 that human developments should avoid the *"straightening of rivers, settlement of natural floodplains and land uses which accelerate water runoff in the rivers catchment areas"* (Hartmann, 2011), because these developments could increase the potential for flooding. Adamson and Cussen (2003) note that in Ireland, the continuous development of flood-prone regions was likely to raise the flood risk, since floodplains are natural regions where flooding is a feature of the environment. They have also been shown to be capable of flood water storage and of serving as a means of flood mitigation (EC, 2006). Many towns and cities in England are located on floodplains that could be at risk from river and coastal flooding (CCC, 2015). Among the many recommendations emerging from the public inquiries after the Easter 1998 floods was the need for stricter control over future developments on floodplains to reduce the damage done to human life (House of Commons, 1998: para. 89; Byer and Horner, 1998).

Flooding, as mentioned above, is recognised as the most common and costliest of the natural disasters (Harries, 2013). In England, the National Risk Register considers flooding a major risk (Cabinet Office, 2013). Annually, extreme floods are responsible for considerable and mounting damage to developments on floodplains (Munich Group Re, 2003; Hartmann, 2011). The IPCC (2007) concludes that human development on floodplains, along with inadequate flood response plans, has increased the potential for damage caused by flooding. Despite such dangers, there have been a great many developments in floodplain areas (Loucks et al., 2008; Hartmann, 2011), in response to a combination of factors such as growing population pressures or because the land was attractive for development. In England and Wales, it has been estimated that 1.85 million homes, 185,000 commercial properties, around 5 million people and half of all agricultural land suffer from a risk of flooding (Parker, 2000; EA, 2001; Proverbs et al., 2012). A decade ago, the EA noted that in the UK there were 2.4 million properties situated on floodplains (EA, 2009). A higher percentage of new homes were being built in areas of high flood risk in 2008-10 (9-11%) than in the late 1980s (7-8%) (Porter and Demeritt, 2012). A CCC (2012) report stated that development on floodplain had accelerated in England over the past ten years. It was noted in 2012 that an average of 12% of all new developments were on floodplains, with 200,000 new homes being built there between 2001 and 2011 (CCC, 2012). Many of these developments were deemed to be protected but one in five faced a significant risk of flooding.

According to Smith and Tobin (1979), the increasing urban population on previously flooded land and areas regarded as floodplains was a significant factor in the growing flood risk at that time. Planning policy sought to ensure that three-quarters of new developments situated on floodplains were in areas of low risk. Crichton (2005) argued that the agreement of the Association of British Insurers to cover flood risk for all domestic dwellings in the UK had encouraged increased development on floodplains, thus increasing the overall national flood risk to property. An Adaptation Progress Report in 2015 found that each year there were 1,500 new homes being built in areas of high flood risk and that 3,100 homes per year were in areas of medium flood risk (CCC, 2015; House of Commons, 2015). The increased building of new developments in such areas was noted to add to future flood protection costs, as future flood events were likely to cause more damage in these areas. For this reason, a framework was necessary in order to better manage new developments in floodplain regions and to prevent inappropriate construction that would expose inhabitants to flood risk. During times of flooding, such areas could experience disruption to the community, damage to property and

possible loss of life. To manage flooding, a framework consisting of regulation and laws was established to mitigate the impact of flooding. The following section thus examines the existing regulatory framework that manages the flood risk.

2.3. Flood Management Regulatory Framework

Disaster management seeks to manage the danger posed by hazards. This research is concerned with the hazard of flooding, the most common of the natural disasters, and with the need for a framework defining the rules and systems regulating flood management. According to the Cambridge Dictionary, a framework is *"a system of rules, ideas, or beliefs that is used to plan or decide something"*, while the Oxford Dictionary defines it as *"a basic structure underlying a system, concept, or text"*. Thus, a legal framework is a system created for resolving disputes (Leenes et al., 2017). In this sense, a regulatory framework can be described as a system designed to plan the management and regulation of an activity. This thesis is concerned with the regulatory framework for disaster management, with a particular focus on flooding regulation. Frameworks can operate in a range of situations, but in the context of this research, a framework consists of the policies, guidelines and legislation that surround environmental management. In particular, the aim of this research is to provide recommendations for improving the regulatory framework in the UK within the context of flooding, which is the most persistent of the natural disasters to affect the country. This hazard is managed through a legal system that has created a framework within which policies and regulations are derived. According to Rieu-Clarke et al. (2017), legal frameworks must encourage the positive elements created after flood disasters whilst reducing the negative elements. Legal frameworks are thus recognised for being influential and playing a role in recognising vulnerability (Handmer and Monson, 2004). As such, effective flood management seeks to learn lessons from prior incidents and incorporate them into the framework. The framework, in turn, empowers agencies and other related bodies in the commission of activities to safeguard society from flooding hazards. Within the UK, flooding regulations have developed gradually through numerous lessons learnt over the years. These have formed a framework whereby powers are conferred within the regulatory system.

The legislative system governing flooding is illustrated in Figure 11, which highlights how law and policy form the basis of the regulatory management of flooding, with these being the basis for current legislation.

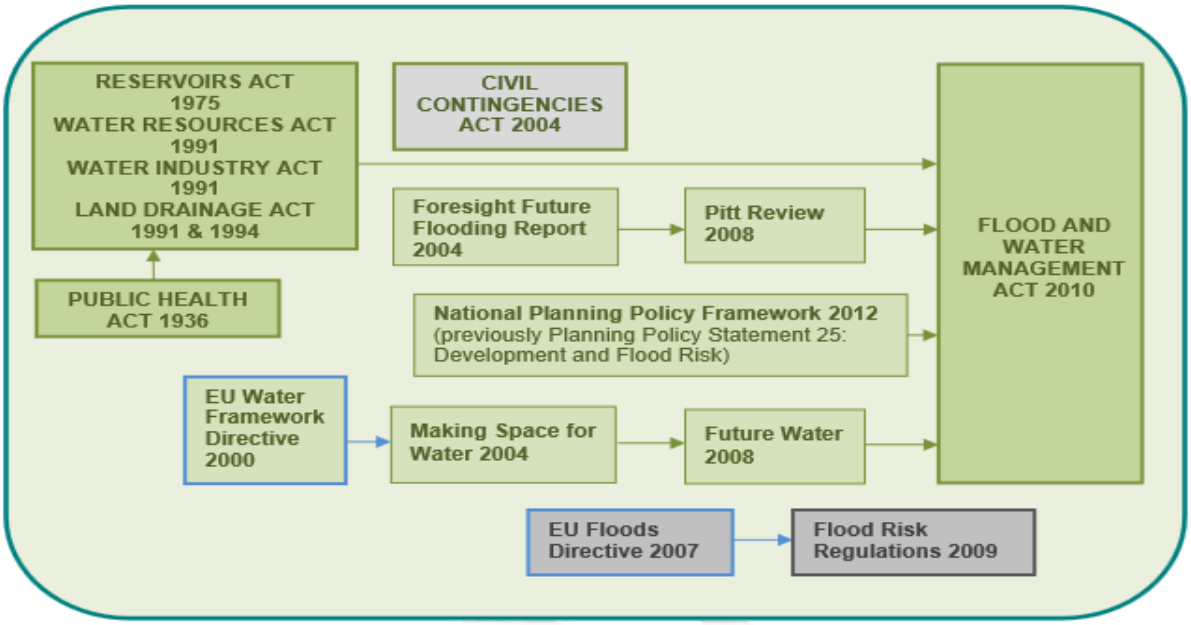

Figure 11: Flood legislation in the United Kingdom *(Source: Devon County Council, 2015)*

In order to control the danger posed by flooding, regulations such as legislation, policy and guidelines are used to manage flood risk. As noted, flood risk is the combination of probability/ hazard and consequence/impact (Sene, 2008). As such, in order to combat the dangers of flooding, flood risk management operates by mitigating the extent of the damage. The UNISDR (2007: 4) defines disaster risk management as *"the systematic process of using administrative directives, organisations, and operational skills and capabilities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster"*. Thus, management and organisation aim to better respond and cope with hazards or disasters, with the goal of mitigating the impact of such events. The EU notes that it is not only feasible but also desirable to *"reduce the risk of adverse consequences, especially for human health and life, the environment, cultural heritage, economic activity and infrastructure associated with floods"* (Directive 2007/60/EC). This directive places a requirement on EU member states to create and maintain a framework to manage flood risk in all its various forms. The tools created as part of this framework include the use of flood risk assessments, hazard maps, management plans, improved strategic coordination and public participation. These constitute the elements of flood defence, with the goal of protecting human lives and property from flooding events. Under the Flood Risk Regulations (2009), a consistent approach to managing flood risk led to a common aim that was adopted across Europe. It established four key stages of activity within a six-year flood risk management cycle as follows:

- **Stage 1**: Undertaking a preliminary flood risk assessment.
- **Stage 2**: Identifying flood risk areas.
- **Stage 3**: Preparing flood hazard and risk maps (required by the end of 2013 and produced by the Environment Agency).
- **Stage 4**: Preparing flood risk management plans.

Developments in the international landscape led to the adoption of such frameworks in the UK. This, in turn, led to the creation of regulatory bodies empowered by the framework to manage floods. Within the UK, the EA operated as a regulatory body and provided guidance on measures needed to protect homes from floods. Effective flood risk management was recognised as important for the UK as it allowed the country to protect against such hazards whilst protecting communities, businesses and infrastructure (NAO, 2014). Legislation served as the basis through which regulatory bodies could enforce and implement works to combat flooding. As a result, the regulatory framework operated with the goal of empowering flood management by providing guidance, policy and regulations. Mehryar and Surminski (2020) note that legislation has a role in flood risk management, albeit one that was not fully explored and recognised. With regard to flooding, the UK has its own history of legislation and policy that has been developed independently over the years, supplemented by the incorporation of international guidelines such as those of the EU in order to improve their implementation.

2.3.1. Flood Management Regulations

For flood management to operate, interaction is needed between multiple disciplines, government and various sectors of society. To accomplish this goal, legislation and policy serve as the guidelines to bring about its implementation. Regulations are derived from a combination of legislation, policy and guidelines which, when put together, form a framework for a regulatory system. They confer powers to set up an institutional framework whereby bodies are empowered to act in the role of regulating flood risk. Any lack of legal clarity could lead to confusion over responsibilities and duties; hence the need to create a legal framework for the effective planning for flood risk. Handmer and Monson (2004: 48–49) consider the role of law in disaster management:

> *National (or domestic) law offers greater opportunities for vulnerability reduction. Firstly, there is far greater scope for the enforcement of rights in national law, because individuals can bring actions in the courts to enforce their rights under national law.*

Public law (which regulates relationships between governments and their citizens, and is distinct from private law, which governs relationships between private citizens) is particularly useful in terms of reducing vulnerability, because the rights enshrined in national public law can be enforced by individuals against national governments, who are often those with the clearest responsibilities and the greatest resources for reducing vulnerability.

This analysis highlights the advantages of using the law in regulating flood risk management. There exists no single set of policies regarding the management of floodplains within the UK. Instead, policy is derived from key legislation and the remits of various bodies set up by central government. The Department for Environment, Food and Rural Affairs (Defra) serves as policy lead for flood defence. The former Department for Communities and Local Government (DCLG) was responsible for leading spatial planning policy. Both of these ministerial departments derive their authority from legislation. For fluvial flood defence, the key pieces of legislation include the Land Drainage Act (1991), the Water Resources Act (1991) and the Environment Act (1995), while planning-related responsibilities are derived primarily from the Town and Country Planning Act (1990), the Planning and Compensation Act (1991) and the Planning and Compulsory Purchase Act (2004). The various laws were consolidated by the suggestions of the Pitt Review (Pitt, 2008). This led to the Flood and Water Management Act (2010), which amended the existing legislation on water-related matters to streamline the regulations for a more holistic approach. This development of legislation, policy and regulations came largely from lessons learnt from various flooding incidents that had affected the UK. For a better understanding of their evolution, a historical view of the development of these regulations is examined in the following subsection.

2.3.1.1. Historical Background

Within the UK, the development of flooding regulation has come gradually through numerous lessons learnt over the years. The Land Drainage Act (1930) is widely considered to be the first comprehensive piece of legislation pertaining to flood risk (Penning-Rowsell et al., 1986). Another of the earliest acts enshrined in law that governed flood protection was the Coastal Protection Act (1949). This allowed for coastal authorities to carry out control measures and prevent coastal erosion, leading effectively to the maintenance and repair of coastal defences. In 1956, water was supplied by over a thousand different institutions and the service varied across the nation. During the 1960s, this system was reviewed and attempts were made to

modernise it, with many of the institutions being merged with one another (Ofwat and Defra, 2006). The Land Drainage Act (1991) also provided legislation on draining of flood water in local land. It listed the duties of the relevant bodies and set out the rights of individuals who owned land by a watercourse. In parallel, the Water Resources Act (1991) provided the powers of the EA on matters relating to flood defence. The Environment Act (1995) required the EA to supervise all matters relating to flood and coastal erosion risk management within England and Wales. It provided the Agency with the main regulatory powers over the water environment (Cullingworth and Nadin, 2006). Thus, it serves as the basis for empowering the Agency in its duties.

The 2007 floods led to changes that were incorporated into legislation, as the findings of the Pitt Review placed a higher concern on flooding (Pitt, 2008). The EU's Flood Directive (2007/60/EC) determined that frameworks were required in order to assess a flood risk. This included a focus on aspects such as the frequency, extent and aftereffects of a flood. Its objective, as stated by Peeters and Uylenburg (2014), was to reduce and assess flood risk in order to manage the risk of any adverse consequences. Implementing the procedures set by the Directive was left entirely to the Member States. The Flood Risk Regulations (2009) incorporated the earlier EU Flood Directive (2007) into national law. The Directive sets out the response in cases of major flooding in Europe. Within the UK, the Regulations created a timetable for Lead Local Flood Authorities in flood risk assessment that need to be completed through a complete six-year cycle. The Flood Risk Regulations (2009) placed duties on the EA and the local authorities to prepare flood risk assessments, flood risk maps and flood risk management plans (Defra, 2009). As such, it sets out regular duties to be performed in relation to flood monitoring and management. It operates alongside other legislation that serves as the foundations of the flood risk management framework. The six pieces of legislation that constitute the foundation of the modern legislative framework are detailed in **Table 4**.

Table 4: UK legislation

Act	Detail
Highways Act 1980	Establishes the duty to manage and operate the roads, including responding to surface water drainage
Water Act 1989	Establishes water companies and the National Rivers Authority
Water Resources Act 1991	Establishes the powers and responsibilities of the National River Authority
Water Industry Act 1991	Establishes the supply of water and sewerage services
Land Drainage Act 1991	Establishes the powers and responsibilities of local authorities, internal drainage boards and riverside owners
Environment Act 1995	Establishes the Environment Agency and transfers to it the powers of the National Rivers Authority

As the table shows, the legislation successively created duties and roles related to water, this culminating in the establishment of formal flood management bodies. A more recent development is the Flood and Water Management Act (2010), which introduced the concept of flood and coastal erosion risk management. It included initiatives to prevent flooding and reduce the impact of flooding incidents. Furthermore, it appointed strategic oversight of national flood and coastal erosion risk management in England to the EA. The 2010 Act served as the legislative mechanism for the management of flood risks and guidance on safeguarding the community, its goal being the reduction of flood risk associated with extreme weather conditions. Section 1 of the Act defines 'flood' as including any case where land normally not covered by water becomes covered by water, excluding certain circumstances such as the overflowing of a sewer system and burst water supply pipes. Risk is defined under Section 2 as involving both probability of occurrence and potential consequences. It further defines the aspects of flood risk and coastal erosion risk covered by the Act as including risk management. In this case, risk management seeks to reduce the potential consequence of an occurrence such as flooding. On local flood risks, the 2010 Act makes it the responsibility of each local council to manage the potential flood risks in its area. This legislation served as the driving mechanism for the creation of flood defences. Under Section 21, the LLFAs are required to maintain a register of structures that could be significantly affected in a flood risk area. The Act also requires the government to publish a National Flood and Coastal Erosion Risk Management Strategy (EA, 2011). Legislation thus servers as the basis on which regulatory bodies enforce and implement works to combat flooding. In addition to law, a number of reviews and reports have helped to shape policy, among these being the Pitt Review.

2.3.1.2. Pitt Review

Following the 2007 floods, an independent review was conducted by Sir Michael Pitt at the request of the UK government. Pitt highlighted a number of factors that he believed were responsible for aggravating the effects of the summer floods and made recommendations against future such incidents. The findings were published in 2008 and became known as the Pitt Review (Pitt, 2008). This saw Pitt undertake the task of examining the country's flood defences in order to determine areas that suffered from weaknesses and required improvement. The government had asked Pitt to provide an independent and fair assessment of the flood management regulations of that time. His findings indicated that floods were the largest peacetime emergency to have affected the UK (Pitt, 2008). The Review stated that more clarity was needed regarding the roles and responsibilities of the different organisations that managed flood risk and warned that there was an increased chance of further such incidents occurring on a smaller scale. Sir Michael made numerous recommendations on improving the system. These were designed to be sustainable and affordable and he cautioning against delay in adopting them, due to the great risk of flooding in the future. The full report as published contains a series of 92 proposals that Pitt describes as needing to be implemented in order to bring about a better degree of resilience and protection for communities from further flood risks.

The recommendations of the Pitt Review include:

- the creation by the government of a Flood and Water Management Bill to incorporate all issues of flooding and to assign responsibilities during such an event;
- in addition to adaptation and mitigation policies, the adoption of long-term strategies in response to predictions regarding extreme weather events and climate change;
- the appointment of the Environment Agency to review all flood risks and engage with the relevant authorities in combating such incidents;
- improvements in the tools and techniques used by the EA and local authorities to better aid in predicting and modelling of floods, along with more effective flood warning services and improved public awareness of floods in risk areas;
- the amendment of legislation and structural development regulations in flood risk areas to allow improvements such as the automatic connection of surface water drainage to sewerage systems, improved dam and reservoir safety measures and the use of proper risk assessment and planning by affected parties.

There followed a review of the 2007 floods by the EA, which found that extensive efforts had been made to mitigate the effects of the flooding but that improvements were needed to better manage future risks. After the publication of the Pitt Review, Defra implemented all of its recommendations and set a target date for the completion of the objectives (Defra, 2008). These were later re-examined, with a report being compiled as part of the review (Defra, 2012). The EA review effectively aided in the formation of the current flood risk management framework and sought to address factors that at the time were impeding flood response, the intention being to improve flood risk management policy within the existing framework to help mitigate any vulnerabilities.

Among the recommendations for improving flood mitigation strategies were:

- improving the efficiency of flood forecasting development programmes;
- a more effective use of timely flood warnings;
- delegation by the government of responsibilities to the EA on the strategic management of inland flood risks, while conferring structured responsibilities to local authorities and other relevant bodies;
- review by the government of flood risk protection standards following the climate change predictions;
- the maintenance of flood defence assets, as an essential aspect of this strategy;
- the updating of reservoir legislation to improve its performance;
- strict adherence to the safe development of flood plains;
- improving public awareness of the risk of flooding and the measures needed to ensure the protection of property and its occupants.

In addition to these suggestions, the Agency stated that two key approaches needed to be adopted for an effective use of flood risk management, namely a) the assessment of flood risk regions by the responsible operators and b) a common action plan and process uniting all relevant organisations, with the use of sanctions to ensure compliance and the maintenance of standards (EA, 2007). It was estimated that within around twenty years, some 200 homes would be at risk of complete loss to coastal erosion and a further 2,000 would be at potential risk (EA, 2009). As such, the element of flood risk was a growing one with further areas capable of suffering from potential flooding. It was with the Pitt Review in mind that legislation to better manage flooding was created in the Flood and Water Management Act (2010). Under the Act, the lead local authority in each part of the UK was required to maintain a strategy for local

flood risk management. The Act created a framework by which the delivery of such national and local strategies could be implemented. Furthermore, it inserted definitions of 'flood', 'Risk Management Authority' and 'Lead Local Flood Authority' in order to better assign responsibilities to the relevant parties. This established the roles of the various parties and defined how these risk management authorities were required to act in managing flood threats. In 2012, a Climate Change Risk Assessment indicated that the UK was already vulnerable to extreme weather events such as flooding and heatwaves. The government's Final Progress Report on the Pitt Review was published in 2012. Similar to the previous two reports, it provided a breakdown of developments in implementing the findings of the Pitt Review. Among the key developments noted in the report were:

- The Flood and Water Management Bill being made into an Act in 2010.
- The publishing of the National Flood and Coastal Erosion Risk Management Strategy in 2011.
- The National Flood Emergency Framework published in 2010.
- The Water Industry (Schemes for Adoption for Private sewers) Regulations 2011.

In addition, the report stated that a number of the recommendations of the Pitt Review were no longer to be adopted. The maintenance of England's food defence capacity was considered a national priority by the government (NAO, 2014). Within the UK, an estimated 5.8 million properties (nearly 20%) suffered from the risk of flooding (Defra, 2013). These elements gave rise to the link between flooding as a natural disaster and law in terms of a system of management to mitigate its effects. It was expected that flood risk within the UK would further increase in the future (Evans et al., 2004). Similarly, many EU Member States had developed lessons learnt from flooding incidents to create flood management guidelines. These included the EU Floods Directive, which had an influence on policy in the UK.

2.3.1.3. EU Floods Directive

Within Europe, many countries were beset by flooding between 1998 and 2002. After severe flooding in 2005, the concept of a shared framework for managing such natural disasters was introduced. A detailed proposal in 2006 to the European Commission resulted in the Flood Directive (Directive 2007/60/EC), a piece of legislation passed by the European Parliament. This merged water policy with that of land policy, the Commission having stressed the importance for flood risk management of incorporating this relationship into regulations (Hartmann, 2011). The Directive covered the assessment and management of flood risks and

was designed to aid Member States in preventing and limiting the impacts of flooding on people, property and the environment. Part of its aim was to create a consistent approach towards flood risk management across Europe. As such, it sought to improve the management of flood risks that posed a danger to human health, the environment and society. It addressed all stages of the flood risk management cycle, including prevention, protection and preparedness (Moss and Monstadt, 2008). The Directive came into force on 26 November 2007 and detailed the requirement to conduct the assessment and management of risks from flooding. This requirement was placed on all Member States in cases where water courses and coastlines were subjected to the risk of flooding. A further duty was to map the extent of flooding and any assets or people likely to be affected in flood zones. This was needed for an effective and coordinated reduction of flood risk. In addition, the Directive reinforced the right of the public to access this information and to participate in the planning process. Thus, it created a framework for improved flood risk management in 27 EU Member States (Pender and Faulkner, 2010). It applied to both inland and coastal water across the whole territory of the European Union.

The Floods Directive (2007) showcased the shift in policy from flood defence to one of flood risk management. It sought to make authorities, communities and individuals better aware of flood risk in order to put into place plans that minimised the consequences of flooding. A key element of the Directive was that it required Member States to carry out preliminary assessment of flood risks by 2011. These identified river basins along with other associated coastal regions that could be affected by flooding. Following identification, these zones were to be included in flood risk maps by 2013, whereupon flood risk management plans were to be drawn up to allow for preventative, protective and preparedness strategies to be in place by 2015. The Directive operated in concert with the Water Framework Directive to allow for the coordination of flood risk management and river basin management plans. Article 7 of the Directive required each Member State to prepare its own Flood Risk Management Plan. Under Article 7(3), environmental objectives set by the Water Framework Directive had to be taken into account when creating plans for flood risk management and coastal risk management plans. This strengthened the policy of restoring floodplains and wetlands to reduce the likelihood and impact of flooding (Moss and Monstadt, 2008). It also included public participation strategies to better prepare and enact these measures. A further aspect of the Directive was to consider the effects of long-term developments such as climate change and sustainable land use on the flood risk management cycle. These were among the requirements of the Floods Directive that

aimed for a consistent approach towards manging flood risk in a six-year planning cycle. Flood Risk Areas were designed to meet the requirements of the Directive and its broad planning process.

Thus, by imposing a number of duties in managing flood risk and taking measures to respond to the danger of flooding, the Directive served to coordinate European efforts at managing flooding (Pender and Faulkner, 2010). It was, however, only the first step towards the adoption by individual Member States of wider-scales measures. As noted by Moss and Monstadt (2008), the Directive did not impose the taking of any specific measures, but rather placed on national authorities the duty to ensure appropriate flood management measures within a general framework for flood risk management that was to be interpreted by each Member State. In the UK, this led to the incorporation of the Directive into national policy, whereby the UK aligned its planning processes with the EU Floods Directive and Water Framework Directive. The former was transposed into English domestic law with the creation of the Flood Risk Regulations (2009). This meant that flood risk management was in line with a consistent pan-European approach. It also influenced further legislation and policy in the UK. As noted, legislation served as the basis for the creation of regulatory frameworks with current guidelines being accomplished by the Flood and Water Management Act (2010). It created the means by which regulatory bodies would act for the purpose of managing flood risk.

2.3.1.4. Flood and Water Management Act 2010

The Coastal Protection Act (1949) was one of the first laws that governed flood protection in the UK. It allowed for coastal authorities to carry out control measures and prevent coastal erosion, leading effectively to the maintenance and repair of coastal defences. Initially, during the first half of the 20th century, flooding was covered by land drainage regulations. This changed first with a policy shift towards flood defence and public protection, then the later adoption of a risk management policy (Penning-Rowsell et al., 1986). The Land Drainage Act (1991) also provided legislation on the draining of flood water from local land. It listed the duties of the relevant bodies and delineated the rights of individual owners of land adjacent to watercourses. In parallel, the Water Resources Act (1991) provided the powers of the Environment Agency in matters relating to flood defence. The Environment Act (1995) required the EA to supervise all aspects of flood and coastal erosion risk management within England and Wales. The EU Floods Directive (2007/60/EC) determined that frameworks were required in order to assess a flood risk. This included a focus on aspects such as the frequency,

extent and aftereffects of a flood. Its objective, according to Peeters and Uylenburg (2014), was to reduce and assess flood risk in order to manage the risk of adverse consequences. Implementing the procedures set by the Directive was left entirely to the Member States.

These developments marked a shift in the perception of flooding from the drainage of agricultural land to urban protection and flood defence, as floodplain settlement became more widespread. However, flood defence was deemed unsustainable in the long run, leading to a new focus on flood risk management (Penning-Rowsell et al., 1986). The Flood Risk Regulations (2009), incorporating the EU Floods Directive (2007) into national law, created a timetable for Lead Local Flood Authorities in flood risk assessment that needed to be completed through a complete six-year cycle. The Regulations placed duties on the EA and local authorities to prepare flood risk assessments, flood risk maps and flood risk management plans (Defra, 2009). It created the framework needed to identify flood risks and take action in areas of significant flood risk. The Flood and Water Management Act (2010), which operated as part of the regulatory framework of flood management in the UK, noted the change towards flood risk management instead of relying on flood defences. This served as the basis of a regulatory framework for managing developments on floodplains.

In response to the widespread flooding events of 2007, new legislation was developed to combat the growing risk of flooding in the UK. This was the Flood and Water Management Act (2010), which assigned a number of duties to councils. A key aim of the Act was to clarify the responsibilities of the various parties, such as the role of local authorities with regard to flood risk management. The goal was an improved and more sustainable management of flood risk for people, homes and businesses. The government thus sought to better safeguard communities by creating bodies that were accountable for the delivery of coordinated strategies on local flood risk management and reduction. The implementation of the Act has been reviewed and it has been acknowledged as a step forward in managing flood risk (Defra, 2017). The next subsection considers the regulatory bodies empowered by the framework and made responsible for the operation of the Act.

2.3.2. Regulatory Bodies

The Land Drainage Act (1930) was the first piece of UK legislation that sought to consolidate the various regulations and institutions involved in flood risk management. This saw all prior legislation and the responsible bodies being reorganised within an official system. The result was a formalised national policy on land drainage levies and management strategies led by the

Ministry of Agriculture and Fisheries. Within the modern management framework, Defra has assumed national responsibility for environmental protection, becoming the lead central government department responsible for flood policy. As such, it provides the majority of the flood and coastal erosion risk management funding to the EA (House of Commons Library, 2017). It has also modified the role of local authorities in the future of flood governance by giving them control of 'non-main' watercourses. These bodies are charged with the enforcement of a flood risk management strategy developed by the Defra and the EA. These changes reflect the view of management as the primary means of combating flooding, as opposed to the more traditional approach of erecting flood defences (Johnson and Priest, 2008). Another central government body with a role in the flood management and recovery process was the former DCLG, which had an impact on planning policy and provided funding to local authorities. The Flood and Water Management Act (2010) provides for Regional Flood and Coastal Committees (RFCCs) to play a key role in the coordination of flood risk management by advising and approving flood defence programmes for their respective regions and by reviewing local authority risk assessments, maps and plans as required by the EU Floods Directive (Directive 2007/60/EC). Thus, RFCCs have a role in assessing and managing risk from flooding; their operation in conjunction with the existing flood risk management framework is detailed in Figure 12.

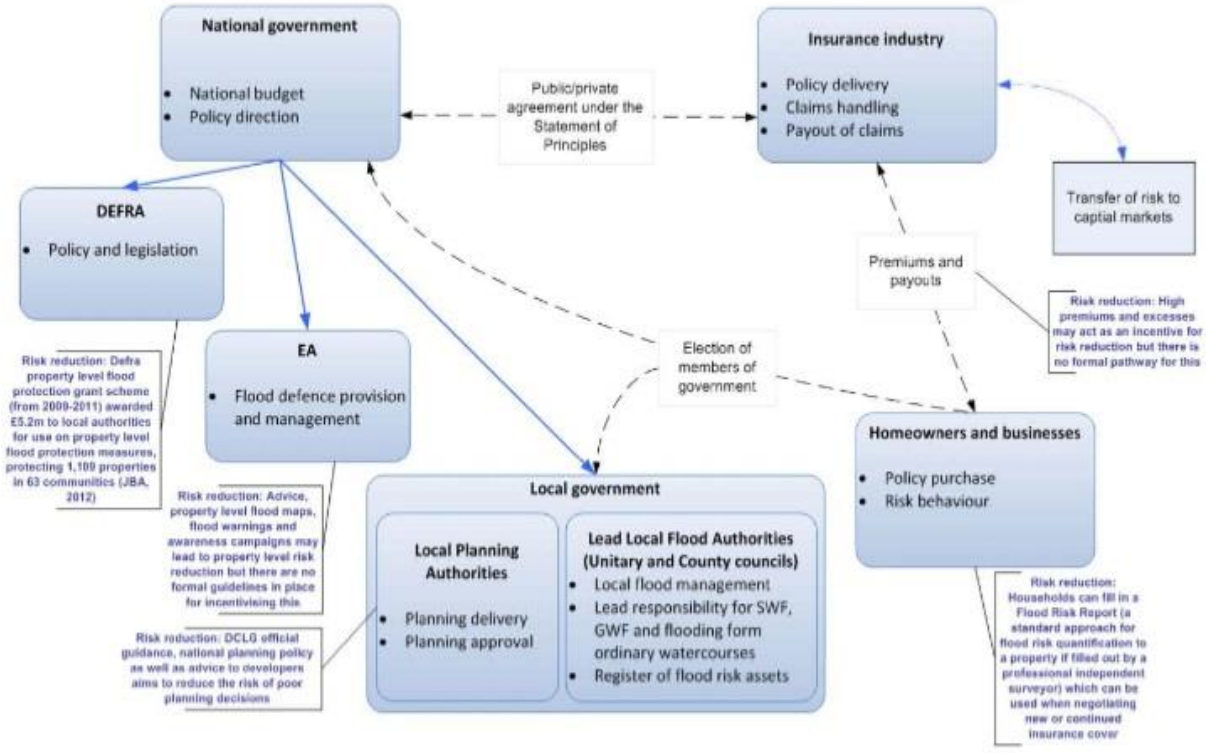

Figure 12: Roles and responsibilities of the government and insurers with highlighted risk reduction roles *(Source: Surminski and Eldridge, 2015)*

The framework illustrated in Figure 12 consists of a web of interconnected bodies ranging from central government to the insurance sector and homeowners. Each has a role in the management of risk and in mitigation measures. No single body is responsible for flood risk, which is the joint responsibility of many bodies. National government is responsible for the budget and policy. Defra, as policy lead, develops guidelines for the designated Risk Assessment Management Authorities (the EA, LLFAs, local councils, water companies etc). Among these, the EA is the lead in managing flooding and risk from coastal erosion management strategy. This includes allocating central government funding for projects managing flood risk from all sources and engaging in various projects. LLFAs are charged with managing flooding on a more local level, such as responding to risk from surface water, ground water and small ordinary watercourses. Water and sewage companies also have a major role in managing flooding and coastal erosion risks by maintaining their respective infrastructure. Internal drainage boards (IDBs) are independent public bodies responsible for controlling water levels in low-lying areas. Other bodies involved in flood risk management include insurance companies and home owners, who are responsible for making their properties resilient to flooding.

Notwithstanding the establishment of this framework, flood risk remains a concern in the UK. Following extensive cases of flooding across England in the summer of 2007, the Pitt Review (2008) concluded that the authorities responsible for managing flood risk *"should co-operate better"* (EA, 2011). The Flood and Water Management Act (2010) identifies "new responsibilities" for flood risk management authorities with a "duty of cooperation" between all relevant authorities. Defra remains the lead government department and develops flood risk management policy. Under Sir Michael Pitt's recommendation, the EA was given the strategic overview for flood risk management and is also responsible for flood risk management activities on main rivers. LLFAs work in close partnership with RFCCs to prepare and maintain a strategy for local flood risk management, including the establishment of a body to approve suitable drainage systems. District councils and IDBs are charged with supervising land drainage, whilst flood defence bodies work on ordinary watercourses or other sources of flooding. The 2010 Act provides replaced Regional Flood Defence Committees with RFCCs, which have:

> *a key role in the co-ordination of FCERM [flood and coastal erosion risk management] by advising on and approving the implementation of programmes of work for their*

areas, and supporting the development of funding for local priority projects and works. RFCCs also provide for local democratic input through the majority membership of representatives from Lead Local Flood Authorities (EA, 2011: 3).

It also states that they should have a wider role in assisting the scrutiny of local authority risk assessments, maps and plans required by the EU Floods Directive.

Section 6(13) of the Act clearly identifies the bodies responsible for managing flood risk, including the EA, LLFAs, district councils, internal drainage boards, water companies and highways authorities. To accomplish their role as flood risk management authorities, these bodies are all granted permissive powers relating to flooding and land drainage. Individual landowners have the primary responsibility for safeguarding their own land and property against flooding. Thus, the Act establishes the EA as maintaining a strategic overview whilst local authorities have a new leadership role in local flood risk management.

2.3.2.1. Environment Agency

The Environment Agency is an executive non-departmental public body sponsored by Defra (House of Commons Library, 2017) and responsible for managing the environment, including flood risks posed by main rivers, estuaries, the sea and reservoirs. The EA's responsibility is for the strategic overview of all sources of flooding and coastal erosion. Flood risk is defined as the combination of probability/hazard and consequence/impact (Sene, 2012). As such, in order to combat the dangers of flooding, flood risk management operates by mitigating the extent of the damage. According to the UNISDR (2007), disaster risk management is defined as *"the systematic process of using administrative directives, organizations, and operational skills and capabilities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster"*. The EU Floods Directive notes that it is not only feasible but also desirable to *"reduce the risk of adverse consequences, especially for human health and life, the environment, cultural heritage, economic activity and infrastructure associated with floods"* (Directive 2007/60/EC). The Directive created the element of flood defence with the goal of protecting human lives and property from flooding events. A link thus emerged with the EA, which offers guidance on measures needed to protect homes from floods. Effective flood risk management has been identified as an important factor for the UK, affording protection against such hazards for communities, businesses and infrastructure (NAO, 2014). It allows for the management of

disaster events and the conditions underlying vulnerability, to reduce the extent of damage. The Environment Agency operates in such a role within the UK, deriving its authority from Defra and from legislation, and operating alongside other flood risk management bodies. The roles of the various bodies are illustrated in Figure 13.

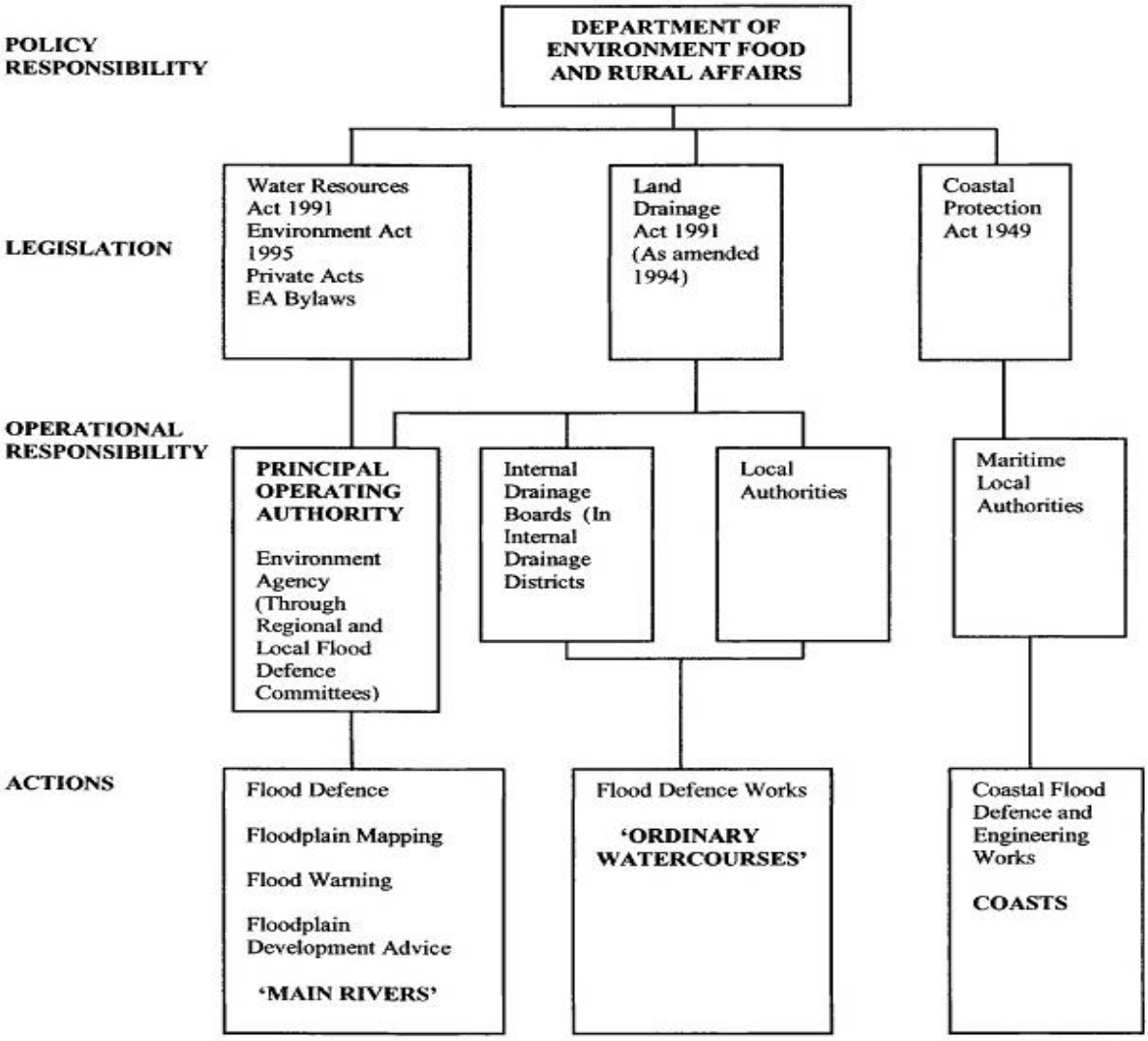

Figure 13: Institutional framework for UK flood management *(Source: Brown and Damery, 2002)*

The Environment Agency acts as the regulatory body responsible for water protection. One of its key duties is to fulfil the requirements of the Water Framework Directive, including protection from pollution in England. It has a role in the strategic overview of flood risk management in the country. The Flood and Water Management Act (2010) states that the Agency *"shall in relation to England and Wales exercise a general supervision over all matters relating to flood and coastal erosion risk management"*. The EA thus supports and supervises other related organisations, including the LLFAs, water companies, IDBs and Highways Authorities. It assesses and organises flood risk to be dealt with by whichever of these

organisations is responsible for a particular aspect. The Agency has permissive powers to manage flood risks from main rivers and the sea and is tasked with developing flood defence schemes to protect residential and non-residential properties along with agricultural land.

One purpose of regulation is to prevent undeveloped floodplains becoming unwisely developed while controlling further development on partly developed floodplains (Parker, 1995). In the UK, flood management involves a complex framework of institutions in its administration, finance and service (Brown and Damery, 2002). Defra and the EA are the leading bodies in developing strategies to mitigate the effects of flooding, the latter having a supervisory duty in matters of flood defence (Brown and Damery, 2002). Legislation such as Parts I and II of the Environment Act (1995) confer investigatory powers on the EA in the commission of its duties. The Flood Risk Regulations (2009) place duties on the EA and local authorities to prepare flood risk assessments, flood risk maps and flood risk management plans (Defra, 2009). While operating in the role of flood defence, legislation also makes it responsible for flood risk management. Cooley et al. (2006) stated that *"land-use management is among the most effective mitigation measure available"*. The EA (2009) supports the view that proper control over land management is the best approach to managing flood risk; hence its assertion that developing non-floodplain land is a means of averting flood risk. This recommendation highlights the fact that floodplains are at danger of flooding and therefore that developing in such areas entails exposure to that risk.

In 2014, the EA commissioned the Long-Term Investment Strategy for Flood and Coastal Risk Management in England Study, an economic assessment of future flooding and coastal erosion risk management from 2015 to 2065 (EA, 2014). Flood Support Schemes for eligible local authorities had been created by the DCLG in response to tidal surges in 2013 (HM Government, 2014). In addition to the EA, the IDBs operated as land drainage authorities with the power to undertake works on any watercourses other than main rivers within their areas. The Land Drainage Acts assigned them the duties of supervising land drainage, improving and maintaining drainage systems, regulating activities in those systems, raising income to support this work and undertaking conservation work. The EA fulfils the role of flood risk management operating authority as well as being involved in the creation of policy (HCEC, 2006).

Despite the above-mentioned measures, there remain a number of challenges with regard to flood management and defence. These include repeated building on floodplains over many years, creating developments which require flood defences to protect property and occupants.

Hartmann (2011) states that policymakers have supported water management agencies in building and leveeing in an effort to create hard flood defences as a means of reducing the impact of flooding events and mitigating any losses sustained. Despite its regulatory powers derived from legislation and its legal status as a statutory consultee in matters of planning, requiring local authorities or planning authorities to inform it of any proposed developments, it has been noted that the EA does not always receive feedback on their recommendations regarding planning applications (House of Commons, 2015). Furthermore, its rulings are not final, as it operates only as a consultee in the planning process, which has its own independent set of guidelines and policies. Other bodies involved with flood risk management include the LLFAs, which are discussed next.

2.3.2.2. Local Lead Flood Authorities

One of the recommendations of Sir Michael Pitt was that local authorities *"should lead on the management of local flood risk, with the support of the relevant organisations"*, because local groups should be responsible for local risks (Pitt, 2008). Accordingly, local authorities were afforded new duties, including managing surface water flooding. Under section 4(7) of the Flood and Water Management Act, a Lead Local Flood Authority could either be the unitary council of the area or the county council. Thus, responsibility was given to councils to serve as LLFAs, a role created under the Flood Risk Regulations (2009). The LLFAs were given local leadership and coordination responsibilities for flood risk management. Under Section 9 of the Act, they were charged with developing, maintaining and applying the flood risk management strategy in their respective regions. As such, they were responsible for managing local sources of flood risk, which in this case meant flooding from surface water, groundwater and smaller watercourses. They had permissive powers and a statutory duty in managing and coordinating these various forms of localised flooding, making them accountable for ensuring the effective management of such flood risks. To accomplish this role, local authorities relied on information gained from either public or private bodies such as IDBs, water companies and emergency services. The Act places a duty on all such bodies to cooperate with one another and share information, in line with Recommendation 17 of the Pitt Review. With this information, local authorities had the power to conduct work to remove flood risk caused by surface runoff and groundwater. Under Section 21 of the Flood and Water Management Act (2010), local authorities are required to maintain a register of structures and features that could suffer from significant flood risk in their respective regions (Defra, 2017), to keep track of flood risk. This information is to be made available to the public and the relevant authorities in order for the

risks to be mitigated or avoided entirely by steering development away from areas of highest risk.

This demonstrates how the framework created by law and policy empowers local authorities. It not only establishes the duties of flood response bodies but also gives them the authority to conduct mitigation measures. These have been further shaped by factors such as the Pitt Review, which aimed to improve the regulatory framework by highlighting barriers and providing recommendations for removing them. All of these elements of a UK-wide central flood risk management strategy are illustrated in Figure 14.

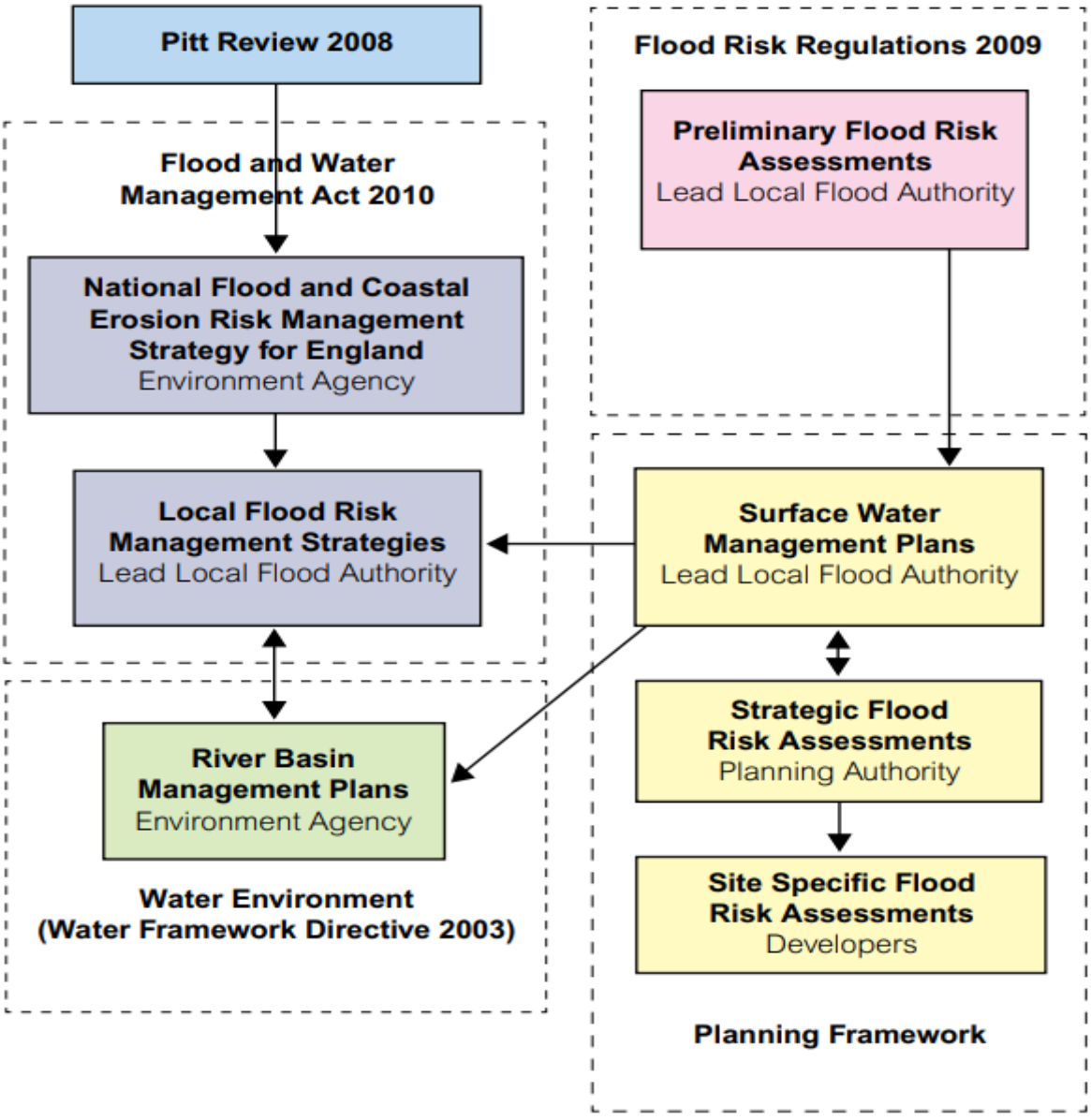

Figure 14: Correlation between law and flood risk management *(Source: Sheffield Flood Risk Management Strategy, 2019)*

This diagram details the link between legislation and flood risk management, showing how the various bodies are empowered to perform duties such as management, assessing flood risk and planning. It also highlights how the Flood Risk Regulations (2009) created the basis for preliminary flood risk assessments performed by the LLFAs, which are responsible for the creation and implementation of the flood risk management strategy in each locality. Section 9(1) of the Flood and Water Management Act (2010) stipulates that *"a lead local flood authority for an area in England must develop, maintain, apply and monitor a strategy for local flood risk management in its area"*. Among the duties of an LLFA are maintaining and restoring natural processes whilst managing water levels in relation to the various sources of flood risk (Defra, 2017). Under the Flood Directive, local authorities in England and Wales are responsible for preparing Preliminary Flood Risk Assessments in order to identify areas of significant risk, with the support of the Environment Agency to ensure the maintenance of appropriate standards and a level of consistency between LLFAs. In relation to flood risk management, the LLFAs are intended to complement the national strategy overview role provided by the EA by deploying their understanding on a local level and assessing the risk of all forms of flooding including coastal erosion. Thus, they take the lead role in delivering management of the risk, with the EA providing support. There is also a duty to map the extent of flooding risk with the extent to which assets or populations could be affected. Under the Act, the RFCCs have a role in making local decisions and aiding in the coordination of flood and coastal erosion risk management. In addition, the LLFAs work alongside other flood risk management authorities under the Flood and Water Management Act.

Each body has a specific role with regard to flood risk management. District councils also serve as key partners in the planning of local flood risk management. Section 19 of the Flood and Water Management Act (2010) states that Local Authorities have a duty to perform investigations to establish which risk management authority has the relevant flood risk management functions and whether each has exercised its duties in relation to floods. In addition, under Section 19(2), the Local Authority must publish the results of its investigations. The Act allows for LLFAs to delegate flood or coastal erosion duties to other risk management authorities by agreement. This allows the latter to work with the LLFAs and others in taking decisions on development in their respective regions, to ensure that these are effectively managed. Internal drainage boards aid in reducing flood risk by acting as independent public bodies responsible for water level management. The UK flood management framework also allocates responsibility to water and sewerage companies to respond to risks of flooding from

surface water and foul or combined sewer systems and to take into account other local flood risks. Finally, local planning authorities must ensure that land use planning is consistent with the Strategic Flood Risk Assessments, guiding the allocation of future development locations in line with Recommendation 7 of the Pitt Review. A further element of flood risk management concerns developments in flood risk areas. Local authorities must exercise their planning control duties to ensure that the risk of flooding is manageable, working in concert with the EA in its risk assessment and management, whilst providing advice to the local planning authority. As such, they should consult on planning applications for development on floodplains as dictated in statute by PPS25.

The following subsections consider the regulation of the planning and purchase processes by the above bodies.

2.3.2.2.1. Planning Process

Within the UK, planning control is the process of managing the development of land, including the erection of new buildings. It has a key role in regulating developments and preventing any significant building without the permission of the local authority. Schedule 4 of the Town and Country Planning (Development Management Procedure) (England) Order 2015 details the relevant consulting bodies, the EA being responsible in cases of building in flood zones. Guidance is provided by the National Planning Policy Framework (p.23): *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere."* Further guidance is offered by national Planning Practice Guidance (PPG) documents; thus, PPG24: Planning and Noise refers to eliminating inappropriate developments in areas of flood risk. Part of the EA's function in controlling flood risk is the prevention of inappropriate developments in floodplain areas (EA, 2009). In 2001, the government produced the Development and Flood Risk (PPG25) guidance on new planning, which allowed for permits to be given to develop on floodplains in England if there was nowhere safe to build, imposing a 'sequential rule' (Crichton, 2008) which requires a precautionary approach to be taken to the allocation of sites for development, placing them in descending order of flood risk. Developments in areas deemed undefended from floods must *"remain safe without increasing flood risk, and ideally reducing the risk"* (Gov, 2009). This was designed to encourage developers to build in areas less vulnerable to flooding. However,

the guidance notes that in exceptional cases, developments can occur on a floodplain, as long as they are safe.

Furthermore, county councils and LLFAs have a duty under the Flood and Water Management Act (2010) to coordinate flood risk management across the country. This includes the creation of management strategies for local flood risks. The EA also contributes by producing flood zone maps and making them available to property owners and local authorities. These maps of natural floodplains detail areas where floods may occur or may be severe if no flood defence structures are present (EA, 2009). Areas of risk are designated Flood Zones 1, 2 and 3, the last representing the highest level of risk (House of Commons, 2015). This service allows owners and developers to be better prepared by becoming aware of the dangers of an area being vulnerable to flooding. The three categories are based on theoretical rather than actual risk, as they assume the total absence of flood defences. The PPG25 Flood Risk Zones are thus seen as only the starting point in the consideration of flood risk.

Flood zoning is a means of soft engineering and represents a relatively natural approach to flood management. Under the national policy, certain land uses are permitted on floodplains depending on the zoning, the intention being to reduce the risk of flooding to properties. Thus, there is a set of criteria in the planning process to allow for building on such sites. This seems to be at odds with the central strategy of avoiding development on floodplains. However, the strategy does note that such sites may be developed if deemed necessary. Thus, the planning process includes the means to allow building on floodplains, albeit under strict criteria. The detailed designation of the various flood zones and the level of risk based on probability of flooding are given in Table 5.

Table 5: Flood zoning

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)[3]

(Source: House of Commons Library, 2016)

To combat floodplain developments, management is seen as the best instrument for public safety (Freitag, 2009). It provides a system of guidelines that seek to restrict inappropriate development. Policy can be used as a means of creating a framework for managing such flood risks. In fact, it is a requirement when building in floodplain regions that occupants are not placed at risk (RIBA, 2009), yet occupants of buildings on floodplains will face a degree of flood risk, which is why there is a regulatory system intended to mitigate the harm. The background is the awareness of a growing danger of flooding in the UK due to a variety of factors, such as climate change. However, a growing issue is the increasing number of developments situated in floodplain regions. New developments built on floodplains that suffer from increased risk as the result of climate change means that individuals situated within them suffering from flood risk. The Climate Change Act (2008) established a legal obligation to adapt in the face of growing dangers from the environment. Legislation serves as the primary means of managing and mitigating the effects of flooding. This is reflected in the EA being entrusted with a strategic overview of matters related to flooding (Defra, 2014a). Through such

regulatory bodies, guidance is given and policy implemented in the control of developments in order to mitigate the risk of damage caused by flood events. However, research has demonstrated that despite the issuing of guidelines against building on floodplains, there has been a growing number of such developments (CCC, 2014; RIBA, 2014). This practice appears to contravene one of the explicit goals of flood risk management.

Local planning policy is largely driven by the national Planning Policy Statements, which have strengthened the roles and responsibilities of developers, regional and local planning bodies and authorities while attempting to apply a more strategic, rigorous and systematic approach to incorporating flood risk into the making of development decisions (Johnson et al., 2007; Goodson, 2011). Among these statements is PPS25, requiring flood risk to be considered during the planning and development processes (CLG, 2006). According to Paragraph 3, *"all forms of flooding and their impact on the natural and built environment are material planning considerations"*. These documents acknowledge the impact of climate change on flood risk and require it to be taken into account when framing policies with regard to the location of new developments. Local planning authorities must apply a risk-based sequential test to assist in adopting the appropriate planning process in the different flood zones. There is an exception to the test that allows for certain developments in zones of high flood risk if there are overriding reasons for this. An amendment was made to Article 10 of the Town and Country Planning (General Development Procedure) Order 1995 to take this into account. Applications for such major developments in flood risk areas are sent to the EA, which in its role as statutory consultee advises on the flood status of proposed development sites in England and Wales (Wynn, 2005). Any major development could meet a sustained objection from the EA, with this being reviewed by the Secretary of State, whose decision determines the final outcome. The reason for this process is to serve as a barrier for such applications and to limit open development on floodplains. Despite this, almost 700 houses were built in areas of flood risk in 2004, against the advice of the EA (HCEC, 2006). The House of Commons Communities and Local Government Committee has noted that between 2000 and 2005, approximately 11% of new homes were built in flood-prone areas (HCCLGC, 2006). Around a quarter of the properties that flooded during summer 2007 had been built within the previous 25 years (Pitt, 2008). This rise in the number of properties built in such areas exposed occupants to flood risk and highlighted the danger to property owners, who should be aware of this risk when buying properties.

2.3.2.2.2. Purchase Process

While bodies such as the EA and the planning authorities serve as the main drivers of practice related to flood risk, the purchasers of properties potentially at risk of flooding are evidently also important stakeholders. The legal process of buying and selling property, referred to as conveyancing, may be conducted either by a conveyancing solicitor or by a licensed conveyancer. The various steps are set out in the Conveyancing and Law of Property Act (1881):

> *Conveyance, unless a contrary intention appears, includes assignment, appointment, lease, settlement, and other assurance, and covenant to surrender, made by deed, on a sale, mortgage, demise, or settlement of any property, or on any other dealing with or for any property; and convey, unless a contrary intention appears, has a meaning corresponding with that of conveyance.*

The solicitor/conveyancer conducts a variety of searches to identify any dangers that may affect the purchaser, including the presence of coal mines, asbestos and flood risk. Such searches cover any matter of environmental concern during the property transaction, whether domestic or commercial (Abbey and Richards, 2016). Flood searches themselves are a recent addition to the conveyancing process, having been introduced in 2008. The conveyancer makes a high-level assessment of risk to the property from the four main sources of flooding, namely river, coastal, groundwater and surface water. These are added to any information that the vendor provides on the property to give a more complete understanding of any risks such as to flooding. In all conveyancing transactions, legal representatives should mention any prospective flood risks, make further investigations as appropriate and report any findings to the respective clients (Silverman, 2015; Roddell, 2017).

Recommendation 63 of the Pitt Review was that flood risk searches be made mandatory as part of conveyancing searches for properties (Pitt, 2008), but this has not been implemented. Such searches are not compulsory under current regulatory requirements, with lenders varying in whether they conduct them or not. The Law Society, with which all solicitors practising in England and Wales must be registered, states that it is best practice for solicitors to conduct a flood risk search where this is deemed appropriate. Any potential risks should involve the client being informed and investigated if a search indicates any danger of flooding.

Thus, these bodies are the relevant parties concerned with any issue relating to a risk of flooding. With this being established, the next section turns to flood risk management.

2.4. Flood Risk Management

Flood risk management is similar to general disaster management, but with a particular focus on flood risk. It is an umbrella term used to describe the various policies, plans and measures designed to reduce the risk of flooding. The goal of flood risk management is *"to minimise flood risk by implementing measures that reduce risk most efficiently"* (Hooijer et al., 2004). Within England, it has undergone a major paradigm shift from 'keeping flood water out' to 'making space for water' (EA, 2009). It has enjoyed growing recognition and replaces more traditional approaches such as flood defence, flood protection and flood management (Sayers, Hall, and Meadowcroft, 2002; Galloway, 2008; Butler and Pidgeon, 2011). Historically, structural means of combating disasters have been favoured. As noted by Mileti (1999), research into disasters was *"dominated by physical scientists and engineers right up until the middle of the twentieth century"*. This changed with the emergence of disaster management, marking a move to non-structural means of mitigating damage from natural disasters. Sayers et al. (2002) describe flood risk management as a system that assesses and compares the structural and non-structural means of managing a flood hazard event. It aims to reduce the likelihood and/or impact of floods and can be defined as *"the continuous and holistic societal analysis, assessment and mitigation of flood risk"* (Schanze et al., 2007). Defra (2003) states that flood risk management is, *"according to context, either action taken to mitigate risk, or the complete process of risk assessment, option appraisal and risk mitigation"* (Sayers et al., 2003: 17). As such, the aim is to manage the risks posed by flood events through a variety of means. Flood risk management can be divided into two different aspects: a) flood risk analysis and assessment and b) risk mitigation (Matej and Vojtekov, 2016). Flood risk assessments seek to establish the level of risk and determine what level is unacceptable. In contrast, flood risk mitigation comprises steps taken to reduce that level of risk through the implementation of certain measures.

Thus, a comprehensive approach to analysis and assessment of the flood risk formed a core component of risk management (Meyer et al., 2009). This allowed for the creation of a holistic approach taken to managing flooding. In the UK, flood risk management was noted for being a devolved matter (POST, 2016). In England, it was predominantly based on the Flood and Water Management Act (2010). This required the establishment of a national strategy for flood and coastal erosion risk management, emphasising the importance of controlling the hazard and reducing vulnerability to its effects, in contrast to other methods that merely sought to control the hazard (Galloway, 2008). This reflects the change in the 1990s to an emphasis on

flood risk management, i.e. accepting that not all floods can be prevented and therefore learning to live with them. This necessitated a better understanding of the different ways in which social and physical actions could contribute to improving flood resilience (Defra, 2005; EA, 2005; NAO, 2001). By dealing with the probability of an event occurring and the impacts associated with that event, the aim was to address various issues such as predicting flood hazards and the measures for risk reduction. The Pitt Review (2008) suggests that flood resilience can be defined as the capacity of a person to anticipate, cope with, resist and recover from the impact of a flood. A briefing to the House of Commons notes that although it is not possible to prevent all forms of flooding, their impact on communities can be reduced by effective flood and coastal erosion risk management (House of Commons Library, 2017). In other words, effective management can mitigate the impact of the hazard, reducing it to more manageable levels. The various elements of flood risk are detailed in the following subsection.

2.4.1. Flood Risk

As already noted, flooding is the most common and the costliest of the natural disasters (Harries, 2013; Surminski and Eldridge, 2015). Floods can result from multiple interlinked events, such as extraordinary rainfall, ill-maintained flood defences or new developments causing a rise in flood risk. All forms of flooding begin with a hazard that can take number of forms, including heavy storms. These events can cause a disaster event. Living near any body of water carries some element of flood risk (Paron et al., 2014). As noted in Section 2.1, the risk triangle shows how a combination of hazard, vulnerability and exposure leads to risk, which in the case of flooding is the product of probability of inundation and the consequences (White, 1942). Here, the hazard represents the frequency and severity of rainfall events or storms. Flood risk is thus defined as *"the function of a flood hazard on an exposed receptor that has a certain vulnerability to a hazard"* (Lamond, 2011). Furthermore, exposure is the density and value of properties located in flood hazard areas, whilst vulnerability is the level of flood resistance and resilience of the properties insured (Crichton, 1999). During a major flood, risk increases with the rising probability of damage and harm to many victims. In contrast, in cases of low flooding, the probability of risk became small. Those affected by an increasing risk are subjected to vulnerability, defined as the potential for loss (Cutter, 1996). As with the disaster risk triangle, these various characteristics form the basis of flood risk.

Flooding hazard results from, *"...an interaction between environmental and social processes"* (Parker, 2000: 8). In the disaster risk triangle, flood risk comprises many of the same elements:

- **Hazard**: In the case of flooding, this is the frequency and severity of rainfall events or storms (Kron, 2005; Lamond et al., 2011).
- **Exposure**: Represented by the density and value of property located in areas suffering from flood hazards (Lamond et al., 2011).
- **Vulnerability**: This refers to the resilience of the properties insured and involves both design and construction (Lamond et al., 2011).

Figure 15 illustrates the correlation between the probability of flood occurrence and its consequences.

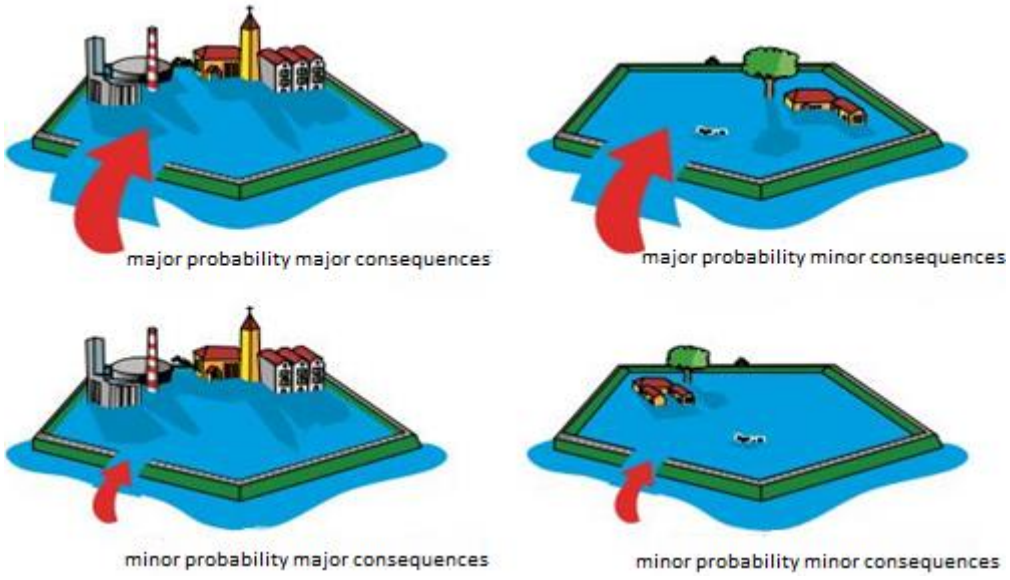

Figure 15: Probability vs. consequences *(Source: Rijkswaterstaat, 2012)*

The four quadrants of the figure demonstrate how these factors result in flood risk and its potential consequences (Gouldby and Samuels, 2005). This emphasises the magnitude of flood risk, which is determined by the natural disaster and the socio-economic characteristics of regions exposed to the flooding disaster. According to Schanze (2006), it can be identified as the link between the characteristics of flooding hazard and flood vulnerability during times of flood hazards. In the mid-1990s, risk was primarily calculated by the various disaster response organisations around the world as a function of hazard and vulnerability. The concept was then re-examined in the mid-2000s with the addition of the element of exposure, which is now considered to contribute to the definition of risk (Blaikie, 2000). Flood risk has come to be determined by rainfall duration and intensity, combined with rainwater impacting on the ground (House of Commons, 2016). This is seen as a factor in relation to surface-water flooding

and during prolonged heavy downpours. Frequent rainfall can saturate the ground in certain areas, allowing a building up of water and resulting in flooding.

This conceptualisation of risk is epitomised by the harmful consequences for human life and the environment when the three elements of the triangle (hazard, exposure and vulnerability) interact. Crichton and Mounsey (1997) notes that vulnerability can be an indication of the extent to which a hazard will impact a property. This has become part of the evolving definition of risk, which now includes further concepts such as capacity, adaptation and preparedness. The Government's Planning Practice Guidance provides a definition of flood risk areas for planning purposes:

> *For the purposes of applying the National Planning Policy Framework, "flood risk" is a combination of the probability and the potential consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.* (HM Government, 2014: para. 002)

Hazards are actual or potential threats that have adverse consequences and come about following a physical event impacting human society. Thus, a hazard may be the result of excessive rain hitting a human community. Those exposed to this hazard are then affected according to their level of vulnerability. A variety of factors affects vulnerability, but ultimately it refers to people's ability or inability to cope with the adverse effects of the hazard created by events such as climate change (IPCC, 2012). Further elements of vulnerability can take the form of sensitivity, adaptive capacity and resilience. Modern flood risk mitigation frameworks are said to not be concerned with protection from floods but rather with understanding the nature of flood risks (Vojinović and Abbott, 2012). Through understanding, it is believed that communities can prepare for the flood risk and for living with it. The next subsection looks at the nature of flood risk with respect to development on floodplains.

2.4.2. Nature of Flood Risk

As noted in Section 2.4.1, perception of risk involves an assessment of the probability of hazard and of the results as seen by society (Bubeck et al., 2012; Becker et al., 2013). An aspect of this definition involves the extent of damage caused by flooding (Haimes, 2009). The literature reports widely that the risk of flooding is likely to increase in the future. Certain communities

and properties have been found to suffer from a greater level of risk than others or to be more vulnerable (Walker and Burningham, 2011; O'Neil and O'Neil, 2012). As stated in Section 2.2.4, floodplains are particularly vulnerable. Such locations are typically seen as ideal for agriculture and urban development due to their proximity to water supply and to navigation. However, this same proximity exposes the occupants to risk of flooding, which is a natural part of the lifecycle of a floodplain. It is estimated that around 12% of England consists of floodplains (Environment Agency, 2019). Projections have suggested that the UK might see double the number of properties being developed on floodplains in the next 50 years. The EA has warned in its long-term investment scenarios that without a strong planning policy, the UK could see an increase in property damage caused by flooding of as much as 38% in the next 50 years (Environment Agency, 2019). Increased development increases the flood risk and this demonstrates the need for strong flood risk management frameworks to mitigate the damage caused by flooding hazards. Increasing developments expose properties and their occupants in areas naturally prone to flooding to a greater degree of flood risk. It has been noted that whilst many developments do follow the EA's guidance, there was a 7% increase in building in such areas (Tromans, 2012). Furthermore, developed floodplains were shown to be highly vulnerable, with this being only an added factor in the wake of as flooding events that bring about more frequent and damaging impacts to such areas (Ledoux et al., 2005; Moss and Monstadt, 2008; Novotny et al., 2010; Werrity, 2006). This highlights the dangers posed by flooding, as the growing threat of such disasters means that such locations suffer from further vulnerability. Figure 16 illustrates the UK government's efforts to highlight the danger of flooding and schemes to bring about resilience.

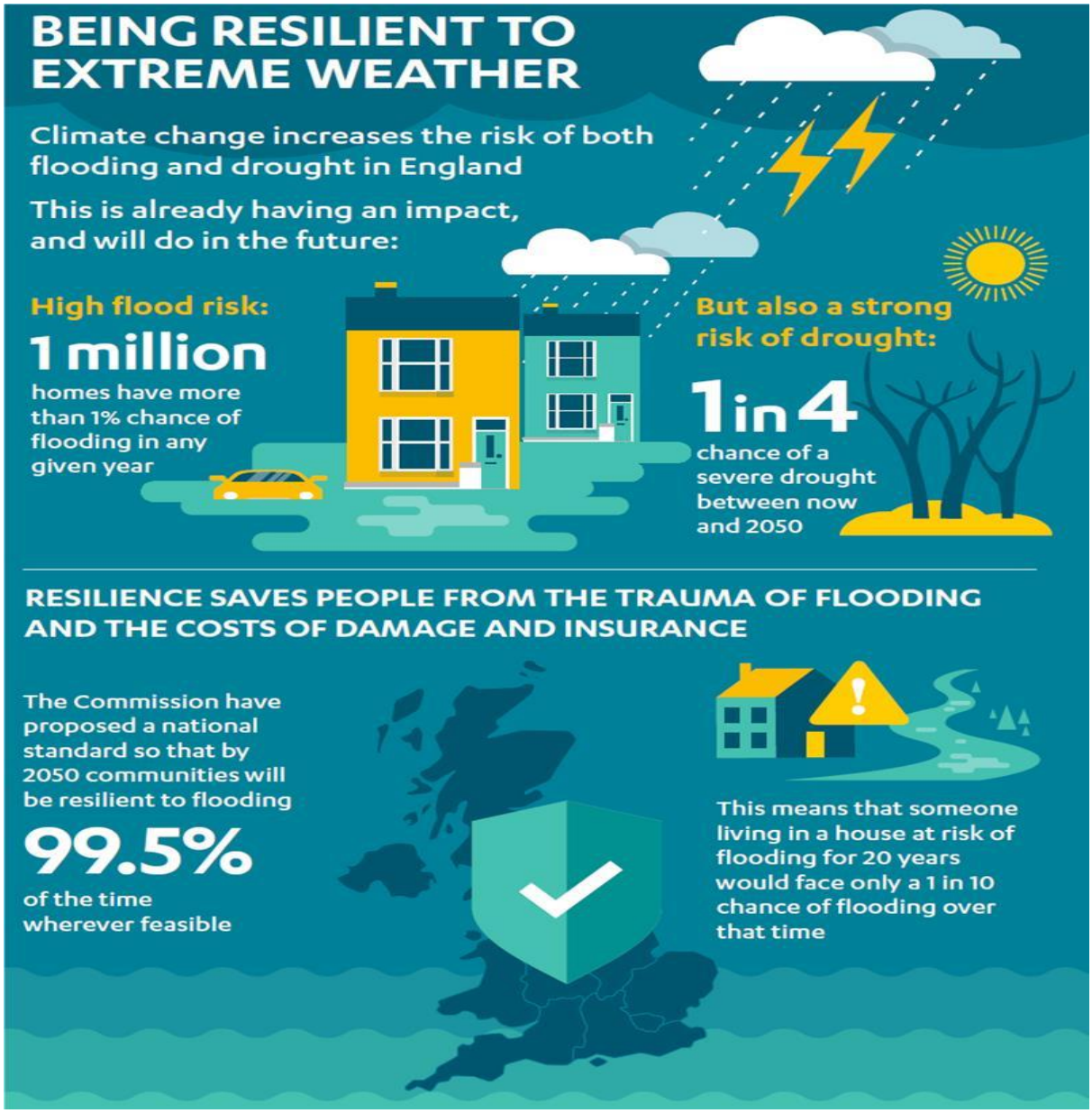

Figure 16: Resilience role in flood risk management *(Source: National Infrastructure Assessment, 2018)*

Flooding has been identified as a significant current and future risk in England, as noted in the National Risk Register and the UK Climate Change Risk Assessment (HM Government, 2012). According to the National Flood Risk Assessment, one in six residential and commercial properties is at risk from either fluvial, coastal or surface water flooding. There has been some methodological uncertainty in ascertaining the estimate of this risk (Penning-Roswell, 2015). Nevertheless, policy has been guided by the approach taken to this assessment of flood risk. The danger has steadily increased over the years due a variety of factors, including population growth, land use changes, aging infrastructure and natural processes. In addition, climate change has been identified as a factor, with growing evidence that it will lead to increased flood

risk in the future (Evans et al., 2004; 2008; Ramsbottom et al., 2012). As noted by the Bonfield Report, sustained rain in 2016 caused extensive damage across the, country with 17,000 properties suffering from flooding and costs amounting to £1.3 billion (Defra, 2016). Expert opinion elicited for the present study is consistent with this finding, as reported in Chapter 4. The literature reports research into a variety of means of addressing challenges and barriers within the flood risk management framework. There have long been calls for further research into improved flood risk management and the introduction of practices to reduce the damage caused by flooding (EFRAC, 2008). The discipline of flood risk management is seen as an attempt to make an effective response to flooding. It involves a variety of strategies for managing the risk of the hazard. Five strategies have been identified as part of the flood response: flood risk prevention, flood mitigation, flood preparation, flood recovery and flood defence (Hegger et al., 2014). These seek to address the threat posed by flooding by making properties and communities more resilient to its effects.

2.4.2.1. Resilience

Disasters are the result of people's vulnerability to flooding hazards. Flood defence aims at reducing the level of impact caused by the disaster event. This raises a further aspect of flood risk management, namely flood resilience, which is a key element in responding to the threat of flooding. Resilient urban systems make use of the flood risk management cycle that covers actions of preparedness, response and recovery. According to Batica et al. (2013), the concept of resilience is interpreted within the confines of the flood risk management framework. It is also a recurring theme in research, with policies aiming to protect people from the effects of extreme weather phenomena (Keim, 2008). This supports the existing 'hard construction' flood defence measures such as dikes and dams, operated as part of the wider framework of flood risk mitigation, flood preparation and response and flood recovery measures applied to flood-prone locations (Hegger et al., 2016). In addition, flood defences are seen as providing a 'false sense of security' and thus potentially adding to vulnerabilities in urban locations (Plate, 2001). Flood risk management, which aims to deliver greater safety and promotion of the natural environment whilst using integrated spatial planning in developments, is not limited to government bodies but involves private stakeholders. Measures involving resilience such as flood-proofing properties require an awareness of flood risk among all citizens, including developers and homeowners, who must be aware of the dangers and willing to take part in precautionary measures to make their properties resilient to flooding. Other aspects include flood warnings and evacuation plans that involve making occupants of flood-prone locations

aware of the dangers. Furthermore, they must engage with the necessary plans set in place during times of emergency. This shows that the flood risk management framework encompasses a wide range of areas across society. It is only when all these aspects work together that it is possible to deliver an effective system which promotes resilience as its core.

The literature offers no single broadly accepted definition of resilience (Klein et al., 2003; Manyena, 2006); rather, a wide variety have been proposed (Haimes, 2009). It can, however, be defined as *"the ability of system/community/society/defence to react to, and recover from, the damaging effect of realised hazards"* (Proverbs and Brebbia, 2014). Flood resilience, therefore, is the ability to survive flood events and recover from the disruption caused by the hazard. The end goal of flood resilience policy is to reduce flood damage in order to allow normal operations to resume after flooding. Hence, flood resilience is situated between engineering and community resilience, as the aim is for communities to survive hardships and thrive (UNISDR, 2009). Flood resilience could thus be described as the preparedness and ability of an area to cope with flooding disasters. The elements that made up resilience include the capacity not only to reduce flood damage but also to rapidly recover from the resultant disruption. International policy instruments such as the UNISDR Strategic Framework and the Hyogo Framework emphasise the adoption of resilience measures in disaster risk management (Cutter et al., 2016; Cai et al., 2018). The mitigation efforts include planning and construction efforts. In this regard, flood resilience is a more holistic and risk-based approach that can be integrated into the flood risk management framework to ensure the effective use of different resources with the overall goal of damage mitigation (Meijerink and Dicke, 2008; White, 2010; Tempels and Hartmann, 2014; Restemeyer et al., 2019).

Resilient flood management aims to minimise the impact of flooding rather than relying on flood defence construction. A factor inherent in flood resilience is the ability to not resist water but rather to live with it (Restemeyer et al., 2015). This represents part of the paradigm shift of flood response, the goal being to improve an area's ability to recover from flooding. Flood-prone areas need resilience-based systems that can survive and absorb the impact of any flood event. The building of community resilience has thus emerged as a means of responding to floods as they have become more widespread and have been recognised as the most destructive of the natural disasters (Montz, 2009; Jha et al., 2012; Mallakpour and Villarini, 2015; Oladokun and Montz, 2019). Thus, the priority in flood risk management is building resilience in flood prone communities (Schelfaut et al., 2011; Joseph et al., 2014; Oladokun et al., 2017; Oladokun and Montz, 2019). This had led to the concept of resilience evolving from resistance

and moved on towards embracing the use of adaptations (Davoudi, 2012; Davoudi et al., 2013). The recognition of resilience as a key factor in flood risk management is not limited to the specialist literature but is manifest in practice, as reflected in the interviews reported in Chapter 4, which refer to mitigating the damage from flooding and to making properties more resilient to future flood risk.

Flood risk management has undergone a paradigm shift from traditional flood control systems to the adoption of flood resilience. Resilience is deemed to offer a more holistic and risk-based approach to effective spatial planning and water management (White, 2010). Resilience can be achieved through a variety of tools and systems. It offers an alternative to traditional means of flood control such as barriers, which offer only a single line of defence whereas flood resilience uses adaptation as a means of minimising flooding (Restemeyer et al., 2015). The aim is to maintain the essential functionality of organisations, businesses and communities, along with individual property owners. Governance has been highlighted as a means of implementing flood resilience measures (Driessen et al., 2016). Ofgem notes that the 2015 floods in Lancaster demonstrated *"the need for the regular review of network resilience by the network companies, underpinned by monitoring of impacts, and use of the latest science and information available on potential climate impacts at a national and local level"* (National Infrastructure Commission, 2019: 6). Through legislation, a more effective regulatory practice could be achieved that incorporates resilience into the existing flood risk management framework.

2.4.3. Floodplain Development

Development on floodplains has many advantages, but unrestrained development is recognised as costly and dangerous (Owen, 1981), because it can lead to properties being built in areas of high risk with no adequate measures to protect them, thus increasing flood risk. Marriott (1999) notes that many of the world's most densely populated areas are situated on floodplains, exposing them to the ever-present danger of flood events. Historically, development on floodplains in the UK has been a voluntary process (Smith, 2003). Any area being considered for development has had to take flood risk into account, especially if there was a history of flooding (Cullingworth and Nadin, 2006). Under the Town and Country Planning Act (1990), the city council serves as the local planning authority responsible for ensuring that any new developments are designed in a way that protects them from flooding and that they do not increase the risk of flooding downstream. In 2004, a consultation with insurers represented by the ABI found that a stronger and more transparent planning system needed to be developed in

order to curtail developments on floodplains (ABI, 2004). The ABI report recommended that the Environment Agency be made a statutory consultee on all planning applications in flood areas. The CCC has stated that further developments on floodplains add to long-term flood risk and to the costs of flood prevention (House of Commons, 2016). As such, these developments further increase the danger during times of flooding and place additional burdens on the existing flood defence measures.

However, there have been many developments on floodplains. A CCC (2012) report highlights concerns over whether the local authorities had considered alternative developments before agreeing to construction on floodplains and whether the long-term effects of climate change on flooding had been considered. The CCC (2012) found that floodplain development had grown rapidly over the past ten years and that while 80% of floodplain developments were in well-protected locations, one in five properties built in such areas suffered from a significant flood risk (CCC, 2012). As to the approval process, the report states that it is *"not sufficiently transparent or accountable"*. Furthermore, the EA has stated that it was aware of the outcome of only 65% of planning applications to which it had objected. A 12-month study states that 90% of floodplains in the UK *"no longer work properly"* and that such developments could impact on the natural ability of a floodplain to function (Entwhistle, 2017). Figure 17 shows an example of development in flood-prone areas of York.

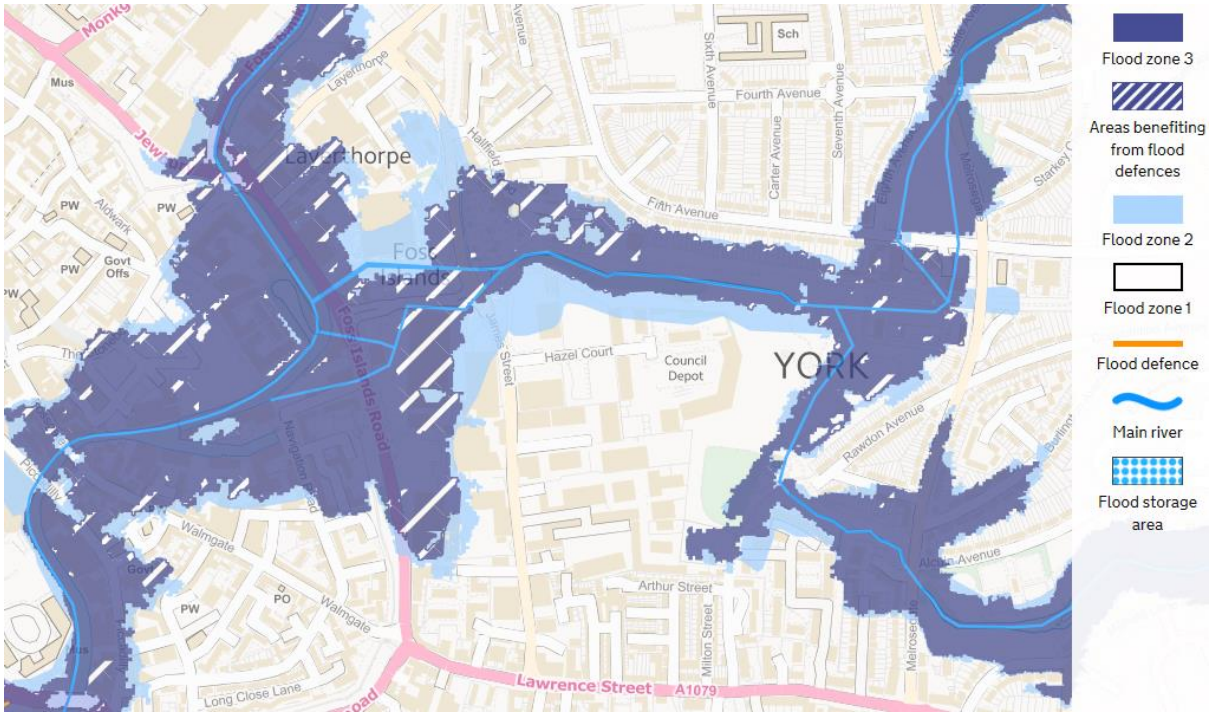

Figure 17: Flood map of York *(Source: Environment Agency, 2017)*

The map, provided by the EA, indicates the level of flood risk by dividing the area into the three main flood zones explained in Section 2.3.2.2.1 (Table 5). This and similar detailed maps indicate the areas prone to flooding along with flood defences and storage areas. It was reported in 2016 that 30,000 new homes had been built since 2008 in areas with 10% or greater chance of flooding in the next ten years (House of Commons, 2016). In 2013, local councils in England and Wales had allowed for at least 87 planning developments that saw the building of 560 homes in areas of such high flood risk that the EA had formally opposed their development (RIBA, 2014). The number of homes reported to have been built in flood risk areas rose by a third in 2013 as compared to the previous year (RIBA, 2014). This shows that despite the risks inherent in such areas, such developments were increasing in number and exposing their occupants to danger during times of flood. According to the CCC (2014), such continued development on floodplains led to an increasing reliance on the use of flood defences. As such, the regulation of floodplain developments could reduce the burden placed on flood defences through the use of an effective flood risk management system designed to avoid inappropriate construction in these areas. This can be achieved through floodplain management, a coordinated strategy for reducing flood damage (Park, 2007). Such an approach could be achieved through a variety of means including emergency/contingency planning, flood control works and regulations to control current and future developments on floodplains. These and other tools of flood risk management are detailed in the following subsection.

2.4.4. Methods of Flood Risk Management

There exists no single solution for managing all flood risk (POST, 2016). In fact, there are various means through which flood risk can be managed. Scrase and Sheate (2005) note that the majority of flood risk management measures during the last two millennia in England have been responses to issues of land drainage. As such, it has been seen as an issue related to improper drainage practices. Traditional approaches to managing flooding have focused solely on technical means to separate water and people (Reiner Böhm et al., 2004; Pardoe et al., 2011). Thus, it operated more on an engineering perspective with the use flood defences. Despite large-scale funding of flood defences, the financial costs from flood events remains sizeable, with an average of £1 billion worth of damage sustained in the UK each year (EA, 2009). This indicates that defences alone do not prevent flooding. As shown in the literature, floods need to be managed to reduce their impact on communities. A key non-structural means of reducing flood hazards is through floodplain development regulation, although it has been acknowledged that both flood warning systems and flood insurance play an important role in

flood management (Parker, 1995). Regulation serves as a means of enforcement and is used to prevent unnecessary developments. However, it is acknowledged that there are other means of managing floods, including the use of flood warning systems to notify people and the use of tools such as flood insurance. These various methods serve as the basis for flood risk management. Dawson et al. (2011) identify three different means of non-structural management: planning, insurance and improvements designed to resist flooding. According to Neuvel and Van den Brink (2009), planning can be a valuable instrument in reducing the impact of flooding. It does this through management and ensuring that inappropriate developments are reduced whilst taking measures to encourage resilience.

Kundzewicz and Takeuchi (1999) observe that Japan is highly vulnerable to floods. A solution to address this vulnerability has been an integrated flood management approach that was deemed the only way to cope with flooding. The UK is unique in respect of flooding, in that legislation specifies a required level of protection (IWR, 2011). The approach of the Dutch government is to compensate for flood losses through the use of a disaster fund financed by general income tax. There is no insurance cover with regard to flooding, with this being attributed to the high level of protection in the Netherlands, meaning that there has been little experience of responding to floods (IWR, 2011). As such, the protective measures have resulted in a lack of experience of flood response. The literature states that flood events have a significant financial impact on property owners, it being widely reported that houses have suffered a post-flood decrease in their value (Yeo, 2003; McKenna, 2010; Richards, 2011). Yeo (2003) reports that the effects of this decease may be felt several years after the flood event, with losses at 25% and rising to 60%. This effect has been emphasised by the publication of flood risk maps showing a link between reduced property values and flood events. The situation is complicated by the fact that properties which have not been flooded may suffer a drop in value if they are in an area of significant flood risk. Conversely, cases have been reported of properties that have been flooded but whose value has increased following repairs that brought about significant improvements to these homes (Yeo, 2003). Such improvements include personal defences such as sandbags, door and window guards or skirts that can be used on individual properties (Bowker, 2007). These are among the various means by which individuals can make their homes more resilient.

The official position of the EA is that flooding can never be prevented in its entirety (Oliver, 2007). As noted, flooding is seen as being a natural part of the environment. With this in mind, the Agency holds the view that it cannot be eliminated. Thus, alternative methods have been

used in managing flood risk. Floodplain management embraces the concept of regulation of floodplain development through tools such as insurance-based incentives (Parker, 1995). Such measures are taken to mitigate any losses and increase the resilience of communities, with the expectation that they will be flooded but that the level of harm will be reduced. Among the various methods of reducing the impact of flood hazards are flood warnings and evacuation plans, which significantly reduce the risk to life and property (NAO, 2001). It has been noted that there is a need to develop an integrated and holistic approach towards the management of flood and coastal erosion risks (ABI, 2004; Defra, 2004; DCLG, 2019). An interconnected approach linking other aspects of flood risk management such as planning, insurance and adaptation could aid in furthering a central flood resilience strategy. Each of these three aspects is now addressed in turn.

2.4.4.1. Planning

Among the various tools to help combat flooding is the use of coherent and effective planning guidance, which can contribute to local and regional sustainability (White and Howe, 2002). It has been noted that planning plays a role in flood defence by minimising developments on floodplains (House of Commons, 2015). Planning policy in relation to flood risk in England and Wales was first introduced in 1992 (Cullingworth and Nadin, 2012). Historically, planning in England was a delegated responsibility of local government, which enjoyed broad discretion in creating local development plans and applications for development within the national framework set by central government (Cullingworth and Nadin, 2006). Following the 2000 floods, the Select Committee on Environment, Transport and Regional Affairs reviewed the increased runoffs caused by new developments and those situated on floodplains. This review, of 'Development on or Affecting the Flood Plain' led to changes in planning guidelines. In response to evidence that developments had contributed to increased flooding, the government revised its long-term strategy towards flood risks and coastal erosion. Among the policy changes was a shift in focus from building flood defences towards recognising flood management, with these considerations being taken from 'Making Space for Water' (Defra, 2005). This strategy placed an emphasised importance on a coordinated approach to land use, planning policy and urban design. In 2006, the UK government issued PPS25, setting out its planning policy on developments and flood risk (CLG, 2010). The later Planning Practice Guide (CLG, 2009) provides more detailed guidelines on the implementation of planning policy. These serve as the basis for local and regional development plans in areas that could see future development and floodplains that were inappropriate for development. A further

element is the management of flood risk by means of measures to reduce the risk of flood damage. This could include approaches such as the proactive management of flood defences or sustainable drainage systems. PPS25 stipulates that floodplain development may occur only on land where the benefits outweigh the flood risks.

The PPG25 guidance (DETR, 2001) introduced stricter rules to prevent developments on land suffering from flood risk, in an attempt to deter developments on floodplains through the use of the planning process (Brown and Damery, 2002). In accordance with PPS25, Strategic Flood Risk Assessments were conducted, categorising flood risk on a district-wide basis. They deliver refined information on the probability of flooding, taking into account the various sources of flooding and the effects of climate change. The planning statements follow a three-tiered approach to future developments, requiring a thorough appraisal of risk that involves the identification of land subjected to flood risk and its extent. Evaluation is determined through Regional Flood Risk Appraisals. The associated changes to planning guidelines came into effect with the government's National Planning Policy Framework. They operate alongside the Planning Practice Guidance documents, whose focus is on flood risk and coastal change in the UK. There is thus a series of tests and thresholds designed to protect property from flood threats, with all Local Planning Authorities being expected to follow the guidelines. These tests and thresholds determine the appropriateness of each proposed new development; if the criteria are not met, then the development in question will not be allowed. PPG25 states specifically that *"inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere"*. Thus, the guidance seeks to steer planning away from areas at high risk of flooding, except in situations where the development is deemed necessary.

The National Planning Policy Framework obliges local authorities in England to include flood risk in the planning process (DCLG, 2012). It details the use of flood risk assessments and sets out the government's policies on different aspects of land use planning in England. The DCLG (renamed in 2018 the Ministry for Housing, Communities and Local Government) follows the guidelines in the Framework and is responsible for its enforcement (HM Government, 2016). Under the National Planning Policy Framework:

> *Local Plans should take account of climate change over the longer term, including factors such as flood risk, coastal change, water supply and changes to biodiversity*

> *and landscape. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure.* (DCLG, 2012: 23)

Further amendments to Article 10 of the Town and Country Planning (General Development Procedure) Order (1995) give planning authorities the statutory duty to consult the EA on all development in areas at risk of flooding. An exception was made in the case of minor developments situated in fluvial or coastal areas (Goodson, 2011). The two tests for planning are the sequential and exception tests. These are provided for under the Strategic Flood Risk Assessments, which serve as the basis for the application of the two tests with the intention of taking flood risk into consideration. The sequential test follows the guidelines in the PPG documents, with developments being allowed in areas of low flood risk whilst steering away building from those at higher risk. The specific aim is to keep developments away from Flood Zones 2 (medium risk) and 3 (high risk), in order to prevent any areas from being affected by the various sources of flooding. The sequential approach is taken in areas known to suffer from flood risk. These guidelines are interpreted by local authorities in line with Local Development Frameworks, with the aim of avoiding inappropriate developments in locations at significant risk of flooding (CLG, 2012). These Frameworks are a series of planning documents outlining individual borough planning policies as required by the Planning and Compulsory Purchase Act (2004). They provide a general direction for individual development decisions (White and Richards, 2007; Barclay, 2009). Final decisions are typically made at a local level by the local authority on a case-by-case basis, although controversial cases may be referred to a higher authority, ultimately the Secretary of State for Housing, Communities and Local Government. Typically, however, the Secretary of State confirms the decisions of the local authority. This devolved process encourages decisions to focus on local circumstances, allowing for a flexible approach that takes local priorities into account (White and Richards, 2007). A survey of planners and developers by Wynn (2005) concluded that they had an awareness of and were sympathetic to the aims of the planning guidelines.

2.4.4.2. Insurance

According to Peeters and Uylenburg (2014), floods are viewed differently from country to country in Europe. In the Netherlands, they are seen as calamities that should be prevented

through the use of infrastructure works, in contrast with Germany, which suffers from more regular flooding but experiences less damage due to adapted land use and low-density populations in flood-prone regions. As a result, Germany suffers less from the adverse effects and consequences of flooding. Countries worldwide also differ in how they respond to flooding. For example, the use of alternative flood insurance is limited to the UK and the USA, whereas flood insurance in Japan is part of a comprehensive flooding cover (IWR, 2011). In the Netherlands, 60% of which is prone to flooding, flood protection policies stem from the Ministry of Infrastructure and Environment, with much of the work being done through the Directorate General for Public Works and Water Management (Rijkswaterstaat, 2012). The Directorate is responsible for the national waters of the Netherlands and handles the practical work of the construction and maintenance of waterways, along with roads, whilst also encompassing flood protection and prevention. Some responsibility for flood protection lies with Dutch water boards, regional government bodies that oversee water management in their designated areas. The twin concepts of flood risk management and water management are integrated in the Netherlands. It has been argued that the country's flood management policy has succeeded not because of major flood defence structures but rather through the use of legislation, policy and organisational structure. National policy with regard to spatial planning is to inhibit development on floodplains on the main rivers. The constitution provides an enforcing role for the water boards, thus strengthening their jurisdiction (Rijkswaterstaat, 2012).

The UK was one of the first countries to develop a private flood insurance scheme (Huber, 2004). As the population of the country grew, there was an increasing need to develop floodplains, with a focus on the protection of urban assets. This was highlighted by the 'gentleman's agreement' that operated between 1961 and 2003, whereby the government and the insurance industry shared responsibility for protecting the public from flooding hazards (O'Neill and O'Neill, 2012; Johnson and Priest, 2008). The insurance sector had taken a key interest in the role of floodplain management. Under the terms of the agreement, it was understood that the government would provide and maintain sufficient flood defences and would control developments in areas of high risk where flood prevention was not practicable (O'Neill and O'Neill, 2012). This became the case following the widespread flooding events of Easter 1998 and autumn 2000. The latter cost insurers £1.3 billion and led to concerns being raised as to the viability of insurance in areas of high risk (ABI, 2001). In the wake of the floods, the ABI, on behalf of its member insurance companies, called upon the government to

invest more heavily in flood defences, control developments in flood risk areas and improve the decision-making process for planning (ABI, 2001). In return, it made a two-year commitment from 2001-2002 to continue providing cover for existing policyholders except in exceptional circumstances (ABI, 2002). Insurance cover for flooding was provided and gave standard protection as long as the government fully implemented PPG258 (ABI, 2002). In 2005, progress was reviewed with changes in government policy being noted, but it was said full implementation was needed to combat flooding. This aim was revisited in the Statement of Principles that came into effect in 2006 (ABI, 2005). According to guidance on new developments, insurers were expected to be able to insure properties built in line with the advice given by the EA (ABI, 2009). This demonstrates the level of commitment by the insurance sector in helping to mitigate the impact of flooding.

One means of addressing flood risk is by expanding insurance for flood damage and improving flood resilience (Dawson et al., 2011). The 'risk triangle' was designed for use by the insurance industry for catastrophe modelling (Crichton, 2015). In England, flood insurance has traditionally operated differently from other national schemes, being underwritten purely by the private market. UK insurers, as noted above, agreed to provide continued insurance cover, but not for homeowners suffering from a very high risk of flooding (Botzen, 2013). As such, people in such areas continued occupying such residences at their own risk. The government and insurance companies had been working together on developing solutions to provide affordable cover for areas of high flood risk without placing costs on other policyholders or the taxpayer (Abbey and Richards, 2016). It was noted that some homeowners in flood prone areas had difficulty in getting flood insurance (Crichton, 2005; Lammond et al., 2009). The lack of cover for flood risk could affect the prospects of obtaining a mortgage to finance the purchase of a property. The Council of Mortgage Lenders indicated that a standard condition of residential mortgages was that borrowers purchase and maintain a standard building insurance. If flood cover was not available, then the Council would take the view that the property was unlikely to be mortgageable. Many owners faced the prospect of their properties becoming uninsurable, unsaleable and indeed uninhabitable, because they lacked cover due to the perceived risk (ABI, 2008). In fact, areas at risk of flooding were likely to have high insurance premiums and excesses (POST, 2016). This added further to the burden on property owners, especially those in flood-prone locations. The ABI estimated that some 200,000 households might become uninsurable when the agreement ended in June 2013 (ABI, 2012).

The fact that in the UK, flood insurance was primarily provided by the private sector reflected the belief that the beneficiary should pay the premiums and be primarily responsible for their own recovery. However, it was recognised that flood insurance would not be commercially viable if only those at risk were to provide all of the premium income (Arnell, 2000). Market-based competition prevents insurers from fully charging actuality-based premiums, leading to cross-subsidy between properties at high risk and those at low risk, with not much difference in the cost of those premiums (Lamond et al., 2009). A further consequence was that the government was seen to have created a false sense of security, so the danger of flooding was not taken seriously by people, thus encouraging flood exposure within the country (Crichton 2002; Tarlock, 2012). There was wide agreement on the role of insurance instruments in managing the financial risks of flooding. However, it was less clear how they could help address the underlying physical risks (Surminski and Oramas-Dorta, 2013). This underlines a failure to acknowledge the role insurance could have in ensuring the resilience of properties suffering from flood risk.

Surminski (2013) describes insurance as an economic tool that takes many shapes and forms, which have a number of common traits, including these:

a. being provided by public or private entities,
b. involving an insured seeking cover, whether compulsory or voluntary,
c. cover being offered either to individuals, businesses, insurers, organisations or governments,
d. covering different types of hazards and exposures along with varying degrees of coverage and
e. payment being offered when a loss is evident or when certain events are triggered.

These various features are designed to achieve the primary aims of insurance, namely compensation for damage and the funding of recovery. Among the various tools of disaster response, insurance is said to be the most effective, especially following large-scale catastrophic events (Kunreuther, 1996). In relation to adaptation, insurance-based economic instruments offer practical advantages such as providing fee discounts should property owners invest in flood resilience measures (Kleindorfer and Kunreuther 1999; Kunreuther and Pauly, 2006). Insurance incentives are said to aid the implementation of flood risk reduction measures (Camerer and Kunreuther, 1989; Kunreuther, 1996; Crichton, 2008; Botzen et al., 2009; Kunreuther and Michel-Kerjan, 2009). The largest barrier to their effectiveness is the absence

of adequate risk-based pricing (Kunreuther, 1996). In terms of compensation, landowners have had no recourse to requesting compensation from the national government, the policy having functioned on a voluntary insurance system since 1961. According to the Association of British Insurers (2016), there were 22,000 insurance claims following the flooding of winter 2015/16 (POST, 2016).

Flood Re, a joint initiative between the government and the insurance sector, was established under Part 4 of the Water Act (2014) as a means of responding to flood risk by offering flood reinsurance. This legislation aimed to promote the availability and affordability of insurance, with cover being provided to properties at risk of flooding. The purpose was to offer affordable flood insurance to the owners of property at the highest risk of flooding by taking a pooled-based approach (Defra, 2013). Through the scheme, insurers are provided with a re-insurance policy at a price potentially lower than one that risk-reflecting pricing would indicate, amounting to discounted flood insurance for policyholders in areas of high risk. The aim is to increase the number of properties with access to affordable flood insurance. Buildings covered by the scheme are domestic properties within the UK at the highest risk of flooding. In practice, Flood Re is included in household property insurance as part of a flood element given to the property owner. As a not-for-profit scheme, Flood Re is owned and managed by the insurance industry. The scheme is set to operate for 25 years only, the properties being expected to be retrofitted and to benefit from resilience measures. When the scheme expires in 2039, however, it is expected that many homes will once more be uninsurable (RIBA, 2018). This view was echoed in the expert opinions elicited during the interviews for the present study, with participants adding that an objective of Flood Re was the promotion of flood resilience in properties. In this respect, it was always intended as a temporary measure, to be followed by a more risk-reflective market for household flood insurance.

The structure of Flood Re is illustrated in Figure 18, showing its operation in relation to the government sector and how it fits within the existing regulatory framework. Reinsurance allows for insurers to insure themselves against large-scale losses with other insurers and to pass the subsequent risk under those policies on to a reinsurance company, such as those operating under Flood Re. These are then put into a fund that refunds the insurers for any claim made by the customer (Defra, 2013; Penning-Rowsell and Priest, 2015). Under the policy, any contractual liability to the original insurer remains, with the customer still able to make a claim. The insurers are obliged to make those payments but can reclaim from the Flood Re pool fund. This allows insurers to assume a greater level of risk on the basis that large claims are more

widely spread. The pool operates in addition to standard home insurance, rather than as a replacement (Horn and McShane, 2015; Surminski, 2017).

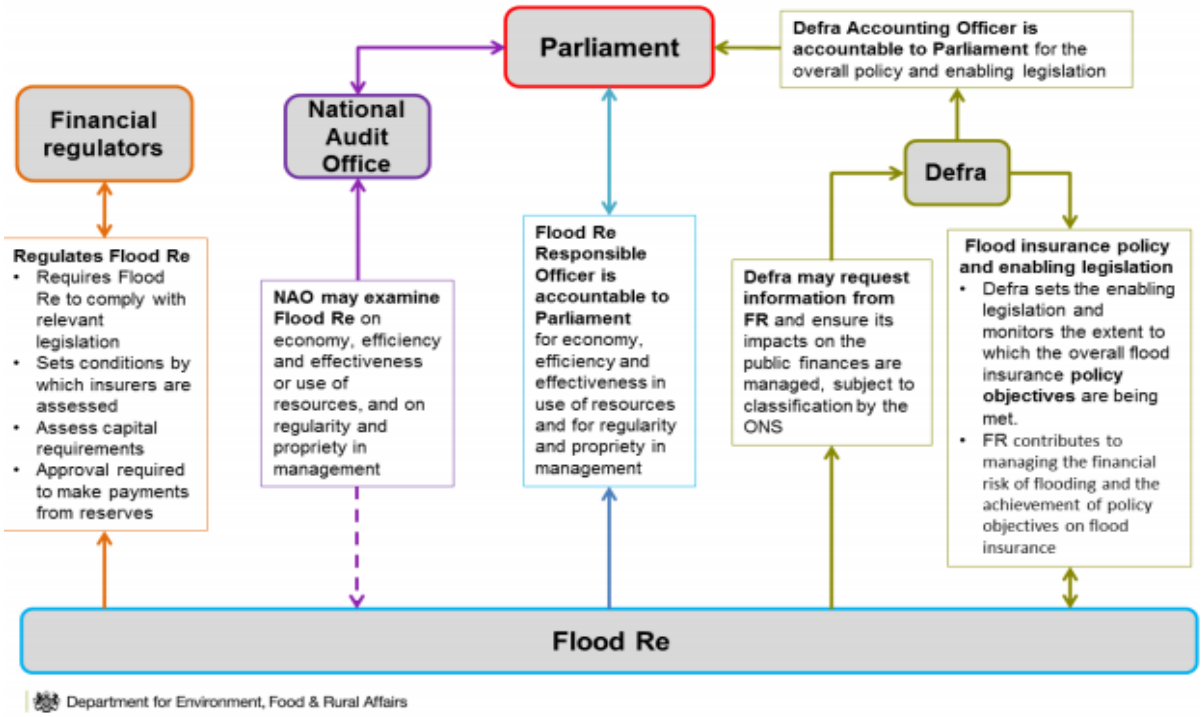

Figure 18: The Flood Re scheme *(Source: Defra, 2014c)*

The purpose of the scheme is not to directly influence flood risk management but rather to play a more supporting role, with the intention of prompting and promoting the idea of reduced costs by providing household flood insurance. The goal is to promote the resilience of properties at high risk of flooding and provide them affordable cover. Thus, it is acknowledged that effective flood risk management plays a key role in ensuring the affordability and availability of flood insurance. As a result, it has become part of the flood component in household property insurance policies. However, the scheme does not incentivise households to take measures to reduce the chances of flooding or the extent of damage sustained by a flooded property.

Figure 19 illustrates how Flood Re operates. When a property owner purchases home insurance cover, the insurer passes the flood risk element of the policy to the scheme. During times of flooding, the insurer pays any valid claims and is reimbursed from the Flood Re scheme. Flood Re was developed by the insurance industry as a means of providing flood cover for those areas at high risk. When it was introduced under the Water Act (2014) it replaced the ABI Statement of Principles and officially came into operation in April 2016 (Roddell, 2017). Part 4 of the 2014 Act states that Flood Re was developed with the intention that:

new housing development should be located to avoid flood risk, or where development in a flood risk area is necessary, it should be designed to be safe, appropriately resilient to flooding and not increase flood risk elsewhere in line with the national planning policies in place. (Defra, 2014b: 1)

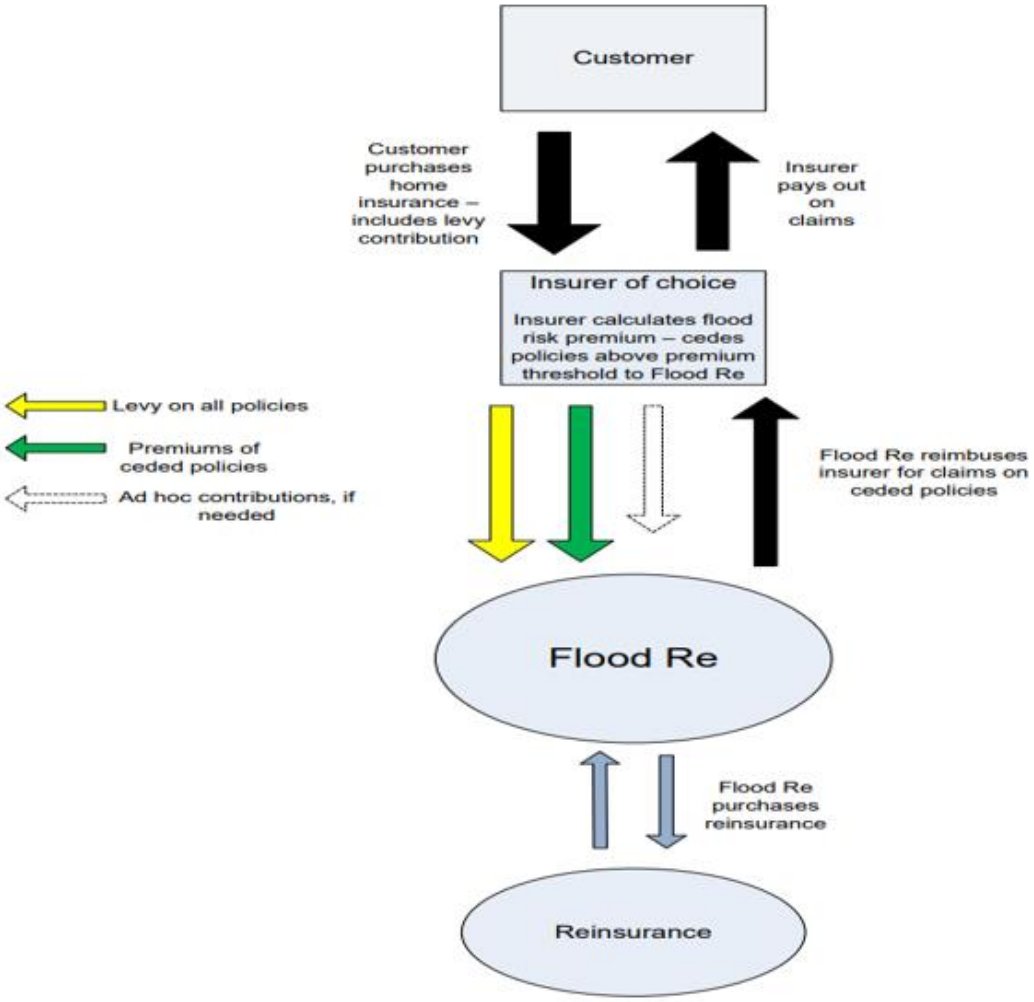

Figure 19: Flood Re scheme *(Source: Defra, 2014d)*

The assistance offered by the scheme is based on the Council Tax banding of the property. If a high flood risk is detected, then the insurance company cedes that element of the policy to Flood Re. The scheme does not apply to properties built after 1 January 2009 in order not to incentivise developments in areas of high flood risk. Finally, commercial properties are not eligible to Flood Re; cover.

2.4.4.3. Adaptation

Another aspect of flood resilience is related to the capacity to adapt (Adger et al., 2005). 'Adaptation' is the term applied to a range of activities that modify an existing system in the

face of a phenomenon. In recent times, its focus has largely been in relation to climate change. Thus, Pielke (1998), Smit et al. (1999), Parry et al. (2007) and UNISDR (2009) identify adaptation as the adjustment of a certain system in response to changing climatic conditions. In the present context, such adjustments are designed to provide some benefit to a property. According to Smit et al. (2001), a range of adaptation categories exist, each based on a different concept. Such categories could include either the natural or social sciences. Adaptive measures can be taken by societies, individuals, groups and governments (Adger et al., 2005). Smit et al. (2001) note that adaptation can occur at a social, economic, technological, physical or political level, usually over a period of time at a specific location. Burton et al. (2004: 10) has developed an adaptation policy framework stating that *"adaptation to short-term climate variability and extreme events serves as a starting point for reducing vulnerability to longer-term climate change"*. Adaptation is one of the means of reducing the risk of flooding through structural and non-structural forms of flood risk management. As noted by Dawson et al. (2011: 644), *"society is capable of adapting and significantly reducing flood risk using currently available measures"*. This highlights adaptation as an important way of responding to flood risk and the beginning of a long-term response to climate change.

The United Nations Office for Disaster Risk Reduction provides the following definition of a related term:

> *Resilience means the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of the hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.* (UNISDR, 2012: 92)

The aim here is to promote the idea of resilience in making properties better able to face flooding hazards by way of adaptations. The IPCC (2014: 1758) defines adaptation towards climate change as *"adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities"*. This not only acknowledges adaptation as a response to phenomena but also notes that it has benefits for society. It can be both autonomous and incentivised by policymaking (IPCC, 2001). The UK government asserts that *"if adapting to climate change is in the private interests of an individual… then it should occur naturally and without the government's intervention"* (Defra, 2013: 7). This places the onus on individuals rather than on governments. Without early and strong mitigation, the cost of adaptation will rise sharply (Defra, 2006). Thus, such measures

are a cost-effective means of bringing about resilience. The Climate Change Act (2008) required the government to prepare a programme of adaptation measures to address climate-related risks (Government, 2008). This created a policy foundation for the task of engaging in adaptive measures to address flood risk.

The IPCC has estimated that without further adaptation, the annual damage caused by flooding would rise by 50% by 2080 (POST, 2016). The UK government's 'Making Space for Water' policy sets goals for implementing flood risk management, requiring urban households suffering from flood risk to undertake all reasonable measures to prevent or minimise flooding of their land (Johnson and Priest, 2008). Such measures have the benefit of reducing the public costs of flood protection. Institutional arrangements determine the extent of adaptive strategies for flooding in the public or private sectors. This is done through policy frameworks and regulations, along with other tools such as incentives, resources and coordination (Wilby and Keenan, 2012). Relevant authorities are responsible for land use planning policies, whilst resilience is a matter for individual property owners. As noted by Urwin and Jordan (2008), the public sector serves as the leading adaptation practitioner within the UK, driven by formal requirements under the National Adaptation Strategy (Wilby and Keenan, 2012). Thus, adaptation is at the forefront of efforts to improve the resilience of properties.

2.5. Challenges and Barriers Identified

From the literature review, it has been established that there exist a number of flood management tools but that their effectiveness in managing flood risk has been the subject of various criticisms. Although there have been successful partnerships in managing flood risk, a parliamentary report has described current strategies as *"fragmented, inefficient and ineffective"* (House of Commons, 2016). Thus, a number of barriers have impeded the effectiveness of these mechanisms, challenging progress towards a more efficient flood risk management framework. The following three subsections examine successively the factors identified by this research as constituting barriers to effective planning, insurance and adaptation.

2.5.1. Barriers to Effective Planning

The nature of floodplains and the dangers associated with them have been discussed in Section 2.2.4. Such areas have historically been seen as attractive locations for development but are naturally prone to flooding. Therefore, systems of risk management have been developed to

ensure that damage to property is mitigated. The European Union established a formal set of rules and duties for member countries to adopt at a national level, set out in Directive 2007/60/EC, which created a system for the assessment and management of flood risks. Thus, the Directive led to the establishment of a basic common flood management framework requiring EU members to establish flood risk assessments, create flood hazard and flood risk maps and develop flood risk management plans that were to be revised every six years. This created an area of common ground by establishing rules and measures that did not increase risk within societies (Priest et al., 2016). The Directive delivered an effective means of discussion and consideration in terms of flood management. This has been invaluable for nations where flood management was still a developing field. Planning systems differ across the EU and legal frameworks vary. Sweden utilises detailed zoning plans that are legally binding on individuals, but with no mechanism to ensure implementation, whereas in the Netherlands, land-use and spatial planning are legally binding and provide certainty on the use of the land (Driessen et al., 2018). This demonstrates how planning serves as a flood risk management tool.

Parker (1995) describes regulation of floodplain development as the principal form of non-structural flood hazard reduction. The Adaptation Committee of the CCC has stated that the planning system has a responsibility to prevent further inappropriate development on floodplains in order to minimise the build-up of long-term vulnerability to future flooding (CCC, 2014). Between 1954 and 1990, UK planning policy placed few restrictions on floodplain development, due to confidence in hard defences against flooding (Crichton, 2012). Since March 2012, development on floodplains has been regulated by the National Planning Policy Framework, which *"sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed"*. In the Netherlands, a policy on the prevention and regulation of floodplain development was largely applied to unprotected floodplains (Poussin et al., 2012). A planner's approach utilised hazard maps and vulnerability as being key components in flood risk management. This was a common approach in other countries, such as Germany and France, where responsibility was largely transferred to local communities (development planning), individuals (Kreibich et al., 2015), banks (mortgages) and industries (insurance; Penning-Rowsell and Priest, 2015). Tromans (2012) notes that the approval process for floodplain development was not sufficiently transparent or accountable, as the EA knew the outcome of only 65% of planning applications to which they had objected.

The insurance sector has sought better control over the planning process with regard to floodplain developments (Crichton, 2012). It operates alongside other approaches such as flood warning systems and flood insurance. Regulation aims to control building on undeveloped floodplains and prevent them from being unwisely used, due to the inherent risks. Thus, it seeks to prevent building on undeveloped floodplains and restrict further developments on those that have been partly developed. Spatial planning is noted for having a central role in the management of flood risk due to its influence over development and land use in England (ABI, 2005; Defra, 2005). A study conducted by Wynn (2005) implied that the great pressure for development in the UK was an impediment to effective flood development control in flood risk areas. It was noted that in 2004 fewer than 700 houses were constructed in flood risk areas against the advice of the EA (HCEC, 2006). In fact, approximately 11% of new homes were built in flood hazard areas between 2000 and 2005 (HCCLGC, 2006). This resulted in around a quarter of properties flooded during summer 2007 having been built in the preceding 25 years (Pitt, 2008). White and Richards (2007) claimed that the UK was a long way from translating central guidelines into local planning practices with respect to flood mitigation. Despite this being the case, a historical review conducted by Potter et al. (2016) concluded that decades-long planning pressures had led to the relaxing of guidelines in relation to floodplain developments. In February 2020, it was found that local authorities in areas that had been flooded had planned to build 11,410 properties in areas at risk, thus exposing them to further danger (House of Commons, 2020). This highlights the growing divide between guidelines steering properties away from flood risk and planning applications seeking further such developments.

2.5.2. Barriers to Effective Insurance

Floodplain locations deemed to be in areas categorised as Flood Zone 3 suffer from the highest level of risk, according to the EA's maps (see Section 2.4.3, Figure 17 and Section 2.3.2.2.1, Table 5). In terms of economic instruments, insurance operates under a system of risk sharing and alleviation. Within the UK, the system of insurance operative from the early 1960s until recently relied on an unspoken agreement between the government and the insurance sector, whereby the government built flood defence structures which prevented flooding whilst the insurance industry provided cover for the flood risk (Christophers, 2019). Under this system, the insured paid a premium to the insurer in order to cover the inherent risks and account for potential dangers to the property. Historically, insurance developed by individuals banding together and insuring one another against financial danger (Gibb, 1957; Lengwiler, 2006). The

EU Floods Directive 2007/60/EC required member countries to develop flood risk management plans but also to consider the use of flood insurance as a means of managing flood risk. Flood insurance plays a central role in the English flood risk management system (Lamond et al. 2009). Flood insurance is a standard component in policies for contents and building insurance in the UK. This covers river, coastal and surface water flooding. Central policy has made insurance coverage a prerequisite for obtaining a mortgage; this requirement has implications for selling property. Insurance payment rates are based on policy agreements made between the national government and insurance companies, thus creating a 'gentleman's agreement' (Penning-Rowsell et al., 2014). On a practical level, it seems adequate to enable recovery measures following a flood event. After a disaster, a compensation system pays for recovery through insurance premiums rather than general taxation. Insurance schemes have a tendency to require governmental support, which can be quite expensive at the national level (Hudson et al., 2016; Surminski and Hudson, 2017).

In flood-prone areas, insurance is least likely to be available or affordable. In addition, new properties within these locations are not eligible for the Flood Re subsidised insurance scheme. This, in extreme cases, leaves the owners having to live in houses lacking any protection from insurance cover, as they are deemed to constitute an uninsurable risk (CCC, 2015; House of Commons, 2015). During the 2015/2016 flooding, there were an estimated 22,000 insurance claims (POST, 2016). This shows that insurance is a tool frequently used by households that have been impacted by flooding. As such, it serves as one of the means for property owners to respond to the hazard. However, it is expected that under Flood Re, longer-term insurance premiums will rise for those at risk and that those at most risk will have to pay much more than at present (Sayers et al., 2015). Furthermore, the increasing danger of climate change means that flooding is only set to increase in the future. The ABI (2019) noted recently that an estimated £110 million was set to be paid to owners of properties damaged in the Yorkshire and Midlands flooding events. Storm Ciara led to an estimated £150-200 million in insurance losses, whilst Storm Dennis resulted in £175-225 million losses (House of Commons, 2020). This indicates that insurance still operates currently in the face of flood threats but faces continued losses as a result of responding to these natural disasters.

2.5.3. Barriers to Effective Adaptation

Flood risk management aims to make communities resilient, i.e. to give them the capacity to cope with the hazard event. In the UK, adaptation offers a number of potential benefits,

including resilience, to the country's economy, natural environment and society. Legislation serves as a key aspect of adaptation as part of the flood risk management framework, as noted in Section 2.4.4.3. This has resulted in the UK Government's National Adaptation Programme, a strategy to address the main risks and opportunities identified in the risk assessment for England. In relation to climate adaptation, the Programme governs the process of implementing measures to bring about resilience (Defra, 2018b). The public sector is said to be the lead adaptation practitioner in the UK, under the said strategy (Urwin and Jordan, 2008; Wilby and Keenan, 2012). Cimato and Mullan (2010) note the role of the government in providing a framework to enable and encourage the use of a decentralised climate change adaptation approach. However, adaptation has largely failed to deliver resilience within the UK flood risk management framework. Mehryar and Surminski (2020) note that despite the growing recognition of resilience, current responses to flood risk remain reactive and are largely driven by 'post-disaster activism'. Thus, flood risk management operates post-disaster, rather than measures being taken to reduce their impact.

Individual-level adaptation has also been found to be limited in the UK because of reliance on the state to provide a full level of protection (Harries and Penning-Rowsell, 2011). This is due to a lack of economic incentives, reducing the willingness of property owners to take part in flood resilience measures. Nevertheless, some individual owners have adopted household-level adaptation measures, but such property-level protection is susceptible to human error, as temporary defences need to be erected or closed prior to flooding. Furthermore, when homes are bought or sold, the awareness of property-level features may be lost (POST, 2016). This can result in any attempted flood resilience measures being abandoned in the process. The financing of adaptation schemes is considered another major barrier to the adoption of such measures (Johnson et al., 2007). Thus, cost appears to factor in the idea of taking such mitigating measures. In Germany and the Netherlands, surveys of households show a willingness to take measures to reduce flood damage, especially if there is a financial incentive such as lowering home insurance premiums (Botzen et al., 2009; Kreibich et al., 2011). This shows that in this case there is a lack of a link between insurance and adaptation. Furthermore, it has been noted that there is a shortage of specialists in the building industry for assessing flood risk in individual properties (POST, 2016). This seems to indicate that even when individuals seek to factor in mitigation measures, there is a lack of skilled expertise to help in providing such adaptation. It had been found to be neither possible nor economical to completely protect all properties from the risk of flooding (Thurston et al., 2008). The UK

government is also committed to bringing about a greater level of adaptation to the country (HM Government, 2019). Therefore, any measures for adaptation to make homes resilient would need to factor in properties that suffer the highest levels of risk.

These barriers have prevented the adoption of a more holistic approach to flood risk management in the UK. Only by addressing these challenges can such an approach be taken, thus improving the effectiveness of flood risk management.

2.6. Chapter Summary

This review of the literature has revealed multiple gaps with regard to floodplain management in the UK. Since the 2007 floods, the UK has experienced a number of flooding incidents, caused or exacerbated by a variety of factors including climate change and building on floodplains, which are particularly vulnerable to flood events because they are naturally prone to flooding. It was noted that over a ten-year period, development on floodplains has accelerated, with 12% of new properties (200,000 homes) between 2001 and 2011 being in flood-prone locations (CCC, 2012). Thus, occupants of these developments are exposed to flooding hazards. The regulatory system in the UK is derived from legislation and policy that have created an institutional framework to manage flooding hazards. Despite improvements in policy, there has been an increasing number of developments on floodplains, with these communities being exposed to floods recently. As such, the purpose of this research is to recommend a regulatory framework to improve the management of floodplain development in the UK. These recommendations are intended for inclusion in the existing framework of floodplain management in the UK. This research adopts the definition of 'framework' given by the Oxford English Dictionary (2003) as a structure composed of parts that are framed together. Popper (1994) defines it as a set of assumptions or fundamental principles of intellectual origin that form the basis for any action. Taking these definitions into account, a framework can thus be seen as a structure formed from a set of principles that serves as the basis for carrying out an activity or action. The framework to be proposed here is for resilience to be incorporated into existing guidelines and policy on flood management for developments on floodplains.

Since the Pitt Review (2008), a number of barriers to effective flood management have become apparent within the UK. In the intervening years, legislation has provided for a modern management system underpinned by the Flood and Water Management Act (2010). However, there remain barriers to the operation of strategies for bringing about greater flood resilience.

It has been noted, indeed, that there is no long-term flood risk management strategy (Surminski and Eldridge, 2015). There is said to be no robust national strategy to combat the increasing threat of flooding, nor any proactive response to the risks that have been identified (EFRAC, 2016). The EFRAC (2016a) report on future flood prevention highlights some long-standing issues in relation to flooding, describes existing flood risk management measures as *"fragmented, inefficient and ineffective"* and joins the call for a more holistic approach to flood risk management (ABI, 2004; Defra, 2004; DCLG, 2006; Defra, 2016). An interconnected approach bringing together aspects of insurance and mitigation would aid in promoting a central strategy of resilience. In respect of governance, EFRAC (2016b) identifies a lack of clarity on the roles and responsibilities of management bodies. The Environment Agency is said to be exercising the dual role of developing strategies and exercising practical management over particular schemes.

To manage flooding, various tools have been used to implement protection measures, including the move from hard defensive solutions to the management of flooding hazards as part of a shift in policy. It has long been recognised that regulating developments on floodplains is one means of managing flooding (Parker, 1995). The aim is to eliminate inappropriate developments and thus to prevent increased flood risk. Crichton (2012) noted that the insurance sector had sought better control over the planning process with regard to floodplain developments. An option that existed then was for the state to restrict floodplain development through the use of planning legislation (Lamond and Penning-Roswell, 2014). This would create a stricter level of control over planning to prevent any inappropriate developments in flood-prone regions. Thus, efforts have been made, through the use of incentives, to encourage property owners to adopt mitigation measures. However, Thieken et al. (2006) noted that few companies made the effort to make individual risk assessments or impose special conditions with regard to flood risk. A further means of managing flood risk is through flood insurance. Market-based insurance could choose to withdraw new cover at any time in the absence of agreements or legislation making the provision of continued protection mandatory (Bouwer et al., 2007; Lamond and Penning-Roswell, 2014). Thus, there has existed nothing to oblige insurance companies to protect those vulnerable to flooding, with any cover potentially being removed at any moment. The only means of ensuring protection for communities vulnerable to flooding is through the use of regulation to require the use of mitigation measures.

In the USA, the Flood Insurance Reform Act (2012) requires premiums to reflect the true risk of living in areas of high flood risk. In comparison to the USA and France, flood insurance in

the UK has historically not been seen as a flood management tool that could be linked to floodplain development control (Parker, 1995). Various sources have reported limited empirical evidence of the success of insurance in encouraging risk reduction behaviour at a household level (Thieken et al., 2006; Treby et al., 2006; Crichton, 2008; Botzen et al., 2009; Lamond et al., 2009; McAneney et al., 2013; Surminski et al., 2015). Parker (1995) found, indeed, that far from discouraging it, the existing approach to insurance had marginally encouraged floodplain development, running counter to the guidance on discouraging building in areas that suffered from flood risk. Clark et al. (2002) later noted that it was not in the interest of insurance companies to finance resilient repairs to domestic property, because customers were not in long-term agreements with their insurers and that rival companies might therefore recruit lower-risk customers at the expense of any company financing resilience. Loss adjusters were said to act in the short-term interest of their respective insurance companies, often recommending the cheapest reinstatement method rather than those providing resilience (Proverbs and Soetanto, 2004). Thus, insurers have not historically been aligned with the central aims of mitigation and resilience, despite the potentially high value of insurance as an element of a holistic approach to flood risk management (Surminski and Eldridge, 2015). State-sponsored schemes could instigate incentives for risk reduction activities due to lack of competition (Lamond et al., 2009). As such, government initiatives could be used to support a coordinated scheme dedicated to achieving flood resilience. Legislation is recognised as having a potentially important if unexplored role in encouraging resilience (Mehryar and Surminski, 2020).

These various factors highlight the greater need for a more unified approach to flood management within the UK regulatory framework, which has drawn on many lessons learnt from various flooding incidents to influence policy and create a stronger system of regulation. Despite this progress, however, there has been a noted rise in developments on floodplains, contradicting the strategy of avoiding such building unless there is no suitable alternative. These areas are exposed to increasing levels of flood risk due to the fact that such locations are prone to repeated flooding as part of their lifecycle. In addition, continued building has impaired the natural functions of floodplains and reduced their ability to aid in natural flood management. Furthermore, properties situated in such locations face notable problems in mitigating the harm done by flood events. Notwithstanding the central strategy of flood resilience, there appears to be a lack of interconnectivity with other flood risk management tools such as insurance, adaptation and other non-structural measures. This has resulted in calls

for a more holistic approach to flood risk management, bringing together other aspects of resilience such as insurance and flood adaptation. One method of achieving this would be through regulation to impose a more holistic strategy, with a particular focus on floodplain regions. This could interconnect aspects of insurance by way of corporate social responsibility while streamlining the process of using companies to bring about resilience. Without such measures, there will continue to be a lack of will to implement flood resilience as part of the central strategy and within the regulatory framework.

Thus, the present research aims to investigate the current regulatory framework in order to provide recommendations and to improve its implementation. The following chapter sets out the research methodology that has been adopted to guide data collection and analysis in pursuit of this aim.

Chapter 3: Research Methodology

The conduct of any research study involves a process of knowledge gathering. Research is the search for knowledge and develops from a certain vision of the world around the researcher. Redman and Mory (1933) define research as *"the systematized effort to gain new knowledge"*. Thus, the goal is the development of new knowledge. Thiétart (2001) notes that research makes use of certain methods with the aim of *"predicting, prescribing, understanding, constructing or explaining"*. Knowledge may come from any research activity, whether theoretical, experimental or observational, but the results have to be substantiated and reproducible (Kennett, 2014). This creates the need for attention to a key element of the research process: the methodology. Research methodology is the *"combination of techniques used to enquire into a specific situation"* (Easterby-Smith et al., 2004: 31). As such, it consists of the various tools utilised in the process of answering the research question. It is the procedural framework within which the research is constructed (Remenyi et al., 1998). Thus, it forms the foundation of a study and the methods for conducting it. It is also the means through which a researcher systematically researches a problem (Kothari, 2009). This is consistent with Remenyi et al. (2003), who describe methodology as an *"overall approach"* to a problem that is put into practice as part of the research process, which is *"the theoretical underpinning to the collection and analysis of data"*. Similarly, Collis and Hussey (2009) note that methodology is the *"overall approach to the entire process of the research study"*. Thus, it places an emphasis on the question to be investigated by the study. Goddard and Melville (2004) describe research as answering unanswered questions or exploring something that does not exist. The use of different methodologies, as such, defines the different types of research and plays a vital role in the overall research strategy (Leedy and Ormrod, 2005). In this regard, methodology operates as an overall approach to the research process, from the theoretical underpinnings to the collection and analysis of the data (Hussey and Hussey, 1997; Gill and Johnson, 1997). Thus, it forms the underpinning of the work conducted by a researcher.

In short, methodology is the *"strategy, plan of action, process or design"* that underpins the choice of a particular research method (Crotty, 1998: 3). Creswell (2009) states that instead of focusing on methods, the researcher should concentrate on the research problem and use all approaches available in an effort to understand the problem. In this manner, the research methodology provides the means through which a result is determined for a specific research problem. It serves as the overall approach to the research process, covering theory, data

collection and data analysis (Collis and Hussey, 2009). There are a number of factors to be considered in determining the approach to methodology, such as the research question and the area of research. Blumer (1969) states that methodology consists of a whole range of strategies in order to achieve that goal, among which are asking questions about the world, finding a researchable problem, determining the best methods of finding data and the interpretation of the findings. Thus, it aims to aid in answering the research question, while Remenyi et al. (1998) suggest that it helps to direct and focus the researcher's thinking in bringing about the creation of new knowledge. Research consists of the systematic search for answers and knowledge in order to develop a conclusion. Collis and Hussey (2009) and Creswell (2009) consider the methodology to be an overall approach to the research design process, encompassing all phases from theoretical underpinning to collection and analysis of data. It is essential for the researcher to select the methods most appropriate for a given study, taking into account various factors such as the need to reduce the effect of potential weaknesses by the adoption of complementary methods having compensating strengths (Tashakkori and Teddlie, 2010; Wilkinson and Birmingham, 2003; Hassard et al., 2009). This chapter gives an account of the adoption of a philosophy, approach and methods to form the framework that has guided the researcher during the course of the present research, beginning with its design.

3.1. Research Design

Creswell (2014) asserts that researchers must question themselves about the knowledge claims and any theoretical perspectives involved in their research. As such, they must reflect upon the strategies they intend to use, as this will inform their methods. Furthermore, they should question how they will collect and analyse information, this being achieved by the adoption of a specific research design. The term 'research design' refers to the overall strategy chosen by the researcher to integrate the different components of the study. It is defined by Leedy (1997) as a plan for a study that provides an overall framework for the collection of data. The process involves a series of decisions on the manner in which the research is to be conducted before arriving at the overall approach to the research design and data collection techniques. According to McMillan and Schumacher (2001), it is a plan for the selection of subjects, research sites and data collection procedures in order to answer the research question. This must be done in a coherent and logical manner, to ensure effectiveness in answering the research problem. As such, research design operates as a strategic framework for action or as a bridge between the research question and the implementation of the strategy (Durrheim,

2004). Thus, it can be described as a blueprint showing how the researcher will collect, measure and analyse the data. The purpose of the research and the research question are suggested starting points for developing the research design, as they provide the researcher with a focus and an aim (Yin, 2003; Saunders, Lewis and Thornhill, 2009). Creswell (2009) explains that the researcher should create a research design that consists of plans, procedures and methods of data collection, analysis and interpretation. The selection of a suitable research design is based on certain criteria, namely the research problem, the target audience and the personal experience of the researcher (Creswell, 2009).

Figure 20 illustrates the 'research onion' representation of the research process provided by Saunders et al. (2016) and adopted by the present researcher. This model was developed to describe the various stages that a researcher should follow in order to create an effective methodology.

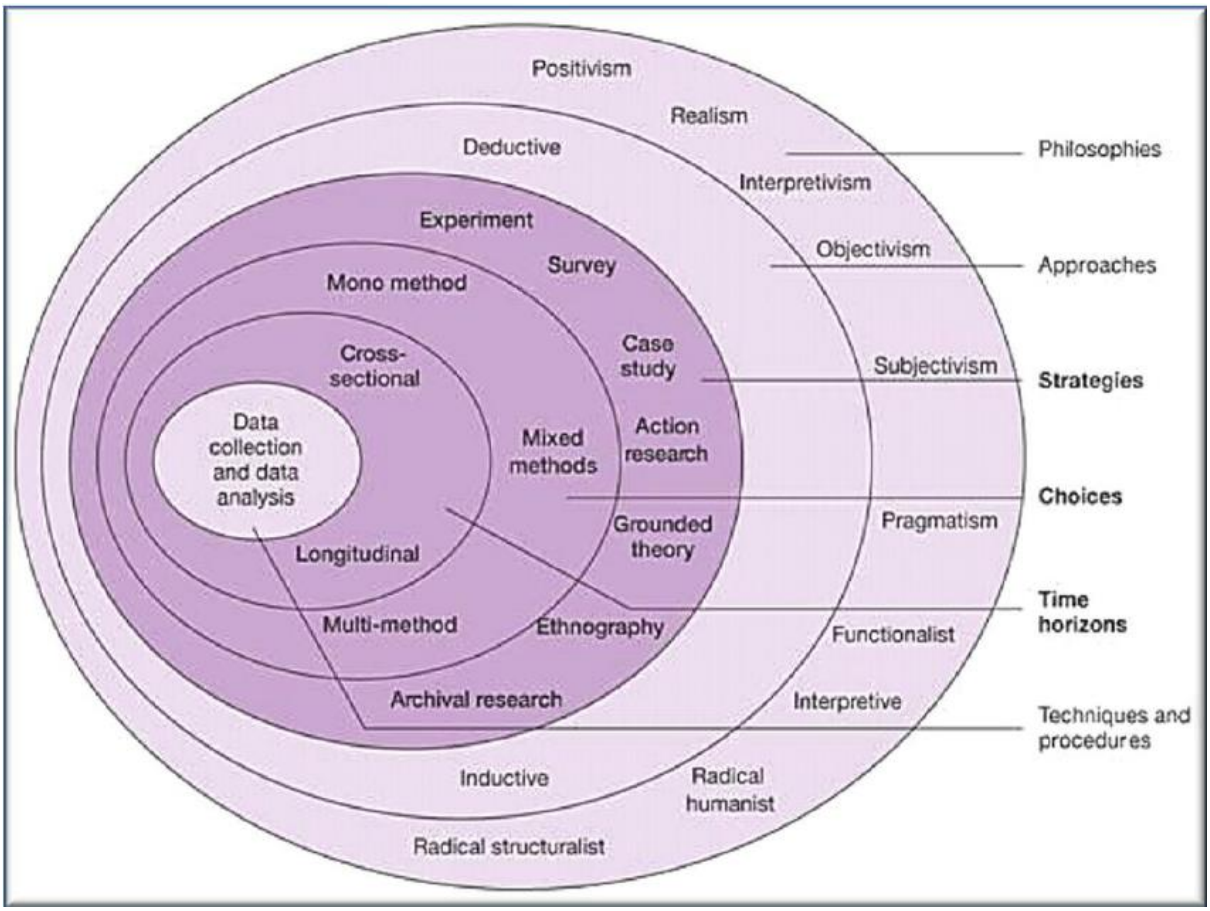

Figure 20: The research onion *(Source: Saunders et al., 2016)*

Saunders et al. (2016) classify research into six stages depicted in the figure as nested in the form of an onion. It presents the key components of research as layers to serve as a step-by-step guide on the thoughts and research process. According to Saunders et al. (2016), the centre of the onion is where the thoughts regarding the research problem lie, with the various layers having to be 'peeled away' in order to reach this position. These layers depict the research philosophy, approach, strategy, techniques and procedures, time horizon and methods of data collection and analysis. Each element constitutes a critical part of the research methodology as it determines how the researcher views the data, specifies the type of data and provides the means for their collection. Thus, these elements form an overall framework of guidance on the methodological choices adopted by the researcher. The research onion has been widely used in research and an updated version has recently been published (Saunders, 2019). It was adopted here because it was seen to benefit the researcher by illustrating the methodological steps needed in an easily understood manner. The selection of an appropriate methodology was largely determined by the research area and the research question. The process of selection began with the research philosophy.

Saunders et al. (2009) identify three kinds of study: descriptive, explanatory and exploratory. Descriptive research seeks to accurately describe observations of a phenomenon, explanatory research aims to provide explanations of certain relationships and exploratory research is intended to discover new phenomena. According to Robson (2002: 59), *"the objective of descriptive research is to portray an accurate profile of persons, events or situations"*; exploratory studies are valuable in finding out *"what is happening; to seek new insights; to ask questions and to assess phenomena in a new light"*. Exploratory studies can be useful in clarifying the understanding of a problem or when the researcher is unsure of the precise nature of the problem (Saunders et al., 2009). According to Collis and Hussey (2009), exploratory research usually relies on qualitative measures. Through an exploration of the literature, it seeks to identify problems, clarify concepts and form hypotheses. This is achieved by means of a number of data collection instruments such as observation, interviews and content analysis. By its nature, exploratory research thus primarily involves the use of qualitative studies. Explanatory research is more likely to be quantitative and to test one or more hypotheses. Finally, descriptive research may make use of quantitative techniques or utilise a combination of qualitative and quantitative methods. It also involves an exploration of the literature, the identification of problems, the clarifying of concepts and hypothesis formation.

Due to the nature of this research study, an exploratory design was deemed appropriate, because the aim is to provide recommendations for improving the effectiveness of flood management and developments on floodplains in the UK. As such, neither descriptive nor explanatory studies would have been suitable. The elaboration of recommendations can be achieved only by exploring a research problem in order to provide a solution. Thus, exploration was appropriate to develop knowledge from other practices that could be adopted in the UK in order to combat the growing danger of flooding, especially with regard to the increasing development of floodplain areas. This involved examining the research area and developing new knowledge based on the various factors in the study. Exploratory research, as defined by Saunders et al. (2009), was therefore deemed most appropriate here. The next element in the process of establishing the methodology was determining the appropriate research philosophy.

3.2. Research Philosophy

The research philosophy is the set of beliefs regarding the nature of the reality being investigated (Bryman, 2012). Thus, it is the beliefs as to the manner in which data about a phenomenon should be gathered, analysed and used to achieve the research aim. Research philosophy can be defined as *"the development of knowledge and the nature of knowledge"* (Saunders et al., 2009). This determines the basis for obtaining the data on a phenomenon and how it is both analysed and utilised. As noted by Easterby-Smith et al. (2004), three factors dictate the importance of the philosophy in the research methodology. First, the researcher's understanding of philosophy can lead to a refinement of the methods used, thus aiding in data gathering. It also illuminates the different types of methodology, allowing the researcher to avoid inappropriate methods. Finally, it aids the researcher in being creative and using exploration in the research. According to Flick (2011), the choice of research philosophy involves making assumptions in order to determine how the researcher will conduct the study. Research philosophy concerns how the researcher views and understands knowledge, processes and phenomena in their field (Saunders and Tosey, 2012). The philosophical stance thus influences the researcher in every aspect of their decisions and choices as to how to investigate the research problem, including the means of collecting and analysing the data (Knight and Ruddock, 2008). Philosophy is composed of a multitude of components that are used to guide the research process. The elements of research form a paradigm that Guba (1990) describes as determining its characteristics, including the nature of reality (ontology), the basis of knowledge (epistemology) and the means of uncovering knowledge (methodology). It is

used to support the researcher's judgment on the methods and strategy employed in the research (Saunders et al., 2009). As such, it serves as the foundation on which the researcher constructs the means of conducting the study.

Saunders et al. (2009) also note that research philosophy supports the creation of knowledge in a particular field and is influenced by the way the researcher thinks. Easterby-Smith et al. (2004) identify the making of the correct choice among research philosophies as the basis of effective research design. Any failure to adhere to philosophical issues could affect the quality of the research negatively. As stated by Bryman (2012), philosophy concerns the nature of reality determined through investigation. Its component element of epistemology addresses the nature and origin of that knowledge (Dawood and Underwood, 2010). This forms part of the assumptions that are made as to the nature of knowledge. The awareness of this reality constitutes the ontology and refers to the attempt to discover knowledge of the wider universe (Saunders et al., 2009; Dawood and Underwood, 2010). There exists a range of research philosophies differing in research goals and in the manner of pursuing them (Goddard and Melville, 2004). May (2011) states that while these philosophical approaches are not necessarily at odds with one another, the choice of research philosophy nevertheless determines the type of knowledge being investigated. Thus, the adoption of a research philosophy determines the appropriate choice of research type and methodology.

The various types of philosophy that can be adopted by a researcher are referred to as paradigms, which Kuhn (1962) describes as sets of common beliefs and agreements that are shared between researchers about how problems can be understood and addressed. According to Guba and Lincoln, a paradigm is:

> *a set of basic beliefs (or metaphysics) that deals with ultimates or first principles. It represents a worldview that defines, for its holder, the nature of the 'world', the individual's place in it, and the range of possible relationships to that world and its parts, as, for example, cosmologies and theologies do.* (1994: 105)

Thus, a paradigm is a cluster of beliefs that dictates the manner in which a study should be conducted and how the results are to be interpreted (Bryman, 2008). It is a philosophical framework that guides the conduct of the research, based philosophical assumptions about the world and the nature of knowledge (Collis and Hussey, 2009). Among these different paradigms are positivism, interpretivism and critical theory, each having its own strengths and weaknesses (Mackenzie and Knipe, 2006). The adoption of a philosophy largely depends on

the focus of the research, as this determines which is most appropriate. Burke (2007) states that positivism makes use of empirical data and rationale with an objective basis. This contrasts with the interpretive paradigm, which involves seeking to understand human experience (Burke, 2007), and with the critical paradigm, which enquires into societal power distribution and political acts or ideology.

For the purpose of this research, the interpretivist paradigm has been adopted. The reasoning for this choice is that the research aims to generate recommendations, which operate on the basis of subjective experience, a line of interpretation which is linked with interpretivism. This paradigm is therefore the most suitable way of extracting meaning from the research process. Part of the process involves creating a link between the researcher and the people they interact with in order to develop a meaningful ontological reality.

3.2.1. Ontology

Ontology is the study of what constitutes reality (Guba, 1990) and has also been referred to as metaphysics (Clark and Creswell, 2008). Thus, it concerns itself with the nature of reality and the assumptions that researchers make about the way the world operates. As such, it refers to the assumptions that we make about the nature of reality (Easterby-Smith et al., 2012). Guba and Lincoln (1994) assert that it refers to the form and nature of reality along with what can be known about it. As such, ontological philosophy is concerned with the nature of reality. According to Baikie (1993), ontology is the *"science or study of being"*, dealing with the nature of reality. An ontology is a system of beliefs which reflects an individual's interpretation of the world and what constitutes it. According to Richards (2003), ontology concerns the assumptions one makes about the kind and nature of reality, thus determining what exists. It addresses the researcher's beliefs about how the world operates and how society is constructed, along with their viewpoint on how they influence everything around them. This view is shared by Snape and Spencer (2003), who see ontology as dealing with the nature of the world and what we know about it. Saunders, Lewis and Thornhill (2009: 110) similarly state that it *"is concerned with the nature of reality"*. Thus, it refers to the awareness and nature of the knowledge of existence of the universe (Dawood and Underwood, 2010; Saunders et al., 2009). Knight and Ruddock (2008) summarise it as denoting the researcher's conception of reality. Thus, it brings into question the difference between reality, the researcher's perception of reality and ultimately how this influences the behaviour of people.

Bryman (2008) is responsible for introducing a related concept, namely 'social ontology', the philosophical consideration in research in relation to the nature of social entities. Thus, it involves social beings and their perceptions of a question being either objective or subjective. Two important aspects of ontology are positivism (objectivism) and interpretivism (subjectivism). These two frameworks can be given different names, but the underlying assumptions are largely similar (Bryman, 2012). Ormstone et al. (2014) state that social ontology concerns *"whether or not there is a social reality that exists independently from human conceptions and interpretations and, closely related to this, whether there is a shared social reality or only multiple, context specific ones"* (p.4). There is an essential distinction here between objectivism and subjectivism. Objectivism is the position whereby social entities exist independently of the social actors concerned with their existence (Crotty, 1998). It plays a key role for positivist researchers who wish to be objective and seek the use of rationality and logic to distinguish fact from value judgements. Subjectivism, by contrast, posits that the creation of social phenomena arises from the perceptions and actions of social actors (Knight and Ruddock, 2008; Saunders et al., 2009). Subjectivism is appropriate for interpretivist researchers, as it provides an understanding of motives, meanings, reasons and subjective experiences that are dependent on time and context.

Qualitative research is by nature interpretive (Denzin and Lincoln, 1994; Creswell, 1998). Therefore, the present researcher has adopted an interpretivist/subjectivist paradigm in order to generate recommendations for improving the regulatory framework in relation to floodplain development. This choice offers a flexible research structure, according to Carson et al. (2001). In comparison, objectivism is more rigid and inflexible, delivering a poor understanding of the social processes that are key to this research, which is why it was not considered appropriate for this study. The fact that recommendations are necessarily largely subjective is linked with the interpretation element of the chosen paradigm. Furthermore, interpretivism is more open to receiving and capturing the meaning of human interaction (Black, 2006). This paradigm link draws meaning from the research process by examining the subjective experiences of experts and occupants of floodplains. Thus, interpretivists could use the paradigm in order to better make sense of this reality and of how it is perceived (Carson et al., 2001). Subjective experience and reality are therefore aligned with the interpretivist paradigm rather than the objective alternative.

3.2.2. Epistemology

Also among the core branches of philosophy is epistemology, which concerns itself with the theory of knowledge. Guba (1990) notes that it questions how an individual knows something. It refers in the present context to the relationship between the researcher and what can be known. According to Gall, Borg and Gall (1996), it is a branch of philosophy that studies the nature of knowledge and the processes by which it is acquired and validated. There is a particular focus on the methods used to obtain that knowledge, its verification and *"the possible ways of gaining knowledge of social reality, whatever it is understood to be. In short, claims about how what is assumed to exist can be known"* (Blaikie, 2000: 8). Thus, it refers to the assumptions about knowledge and how it can be obtained. Guba and Lincoln (1994) claim that it requires the researcher adopt a position of objective detachment in order to discover how things really are. Thus, there is a presumption that the researcher and the known are separate entities, independent of one another and unable to influence each other. This 'known' element becomes a truth which is objective and quantifiable in terms of empirical data. It is for this reason that Rescher (2003) describes epistemology as the theory of knowledge, while Saunders, Lewis and Thornhill (2009) state that it is concerned with *"what constitutes acceptable knowledge in a field of study"* (p.112). Bryman (2008) defines epistemology as asking *"the question of what is (or should be) regarded as acceptable knowledge in a discipline"* (p.13). The underlying epistemology serves as the means of guiding the development of any research. According to by O'Gorman and MacIntosh (2014), it is the study of knowledge and consists of theories about what constitutes knowledge, as well as the understanding of phenomena. An element of this philosophy involves an explanation on how a researcher can come to hold particular beliefs and knowledge. There are a number of related philosophical stances, including positivism, interpretivism and pragmatism.

Positivism holds that reality, or the world, exists externally and can therefore be measured through objective methods instead of through a subjective approach (Easterby-Smith et al., 2008). Positivists argue that *"the world exists externally and that its properties should be measured through objective measures rather than being inferred subjectively through sensation, reflection or intuition"* (Easterby-Smith et al., 2004: 28). This is also known as objectivism, namely the belief that social phenomena and their meanings exist independently of their social actors. Thus, objectivists believe in causality and that *"there are independent causes that lead to the observed effects"* (Remenyi et al., 1998: 32). This viewpoint states that

the observer is independent from what is being observed and that the conduct of a study should be determined by a set of objective criteria. It requires the setting of a research question that can be tested and allows for explanations that are measured against accepted knowledge in the world. It prefers the researcher to collect data on an observable reality whilst searching for regularities and causal relationships to generate generalisations (Gill and Johnson, 2010; Saunders, Lewis and Thornhill, 2012). As such, the position held by positivists is that all phenomena can only be understood by using scientific methods. A key focus is on the delivery of quantifiable results that can be subjected to statistical analysis. The result is that hypotheses are either verified or refuted, based on observed effects. As such, objectivism seeks to *"identify causal explanations and fundamental laws that explain regularities in human social behaviour"* (Easterby-Smith et al., 1991: 23). This involves the generalisation of results from observation of an ample sample size. Positivists search for causal explanations and fundamental laws, adopting the deductive approach to research (Easterby-Smith et al. 2004; Gill and Johnson, 2002; Remenyi, 1998). Part of the research process involves the creation of hypotheses from the researcher's own conceptualisation of a particular phenomenon. Positivists adopt a neutral theoretical position devoid of subject content, from which they can then develop research material that can be replicated by other scientists to generate similar results.

Interpretivism or social constructivism is a stance whereby researchers seek to understand and explain differences in experience (Saunders et al., 2012). As such, it lies at the opposite end of the spectrum from positivism, rejecting its belief in an external objective reality. Hudson and Ozanne (1998) explain that interpretivists believe that there are multiple realities and that these are relative. Lincoln and Guba (1985) expand on this by highlighting the dependence of multiple realities on other systems for meaning. This makes them more difficult to interpret in terms of fixed realities, according to Neuman (2000). As such, Carson et al. (2001) state that the knowledge obtained is socially constructed rather than objectively determined; they add that interpretivists avoided rigid structural frameworks such as those used in positivist research and instead adopt more personal and flexible research structures. Such structures are more receptive of human interaction (Black, 2006). The goals of interpretivist research are understanding human behaviour and interpreting its meaning, rather than generalising or predicting causes and effects (Neuman, 2000; Hudson and Ozanne, 1988). Interpretivists focus on understanding meanings, motives and reasons, along with other subjective experiences that

are time- and context-related (Hudson and Ozanne, 1988; Neuman, 2000). As such, they believe there is more depth that can be determined through the experiences of the individual.

The third paradigm considered here is pragmatism, which holds that both constructivist and objectivist styles are valid ways to approach research. According to Feilzer (2010: 8), it *"sidesteps the contentious issues of truth and reality"*, allowing researchers to use either or both viewpoints on the influence of social factors to create a practical approach to research. It focuses *"on 'what works' as the truth regarding the research questions under investigation"* (Tashakkori and Teddlie, 2003: 713). In pragmatic research, the research question is crucial in deciding the research philosophy, in order to finding a practical solution to a problem. Thus, it accepts concepts as relevant only if they support action towards that objective. An element of the pragmatic viewpoint is its recognition *"that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities"* (Saunders, Lewis and Thornhill, 2012). It differs from positivism and interpretivism in that it can integrate more than one form of research approach and strategy within a single study. In addition, it can integrate multiple research methods, such as qualitative, quantitative and action research. Cherrholmes (1992) and Murphy (1990) state that among the basic concepts of pragmatism is that it is not committed to any single system of philosophy and reality (Creswell, 2008). In that regard, it affords researchers the freedom to choose the methods, techniques and procedures of research that best meet their needs and purposes.

Thus, epistemology is *"a general set of assumptions about the best ways of inquiring into the nature of the world"* (Easterby-Smith et al., 2004: 31). For the purposes of this research, a pragmatic stance has been adopted, because it offers a range of flexibility by drawing upon the strengths of both positivism and interpretivism in the interest of answering the research question. It has allowed the researcher to use whatever means were needed to achieve the research objective, resulting in fewer philosophical assumptions binding or restricting him in the way the research was conducted. It has allowed for multiple realities to be derived from quantitative and qualitative research and for these elements to be acknowledged. The regulatory nature of this research means that the researcher has had to apply his own unique interpretations of reality. Pragmatism accords well with the legal nature of this research in that it was largely based on subjective interpretation.

3.2.3. Axiology

Axiology is the branch of philosophy that deals with values (Saunders et al., 2012; O'Gorman and MacIntosh, 2014). In the context of research, it concerns itself with judgements of the researcher's values and whether these play a part in the research process. Thus, it concerns the values that are attached to knowledge and aids in determining what are recognised as facts and the interpretations that are drawn from them (Collis and Hussey, 2009). This involves researchers making their values known and reporting them, along with their biases regarding information gathered in the field. Axiology *"studies judgements about value"* (Saunders, Lewis and Thornhill, 2009: 116). Heron and Reason (1997) refer to *"values of being, about what the human states are to be valued simply because of what they are"* (p. 287). Heron (1996) notes the role played by values in the various stages of the research process, acknowledging that these values have importance because they determine whether the results are credible. Axiological skills allow researchers to articulate their values, which serve as the basis for judgements; these in turn allow them to examine the manner in which they conduct their research. Saunders et al. (2009) note that this aspect of research is based on one's world view, cultural experience and an upbringing in realism. For research to be credible, axiology plays a significant role, as the results incorporate the researcher's own values during the various stages of the research process.

Thus, axiology is concerned with assessing the researcher's own values at all stages of the research process. As a result, it refers primarily to the aims of the research. As a philosophy, Lee et al. (2008) state that it attempts to clarify the way researchers explain or predict the world or whether they seek only to understand it. It draws upon the different philosophies as these influence the axiological stance. As positivism is value-free, it allows a researcher to maintain an objective and independent stance (Saunders et al., 2012). Axiologically, positivism is a philosophical stance holding that research is value free and thus unaffected by any biases. In contrast, interpretivism considers the researcher to be part of the research and incapable of being separated from it. Thus, the researcher's own values form part of the recognised facts and play a role in the interpretation of the data. As noted above, pragmatism allows for both positivist and interpretivist stances, accepting both observable phenomena and subjective meanings to answer research questions (Saunders et al., 2012). Its adoption in the present research means that in an axiological sense this has both value-free and value-laden aspects.

In other words, axiology ultimately allows researchers to understand and recognise the role of their own values and opinions. It holds that these values play a part in the collection and analysis of the research rather than seeking to eliminate their influence. This element of research philosophy as a result aims to determine if the researcher is attempting to explain, predict or understand phenomena. The axiological stance of this research is value-laden, in that the values of the researcher have influenced the research process and its results. While positivism is considered value-free, the researcher maintaining an objective stance independent of the data (Saunders et al., 2012), it was not considered appropriate for this study, which has required the researcher to obtain information through personal interaction and to interpret it subjectively.

3.2.4. Pragmatism

The pragmatic philosophical stance taken in this research has allowed the researcher to gain practical knowledge on the subject matter. Pragmatist researchers focus on the problem by taking its social and historical context into account; rather than relying on a single method, they use multiple relevant techniques of data collection to answer the research question (Creswell, 2007). Kelemen and Rumens (2008) state that pragmatism asserts the view that concepts are relevant only when they support action (Saunders, Lewis and Thornhill, 2012). According to Schuh and Barab (2008), the pragmatist viewpoint focuses on the functional consequences of knowledge. The pragmatic paradigm implies an overall approach to research that mixes data collection methods and data analysis procedures within the research process, according to Creswell (2003), who explains that phenomena and knowledge are formed by interactions between people and by their interactions with their environment. Similarly, Saunders and Tosey (2012) note knowledge is derived from the practical consequences of the research and suggest that there exists no single point of view that could fully and accurately portray a situation. As such, the reason for choosing pragmatism was the flexibility offered by the combination of positivism and interpretivism. According to Saunders et al. (2009), pragmatism allows researchers to adopt any of the ontological, epistemological and axiological stances outlined above, based upon their own interest and understanding of the research. Thus, it recognises that every method has its own limitations and that the different approaches could complement one another. As noted by Tashakkori and Teddlie (1998: 30), the goal is to *"study what interests you and is of value to you, study in the different ways in which you deem appropriate, and use the results in ways that can bring about positive consequences within your value system"*. The

aim of this research is to provide subjective recommendations, linking it to interpretivism. However, pragmatism is preferable to any a single method, due to the efficient use of both methods.

3.2.5. Summary

The research philosophy is the set of beliefs regarding the nature of the reality being investigated (Bryman, 2012). This determines the basis for obtaining the data on a phenomenon and for how it is analysed and utilised. According to Flick (2011), the research philosophy sets assumptions regarding the manner of conducting the study. Dawood and Underwood (2010) state that there are several branches of philosophy, including aesthetics, epistemology, ethics, metaphysics and logic. In research, the various philosophies that can be adopted include positivism, interpretivism and critical theory, each having its own strengths and weaknesses (Mackenzie and Knipe, 2006). The adoption of a philosophy depends largely on the focus of the research. Burke (2007) states that positivism makes use of empirical data and rationale with an objective base. This contrasts with the interpretive paradigm, which seeks to understand human experiences, and with the critical paradigm, concerned with societal power distribution and with political acts and ideology (Burke, 2007). The present research has adopted the interpretivist paradigm as appropriate to the aim of providing recommendations for improving the regulatory framework in relation to floodplain development. Recommendations operate on subjective experiences and this line of interpretation is linked with the interpretivist paradigm. Part of the research process involved creating links between the researcher and the people with whom he interacted in order to develop a meaningful ontological reality.

A further basis of the ontological reality was the focus on improving the regulatory framework, requiring legal research, based largely on the interpretation of legislation and cases. Rubin (1988) argues that legal research differs from non-legal research in the sense that the content of any work needs to be new. Legal research is undertaken, according to Kissam (1987), either to examine new law or to explain the interpretation of a principle, case or legislation. Legal research may be categorised as either doctrinal or non-doctrinal (McConville and Wing, 2007). Salter and Mason (2007: 114) assert that:

> *…there is no 'black-letter law'. Everything is subject to interpretation by the courts… Lawyers specializing this field still need to research, and cannot guarantee what the law is, simply because it is so vast and changing, subject to your judge's interpretations and the facts of your case as the judge believes.*

As this research seeks to improve upon the regulatory framework, a background of law was necessary and was most appropriate for this kind of study. As established, law is based largely on interpretation and this aligns with the interpretivist paradigm. With the research philosophy chosen, the next element was the selection of a research approach.

3.3. Research Approach

The second layer of the research onion concerns the approach, i.e. the manner of data collection and analysis (Saunders et al., 2012). Yin (2003) refers to this aspect of the research process as the strategy. As such, it can be said to equate to the method of inquiry. Myers (2009) states that research methods are a strategy of enquiry that moves from underlying assumptions towards research design and data collection. It determines the research design and the form of data collection. This results in it operating as the link in methodology between the philosophy adopted and the choice of methods used to collect and analyse the data (Denzin and Lincoln, 2005). Gill and Johnson (2002) argue that there is no one best approach to research, the choice of approach being governed by a number of variables. Saunders (2009) concurs that there exist a number of approaches that can be adopted when conducting research; these are named deductive, inductive and abductive (Dawood and Underwood, 2010). They operate as variants of the relationship between theory and research (Bryman and Bell, 2011). Each of these approaches offers a different set of advantages for the researcher, as outlined below.

3.3.1. Deduction

Deductive research operates by producing a hypothesis from a theory relating to the focus of the research, thus testing the theory. According to Saunders et al. (2009), deductive reasoning allows the researcher to create a hypothesis from an existing theory and collect data for analysis to test the hypothesis and thus to confirm or reject the application of theory. As such, it seeks to develop a hypothesis from a pre-existing theory, adopting a research approach to test it (Silverman, 2005). If necessary, the researcher can modify the hypothesis and repeat the process. Deduction is characterised as development from the general to the particular, with a general theory and knowledge base being used to first establish a foundation, then testing it against the specific knowledge gained from the research process (Kothari, 2009). The deductive researcher uses the literature to identify theories and tests them by means of the data. Saunders et al. (2000) suggest that researchers should be independent of the phenomena they observe, in line with the deductive approach. Robson (2002) suggests using deductive

reasoning as a theory-testing practice that arose from established theory or generalisation, in an attempt to validate the theory in a specific context. As such, it operates from a more general view to a more specific one, with conclusions being drawn from available theory (Saunders et al., 2007). Data can be gathered from a variety of sources and used to confirm or reject the hypothesis (Gill and Johnson 2010). Deductive reasoning thus aims to respond directly to a yes/no question.

3.3.2. Induction

In contrast, the inductive approach to research seeks to develop or build theory through the use of investigatory methods and reasoning over a period of time (Saunders et al., 2009). As such, there is no framework that informs the data collection and the research focus can, as a result, be decided after the data have been collected (Flick, 2011). The inductive approach involves the collection of data and the development of theory based on the results of data analysis. It can be characterised as moving from the specific to the general (Bryman and Bell, 2011). In other words, the process goes from research question to observation and description to analysis before proceeding to generate new or modified theory. The data can be analysed in order to fit into an existing theory (Bryman and Bell, 2011). Induction refers to the means by which the researcher contextualises the knowledge and events. Thus, knowledge is derived from an understanding of the data and its analysis (Denzin and Lincoln, 2003c; Kuada, 2012). Inductive researchers tend to gather data from small samples in order to analyse it and develop a theory to solve the problem. Induction is typically used in qualitative research in the absence of theory informing the research process, with the benefit of reducing potential researcher bias during data collection (Bryman and Bell, 2011). Interviews are often employed to collect the data, which are then examined for patterns among the respondents (Flick, 2011). The researcher then uses the data to create a hypothesis and to construct a theory that matches the research problem, with the goal of making inductive arguments (Mertens, 2008). Through this means, a researcher can set about solving a research problem.

3.3.3. Abduction

The third alternative type of reasoning is the abductive approach, which Dawood and Underwood (2010) describe as the combination of the other two approaches. Saunders et al. (2009) suggest that it is not compulsory to strictly follow an inductive or deductive trajectory and that a combination of the two can be used in a study. In fact, they assert that by using both

approaches the researcher can achieve a logical and correct result, using multiple research strategies and methods to arrive at a logical and practical solution to the research problem. Furthermore, by using both empirical and non-empirical paradigms, the researcher can make observations for the development of a hypothesis that solves a practical problem and creates new knowledge of reality. Saunders et al. (2012) discuss the concept of multiple strategies and argue that this approach has an advantage over either of the two individual strategies.

3.3.4. Chosen Research Approach

An understanding of the methodological literature identifies abductive reasoning as appropriate for this research as it makes use of both approaches. Deduction is typically associated with quantitative methods, whilst induction is linked with qualitative methods (Saunders et al., 2009). Each has its own strengths and both are capable of being invaluable to a researcher. This research has adopted a pragmatic philosophical stance because the research question concerns flood risk management. Abductive reasoning is further linked to both the inductive and deductive approaches that could be used to solve a research problem (Creswell, 2009; Dawood and Underwood, 2010; Saunders et al., 2012). Taking the abductive approach has allowed the researcher to adopt multiple strategies and methods in order to find the best solution to the problem, mixing empirical and non-empirical approaches in order to extract new knowledge. This research has thus involved the gathering of both quantitative data and data from qualitative-based sources, such as literature. According to Dawood and Underwood (2010), this approach is concerned with the discovery of new facts and knowledge by combining deductive and inductive reasoning. An abductive stance allows for greater flexibility in following whichever of the contrasting approaches best suits the needs of each stage of the study. The level of reasoning provided by these approaches has determined the underlying methods of acquiring the data for this research, allowing the researcher to use multiple techniques to acquire knowledge on the nature of flood risk management. This is consistent with pragmatism and has thus allowed the researcher to select the relevant research strategy.

3.4. Research Strategy

The strategic element of research methodology operates as part of the larger element of research approach. Research strategy is defined by Saunders et al. (2009: 600) as *"the general plan of how the researcher will go about answering the research questions"*. As such, it guides the research question and objectives that are needed to achieve the aim of the research.

Similarly, Bryman (2008: 698) identifies strategy as *"a general orientation to the conduct of research"*. Research strategy concerns the approach taken towards data collection and analysis. Remenyi et al. (1998) state that it sets the overall direction for the research, including the manner in which it is to be conducted. Research strategy determines the form of study being planned and the results that are sought for its completion. The selection of an appropriate strategy is determined by the research objectives, the extent of existing knowledge and the time available, along with other resources and any philosophical underpinnings (Saunders et al., 2007). Strategy operates as a generalised plan for solving a research problem with a set structure and outline that need to be implemented to achieve the objective. It takes into account a variety of factors including the form of research and the kind of logic employed. Saunders et al. (2009) note that the majority of research strategies correspond to the deductive approach. In terms of research design, Thiétart (2001) notes its importance as a framework whereby the various aspects of a research project are linked together. Gill and Johnson (1997) and Remenyi et al. (1998) highlight the importance of having a research strategy through which aspects such as the research question, literature review, data, analysis and results are constructed.

Saunders and Thornhill (2003) also comment on the definition of research strategy being the means by which the research question is answered. Thus, they detail the means through which the researcher conducts the work. A variety of factors are taken into account as part of the strategy, including the form of research and the kind of logic used by the researcher. According to Easterby-Smith et al. (2008), knowledge of the different research traditions could aid in adaptation to the circumstances of the researcher. Through this means, aspects such as the research question, literature review, data, analysis and results are constructed. Saunders (1997) states that the specific research strategy is largely determined by a number of factors, including the type of research question, the researcher's control over actual events and the focus on contemporary or historical phenomena.

The research strategy determines how the researcher intends to carry out the work (Saunders et al., 2009). Thus, it provides a direction for the research along with the processes to be followed (Remenyi et al., 2003). Remenyi et al. (1998) explain that a qualitative is likely to be effective in studying human and psychological factors, whereas a quantitative approach could be useful for investigating various factors in a wider population sample. The present research plan was largely driven by the methodology and data collection methods. The components of strategy include the research paradigm, design, methods, sampling strategy and data analysis techniques. It was driven largely by the different types of methodological approaches, namely

qualitative, quantitative and mixed methods. As previously stated, a mixed-method design was adopted for this line of research as it afforded the researcher a level of flexibility in making use of both types of data collection and analysis methods (Creswell, 2009; Saunders et al., 2009).

Robson (2002) describes strategy as the general approach taken to an enquiry and explains that the various strategies can be classified in different ways. In this manner, the strategy operates as a road map towards achieving the goal of the research, fulfilling its objectives and answering the research questions (Saunders et al., 2009). Within each of the three alternative basic forms of research strategy, namely qualitative, quantitative and mixed, there exist a range of individual strategies, including experiments, surveys, case studies, action research, grounded theory, archival research and mixed methods (Creswell, 2009; Dawood and Underwood, 2010; Saunders et al., 2009). The selection of the appropriate strategy was an important element in the research, as detailed in the following subsections.

3.4.1. Types of Research Strategy

Research strategy also refers to the techniques employed by researchers in undertaking their study. A such, it governs the means by which the data are gathered. These techniques may include surveys, interviews and other similar methods of collecting the information needed to address a research problem (Saunders et al., 2009). Among the different strategies that could be adopted are experiments, surveys, case studies, action research, grounded theory, ethnography and archival research (Saunders et al., 2012). Leedy and Ormrod (2001) recommend case studies, grounded theory, ethnography, content analysis and phenomenology as suitable methods for gathering qualitative data. Each can be used to meet different needs and objectives (Creswell, 2003). The adoption of a combined approach is suggested by Tashakori and Teddlie (2003). An advantage is that it provides different perspectives on the research questions and makes interpretation more reliable (Saunders et al. 2009). The strategies considered for use in the present study are detailed below.

- **Case Study**: This strategy involves the development of detailed and intensive knowledge surrounding either a single case or a small number of related cases. Robson (2002: 178) defines as it as *"a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence"*. Alternatively, Yin (2003: 13) defines it as *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not*

clearly evident". Saunders et al. (2009) identify this type of research as being common in the social sciences to study a particular individual or group in depth. A key advantage of this strategy is that it provides rich understanding in a real-life context. For the social sciences, it allows the study of one organisation, event or individual over a period of time.

- **Ethnography**: This differs from case study in seeking to study an entire group that shares a common culture (Leedy and Ormrod, 2001). Creswell (2003: 14) refers to *"ethnographies, in which the researcher studies an intact cultural group in a natural setting over a prolonged period of time by collecting, primarily, observational data"*. It focuses on behaviours to identify norms, beliefs, social structures and other similar factors. Thus, ethnographic researchers seek to understand the changes in a group's culture over a period of time. As a result, the findings of such a study are limited in generalisability. For this reason, it was deemed inappropriate for the present research, as this was the study of behaviour within a select group.
- **Grounded theory**: Creswell (2003: 14) describes grounded theory research as where *"the researcher attempts to derive a general, abstract theory of a process, action, or interaction grounded in the views of participants in a study"*. According to Leedy and Ormrod (2001), this type of research starts with data, using it to develop a theory. As such, the collection of the data begins without the formation of an initial theoretical framework. Instead, the theory is formed from the data gathered in a series of observations. Thus, it uses an interpretative process to explain behaviour, with the theory being formed by induction and deduction. Creswell (2007) notes that the greatest disadvantage of grounded theory is the need to set aside research bias and theoretical ideas. This, combined with the fact that it offers generalisations, means that it would not be appropriate for the present research.
- **Action research** is defined by Leedy and Ormrod (2005: 114) as *"a type of research that focuses on finding a solution to a local problem in a local setting"*. It is unique in treating the researchers themselves as part of the practitioner group facing the problem that the research attempts to address (Creswell, 2005). Thus, the aim of action research is to investigate a local and practical problem. For this research, the local setting was limiting for the researcher, which was a reason for this method not to be considered appropriate.

- **Experiments**: The experimental strategy is defined by Robson (2002: 88) as *"the measurement of the effects of manipulating one variable on another variable [which] is generally related to the natural sciences"*. It examines the nature of the relationship between two or more variables as part of a causal study. Saunders et al. (2009) similarly define experiment as being the study of casual links between an independent and dependent variable. It typically uses deductive means to test a hypothesis and is most closely aligned with the natural sciences. Creswell (2009) notes that experimental research is quantitative by nature, which is why it was not considered for this study.
- **Survey**: The survey strategy is defined as *"the collection of data on a number of units with a view to collecting systematically a body of quantifiable data in respect of a number of variables which are then examined to discern patterns of association"* (Bryman, 1989: 104). As such, it involves the gathering of information in a standardised form from a group of people. It is notable for being a popular research strategy as it allows a large amount of data to be collected from a chosen sample (Saunders et al., 2009). The advantages of this strategy for the present study include the collection of quantitative data with the options of structured observations and interviews.
- **Archival research** is a strategy involving the collection of data from existing sources. According to Leedy and Ormrod (2010: 165), it is a form of historical research whereby *"the researcher makes every effort to find firsthand accounts and artifacts of an event"*. The use of existing documentation allows for a great depth of information for the researcher in corroborating or challenging data collected in other ways (Salkind, 2009). Such archival data can take a variety of forms, including civil records, diaries, films, letters, photographs and similar forms of primary data (Leedy and Ormrod, 2010). A major disadvantage of this method is its limited flexibility. Furthermore, archival records tend to furnish older information and may not provide a view of the current situation in the research area. This strategy was therefore not considered appropriate for this study, which is concerned with an existing phenomenon, namely flooding.

According to Robson (1993), there were traditionally considered to be just three types of research strategy: experiment, survey and case study. However, Saunders et al. (2009) note that no research study should be restricted to a single strategy; a survey could be conducted as part of a case study, or other combinations could be used to achieve the research objective. As a result of the above considerations, the two data collection strategies chosen for this research

were survey and case study. This combination offers more flexibility than other research designs and allows the researcher to retain the holistic characteristics of real-time events whilst investigating empirical events. The two elements of the strategic approach taken in the current research are detailed in the following subsections.

3.4.2. Survey Strategy

Survey strategies are often associated with the deductive reasoning approach. According to Sanders, Lewis and Thornhill (2012), the survey strategy is used for exploratory and descriptive research, providing a way of collecting large amounts of data in order to address the questions of 'who', 'what', 'where', 'when' and 'how' on a given issue. According to Isaac and Michael (1997), survey research is used:

> *…to answer questions that have been raised, to solve problems that have been posed or observed, to assess needs and set goals, to determine whether or not specific objectives have been met, to establish baselines against which future comparisons can be made, to analyse trends across time, and generally, to describe what exists, in what amount, and in what context.* (p. 136)

Through such means, a great deal of rich statistical data can be generated. Surveys are designed to provide *"a snapshot of how things are at a specific time"* (Denscombe, 1998). As such, they serve as a means of generating significant knowledge. Bryman (1989: 104) defines the survey strategy as *"the collection of data on a number of units with a view to collecting systematically a body of quantifiable data in respect of a number of variables which are then examined to discern patterns of association"*. A typical survey design consists of structured questions for respondents to answer in the form of a questionnaire or a series of interviews (Robson, 2007). Surveys can be categorised as either descriptive or analytical, the former being used to investigate current opinions or attitudes for a research target, while the latter examines the relationship between respondents' attitudes and the research. This approach involves communication with multiple respondents to produce both quantitative and qualitative data for analysis, in less time and at a lower cost for a relatively large sample size (Robson, 2007). As such, it offers the opportunity to gather a large quantity of data for analysis.

Yin (2003) notes that the survey strategy can benefit a researcher if the goal is to describe a phenomenon's incidence or prevalence and predict the outcome. It requires a clear and specific

objective that operates as a means of gaining clear knowledge by a common data-gathering technique. The meaning behind the results of a survey are determined through the use of an analysis plan, whereby the results are analysed to determine patterns in the data. According to Robson (2002), this strategy is useful if the aim of the study is to gain a rich understanding of the research perspective and for the process being endorsed. According to Saunders et al. (2003) and Collins and Hussey (2003), surveys provide a means of data collection that can be applied to sizeable cohorts in cost-effective ways. This strategy has a number of advantages, including ease of distribution, being economical and having a wide reach for participants. Surveys can be disseminated in a number of ways such as through the post, by email or via social media and online groups. However, it has a number of drawbacks, among them being that the questions cannot be detailed enough to provide a clear idea of what each participant's answers truly mean. Surveys are also generally inflexible, offering respondents a choice of fixed responses. As such, they cannot be used to gather detailed responses to more open-ended questions. In addition, response rates are often low (Saunders et al., 2012). On the other hand, responses can be analysed statistically through the use of computer programs. In the present mixed-method research, given the nature of the data gathered from the survey, a secondary form of data collection was used to elicit more in-depth data, via the case study strategy.

3.4.3. Case Study Strategy

A case study involves the extensive study of one or more individuals or cases in a real-life context. Bromley (1990: 302), defined it as *"systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest"*. It enables a researcher to examine the data closely within a specific context. Yin (1984: 23) describes this strategy as *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used"*, while for Saunders et al. (2009: 145) it is *"a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence"*. Stake (2000: 435) explains that *"case study is not a methodological choice but a choice of what is to be studied, by whatever methods we choose to study the case"*. As such, it is not a method but rather a research strategy that encompasses a number of different methods, whether qualitative, quantitative or both. Yin (2003) observes that case studies can be used for different purposes, including exploratory, explanatory and descriptive research. The purpose of case

study research is to assess a single area of study in order to establish its key features and draw generalisations (Bryman, 2012). According to Davies (2007), the case study strategy involves the development of detailed and intensive knowledge over either a single case or a small number of related cases. Three alternate types of case study are summarised in Table 6**Error! Reference source not found.**

Table 6: Case study types

Type	Description
Exploratory	• Usually employed when present literature and knowledge is inadequate. • Research questions are often broad and the use of hypotheses is rare. • Data collection may be commenced prior to the definition of research questions. • They can be deliberately designed to help build theory through inductive methods in order to create hypothesis about new research questions.
Explanatory	• Used when seeking to provide causal explanations – how events occurred. • Considered the only appropriate type for theory testing.
Descriptive	• Is used to present a rich and comprehensive description of an entity of interest in the context in which it transpired.

(Source: O'Gorman and MacIntosh, 2014)

Each type of case study is associated with a different outcome and purpose, the choice ultimately being determined by the researcher as most appropriate for a given research project. To the list of exploratory, explanatory and descriptive types, Mariano (1993) adds a fourth, namely interpretive. Creswell (2009: 227) notes that the case study strategy provides significant depth through the use of essentially qualitative inquiry into *"a program, event, activity, process, or one or more individuals"*. Yin (1994) expresses the view that case studies are a preferred strategy when questions of 'how' and 'why' are posed. According to Creswell (2003: 15), a case study occurs where a researcher *"explores in depth a program, an event, an activity, a process, or one or more individuals"*. Leedy and Ormrod (2001: 149) add that a case study constitutes an attempt to uncover *"more about a little known known or poorly understood situation"*. For Creswell (1998), the structure of such a study should consist of a problem, context, issues and lessons learnt. Case studies are held to be useful because they enable researchers to examine data on a micro-level and can be deployed to examine real-life situations, such as those that govern social issues and problems. Hussey and Hussey (1997) state that a case study is *"an extensive examination of a phenomenon of interest in which the importance of the context is critical"*. They also recognise four types, which they label as descriptive, illustrative, experimental and explanatory. Data are gathered by a number of means

including documentation, archival records, interviews, direct observation, participant observation and physical artefacts (Yin, 1994). Saunders et al. (2009) note that these various data collection techniques may be used either individually or in combination. The present researcher investigated the phenomenon of interest in depth by using a number of data gathering tools to produce evidence leading to a better understanding of the situation and to answer the research question.

Creswell (2007) describes case study research as a qualitative approach whereby a researcher explores a bounded system (a case) or multiple bounded systems (cases) over a period of time. This is done through a detailed, in-depth data collection process involving multiple sources of data that could include observations, interviews, or the examination of audio-visual material, documents and reports. The investigator then reports a case description and extracts themes based on the object of study. It has been suggested that the use of multiple case studies could help to improve the validity of such research due to the use of a variety of sources (Saunders et al., 2012; Yin, 2014). However, the justification for the use of a case study lies in the selection of particular cases. To draw clear conclusions from data, it is advisable that the number of cases be restricted. Yin (1984) notes that this serves as a unique method of observing any natural phenomenon manifested in a set of data.

The aim of the present research is to provide recommendations for improving the current regulatory framework for floodplain development and management in the UK. To achieve this research rationale, the case study strategy facilitated an in-depth examination of two floodplain areas critically affected by flood events. A comparative study was then conducted to generate data on potential key areas of improvement and the challenges faced by the communities in those areas. This strategy allowed for the use of quantitative, qualitative or mixed methods of data collection and analysis, as noted by Yin (2014). The primary method of data collection the use of semi-structured interviews, encouraging interviewees to express their views in depth. The researcher guided each interview by ensuring that the participant remained focused, through the use of open-ended questions (Saunders et al., 2012). After completion of the interviews, the data elicited was analysed by means of qualitative analysis techniques. This consisted of case study reports being generated separately so that comparisons could be made and a final report composed to recommend the development of an improved regulatory framework.

3.4.4. Summary

Saunders et al. (2009) state that the research strategy determines how the researcher will carry out the study in question. It provides a direction for the research along with the processes to be followed in conducting the study (Remenyi et al., 2003). The research plan is largely driven by the chosen methodology and data collection methods. Components of the research strategy include the philosophical paradigm, the design, methods, sampling strategy and data analysis techniques. It is characterised by the choice of qualitative, quantitative or mixed-method methodological approaches. As discussed below in Mixed Method, mixed methods were used in the present research to afford the researcher a level of flexibility in selecting the instruments of data collection and analysis (Creswell, 2009; Saunders et al., 2009). The step-by-step guide illustrated in Figure 21 shows how each element of the research methodology determined the next element of the process (Crotty, 1998).

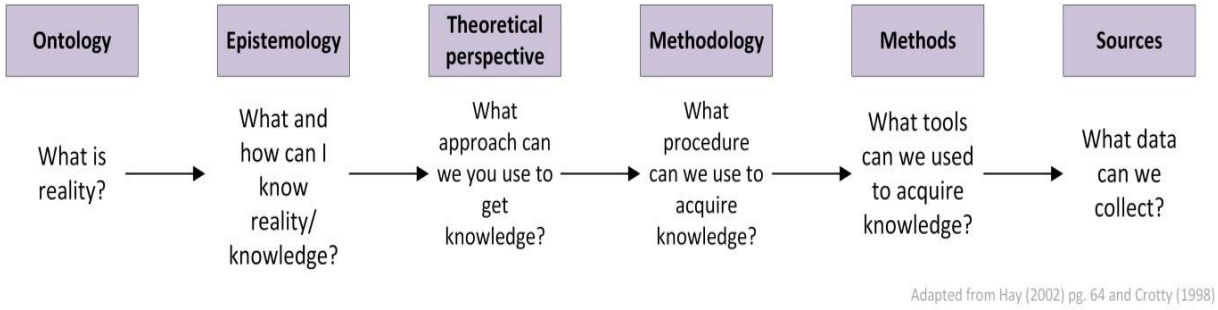

Figure 21: Methodological steps in the research process *(Source: Crotty, 1998)*

The aim of the research is to provide recommendations, making interpretivism an appropriate choice. This is linked with qualitative research, whereas details were provided by questionnaires, more closely aligned with quantitative research. A combination of the two approaches allowed the use of different methods in answering the research question and this was the main reason for the adoption of mixed methods. The qualitative aspect allowed for the use of case study interviews, while the quantitative element was represented by survey questionnaires. The effective use of these strategies thus gave rise to the various data collection tools used to generate data. The interviews were with experts in floodplain management and development, whilst the questionnaires elicited the experiences and perceptions of floodplain occupants. Finally, the time horizon of the study was set by the phenomenon under study being a current one within the UK.

3.5. Research Choices

The methodology of any research involves the use of a number of different research methods, defined as *"individual techniques for data collection, analysis, etc."* (Easterby-Smith et al., 2004: 31). These methods, as noted above, may be qualitative, quantitative or mixed (Creswell, 2003). Qualitative research usually requires the analysis of written material, whereas quantitative research comprises the analysis of numerical data and the mixed-method approach combines these two types. According to Denzin and Lincoln (2005), qualitative research can be described as an activity that places the observer within the world they are observing. Silverman (2005: 14) warns that qualitative research *"can mean many different things involving a wide range of methods and informed by contrasting models"*. It generally takes an interpretative and naturalistic approach to the world. Patton (2002: 39) defines it as follows:

> *…an approach that uses a naturalistic approach which seeks to understand phenomena in context-specific settings, such as real-world settings, where the researcher does not attempt to manipulate the phenomena of interest… It is any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification, but instead the kind of research that produces findings derived at from real-world settings where the phenomena of interest unfold naturally.*

This allows for the study of a phenomenon in its natural environment. Qualitative researchers seek to understand or interpret such phenomena in terms of the meanings that people give to them. Thus, qualitative research implies an emphasis on the qualities of entities, processes and meanings that are being examined but not measured (Denzin and Lincoln, 2005). This contrasts with quantitative methods, which take a more numerical or statistical approach to research design. According to Leedy and Ormrod (2005: 102), *"quantitative researchers seek explanations and predictions that will generalize to other persons and places. The intent is to establish, confirm, or validate relationships and to develop generalizations that contribute to theory"*. As such, the researcher remains independent of the research and uses the data to measure reality objectively. It is for this reason that it corresponds with the empiricist paradigm (Creswell, 2003). The findings from quantitative research can be used to predict, explain and confirm qualitative findings. Figure 22 lists a number of the advantages of each approach.

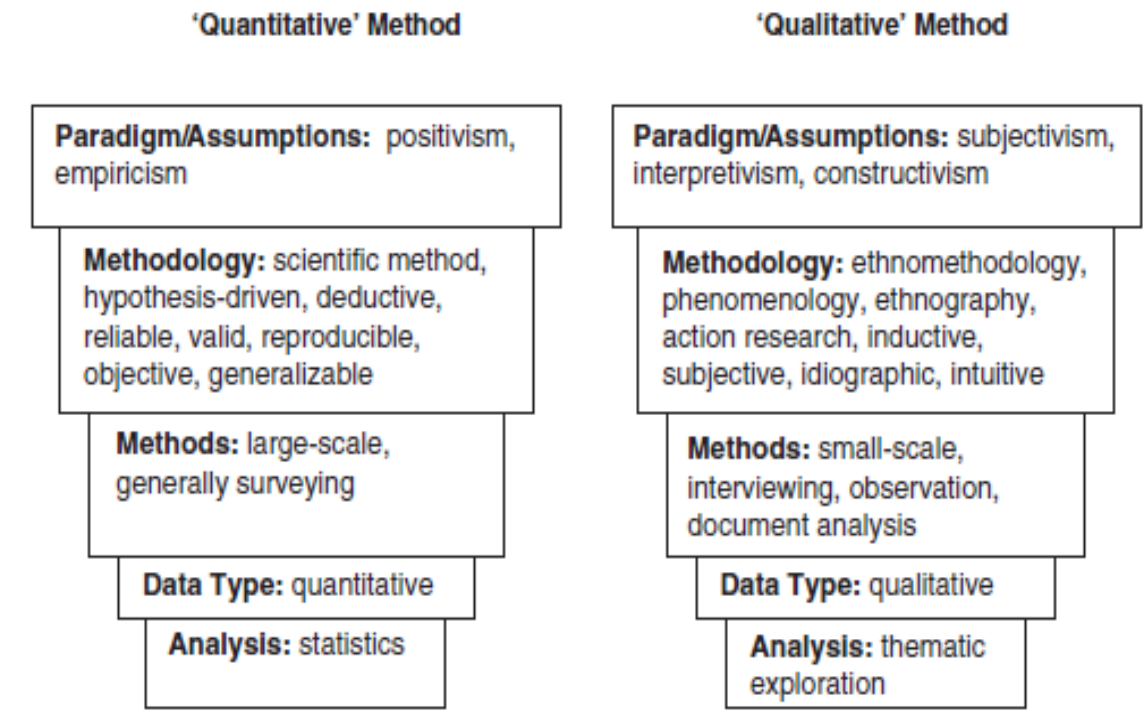

Figure 22: Quantitative vs. qualitative *(Source: O'Leary, 2004)*

Qualitative and quantitative research choices represent the two ends of a continuum (Newman and Benz, 1998; Creswell, 2014), the main distinguishing feature being that qualitative methods make use of words, whereas quantitative ones utilise numbers. The third approach is to use a combination of qualitative and quantitative methods, which Jick (1979) describes as having been recognised increasingly over the years for its ability to deliver the strengths of both approaches. Bryman (1988) agrees, arguing for a combination of the qualitative and quantitative approaches to achieve 'the best of both worlds'. Researchers are required to adopt the most suitable methodology to enrich their findings. The choice of methodology is often determined by a number of factors, including the topic of interest. The current researcher opted for a mix of methods because of the broad scope of knowledge that could be attained by this approach. Furthermore, the combination was expected to overcome the limitations of each individual method. As such, it offered a range of means of providing sound recommendations for improving the framework of regulation on floodplain development.

3.5.1. Quantitative research

Quantitative research deals with numbers and measurable data in a systematic manner and is defined by Creswell (1994: 1-2) as *"an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analysed with statistical*

procedures, in order to determine whether the predictive generalization of the theory holds true". This approach was originally developed in the natural sciences to study natural phenomena. A key characteristic noted by Punch (1998: 4) is that *"the data are in the form of numbers"*. This approach treats the world as separate and outside the researchers; it assumes the existence of *"an objective reality independent of any observations"* (Rovai et al., 2014: 4). It is used to investigate a phenomenon and its constituent relationships, thus answering research questions regarding the relationships among measurable variables with the aim of explaining, predicting or controlling the phenomenon of study (Leedy, 1993). Quantitative data are collected when a researcher adopts the positivist epistemological approach which allows for these data to be scientifically analysed. According to Hussey and Hussey (1997), quantitative research aims to deliver objective and unbiased results that are not influenced by the actions of the researcher.

A central characteristic of quantitative methods is the assumption of a single objective truth that exists independently of human perception or input (Lincoln and Guba, 1985). In this way, the researcher is objective and separate from the research matter. Thus, quantitative methods emphasise numerical results and attempt to limit the number of human factors. It is for this reason that formalised questionnaires distributed on a large scale serve as one quantitative method. As such, Bryman (1989) notes that a quantitative approach is linked to positivism, which seeks to study people by the application of scientific methods. The approach can be used for the testing of objective theories by examining and studying the relationships among variables. In this manner, quantitative research makes use of data collected so that information can be quantified, whereupon it is subjected to statistical analysis in order to either support or refute a claim to knowledge (Creswell, 2003). As quantitative research involves numbers, these variables can be measured through various instruments and analysed by statistical means. It is regarded as a deductive research approach (Rovai et al., 2014), because it makes use of assumptions about testing theories deductively and offers protection against bias whilst controlling alternative explanations and because inferences are drawn from the testing of statistical hypotheses regarding the characteristics of sample populations. Quantitative means are also sought to generalise and replicate the findings of such research.

Cohen et al. (2000: 22) assert that human behaviour *"is essentially rule-governed [and] should be investigated by the methods of natural science"*. Similarly, Creswell (2002) expresses the view that quantitative research is largely derived from the physical sciences, such as chemistry and physics. As such, there is a clear focus on objectivity and remaining apart from the object

of study. The aim is that the object of study is controlled, with the researcher being objective, while precise measurement of the data can be achieved with any description capable of being achieved through statistical terminology. The aims are to increase objectivity, replicability and the generalisation of the findings in order to permit prediction. As such, it is important for researchers to set aside their experiences, perceptions and any biases during the research. This will reduce any undue influence on the conclusions drawn from the research findings. Creswell (2003: 18) states that quantitative researchers can *"employ strategies of inquiry such as experiments and surveys, and collect data on predetermined instruments that yield statistical data"*. Among the many methods aligned with the quantitative approach are experiments, quasi-experiments, evaluation research, surveys and meta-analysis. It can also make use of existing data and subject it to analysis. Quantitative methods tend to favour probability sampling so as to maximise the number of participants and meet the assumptions of particular analytic strategies. These statistics can be used either to infer or to generalise findings to large populations of people. At the core of these differing approaches is the adoption of the positivist philosophy. Thus, data collected through the use of instruments such as tests or surveys can be quantified and converted for statistical analysis. There is a reliance on probability theory in testing statistical hypotheses aligned with the research question.

While it has a number of advantages, there are limitations to the questionnaire-based approach. A disadvantage of the quantitative approach is that it is inflexible in that it fails to take into account people's unique viewpoints and interpretations in constructing meanings. Furthermore, details of human factors are limited, as statistics do not take such variables into account. Ultimately, the researchers themselves cannot be totally objective, as they are subjectively involved in the choice of research problem and in the interpretation of the findings. These limitations led to the decision not to restrict the present research to the quantitative approach. Indeed, such a restriction would not have been appropriate in a piece of research aiming to provide recommendations. In addition, the research sought a deeper understanding of the phenomenon of flooding, which is subjective by nature. Consequently, while aspects of quantitative research are useful for determining general trends in sample populations, the present study complemented this by the complementary adoption of the qualitative approach to methodology.

3.5.2. Qualitative research

The qualitative to research was developed in the social sciences to enable researchers to study social and cultural phenomena. A simple definition is that *"qualitative research is empirical research where the data are not in the form of numbers"* (Punch, 1998: 4). The aim of such research is to understand the social reality of individuals, groups and cultures. It places an emphasis on exploration and understanding with the purpose of discovering *"the meaning individuals or groups ascribe to a social or human problem"* (Creswell, 2014: 4). Similarly, Rovai et al. (2014: 4) point out that this approach *"values individuality, culture, and social justice"*. In this regard, qualitative research serves as a situated activity that places observers within the world they are studying (Denzin and Lincoln, 2005). Thus, it is exploratory by nature and is used to define a problem or develop an approach to an issue. It does this by exploring issues of interest and other distinctions to the research problem. Denzin and Lincoln (2005) note that this approach gain perspective through investigation in a phenomenon's specific context and determining the meanings that individuals bring to it. A key premise is that such an event can be properly understood only if observed in context. To accomplish this aim, qualitative researchers must immerse themselves in the setting, if possible, in such a way that all participants feel and live as part of this reality in the natural setting. A central premise of qualitative is open enquiry, in that there are deemed to exist multiple socially constructed truths about that reality, which the research aims to discover (Lincoln and Guba, 1985).

According to Denzin and Lincoln (1994: 2), *"qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them"*. It involves an interpretative and naturalistic approach to the world, where qualitative researchers study a phenomenon in its natural setting so that they can attempt to make sense of the phenomenon and interpret it through the meanings that participants give to it. Thus, qualitative research emphasises the quality of any relevant entities and their role in processes and meanings that are not examined, measured or experimented on, because it assumes that each individual view is unique (Denzin and Lincoln, 2005). As such, it is a means of exploring and understanding the meanings ascribed by groups or individuals to a social or human problem. The process involves the use of emerging questions and procedures, with data typically collected in a person's normal setting. It is then followed by inductive data analysis that builds on the particulars towards a general theme. The researcher can then derive his or her own

interpretation of the meaning of the resultant data. As such, this approach favours the use of inductive reasoning and rendering meaning to complex situations. An advantage of the qualitative approach was that it offers a flexible structure for the researcher.

Qualitative research, according to Lincoln and Denzin (2002: 1047), is complex on several levels; it is:

> *many things at the same time. It is multi-paradigmatic in focus. Its practitioners are sensitive to the value of the multi-method approach. They are committed to the naturalistic perspective and to the interpretive understanding of human experience. At the same time, the field is inherently political and shaped by multiple ethical and political allegiances.*

Qualitative researchers want study participants to provide their own input to the research and to state their opinions in their own words. In other words, qualitative research is a process of interaction with the participants which affords researchers an inside view of the phenomenon, allowing them to identify issues that would have been missed by most scientific and positivistic methods.

Qualitative methods are typically described as inductive, as there is an underlying assumption that reality is a social construct. Qualitative variables are complex, interwoven and difficult to measure, which is why the insider perspective is essential (Rovai et al., 2014). As such, a detailed exploration of the research topic is needed to deliver an understanding of the deeper meaning behind a given phenomenon. In qualitative research, there exist different claims to knowledge, enquiry strategies and data collection methods, along with the analysis techniques that are employed (Creswell, 2003). Inductive data analysis is used in order to better understand the interaction of mutually shaping influences (Lincoln and Guba, 1985). Creswell (2003) lists five strategies that are linked with this approach: narratives, phenomenological studies, grounded theory, ethnography and case studies. Data can be gathered through a number of instruments including interviews. Samples tend to be small and purposive sampling strategies are often employed.

There are certain limitations to this research approach. Qualitative researchers may find it difficult to make use of quantitative predictions. Furthermore, a large pool of participants would be needed in order to test a hypothesis or generate a theory from a study. For this research, meaning was developed through recommendations and thus elements of qualitative research were valuable. However, there was no way to determine general trends, namely on

participants acquiring flood insurance or employing the various means of adaptation. Thus, the use of purely qualitative methods would have unduly limited the research. It was for this reason that the third approach was considered, namely that of mixed-method research.

3.5.3. Mixed Methods

The most common meaning of the term 'mixed methods', which is directly applicable to the present study, is the combination of quantitative and qualitative methods of data collection research (Tashakkori and Teddlie, 2003). According to the definition provided by Jonson, Onwuegbuzie and Turner (2007: 123),

> Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration.

Jick (1979) notes that this combination of qualitative and quantitative methods makes available the strengths of both approaches, while Tashakkori and Teddlie (2003: 687) report that *"the emergence of mixed methods as a third methodological movement in the social and behavioural sciences began during the 1980s"*. As such, it has become an increasingly commonly adopted form of research approach. The adoption of this research approach to the present study was largely determined by the nature of the research problem. If it was appropriate, then a better understanding of the challenges and barriers under investigation could be achieved than by the use of either qualitative or quantitative methods alone. Among the range of methods available for mixed-method research to accomplish its goals are surveys, interviews, observations and focus groups (Creswell, 2009). Jonson, Onwuegbuzie and Turner (2007: 123) distinguish between mixed-method studies and programmes: *"A mixed methods study would involve mixing within a single study; a mixed method program would involve mixing within a program of research and the mixing might occur across a closely related set of studies"*. The mixing of different approaches gives the researcher multiple options. The characteristics of the qualitative, quantitative and mixed-method approaches are listed in Table 7.

Table 7: Methodological approaches

PROCEDURES			
Characteristics	**QUALITATIVE METHOD**	**QUANTITATIVE METHOD**	**MIXED METHOD**
Data collection instruments	• Interview • Observation • Bibliographical and documentary survey	• Questionnaire	• Concurrent: with one single instrument quan/qual • Sequential: more than one instrument used in distinct moments
Structure of the instrument	• Interview schedule with open questions or sequence of topics and subtopics • Observation schedule • Set of concepts and compilation schedule	• Fixed standard questionnaire, with structured questions and alternative answers; may include some open-ended questions (optional)	• Fixed standard questionnaire, integrated to interview schedule; observation schedules; and set of concepts and compilation schedule
Kind of data record	Narrative text, audiovisual media, summary of bibliographical/documentary research	• Dichotomic, scales and multiple choice; literal transcriptions of answers to open-ended questions.	• Integration of techniques: alternative pre-defined answers, narrative text, sound records, photographs, film shooting, and documents summary
Mode of data processing	• Data files (interviews, documents etc) • Data organized in categories • Files of bibliographical/ documentary summaries	• Statistical database • Files of bibliographical/ documentary review notes	• Statistical database • Files of interviews, testimonies, files of documents • Data organized in categories • Files of bibliographical/ documentary summaries
Data analysis and interpretation (incorporating theoretical references and literature and documentary review)	• Explanation of the narrative structure of texts • Contextualization and interpretation of the meaning of images and sounds • Content analysis of documents and testimonies	• Behavior of variables, indicators and indices • Descriptive or inferential statistics • Univariate, bivariate or multivariate analysis • Elaboration of statistical tables, charts and graphs • Statistical tests	Integrated analysis of qual/quan data • Findings presented as tables, charts and graphs, triangulated with excerpts of testimonies, narratives and reports • Triangulation of text and audiovisual documents

(Source: Santos, 2009)

There exist a multitude of methods of acquiring data related to the qualitative, quantitative and mixed-method approaches, which include observation charts, questionnaires, interview schedules, photos, videos, official statistics and documentary data (Santos, 2009). These provide a range of different tools for data collection. Qualitative research looks into the process, whilst quantitative research determines the outcome (Creswell, 2009). As such, the individual methods offer a range of options to answer research questions. As stated by Myers (2009), data

sources for qualitative research can include observation, interviews, questionnaires and documentation, along with the researcher's own reactions. Thus, they offer tools that allow for greater scope in eliciting subjective experiences and accounts. In contrast, questionnaires and statistics serve as the means of collecting and analysing quantitative data (Santos, 2009). Mixed methods operate by combining the different methods used in both approaches. Qualitative studies, when combined with quantitative techniques, aid in interpreting and better understanding the complex reality of any given situation, along with the implications of quantitative data (Creswell, 2009). As such, numerical techniques can be used to add precision to narrative explanations by way of words or pictures.

Mixed methods provide a depth of understanding to a research inquiry by combining qualitative and quantitative approaches to fulfil the research goal. The mixed approach offers a wide range of tools for the researcher to acquire data. Bryman (1988) argues for the combination of qualitative and quantitative methods in social research, so that each compensates for the weaknesses of the other while drawing on the strengths inherent in each method. In the view of Creswell and Plano Clark (2011), mixed methods allow for a rapport between the two approaches, thus delivering a greater understanding of the research problem than any one method alone. Thus, the mixed-method approach has been described as one of the central tenets of pragmatic philosophical reasoning in research (Tashakkori and Teddlie, 2003). It allows for a broader and a more complete range of research questions to be addressed, due to the fact that the researcher is not confined within the bounds of a particular method of research. As a result, the researcher can understand any contradictions that exist between quantitative sets of data and qualitative results. This allows a better understanding of contradictions between these findings and delivers a better reflection of the participants' points of view. Furthermore, it allows the researcher to address the weaknesses one of approach with the strengths of another. Thus, it provides strong evidence for any conclusions drawn, by adding insights and methods that could be missed by adopting either of the two different approaches alone. The mixed-method researcher can thus be seen to adopt a simple yet complete approach to answering the research question.

As Saunders et al. (2009) assert, the methodological strategy adopted is ultimately dependent on the nature of the research question, the aim and objectives, the state of knowledge, the time available and the philosophical approach taken. For the purpose of the present research, a mixed-method approach was deemed appropriate because of the greater scope and flexibility offered in answering the research aim. It also afforded the researcher the use of triangulation

by using various forms of data in order to circumvent any limitations of a single method. Jick (1979) states that triangulation offers researchers the opportunity to be more confident in their results. For this research, it allowed accounts of the practical experiences of people living on floodplains to be cross-referenced with knowledge elicited from experts in the field of flood risk management, the aim being to offer recommendations for improving the regulatory framework of floodplain management and development in the UK. The use of mixed methods has allowed the researcher to employ a range of strategies in pursuing this research aim.

3.6. Time Horizon

The time horizon is the temporal framework within which the research is intended to reach completion (Saunders et al., 2009). It should be noted that it operates independently from the choice of research methodology. The research onion specifies two types of time horizon: the cross sectional and the longitudinal (Bryman, 2012; Saunders et al., 2009). A cross-sectional study observes a phenomenon at a particular moment in time. Data are collected on a phenomenon that is already established, examining more than one case at a single point in time (Bryman, 2007), providing a 'snapshot' view of the phenomenon of interest (Flick, 2011). In contrast, a longitudinal study observes a phenomenon over an extended period of time by collecting similar data repeatedly during that time (Goddard and Melville, 2004). Since the aim of the present research is to provide recommendations on the regulatory framework for floodplain development, a current phenomenon that could be studied only at the current time, a cross-sectional time horizon was the enforced choice.

3.7. Data Collection and Analysis

Data collection is a key element in any research, as it delivers tangible information that is required to prove or disprove a theory, or on which new theory can be built. There exists a vast array of methods that can be used for the gathering of data (Denzin and Lincoln, 2003). Bryman (2012) states that data collection and analysis are largely dependent on the type of research methodology adopted. Kothari (2004) identifies two distinct forms of research data, namely primary and secondary data. Primary data are *"the data collected specifically for the research project being undertaken"* (Saunders and Thornhill, 2003: 486). Primary data can be gathered directly from respondents in a number of different ways (Saunders, Lewis and Thornhill, 2000). In contrast, secondary data may be defined as having been *"already collected in some other context than the present study"* (Robson, 2002: 552). They are useful in providing the

necessary background information which reinforces the credibility of the research and aids in clarifying the research problem during the exploratory research process. Thus, primary data are first-hand data collected in their original form by the researcher, whereas secondary data have already been collected by another party and subjected to a statistical procedure. Researchers can use a variety of methods for the collection of data, such as surveys, interviews, observation and focus groups (Creswell, 2009). Bryman and Bell (2007) highlight the importance of using raw data sources such as written documents to generate qualitative data that can be used to generalise statistical measures.

According to Saunders (2009), research strategies aid the researcher in making use of specific data collection methods in support of arguments. For this research, samples were taken of representative segments of a large population and operated as the means by which data were gathered (Bryman, 2012). Qualitative methods potentially available were ethnography, participant observation, in-depth interviewing and conversational interviewing (Bryman and Bell, 2011; Kuada, 2012), while the equivalent quantitative methods were questionnaires and quantitative interviews (Kuada, 2012). Truscott et al. (2010) argue that mixed methods afford a greater degree of flexibility with regard to data collection and analysis by drawing strength from both approaches and overcoming any limitations, rather than seeking to replace them (Kuada, 2012). Dornyei (2007) notes that researchers tend to collect qualitative data most commonly by way of interviews and questionnaires. The former are more powerful in building narrative data and allow the researcher to investigate participants' views in greater depth (Kvale, 1996; 2003). Similarly, Cohen et al. (2000: 29) argue that interviews provide *"a valuable method for exploring the construction and negotiation of meanings in a natural setting"*.

Among the various instruments that could have been used to gather data, Table 8 lists those used to accomplish the aim of the present study. These included the use of secondary documentary sources to identify the floodplains and explore the background, legislation and regulatory bodies. Saunders et al. (2009) explain that secondary data, originally collected for some other purpose, may be both qualitative and quantitative in kind. Following the secondary data, a survey was conducted by means of interviews and questionnaires in order to gather primary data on public experiences. According to Yin (2003:109), data analysis consists of *"examining, categorizing, tabulating, testing, or otherwise recombining both quantitative and qualitative evidence to address the initial propositions of a study"*.

Table 8: Instruments used to accomplish objectives

Objective	Strategy	Technique	Purpose
Identification of floodplains	Survey	Literature review Interviews	Identifying development areas at added risk of flooding
Legislation and regulations	Survey	Literature review Interviews	Highlighting the framework of law, regulations and policy
Regulatory bodies	Survey	Literature review Interviews	Noting the responsible regulatory bodies and their powers
Challenges and barriers	Survey Case study	Literature review Interviews Questionnaire	Gathering public and expert opinion of gaps in the legal framework
Recommendations	Survey Case study	Literature review Interviews Questionnaires	Providing recommendations from expert opinion and through study of the literature

In the present research, semi-structured interviews and questionnaires were used to garner both expert and public opinions. Elements of a survey were utilised to discover public awareness and preparation in light of flooding. Questionnaires were used with the goal of obtaining detailed responses from victims of flooding in order to determine their experiences thereof, with the objective of identifying flaws in the present regulations that might weaken the regulatory framework. Following the questionnaires, interviews were used to garner expert opinion from specialists, such as officials of the EA, insurers and lawyers. The case study aided in determining the recommendations that could be used to improve the regulatory framework in relation to floodplain development.

3.7.1. Questionnaire

Questionnaires can be used to gather both quantitative and qualitative data, depending on the nature of the questionnaire items. Quantitative questionnaires can be useful in that the results are quantifiable and measurable against other types of variables in an objective manner (Saunders et al., 2007). They comprise a predefined set of items falling into two common categories: closed-ended and open-ended questions. Analysis of this quantitative data can then be used to draw inferences and develop themes, allowing the researcher to study numerous variables at one time. A critical weakness, however, is that using only quantitative data provides no insight into the causes, effects and processes involved in the phenomena being studied. Another issue is the possibility of bias, such as through the selection of participants, the timing of the survey and its design. Seltiz et al. (1976) and Thiétart (2001) note that another problem with the use of questionnaires is the need to obtain permission. Assuming that this is

granted, questionnaires can be administered in a variety of ways, including by post, by telephone, face-to-face or online. Each provides a different set of advantages and disadvantages. Seltiz et al. (1976) argue that questionnaires are convenient for respondents to complete, cheap to administer and a relatively easily implemented means of gathering firsthand primary data. However, there are a number of limitations associated with their use, among which are that respondents may not understand what is being asked of them, resulting in inaccurate and invalid data (Bryman and Bell, 2007). Therefore, an issue with questionnaires is that the information given may not be a true reflection of events. To mitigate this risk, simple questions should be asked in order to reduce uncertainty of responses. In the present research, efforts were duly made to ensure that direct questions were asked, with options provided to give respondents a clear idea of the question being asked along with set responses to help guide them to an answer. In addition, efforts were made to ensure that the questionnaire was limited to a certain number of pages in order to prevent respondents from being bombarded with too much information. The reasoning behind the use of a questionnaires was to allow the researcher to collect a large body of data in a short time and to provide a means of addressing a large number of issues in a standardised way.

More specifically, a mainly quantitative questionnaire was used in order to elicit the experiences of occupants of a community situated on a floodplain. This included background questions on the participants, questions relating to their experience of flooding and finally their opinions on flood-related matters. The questionnaire is reproduced in Appendix 7: Questionnaire . The quantitative data from the questionnaires were analysed using SPSS, because this program allowed the survey data to be exported for detailed analysis. However, certain questions were open-ended to allow the participants to express their views. The data so gathered were analysed by qualitative means such as content analysis, a method of compressing large amounts of text into more easily understood content (Krippendorff, 1980).

The questionnaire was divided into three sections, headed Participant Background Information, Experience of Flooding and Opinions on Flooding. The first section sought to elicit background information on participants, namely their general location, the length of time that they had lived there and the nature of their residence. The second section then looked into their direct experience of flooding, asking whether they resided in a flood-prone location, whether they had insurance, whether adaptations had been made to the property, what their flood experience had been, what damage their property had sustained and the nature of any barriers they had

faced during flood events. The final section asked for their opinions on a range of flood-related issues by giving them the choice of responses on a 7-point Likert scale ranging from 'Very strongly agree' to 'Very strongly disagree'. Typically, 5-point scales are used in such questionnaires, but 7-point scales have gained in popularity (McCoach et al., 2013). The latter type was used here in order to give more options for respondents to express their views on flooding. Cairns (2019) notes that a 7-point scale can even offer more expressiveness for respondents and allows them more choice on their preferences. In total, there were 38 items in the case study questionnaire, nine of which were open-ended questions inviting participants to offer comments. It was thought that a comprehensive survey would have the benefit of eliciting a full range of responses from participants and that this variety would provide a broad set of data on the problem while having the potential to deliver further insight into issues not considered by other data collection methods. The rich dataset obtained in this way is reported in Chapter 4 and discussed in Chapter 5.

3.7.1.1. Sampling

A research sample is a subset of the population of interest, selectively chosen as representative because access to all members of the population would be prohibitively costly in time, money and other resources (Bowling, 2002). While the proportion of the overall population examined in a given research study is important, the sample size refers to the absolute number of units; in this case, of respondents (Newman, 1998). In quantitative research, the sample size is important in determining the reliability of the results; if it is less than 30, individual respondents may skew the results, while a larger sample size delivers more reliable findings (Flick, 2011). A key feature of the selection of a sample is whether the chosen participants are indeed representative of the population in respect of the scope of the research. To ensure representativeness, the present researcher used a government tool mapping areas vulnerable to flooding as a means of sampling. According to Kothari (2004), a number of elements must be considered when choosing a sample design, in order for the results to carry a reasonable level of confidence: the sample should be truly representative, the sampling error should be small, the sample size should be financially viable and any systematic bias should be well controlled. Among the various sampling techniques that could have been used to select an appropriate sample (Bryman, 2012), the present study adopted random sampling, whereby individuals were chosen at random from the population living on floodplains whose properties were vulnerable to flooding.

The two areas chosen for the case studies, based on experience of flooding, were in Cumbria and York. The specific locations were selected as being situated on floodplains and having prior experience of flooding. Key areas were targeted by using the online tools available on the EA website for identifying flood risk areas. All potential participants were sent an invitation letter, a participant information sheet and the questionnaire form, all of which are reproduced in the Appendices. These were administered through a variety of means: face-to-face, telephone, email and links to the questionnaire on the Bristol Online Survey website. Informed consent was obtained in all cases before the start of the survey. The consent forms are reproduced in Appendix 5: Consent Form for Survey Participants and Appendix 6: Consent Form for Interview Participants. A total of 150 questionnaires were distributed to occupants of floodplains and 101 responses were received. This was considered to represent an acceptable number of responses for reliable data analysis.

3.7.1.2. Analysis

To achieve the research objectives, the quantitative data were analysed using both descriptive and inferential techniques. Through descriptive statistics, the basic features of the data were described for analysis. This consisted of simple summaries of the sample and the measurements. Descriptive studies were used to estimate specific elements and parameters in the population. In contrast, inferential statistics allowed the researcher to infer from the data what the population might think, based on the responses given by the sample. This form of statistical method goes in line with the positivist research philosophy, because of the factual nature of quantitative data used in this form of analysis (Davies, 2007).

The purpose of this element of the research was to fulfil the fourth and fifth research objectives (Sections 1.3 and 3.7; Table 8), dealing respectively with challenges and barriers within the existing regulatory framework and with recommendations to improve it. The researcher made use of interpretivism and thus of descriptive statistics, using SPSS and Excel to analyse the data. This involved coding the data based on the different questions, ranging from gender to whether participants had flood insurance. When collated, the data were inputted into SPSS to undergo various forms of analysis. This included the use of cross-tabulation to compare different variables, case processing consisting of values that could not be analysed, one sample t-test to examine the mean difference in values and descriptive statistics on the data. Triangulation was then used to coordinate the questionnaire data provided by floodplain

residents with that obtained during the interviews with experts, discussed in the following subsections.

3.7.2. Interviews

While survey techniques such as questionnaires are designed to provide a snapshot of events or situations at a specific time (Denscombe, 1998), interviews allow the researcher to obtain an in-depth view of each interviewee's mindset and experiences of the world. According to Kvale (1996: 174), an interview is *"a conversation whose purpose is to gather descriptions of the [life-world] of the interviewee"*, with the goal of interpreting the meaning of a particular phenomenon. Schostak (2006) adds to this definition by noting that such conversations are extended and aimed at providing in-depth information on a given subject. This allows the phenomenon to be interpreted through the views of the interviewees. Survey interviews are a form of qualitative research that aims to find the true meaning of individuals and events by examining attitudes, behaviours and experiences. Such interviews may be unstructured or semi-structured, depending on the aim of the study. Unstructured ones allow the interviewees to relate their experiences in their own words with prompting by the interviewer to direct the dialogue, whereas semi-structured interviews are defined by the use of a prepared question guide. The aim of this strategy is to provide in-depth findings through informal discussions with the participants (Collis and Hussey, 2009). Patton states that semi-structured interviews offer a means of providing more structure than a completely unstructured informal conversation, yet with a relatively high degree of flexibility (Rubin and Babbie, 2001). An interview guide was therefore used in the present study, comprising of a list of important questions to be used in each of the interviews. Each of these consisted of a core question with many associated questions related to it, in order to guide the questioning (Creswell, 2007). Holstein and Gubrium (1997: 114) assert that:

> *…understanding how the meaning-making process unfolds in the interview is as critical as apprehending what is substantively asked and conveyed. The hows of interviewing, of course, refer to the interactional, narrative procedures of knowledge production, not merely to interview techniques. The whats pertain to the issues guiding the interview, the content of questions, and the substantive information communicated by the respondent.*

According to Saunders et al. (2009), in addition to semi-structured and unstructured formats, interviews may alternatively be highly structured and formalised. Such structured interviews are characterised by being mostly organised around predetermined direct questions that require immediate answers, often a simple 'yes' or 'no', with little freedom for either interviewer or interviewee (Berg, 2007). This contrasts strongly with unstructured interviews which, as noted above, offer greater flexibility and freedom to both parties (Gubrium and Holstein, 2002). Semi-structured interviews combined the two extremes, offering a more flexible version of a structured interview. This *"allows depth to be achieved by providing the opportunity on the part of the interviewer to probe and expand the interviewee's responses"* (Rubin and Rubin, 2005: 88). Semi-structured interviews, also known as non-standardised or qualitative interviews, provide a deeper understanding of social issues and phenomena than quantitative methods such as questionnaires (Saunders, Lewis and Thornhill, 2009). Scheurich (2007) states that interviews are aligned with the positivist and interpretivist philosophies. According to Miller and Glassner (1997: 99), interviews aim to *"identify a position that is outside of [an] objectivist-constructivist continuum yet takes seriously the goals and critiques of researchers at both of its poles"*. Thus, whilst outside the objectivist view, they offer a range of responses in pursuit of research goals. In the context of the present research, semi-structured interviews were deemed appropriate to gather, from experts in flooding, qualitative data on the social phenomenon of developments on floodplains and managing the risk posed by them, with the aim of improving the regulatory framework within the UK.

As well as differing in structure, interviews vary in how they are conducted, e.g. by telephone or face to face, individually or in groups (McMaster, 2005; Flick, 2002; Corbin and Strauss, 2008). In the present study, experts were interviewed individually, fact to face, following the advice of Saunders, Lewis and Thornhill (2009) and of Bryman and Bell (2011) to benefit from the flexibility of the semi-structured format, meaning that the interviewer did not need to follow the exact order of the list of questions, nor to be restricted to those questions alone. This allowed for greater scope and flexibility, as new discussion points could be addressed in light of new information given during the interview. The interview guide reproduced in Appendix 8: Interview Guide was created from the preliminary findings of the literature review.

3.7.2.1. Sampling

In line with the pragmatic stance adopted in this research, the interviewees were selected by means of the purposive sampling technique. This is a form of subjective sampling where

researchers rely on their own judgment to choose members of the population to participate in their study. It allows for the selection of only those units (in this case, flood risk management experts) whose data will facilitate the answering of the research question and the attainment of the research objectives (Saunders et al., 2012). Suggestions of the required sample size for this form of qualitative research strategy vary from five to more than 60 (Mason et al., 2012; Creswell, 1998). These authors agree that there is no single correct size for a sample and suggest that the main criteria for the creation of a sample are the research purpose, the philosophical stance, the methodological approach and the available time. A sampling strategy based on a set of criteria is useful for quality assurance purposes (Miles and Huberman, 1994; Creswell, 2007). Sandelowski (1995) states that sample size depends on the judgement of the researcher and that a sample of ten participants is generally adequate for a qualitative study. The present sample of interviewees was selected according to the principle of saturation, the point when the researcher faces information redundancy because interviewees are repeating themselves (Sandelowski, 2008). It was decided to interview ten flood experts to avoid such redundancy while eliciting a range of responses. The researcher therefore selected ten individuals whose background and expertise identified them as experts on flooding. A thorough search was conducted using these criteria and the relevant individuals were contacted via academic links and through the internet. They included flood risk managers, flood response managers, academics, insurance experts, community leaders and legal experts across the UK. The data were gathered by means of an interview recording protocol that allowed the researcher to take notes during the interview process (Creswell, 2007). This permitted further analysis in order to discern patterns and key points of interest for the research.

The interviewees were all experts in differing specialities, ranging from academics and businesspeople to flood risk managers, the common factor being their ties to flood risk management. The only criterion for their selection was their knowledge of UK-based flooding. Selected organisations and experts were approached through a variety of means including personal contacts, networking, conferences, seminars and online searches. After contact, each received an invitation letter (**Appendix 3**: Invitation Letter for Interview Participants) and participant information sheet (**Appendix 4**: Participant Information Sheet) by email, inviting them to the research and giving an overview of the study and their involvement in it. A confirmation email followed this contact to ensure that the documents had been received. Once consent was given, each participant was contacted to arrange a suitable date, time and venue for the interview. Informed consent was indicated by a signature on the consent form.

Interviews were conducted either face to face or by telephone if this suited the interviewee's availability. Each lasted around an hour, depending on whether all of the points in the interview guide were discussed. The purpose of the interviews was to identify key factors in relation to floodplain management and development, particularly how the regulatory system operated, any key problems, how these could be combated, what lessons could be learnt and what solutions to overcoming these barriers might be suggested. Of the ten experts invited to participate in interviews, only seven responded and this was considered less that the acceptable minimum number required for reliable analysis of the data on the UK flood risk management framework.

3.7.2.2. Analysis

The analysis of qualitative data is noted for being complex due to the use of text rather than numbers. Interpretive researchers derive their data from direct interaction with the phenomenon of study. Qualitative interviews tend to generate large amounts of data, the analysis of which involves searching for meaning through direct interpretation of what is reported by the respondents (Neuman, 2007). Bogdan and Biklen (2003) describe qualitative data analysis as *"working with the data, organising them, breaking them into manageable units, coding them, synthesising them, and searching for patterns"*. Dörnyei (2007) estimates that a one-hour interview may take up to seven hours to transcribe, generating around fifty pages of transcript, while Creswell (2009) notes that the analysis is further complicated by the need to be reflexive, in that it includes the researcher's experiences of the interaction. Qualitative interpretations can be analysed by means such as content analysis or grounded theory (Glaser and Strauss, 1967), and by way of thematic analysis (Braun and Clarke, 2006). Qualitative content analysis focuses on portraying reality through discovering meanings from textual data (Silverman 2011). As such, the researcher plays a critical role in interpreting the meaning behind the words and providing context for the text (Saunders et al., 2012). The analysis of qualitative interview data in case study research involves searching for patterns in the data that may explain or identify causal links, by means of transcription, coding, categorisation, summarisation and condensation (Yin, 2003). This is an important process, as it allows for a better sense of the content of the data.

Content analysis is used to analyse documents and texts by assigning their contents to predetermined categories in a systematic and replicable manner (Saunders, Lewis and Thornhill, 2012). It is one of the most common approaches to qualitative analysis. According to Kulatunga, Amaratunga and Haigh (2007: 501), content analysis comprises *"a set of*

procedures for collecting and organizing non-structured information into a standardized format, which facilitates making inferences about the characteristics and meanings of written or recorded material". According to Krippendorff (1980: 21), it is *"a research technique for making replicable and valid inferences from data to their context"*. The aim of the analysis in the present study was to provide a condensed and broad description of the case study phenomenon, namely flood risk management, looking to conceptualise or categorise that description. It preserves the advantages inherent in quantitative content analysis and can be applied to a more qualitative text interpretation. Weber (1990) describes content analysis as a research methodology using a set of procedures to make a valid inference from text. It operates as a systematic and objective means of describing and quantifying a phenomenon (Krippendorff, 1980). Weber (1990) notes its use as a technique facilitating the focus of discovery and description on an individual, group, institution or social phenomenon.

The aim of this research is to improve upon the regulatory framework of floodplain management in the UK. The researcher thus had to investigate the data gathered in order to check for new meanings and themes. This was achieved through the use of analytical tools to understand the data gathered during the interviews, which were audio-recorded, transcribed and coded for analysis. The small sample size allowed manual analysis and coding of the data. The initial structure used for categorisation was identified using the literature; while this served as a guide, the researcher remained open to further emerging data that could result in new categories being present for further investigation. Easterby-Smith (2008) state that content analysis can be done by analysing words and searching for recurring patterns of words and phrases. This allows the researcher to investigate the data gathered in order to check for new meanings and themes. As noted in Section 3.7.1.2, triangulation with the questionnaire survey guided the design of the interviews with experts in the flood risk management sector. These as these two datasets, together with the literature review then formed the basis of the discussion, being used to determine the effectiveness of the current flood risk management framework in the UK.

3.7.3. Ethical Considerations

A key element of any research project is the consideration of ethical standards. According to Bogdan and Biklen (1992: 49), ethics can be defined as *"principles of right and wrong that a particular group accepts"*. In the case of research, a code of ethics should address each participating or affected individual's right to dignity, privacy, confidentiality and avoidance of

harm (Punch, 1986; Glesne and Peshkin, 1992). The conduct of the present research raised a number of ethical considerations related to the data collection methods, namely interviews and questionnaires, as the data were elicited from human respondents. Silverman (2000: 201) notes that researchers often enter the private spaces of participants, while Creswell (2003) emphasises the obligation to respect their rights, needs, values and desires. According to Cohen et al. (2000), interviews can be considered an intrusion into the private lives of respondents in terms of the time allotted and the level of sensitivity of questions being asked, thus necessitating that high ethical standards be maintained. In order to gain the support of participants, researchers should convey to them that they are taking part in a study and explain its purpose without employing any form of deception as to the nature of the work (Creswell, 2007). Thus, consent is a critical factor in data collection. As with any such undertaking, the present researcher was obliged to ensure that participants had a full understanding of the purpose, methods, risks and demands placed on them by the study (Best and Kahn, 2006; Jones and Kottler, 2006). Participants were also offered the opportunity to withdraw their involvement in the research at any time.

The work reported in this thesis has followed the guidelines and code of practice of the United Kingdom Research Information Office, due to this study falling under the category of 'Science and Technology'. As such, participants were provided with the necessary details of the research, to ensure that they understood its purpose and their involvement. Furthermore, the consent of each participant was given and they were assured that their data would be collected securely and confidentially and that their anonymity would be maintained throughout the research. They were told that participation was voluntary and that they could withdraw from the research during any stage and were entitled to have their data given back to them without giving a reason for their withdrawal.

Ethical approval of the research was provided by the University of Salford after all of the ethical requirements had been fulfilled. This allowed the researcher to gather data and to recruit participants for the interviews and surveys. A copy of the ethical approval letter is provided in Appendix 1: Ethical Approval Letter.

3.8. Research Credibility

The final stage of the research was the writing up of the study in the form of this thesis. This included the final product of the research process, i.e. the reporting of results, findings from literature and evidence, along with conclusions. Credibility and validity are important in

assessing the quality of any qualitative research study. According to Yin (2003), the quality of a research design can be judged against four criteria: constructing validity, internal validity, external validity and reliability. Construction of validity involves identifying the correct operational measures for the concept being studied (Yin, 2009). Remenyi et al. (1998) note that internal validity consists of all causal and explanatory studies being identified in the relationship between different events. The next factor is external validity or generalisation, which involves the application of research results to people or situations beyond those in the study itself (Collis and Hussey, 2009). Reliability is concerned with whether the evidence and measures used are consistent and stable.

3.8.1. Verification

Following the data analysis, the resultant findings underwent a verification process to determine the accuracy of the results. This research made use of triangulation as a means of validating the findings. This involved the use of alternate perspectives to validate, challenge and extend the existing findings. According to Cohen and Manion (1986: 254), the triangulation of research findings is *"an attempt to map out, or explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint"*. This metaphor refers to the use of two known geographical points to locate the position of a third unknown point by creating a triangle on a map. Altrichter et al. (1996) regard it as a means of achieving a more detailed and balanced view of the research. Triangulation operates on the assumption that using multiple data sources and methods will increase confidence in the research findings and the conclusions drawn (Bryman, 1988). Thus, it addresses the issue of internal validity by using more than a single method of data collection in order to answer a research question. In the study reported in this thesis, triangulation took the form of the use of multiple sources of data, namely a literature review, a questionnaire survey and a set of semi-structured interviews. To validate the results of the survey, a number of independent experts from flood risk management organisations within the two floodplain communities were consulted on the findings, to ensure a balanced view of the variables and the overall framework that had been developed as part of the study. These experts were thus consulted to determine whether recommendations for improving the flood risk management framework properly addressed the existing challenges and barriers to its effectiveness. The verification process is detailed in Section 5.5, which cites the experts' comments on the findings. This process involved two expert participants being consulted on whether the findings would be likely to lead to a more effective flood risk management policy.

3.9. Chapter Summary

The methodology adopted in this research was guided by Saunders's research onion, whereby the systematic approach of going through each layer allows for the rigorous establishment of the best method by which the research problem could be examined. This process was largely guided by the nature of the research aim, which was to provide recommendations for improving the effectiveness of flood management and developments on floodplains in the UK. As such, the nature of the recommendations was largely based on interpretation, with a research philosophy founded on pragmatism. The pragmatic stance provides greater flexibility for the researcher in taking any measures, so long as it addresses the research goal and avoids the limitations imposed by any single philosophy. Similarly, the abductive research approach was adopted because it offers the option of utilising the strengths of the other approaches. This, in turn, guided the research strategy, namely the use of a survey and a case study as the means of gathering data. In terms of research choice, mixed methods were employed in order to provide greater flexibility in answering the research questions. A longitudinal time horizon was employed, as the researcher was examining the phenomenon of flooding in the UK over a long period of time. With the methods and philosophy decided, the researcher then proceeded with making use of techniques and procedures in gathering data. This included the use of questionnaires sent to floodplain respondents and the semi-structured interviewing of experts in the field of flood management. Ethical considerations included gaining the explicit and informed consent of the parties involved and the assurance of complete confidentiality. The chapter ended with an examination of the credibility of the research and of the verification techniques used to examine the findings, specifically triangulation and the consulting of experts on the interpretation of the results.

The following chapter reports the findings of the study in the form of the data collected and its analysis.

Chapter 4: Research Findings

The first three chapters of this thesis having established the background to the present study and detailed its methodology, is worth recalling at this point that the aim is to provide recommendations for improving the effectiveness of flood management regarding developments on floodplains in the UK. As explained in the previous chapter, data were gathered by three means: a literature review (0, which revealed that there had been calls for a more unified and legally based flood risk management framework as one tool with a role in shaping flood response, a questionnaire survey of floodplain residents, to elicit details of their exposure to flood risk, and semi-structured interviews with experts on flooding and the national flood risk management framework. This chapter delivers the findings under three main headings: Section 4.1 reports the results of the questionnaire survey, Section 4.2 reports the interview findings and Section 4.3 offers analyses of these two sets of findings. Section 4.4 then considers the challenges and barriers to effective flood risk management emerging from analysis of the data, in light of those identified in Section 2.5 of the literature review, and the chapter ends with a summary.

4.1. Questionnaires

4.1.1. Determination of Case Study Sites

Participation in the two arms of the questionnaire survey was based on residence in the two case study locations, in Cumbria and York, which in turn were chosen for being situated on floodplains and having been affected by flooding in recent years. Identification of the floodplains and the specific areas in question was determined by consulting general maps and flood maps available on the Environment Agency website. Use was also made of a tool recently launched by the UK government called the 'Long term flood risk assessment for locations in England'. This service can be used to determine the level of flood risk for a property by inputting its postcode.

4.1.2. Questionnaire Findings

This subsection outlines the findings from the questionnaire survey, which are analysed in detail in Section 4.3.1. Descriptive analysis is used here to present the preliminary responses of the 101 people who responded to the questionnaire.

The questionnaire began with a section covering the general background of the respondents, who were first invited optionally to state their names. The second question, on gender, revealed that 44 (43.6%) were male and 57 (56.4%) female. Participants were then asked to place themselves in one of five age groups, as reported in Table 9.

Table 9: Age groups of respondents

Rank value	Option	Count
1	18-24	8
2	25-34	15
3	35-44	27
4	45-54	18
5	55+	33

The table shows that the largest group of respondents were aged 55 years or over and that almost as many were aged 35-44, followed by the 45-54 bracket. The remaining respondents were aged under 35 years. The following optional question, inviting participants to list their occupation, received 38 responses ranging from ‘retired’ and ‘student’ to ‘public servant’.

Among the 101 respondents, 70 indicated the general location of their address, which was also optional. The target areas were further divided into numerous locations based on risk of flooding. In Cumbria, where 45 participants lived, the detailed responses revealed that 29 lived in Kendall, three in Keswick, seven in Appleby, four in Carlisle and one in Ambleside. Twenty-four of the 70 reported living in York and the remaining one participant did not fill in the address section.

When asked about their status as occupants, 34 respondents stated that they were owner-occupiers who were still paying the mortgage, whilst 31 reported having paid off the mortgage on their property. These two categories constituted almost two-thirds of participants in the survey. Only 17 respondents were in privately rented properties, eight in social housing and one in a property rented through a private agency. Seven people reported that they were living with their parents and one was in student accommodation. On the age of the property, almost four-fifths of participants (79 respondents) reported residing in properties that were over five years old, five stated that they were in new-build properties that were built less than five years

ago and the remaining 17 did not know when the property was constructed. An optional related question asked respondents if they knew exactly when the property was built, with only four responses providing an exact year.

On the type of property, more than a third of participants (35) were in semi-detached houses, 27 in terraced accommodation, 18 (17.8%) in detached houses, 12 (11.9%) in bungalows and nine in flats.

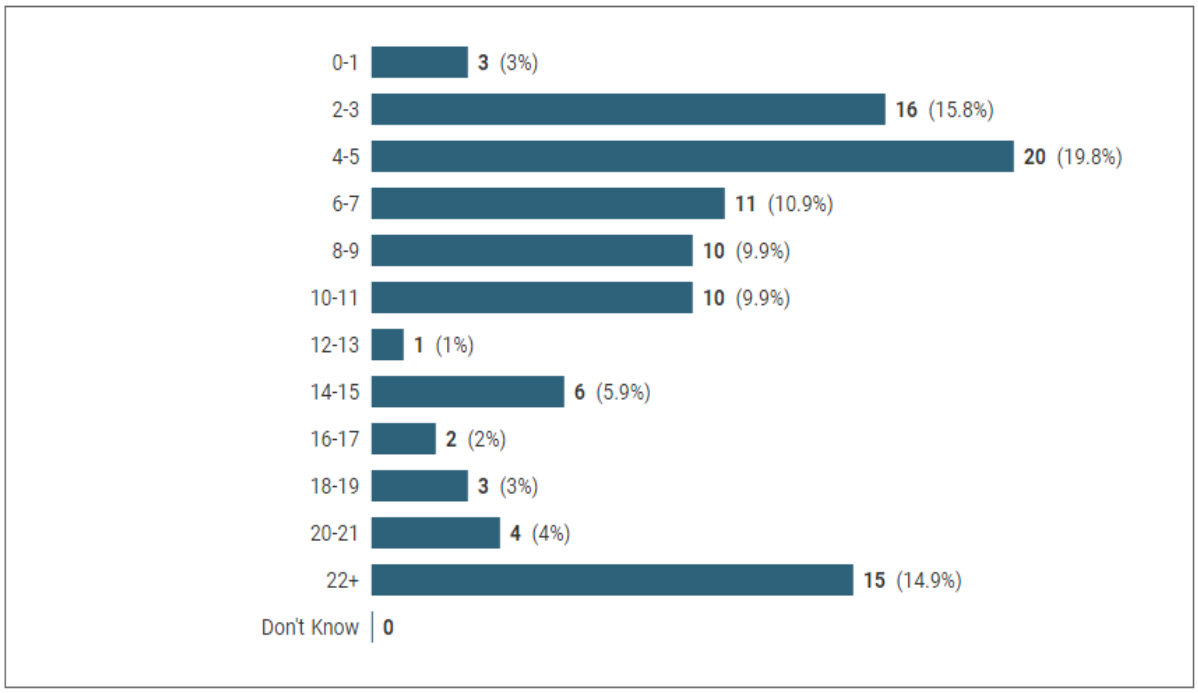

Figure 23: How long have you resided in the property (in years)?

Figure 23 illustrates the frequency of responses to the next question, on how long respondents had resided in the property. This bar graph shows that the two-year period of residence receiving the largest response was 4-5 years, followed by 2-3 years, then 22 or more years. Among the remaining responses, a total of 31 participants reported having lived at that address for between six and eleven years. Six had lived there for 14-15 years and no other two-year option received more than four responses. In other words, two-thirds of respondents had been at their current address for between two and eleven years.

Figure 24 shows that almost three-quarters (73.3%) of respondents answered affirmatively when asked whether they were in a flood-prone area, while twenty-two replied that they did not reside in a flood-prone area and the remaining five did not know.

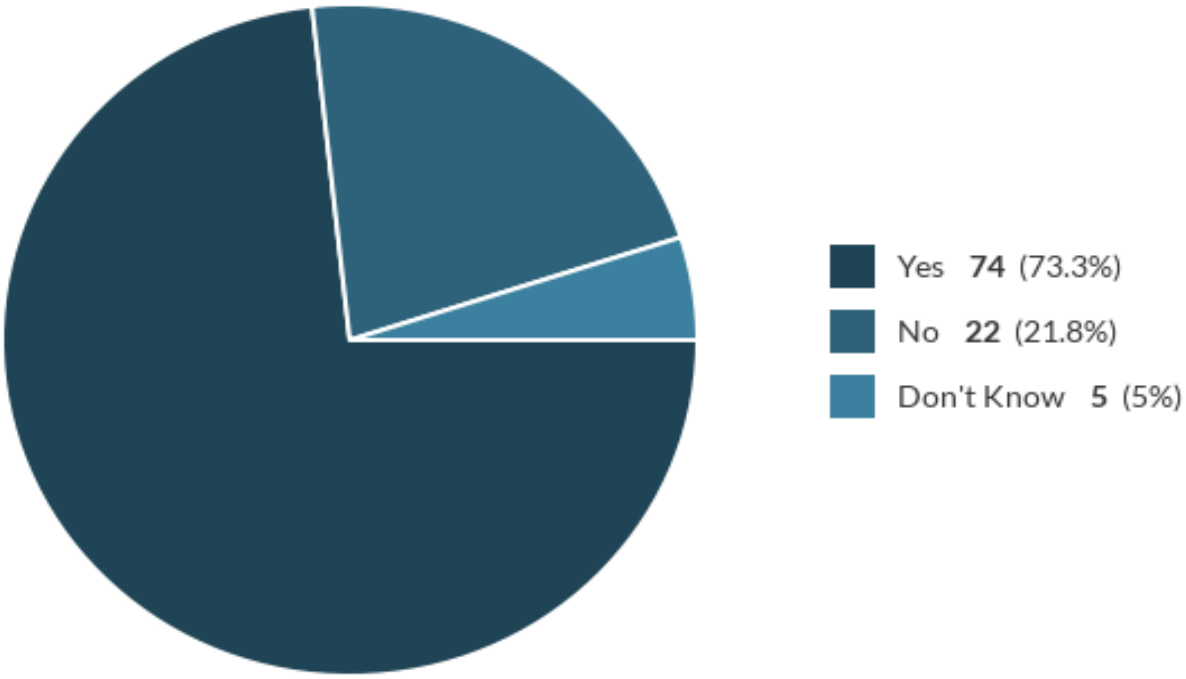

Figure 24: Are you in a flood prone area?

Among those who stated that they were in a flood-prone area, the majority (40 people; 58.8%) reported having been unaware that the house was on a floodplain prior to moving to their property, compared with 28 (41.2%) who said that they were aware of this. However, 41 (62.1%) stated that they had been informed during the purchase or on moving in that the property was on a floodplain, whilst 25 (37.9%) said that they were not informed. On flood searches/surveys of the property, 39 (47.6%) said that these were conducted, whilst 17 (20.7%) said that they were not and 26 (31.7%) that they did not know.

A majority of participants did not have flood adaptations to their properties. Only fifteen reported that they did have flood adaptations, whilst 78 replied 'no' and seven (7%) selected the 'don't know' option. Among those who replied positively, only six specified the nature of the flood adaptations, which waterproof plaster, flood-proof vents, buildings raised above the ground, flood gates, higher banking and sandbags provided by the landlord.

The next question asked respondents whether they had flood insurance. Seventy-five (77.3%) said that they did and 22 (22.7%) replied 'no'. Table 10 shows that 62 participants reported having experienced flooding of their property in the past, while 38 stated that they had not.

Table 10: Have you experienced flooding in the past?

Rank value	Option	Count
1	Yes	62
2	No	38

When those who answered 'yes' were asked the related question as to how long ago they had last experienced flooding, 48 of them (76.2%) selected the option of 0-1 years ago, ten (15.9%) said they had suffered flooding 2-3 years ago, one each chose 4-5, 10-11 and 14-15 years ago, and two said that it had been more than 15 years ago. Responses varied on the extent of flooding to the property. Among the 207 individual responses of participants, 57 (27.5%) identified their road/driveway, 49 (23.7%) the garden, 39 (18.8%) their garage and 59 (28.5%) the ground floor of the dwelling. Three (1.4%) mentioned another part of the property and no one reported the upper floor having been flooded. The follow-up question provided a free text section for respondents to give an account of their experience of their home being flooded, with 54 providing a comment.

The following question asked how many times each property had been flooded. Of those who responded, six (9.4%) replied that this had never happened, 24 (37.5%) said that it had happened once, 28 (43.8%) twice and six (9.4%) three times. No respondent selected either of the remaining options (4 and 5+ times). In other words, the great majority of those answering this question had been flooded once or twice in their current home.

Of those who responded to the questionnaire item on insurance, 39 (68.4%) stated that they had claimed on their flood insurance in the last five years, in comparison with 18 (31.6%) who replied that they had not. A follow-up open-ended question asked respondents to provide an account of their flood insurance claim experience. Thirty-two respondents responded with a written comment on their experience. The following question asked if participants had suffered any losses from recent flooding that were not covered by insurance. Twenty-seven respondents (57.4%) responded positively and 20 (42.6%) replied that they had not. Thus, a majority reported having suffered losses that were not covered by insurance. Again, a supplementary question invited a detailed account of these losses, to which 27 provided a response.

This links to the next question, on insurance costs: Participants were asked whether they had experienced a rise in their insurance premiums following the recent flood events. Among those

who responded, 23 (36.5%) selected ‘Yes (a lot)’ and 18 (28.6%) ‘Yes (a little)’, while seven (11.1%) responded ‘No (remained the same)’ and 15 (23.8%) reported not being sure whether there had been such an increase.

On flood prevention measures after the flooding, five people (6.8%) said that they had taken out flood insurance, 26 (35.6%) selected ‘Flood adaptations’, 14 (19.2%) ticked ‘Other’ and 28 (38.4%) stated ‘None’. The following question asked this last group why they had not taken flood prevention measures. Among those who responded, 37 provided a comment in the free text box.

Participants were then asked about any challenges or barriers they had experienced as a result of flooding, eliciting 30 comments in the free text box. The next item invited further comments on what participants believed could help in combating flooding on floodplains, to which 67 participants provided a response.

The following section asked respondents to answer a number of questions of perception or belief by selecting responses on a 7-point Likert scale to a number of statements related to flooding. On whether the flooding events of recent years were the result of climate change, the largest number were the 32 (32%) who were ‘indifferent’ whilst 26 (26%) agreed with the statement, 13 disagreed, 12 strongly agreed, nine (9%) very strongly agreed, seven (7%) strongly disagreed and one very strongly disagreed with that statement. In other words, 47 agreed more or less strongly, while only 21 disagreed to some extent.

On the statement that flooding is a natural disaster that cannot be stopped, there was again a majority, although a less strong one, for a positive response. In detail, 29 respondents (28.7%) were indifferent, 19 (18.8%) agreed with the statement, 14 (13.9%) strongly agreed and nine (8.9%) that very strongly agreed, whereas 20 (19.8%) disagreed, six (5.9%) strongly disagreed and four very strongly disagreed.

The next statement was that individuals in a flood risk area should expect to be flooded. Thirty-six respondents (35.6%) were ‘indifferent’, 23 (22.8%) agreed and 17 (16.8%) disagreed. There were a further 15 (14.9%) who strongly agreed, 6 (5.9%) who strongly disagreed, 3 (3%) who very strongly agreed and one (1%) who very strongly disagreed with the statement.

Respondents were then asked their opinion on whether the government should require insurers to continue insuring properties against flooding. There were 34 (33.7%) who strongly agreed, 26 (25.7%) who very strongly agreed and 23 (22.8%) who agreed. Among the remainder, 11

(10.9%) were indifferent, 1 (1%) disagreed and 6 (5.9%) strongly disagreed with the statement. Thus, an overwhelming majority supported the statement.

In the following item, participants were asked whether more funding should be spent on flood prevention methods. There were 39 (38.6%) who strongly agreed, 33 (32.7%) who very strongly agreed and 11 (10.9%) who agreed. Conversely, only 7 (6.9%) strongly disagreed and 6 (5.9%) disagreed, while 5 (5%) were indifferent.

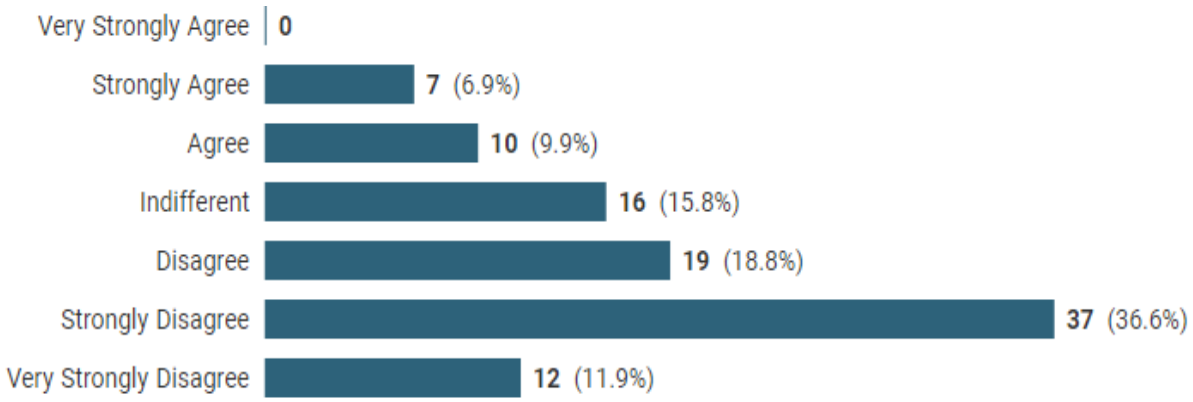

Figure 25: Is flood insurance affordable?

Figure 25 charts responses to the statement that flood insurance is affordable. Thirty-seven participants (36%) strongly disagreed with that statement, thereby expressing the opinion that flood insurance was not affordable. A further 19 (19%) disagreed and 15 (15%) were indifferent, whilst 12 (12%) very strongly disagreed with the statement. There were 10 (10%) who agreed and 8 (8%) who strongly agreed. All in all, these responses indicate that a large majority felt flood insurance was not affordable. The 'Very Strongly Disagree' category consisted of those who felt that flood insurance was not affordable at all. In contrast, the 'Very Strongly Agree' category would have consisted of people who felt that flood insurance was clearly affordable and saw no issue on the matter. However, none of the respondents selected that option.

The next statement was that protection against flooding could be handled by funding flood defences. There were 30 (29/7%) who strongly agreed, 26 (25.7%) who agreed and 20 (19.8%) who very strongly agreed with that statement. A further 17 (16.8%) were indifferent, 4 (4%) disagreed and another 4 (4%) strongly disagreed. A large number of respondents were thus of the belief that funding of flood defences was a means of protecting against flooding.

Respondents were then asked whether they believed that protection against flooding could be dealt with by regulations eliminating inappropriate developments on floodplains. There were 35 (34.7%) who very strongly agreed and 34 (33.7%) who strongly agreed. Another 14 (13.9%) were indifferent and 9 (8.9%) gave their response as 'Agree'. A further 5 (5%) strongly disagreed, 3 (3%) disagreed and 1 (1%) very strongly disagreed. In other words, a majority of participants believed that the regulation of floodplain developments was a useful component of flood protection.

On whether planning permission for floodplain development was adequate, there were 37 respondents (36.6%) who strongly disagreed with that statement, 20 (19.8%) who very strongly disagreed and 16 (15.8%) who disagreed, with 14 (13.9%) being indifferent. There were only eight (7.9%) who strongly agreed, three (3%) who agreed and a further three (3%) who very strongly agreed. This shows that a strong majority of survey participants felt that current planning permission was inadequate in managing the risk of flooding.

The following item was an open invitation for participants to make any further comments on the issue of floodplain management and floodplain development, to which 31 individuals provided a response. These varied, with a significant number summarising their comments from other free text sections of the questionnaire, noting, for example, the rising cost of insurance after repeated flood events. Other answers referred to growing issues regarding the affordability of flood adaptations and insurance, as well as the feeling that the danger of flooding was likely to increase in the future. Among the 31 responses, nine added more depth to their comments, providing individual breakdowns of the problems they had experienced.

4.2. Interviews

4.2.1. Interviewees' Background

Participants in the interviews were all experts in the field of flooding. Expertise was determined by their roles and areas of interest. The participants, whose occupations, experience and roles are listed in **Table 11**, were chosen to represent different aspects of the floodplain management system, in order to provide a full and clear understanding of the regulatory framework. As such, managers were selected to showcase active roles taken to safeguard the community and academics were chosen to showcase academic knowledge on the matter of flooding. Despite a target of 10 interviews, only seven respondents were successfully recruited to take part in the

interviews. This fell within the acceptable range of sample size, given the variety of fields from which they came.

Table 11: Expert interviews

Interviewee	Occupation	Experience	Role
1	Flood manager	19 years	Overview of the flood management process
2	Academic	9 years	Theoretical background around flooding
3	Flood action group manager	12 years	Practical experience of flood management and challenges
4	Academic	6 years 10+ years in insurance industry	Theoretical background around insurance and flooding
5	Community business support manager	2 years	Overview of flood insurance and flood resilience challenges
6	Flood manager	10 years	Flood risk management framework
7	Academic	7 years	Challenges experienced by insurance industry

Other relevant details of the interviewees are as follows:

- **Interviewee 1**: A flood risk manager for a city with a range of experience in flood management.
- **Interviewee 2**: An academic who had written widely on flooding, flood risk and flood management.
- **Interviewee 3**: A flood response leader for a flood action group who served as the lead in a community in responding to flooding and had personally experienced flooding on a number of occasions.
- **Interviewee 4**: An academic with a number of publications on flood insurance who had previously worked in the insurance sector.
- **Interviewee 5**: A community manager operating a business that served as a liaison between the town council and the local businesses in the town centre, where he helped manage the response to flooding in 2015.
- **Interviewee 6**: A flood risk manager who operated in a flood prone region, with years of experience in flood risk management.
- **Interviewee 7**: An insurance expert with experience in matters relating to flood risk.

4.2.2. Interview Findings - Themes

Wide-ranging findings emerged from the interviews with experts, each of whom had a different area of expertise. All had experience in the area of flooding, whether it was in practice or as an academic. Thematic analysis was used to explore the interview data, as it is most common form of analysis of qualitative data. This technique emphasises the identification, analysis and interpretation of patterns present within the data (Braun and Clarke, 2006). The main themes that were developed and which became part of the research findings were flooding, developments, regulation, insurance, adaptation, flood defences and funding. The following subsections successively examine each of these in detail.

4.2.2.1. Flooding

Flooding, as discussed in the literature review, is the most frequent natural hazard to affect the UK. A theme commonly raised during the interviews was that of the nature of flooding, reflected in flood awareness and the public perception of flood risk. The experts highlighted the societal need to understand that flooding could not be stopped entirely but instead had to be managed. As stated by Interviewee 1, *"We can never remove the risk of flooding completely. What we can do is minimise the likelihood of it happening, or minimise the impact, if it does happen"*. It was noted that the terminology had changed from that of flood defence to flood risk management, due to it being impossible to eliminate all flood risk. In fact, Interviewee 3 warned that the danger posed was bound to increase in the future:

> *So people have got to get to grips with this seriously. Waiting for that 30% more rainfall, over the next 20/30 years, this is getting serious. A 90% increase, in you know, rainfall by the end of the century*.

Interviewee 4 stated that *"flood risk can be managed and reviewed but it cannot be avoided"*. A key lesson of the recent flooding that Interviewee 5 noted was that it could not be pushed aside as a 'one-off' event, given that there was a strong chance of further flood events in the future.

An issue raised by Interviewee 1 was that the risk of flooding was not taken into account by society as a whole, either among the public or on the part of politicians. The Interviewee suggested that people had only a short-term memory when thinking about flooding and commented on a 'missing gap' concerning the role of homeowners in combating flooding: *"Sometimes it takes repeat flooding of two or three times before people finally realise that they*

have a role to actually make their home resilient to flooding and take actions to actually prevent that from happening in future". Furthermore, according to Interviewee 1, the need for awareness was not restricted to the public but extended to decision-makers and politicians. They also commented on the shift in terminology from flood defence to flood risk management. This is consistent with statements in the literature concerning the shift in focus to flood risk management. Interview 7 believed that there were multiple ways of responding to flood risk and that this was not restricted to engineering, because *"flood risk management is a web of different processes. Law, policy, insurers, homeowners… they all work together to respond to flooding"*.

However, an important element of this emerging theme is the failure of society at large to address the nature of flood risk. Interviewee 1 warned that *"flood risk is not seen as a day-to-day risk for people or for decision-makers"*. All of the interviewees mentioned that the approach to flood response had been more reactive than precautionary. Interviewee 2 observed that public awareness and preparedness were factors in flooding; there was often discussion of flooding and focus on it, but then it would disappear from the public mind before being discussed again. Many interviewees mentioned that studies had shown that property owners tended to take steps to combat flooding only after they had experienced a flood event. Thus, according to Interviewee 2, *"studies tell us... that when the property gets affected a number of times, then that increases the chance of the property owner doing something about it"*. Interviewee 3 expressed a similar opinion, asserting that it was after the experience of a flooding disaster that people actually took steps to combat the risk. Thus, awareness was manifested in action only upon directly experiencing the hazard. Conversely, there sometimes exists the perception that once flooding has happened, property owners do not think it will happen again and thus do not take resilience measures. The cases of Interviewees 3 and 5 are notable, as both developed their expertise after experiencing flooding themselves and then taking an active role in flood management and response.

An important point mentioned by Interviewee 5 was that businesses needed a plan and must be prepared by signing for early warnings and alerts, as well as being ready for flooding. A personal view of the expert was that not enough businesses were prepared in the event of flooding. This view was shared by Interviewees 6 and 7, who believed that society was not prepared to handle flood risk. A common thread in these contributions was the lack of public awareness of flooding and a corresponding failure to take the appropriate measures to combat future flood events.

Interviewee 5 noted that some had taken part in such resilience measures but the great majority had not done so. In their view, this was due to a combination of businesses not taking part in flood prevention and not enough incentives being offered by the insurance sector. The expert ascribed this to the priorities of individuals and suggested that this had impacted flood risk management efforts. It emerged from the interview that business owners had to prioritise their business interests over flood insurance due to the expense of flood resilience options. A personal view of the expert based on visiting businesses in a flood-affected area was that only a few engaged in such resilience measures. A key element mentioned by Interviewee 4 was that 'ownership' of the risk and understanding of the risk level was important. As such, transparency became an issue and a clear sense of coordination, responsibilities and roles was needed. The government and homeowners, in the view of this interviewee, should shar responsibility for tasks such as clearing drains and the removal of surface water. Heightened awareness was associated with the need for property owners to assume their part in combating flooding rather than relying on another party. Interview 6 expressed the view that *"the lack of acceptance of everyone having a role in flood risk management partly contributes to the current reaction-only mindset"*. They commented that more awareness of flood risk would lead to a more proactive approach on a societal level.

All of the interviewees agreed that flooding was an existing issue that was set to increase in the future. They saw flooding as inevitable and therefore believed that society must acknowledge the danger it posed and take measures to manage flood risks, at both a governmental and a community level, with flood awareness being a necessity.

4.2.2.2. Development

A common theme emerging from the interviews with experts was that there had been an increase in the number of properties built on floodplains in the UK, magnifying the flood risk for the occupants of such properties, since floodplains are by nature prone to flooding. However, the clear majority opinion among the interviewees was that new developments should be allowed on floodplains, so long as flood resilience measures had been adopted. Interviewee 2 stated simply that developers should be allowed *"to build with adequate management measures, flood management measures"*. Similarly, Interviewee 5 believed that each application for permission to build on a floodplain should be decided on its own merits. They also stated that if the planners had properly assessed the development and taken proper measures with resilience in mind, then building on the floodplain could safely go forward.

Building in floodplain areas was seen as a calculated risk so long as protective measures were made against flooding. On floodplain development, Interviewee 2 mentioned the existence of a regulatory system whereby risk assessments were conducted in order to minimise the flood risk. They also stated that stopping floodplain development completely was not possible due to population increases because it would mean that building in certain areas could not be done at all. In a discussion of floodplain development, Interviewee 4 expressed the opinion that new properties should not aggravate the flood risk situation but observed that there was public policy pressure to allow new property developments on floodplains. Interviewee 3, however, disagreed with the others on the matter of building on the floodplains, asserting that new developments should not be allowed, that people living in such areas faced a stressful life and that they did not receive adequate support: *"You have to live with fear if you live on a floodplain."*

On the theme of floodplain development, Interviewee 2 said that the focus should be on making properties there and in surrounding areas better equipped to handle flood events. They argued that rivers in the UK, not being as large as some elsewhere, could be much more effectively managed. Thus, attempts should be made to better control and manage them by means of engineering. Furthermore, Interviewee 2 stated that even in areas of high flood risk, there was the potential for development, as technology had improved to the point of being better able to cope with the added level of risk. Thus, there was the potential for improved engineering work to better control the river waters. Another factor mentioned by Interviewee 2 was that occupants of rented accommodation on floodplains were unable to take part in influencing decisions to make these properties more resilient to flooding. Instead, it fell to property owners to make the required investment, but they might not necessarily be willing to contribute to resilience measures, even if the tenants desired them. Furthermore, the problem of property owners not being interested in taking part in flood resilience measures was an issue affecting not only homes but also industrial buildings and business premises.

Contributing to the theme of development, Interviewee 6 said, *"Statistics show that planning has a drive to build and floodplains tend to be a site for development"*. The expert added that combined with factors such as climate change, this exacerbated the issue of increased flood risk, because further properties were exposed to the hazard. However, they felt that this was acceptable so long as adaptations were made to the properties and mitigation work was done. In contrast, Interviewee 7 stated that the easing of floodplain development restrictions went against policy guidelines: *"Generally speaking, guidelines steer property development away*

from floodplains but in the end… the Environment Agency can only advise on applications. They do not decide on an application". This response highlights the role of the EA and its purely advisory function in relation to planning applications.

In summary, the majority of interviewees agreed that development was possible on floodplains. Two of these experts added that such developments could even occur in areas at high risk of flooding, so long as appropriate protective measures had been taken.

4.2.2.3. Regulation

The third main theme touched upon by interviewees was that of the regulatory framework in the UK. Regulations serve the important function of providing enforcement to manage flooding. Interviewees were generally of the opinion that the UK possessed a strong regulatory system. Interviewee 2, for example, observed that there was an overall strategy that created civil contingencies and ensured that local authorities had guidelines in place. Interviewee 1 primarily identified the EA as a regulatory body with permissive powers and *"duties to manage the risks from main rivers, main arterial rivers that flow round the country"*. On the regulatory framework, Interviewee 1 stated that *"the Environment Agency, lead local flood authorities, internal drainage boards, all have by-laws or powers available to them to actually manage the issues that arise within that river corridor"*. Interviewee 2 asserted the judgement that flood response within the UK was good in comparison with other countries; indeed, that the country served as a model for developing nations: *"Flood management policies and planning and all the measures in place in the UK are extremely good"*. This appraisal was made in comparison to countries whose territory consisted largely of floodplains, such as Bangladesh. However, the interviewee did note that there was room for improvement within the UK's regulatory system. Similarly, Interviewee 7 said, *"You have seen the role that law and policy has had over flood risk management. I mean, we saw it with the consolidation of legislation over the years and the Pitt Review saw guidelines being refined over the years"*. Thus, they seemed open to the idea of law playing a role in flood risk management.

Although strong, the regulatory system appears to lack a unified strategy. The current approach to flood risk, according to Interviewee 1, was one of reactive rather than preventative flood management. A goal should be that *"ultimate sustainable drainage issues are a great proxy for what will end up with catchment-scale solutions"*. Interviewee 4 raised a related criticism: *"One of the key points is that flood risk management is not seen in a holistic way"*. This view is consistent with a recommendation made by Kundzewicz and Takeuchi (1999), in relation to

combating flooding in Japan, that holistic flood management was needed before, during and after a flood event, rather than a disjointed focus on certain individual aspects such as coastal or infrastructural measures. Thus, it was felt that what was needed was a general view of flooding and a rounded approach to the various aspects of flood risk and to how they interacted with one other. They also argued for the need to examine how policy related to flood risk. Interviewee 4 spoke of the need to acknowledge that flood risk management in the UK was not only *"a current problem but also a bigger problem in the future"*. Thus, a core approach had to be adopted in the country before issues such as planning could be considered, as a transparent viewpoint was needed on flood risk management. An integrated approach to the management of flood risk was identified as a new paradigm that had appeared in recent years (Brown and Damery, 2002; Fleming, 2002; Plate, 2002; APFM, 2004; Werritty, 2006; Green, 2010). Such a view involves multiple factors being integrated into a centralised strategy for managing flood risk.

Interviewee 2 warned of a lack of clarity on individual responsibilities, which could be regulated by imposing a duty on local councils to adopt a clear role in response to flooding. This would allow for a coordinated strategy covering the response of all parties to flooding and flood management. While the existence of flood response groups was acknowledged, these were not formally constituted and there was no coordination linking them to a central strategy. To better communicate this view, Interviewee 2 proposed that *"if the government makes the policy, you know, a legal requirement, then the local council... will have to follow suit"*. On the cost of putting this into effect, the expert suggested that this would not be very high, because many elements, such as the strategy, were already in place. Instead, it was linking these to the local level that needed in order to better flood management response.

Interviewee 1 argued that for any legislative changes to work, it would be necessary to take into account these bigger concepts. To advance people's understanding of water being an issue, it was said that legislative and funding rules would need to be amended. According to this interviewee, the establishment of *"sustainable drainage"* would require the government *"to put in place strong legislation, some strong planning legislation"*. However, country-wide solutions would not be viable; what was needed was catchment-level flood management legislation and policy.

In contrast to the other experts, Interviewee 3 believed that regulatory bodies such as the EA were a barrier to effective flood management. The Interviewee, drawing on personal

experience, felt that community needs were not taken into account by the Agency and that this needed to be rectified. They believed that flood resilience needed to focus on helping communities and that Natural England had too great a role in flood risk management. The expert called for flood risk management to be in the hands of more qualified and experienced individuals who understood the full-catchment approach. Such people would have hydrology and geology expertise, in contrast to experts from Natural England: *"It's the approach that's wrong. The mind-set is not there"*. Interviewee 3 made a comparison with the Netherlands, stating that there were lessons to be learnt from that country, which had managed flood risk better than the UK. The expert also argued for a unified approach to flood management and asserted that *"governance of flood prevention should be led by community needs"*. The current approach of catchment management was deemed to be a good one, but the entirety of it had to be managed. This was a view shared by Interviewee 7, who said, *"Governance has an important role in flood risk management. Without it, I don't think we would have a strong flood risk management system in place"*.

Interviewee 4 commented that the recent UK Climate Change Risk Assessment had identified a disconnect between flooding and other risks, in particular to businesses. The interviewee suggested that funding might be an issue in the current UK system relating to flood risk; while funding alone could not resolve the situation, managing such funds effectively was a key issue. They argued that there needed to be a shift in perception to the managing of flood risk. The expert acknowledged that there was currently an objective and direction but criticised the existing framework as lacking an aim. A gap was said to exist in the link towards a more strategic approach across government and other areas. The expert mentioned that there needed to be a proper response strategy, as the current system was haphazard and did not consider water flooding. This was an area where improvement and a sharper focus were needed. To implement change, Interviewee 4 believed that flood risk needed to be better integrated during the planning stage, because the current approach to flood risk management was based on the concept of a 'cycle' and was reactive rather than precautionary. Thus, responses consisted largely of brief discussions beginning at the time of flooding and ending immediately after the disaster. The expert warned that this was not a strategic approach and that a long-term flood risk management strategy was needed, while acknowledging that the EA and Defra were moving in that direction. The interviewee commented that such a strategy needed to be underpinned and supported by other policies, including on planning and infrastructure, with a common understanding of flood risk.

There was consensus among the interviewees that the UK had a strong regulatory system on flood management but that there was scope for improvement. It was concluded that there was a strategy in place but that it lacked direction and flood risk was not seen in a holistic manner. Furthermore, although a strategy existed, there was a disconnect at a local level, with no clear division of responsibilities between the government and communities.

4.2.2.4. Insurance

A perception commonly expressed by the interviewees was that insurance did not fully address the problems inherent in the flooding of properties built on floodplains. Among a number of issues that emerged was the view of the experts that there appeared to be a disconnect between the insurance sector and the flood management sector. Thus, Interviewee 1 stated that insurers utilised their own databases, guidelines and mapping systems rather than those of the EA, treating flood risk alongside other dangers such as vehicular threat or property threat. A similar point was made by Interviewee 5, who stated that insurance was not an option in a town centre close to a river; in their own experience of such a location, the majority of independent businesses situated there did not have flood insurance. The key factor, according to this interviewee, was that these businesses could not take out insurance because it was not affordable, given their proximity to the river, even though this was crossed by a bridge. He stated that while the businesses in the centre were not in practice connected to the river, the insurance mapping system categorised them as in an area at high risk of flooding. In short, the businesses were classed as facing a flood risk simply because they were adjacent to the river, with the consequent problem of the affordability of insurance. The Interviewee stated that the business owners saw the area as being at low risk because the river was crossed by a bridge, whereas the insurance companies perceived it as being at high risk of flood events. Therefore, either insurance was simply not offered or the premiums were unaffordably expensive. Thus, the smaller businesses had to operate without flood insurance protection.

Interviewee 2 agreed that insurance was area in need of improvement, giving the example of Cockermouth, where *"there were situations where before the flood debate it was like zero pounds excess and after the flood 15,000, 25,000, 35,000! So, you know, so that means if that property gets affected again, the first 35,000 the owner will have to suffer"*. In other words, following a flood event, not only would insurance premiums rise but policyholders would also be faced with considerably higher excess payments. This view was shared by Interviewee 5, who stated that after the recent flooding, the situation had become worse in relation to obtaining

flood insurance. The fact that the centre had been flooded once already had a negative impact on anyone attempting to take out insurance; some businesses might have endeavoured to buy flooding insurance cover, but the insurers had taken note of the much more apparent flood risk following the recent flooding. As a result, the cost of insurance made it unaffordable for smaller businesses. Indeed, the majority of businesses, especially the smaller ones, were unable to insure themselves against flooding and had to take the risk without cover. In terms of recommendations, Interviewee 2 felt that two key steps should be taken to combat flooding, namely the provision of support for insurers to cover businesses and the adoption of awareness-raising measures. The expert felt that insurers needed to aid property owners in taking active steps to improve flood resilience and that people's current approach was more reactive than proactive. Interviewee 4 made a related criticism of the current flood insurance provision: that it did not support flood risk management but operated more as a stopgap solution. It was *"not addressing the underlying problem"* and did not respond to the issue of increasing flood risk.

These discussions brought up a related sub-theme, which was Flood Re. Interviewee 1 mentioned that the operation of Flood Re allowed a reinsurance pot to be created but that this would end in the 2030s, when a market-led economy would be created. Thus, steps needed to be taken to ensure that properties would be flood resilient in the future. Similarly, Interviewee 3 said that Flood Re had improved the availability of insurance cover, but that this would remain effective for only 25 years and for people in their own homes or in social housing. In the interviewee's opinion, it was doubtful whether occupants on floodplains would enjoy Flood Re cover indefinitely, because the purpose of the scheme was to give residents of floodplains time to adapt their homes against flood and make them more resilient in the interim period. Thus, insurance alone would not resolve the situation. Interviewee 4 also made mention of Flood Re, stating that there was an opportunity to bring together insurance companies and government to create a unified approach to flood resilience. The operation of a competitive insurance market meant that there was too little focus on flood resilience, so that in practice, the insurers had little contact with homeowners on such matters. Nevertheless, Interviewee 4 did note that the UK had a functioning insurance market which helped with much of the cost. The expert described Flood Re as aiming to make insurance affordable but only as a short-term solution, leaving underlying risks on the floodplains to be addressed. There was also a danger of creating a false sense of security for such owners. The participant commented that there was a great need to encourage transparency and discussion of ways to improve flood response

management. Costs would be incurred as a result and there was an issue as to who would bear the expense, a question whose answer would have to be determined by society.

Interviewee 1 further suggested that the insurance sector should be treating loss adjustment as a two-stage assessment process: The first stage should be replacement or reconstruction of the dwelling, then flood resilience measures could be considered at the second stage. Thus, a key factor discussed was that the insurance sector did not include flood resilience in flood management. As such, insurance in relation to flood resilience had been discussed in general by society but there had been no further development on this matter. The insurance sector was said to hold the view that flood risk management was a government responsibility, rather than accepting its own role within the framework. An added issue related to flood response was that people did not want flood resilience but rather flood resistance. Once the flood level dropped, they would place blame on others, rather than accepting the flood situation and the inherent risks. Interviewee 1 argued that what was needed was *"a system that allows us to bring in multi benefits and multiple outcomes"*. They affirmed that that multiple objectives needed to be achieved, including flood alleviation schemes, the management of flood issues and a systematic response to flood risks to key infrastructure and the community. In terms of priority, the expert noted that all of the various issues related to legislation, funding, insurance and so on were interrelated, requiring a coherent strategy to bring about effective flood risk management. Similar views were expressed by Interviewee 7.

Interviewees also spoke of the insurance industry's perception of flood risk; for example, Interviewee 5 opined that risk perceived on a flood risk management basis was different for insurers, who tended to rely entirely on their maps, rather than investigating mitigating factors. Thus, a large proportion of businesses in a town centre were without insurance cover or were offered insurance at prices that they could not afford. An problem raised by Interviewee 3 was the absence of qualified surveyors after flooding disasters. It was suggested that insurance companies should provide adequate independent surveyors with a goal of guiding people towards flood resilience. Instead, it was noted that the current situation was that there were companies simply looking to sell their products rather than guide homeowners towards flood resilience. During the interview, the expert suggested that the situation could be improved by advisers from the local council going into the floodplain community to provide advice on flood resilience. More broadly, cooperation from the local council might help floodplain communities suffering from flood events. This suggestion reveals the link between the theme of insurance and that of adapting properties to make them more resilient to flooding, which is

dealt with in the next subsection. Interviewee 6 argued for *"greater coordination and a more holistic approach that can bring closer cooperation from the insurance sector"*.

In summary, the interviewees were unanimous in the view that insurance was not affordable for floodplain communities. They criticised the insurance sector for operating a system that did not take flood management into account and therefore did not actively encourage flood resilience measures. Any flooding event then aggravated the problem, prompting increases in the cost of insurance which made it unaffordable for individuals and small businesses. Flood Re was acknowledged as a positive development but interviewees argued that improvements could have been adopted. Furthermore, Flood Re was only temporary, the intention being that property owners should implement flood resilience measures, but these had not been actively promoted.

4.2.2.5. Adaptation

A theme related to insurance and raised by numerous experts was that of flood resilience adaptations, as mentioned above. Interviewee 5 stated the belief that a number of businesses had managed to implement flood adaptation measures, but that in some cases, these measures were extremely limited; for example, some businesses had kitchens on the ground floor and were not able to do anything to make these more resilient. Among the measures that could be taken were moving items to prevent them from being damaged during flood events. However, businesses operating from older premises were not able make the necessary physical adaptations to these buildings. In other cases, businesses had invested heavily in flood adaptation. Interviewee 3 expressed *"serious doubts to whether many people will actually spend any money or do anything proactively to protect their properties"*, fearing that instead, property owners would simply wait until the next time they were flooded. This flood response leader thus believed that the government would be disappointed by the response to the insurance problem. Furthermore, the insurance companies themselves *"should be much more proactive in trying to get people to rebuild in a resilient way and there is not enough support from the insurance companies for doing that, particularly post flood"*. The interviewee held the view that taking part in flood resilience measures would not be difficult for the insurance companies. Interviewee 2 suggested that this should be reflected in insurance premiums for any owner who invested in flood adaptation which improved the flood resilience of a property. Such measures would be seen as a justification of adaptation and would thus incentivise such initiatives.

Interviewees 4 and 2 both warned that resilience was not fully incorporated into the overall flood resilience strategy and that the insurance sector did not take into account flood adaptations to properties; insurers did not factor this into their cost calculations, so it was not reflected in premiums charged. There was consequently no financial incentive via insurance costs for property owners to take flood resilience steps, which in turn impacted upon the implementation of adaptation measures. These two interviewees therefore called for more linkage between flood insurance and flood-related adaptations. They also noted that the insurance sector did not provide a detailed risk assessment and that it operated under a different system rather than a specialised one on flood risk. Interviewee 4 argued that insurance should better reflect resilience measures in reducing risk, rather than simply restoring a property to the condition it had been in prior to the flood damage. As a result, a theme that emerged was that of insurance as an issue with regard to flood resilience. The experts duly recommended that insurers should be encouraged to work more closely with property owners and those engaging in repairs to adopt a flood resilience approach. A further suggestion was the provision of greater incentives for individual property owners to install property-level protective measures themselves, such as via discounted insurance premiums or other such incentivising schemes. There had been coordination between the government and the insurance sector with the introduction of schemes such as Flood Re. However, Interviewee 2 argued that because insurance claims were for the restoration of properties to their pre-damage condition, any resilience adaptation would be an investment for the owner. An incentive-based approach would be likely to improve resilience, as it would encourage owners to make use of adaptations and this could be efficiently achieved by reflecting such measures in the cost of insurance. This expert criticised insurance as currently favouring *"non-betterment"* rather than *"improving existing properties"*.

Interviewee 1 identified a counter-argument, however: that incentivising resilience adaptations might make the affected properties more difficult to sell, if potential purchasers were deterred from buying by the very existence of flood-related adaptations. This became an emerging issue when the interviewee suggested that purchasers were less inclined to buy such dwellings. However, it was acknowledged that the country could not resort to building larger defences but rather needed to focus on catchment-scale management. Interviewee 3 proposed that closer collaboration with local authorities in adaptation work might improve resilience and suggested that local authority surveyors could play a more direct role by giving qualified independent advice on flood-prone properties. Interviewee 6 asserted that the lack of wide-scale mitigation

defeated the purpose of current flood risk management efforts, which was to bring about resilience to communities: *"If we do not have adaptations in place then really the purpose of Flood Re is somewhat defeated. It was meant to provide a stop-gap and allow properties a chance to become resilient to future flooding"*. This expert believed that resilience was a desired goal in flood risk management, as it made properties better able to manage future flood events.

In summary, all of the interviewees agreed that insurance had a part in making flood adaptations affordable and argued that more efforts were needed to introduce a more holistic approach to flooding that would encourage resilience. There was consensus on the uncertainty surrounding Flood Re and on the assertion that it would make the insurance of affected properties more affordable. Meanwhile, the ultimate aim of bringing about change through the use of adaptations was not being achieved. Thus, there was uncertainty regarding the future role of Flood Re.

4.2.2.6. Flood Defences

On the theme mentioned of flood defences, the general opinion was that they were adequate but that there was potential for improvement. Interviewee 1, for example, described defences as having been built to a good standard and to have reduced the risk of flooding in areas formerly at high flood risk. Regarding flood defences, *"the impact of flooding on society, the economy and the environment, I think we have an extensive and good range of defences already in place and people"*. The interviewee noted that the standard of flood defences within the UK was of good quality and that these protected people, their livelihoods and communities. Remarking that a number of these defences had been constructed at a time when knowledge of climate change was not as developed as at present, the expert said that the impact of flooding was greatest in those areas that lacked defences. However, they believed that the people in such areas understood the risk of flooding and actively took steps to make their homes resilient. Interviewee 1 warned, nevertheless, that the presence of defences did not eliminate flood risk in the future. Interviewee 2 suggested that flood defences could be revisited and improved upon as part of a cyclic programme of flood risk management. A similar view was expressed by Interviewee 4, who emphasised maintenance as an important factor in flood risk management, while Interviewee 2 stated that some of this was being done by the EA.

Interviewee 4 described maintenance as an important issue that was overlooked. There was a need for the systematic monitoring, maintaining and upgrading of flood defence schemes. This

was also the opinion of Interviewee 1, who called for such defences to be examined and re-evaluated to ensure that they remained effective. Similarly, Interviewee 2 commented on the need to evaluate existing defences to ensure that they remained at a good standard, while Interviewee 6 believed that all existing flood defences should be updated to make them better able to handle increasingly severe and frequent flood events caused by climate change. In summary all of the interviewees described flood defences in the UK as of a good standard but felt that maintenance was a concern.

4.2.2.7. Funding

The final major common theme emerging from the interviews was that of funding. Interviewee 1 identified the need for a *"range of effective defences now, but we need to ensure that we maintain funding to maintain them and funding to operate them, improve them"*. Funding was said to need to change significantly to allow for catchment-wide improvements to flood response solutions. Mention was made by Interviewee 1 of the Bonfield Review, which recommended that flood resilience should be incorporated into building regulations: *"Really, resilience grant funding of property-level protections and property-level resilience needs to be part of the building regulations"*. At the moment, the government was said to allow for funding and grants for flood resilience only in response to flood events. The expert argued that funding should be available to allow for flood protection renovations to be made to flood-risk areas. At present, there was a tendency for funding to be allocated after a flood event. Instead, it was recommended that there should be a clear funding process and that its availability ought to be widened to cover the multiple benefits of different and wide-ranging schemes. Thus, a wide range of schemes could be delivered by way of local investigations, formal appraisals and funding approvals being put into place. Similar views were expressed by Interviewee 2, while Interviewee 6 believed that a more proactive approach to the funding of schemes aimed at improving resilience would be desirable.

On funding, Interviewee 3 complained that *"the government has not given local authorities much money. It's been restricted and restricted and restricted"*. In their own role, the Interviewee had campaigned for grants to help a flood-damaged area to recover. However, they objected that the money given was not sufficient and that greater investment had to be made by homeowners to recover from their losses. According to this expert, there was not only a lack of funding but also a failure to put community needs first. The interviewee felt that there was a lack of coordination with local groups and that this had become a problem. Interviewee 4

suggested that lessons could be drawn from the experience of other countries and that while cities in the UK were taking flood risk seriously, they were constrained by a lack of resources. There was not always a dedicated employee responsible for flood risk management, a failure which the interviewee ascribed to the issue of funding, emphasising the need for sufficient funding of flood risk management efforts. In particular, such funding needed to achieve a set of objectives, directives and direction. Thus, the interviewee underlined the need for a strategy to encourage the reduction and management of flood risk. Interviewee 7 agreed with this view and added that set goals could be embodied in legislation and policy guidelines.

There was thus agreement among the interviewees that funding was an issue and that there needed to be a clearer approach to addressing it so that an appropriate amount could be directed towards flood-affected communities.

4.3. Analysis of Findings

4.3.1. Analysis of Questionnaire Findings

From the preliminary analysis, one of the key factors that can be established is the increasing exposure of floodplain developments to flood risk. It was evident that a majority of respondents had experienced multiple flood events, each of which had had an impact on the communities affected, including economic loss and the disruption of their lives. This finding is corroborated by the views expressed in the interviews with experts in the course of this research. Analysis of the questionnaire responses indicates that the majority of respondents feared an increased incidence of flooding in the future and felt that this was the result of climate change. This finding is consistent with the literature review having identified numerous authors and authorities as pointing to the growing danger posed by flooding, both globally and within the UK. As explained in Chapter 3:the communities sampled by the questionnaire survey were selected with reference to flood maps. Those living on floodplains were targeted in order to elicit their direct experiences of the phenomenon under examination. One objective of this research was to examine the challenges experienced by floodplain communities in the UK and to identify barriers to progress in preventing flood damage. These data were derived primarily from the questionnaire responses, the majority of participants having experienced flooding within the preceding year.

The majority of responses were from owner-occupiers who had either paid off their mortgages or were still paying them. A minority of respondents were either in rented accommodation or

were living with their parents. Thus, most were in a position to take part in the implementation of resilience measures affecting individual properties. It is useful to distinguish between old- and new-build properties, the latter being defined as having been built no more than five years before the date of the survey, while it is the old-build category which accounts for almost four-fifths of questionnaire responses. The reason for this questioning was to determine if adaptations were being considered as part of recent developments and to highlight potential dangers with older properties that required adaptations in order to make them more resilient. These questions were designed to gauge the nature of the properties occupied by respondents, so that a deeper analysis could be conducted to determine respondents' knowledge of flood risk, their experiences of flooding, any challenges they faced and their opinions about future flooding.

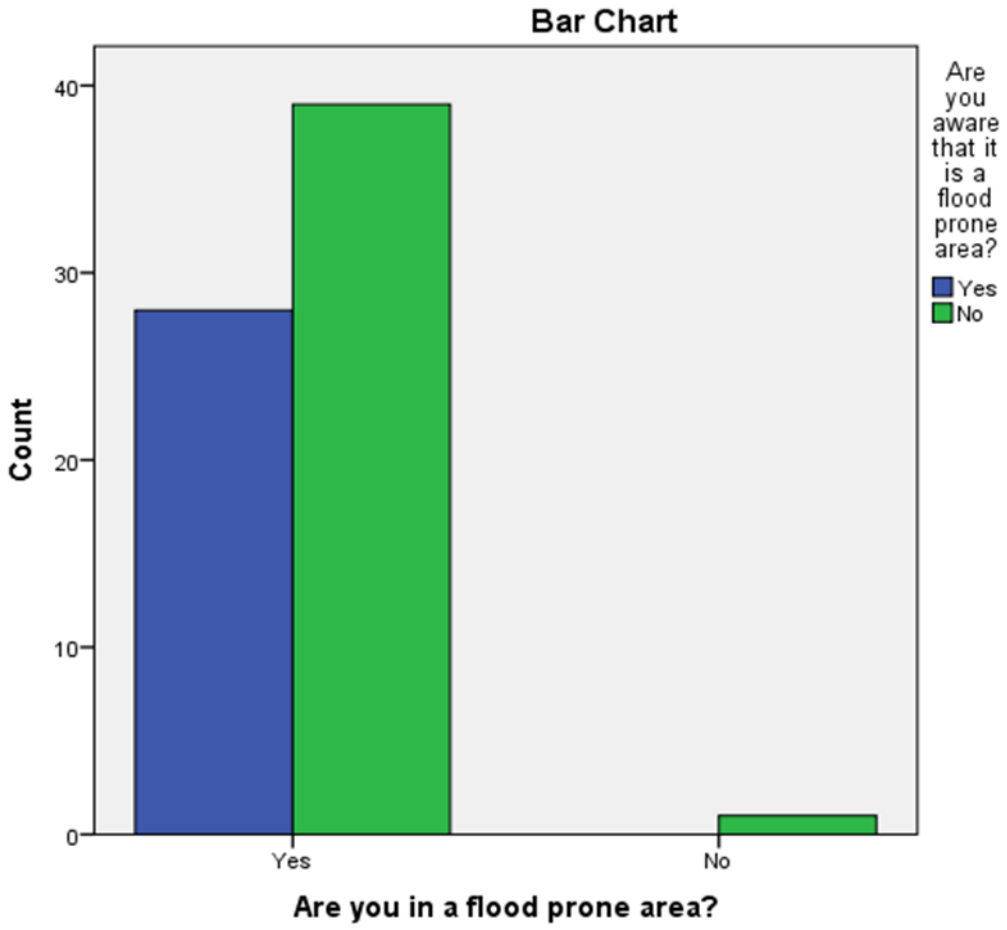

Figure 26: Flood awareness

As shown in Figure 26, the majority of respondents were unaware of their homes being located in a flood-prone area. The two bars indicate whether the participants were aware it was a flood-prone area before coming to reside in the property. The majority indicated that they were not aware of being situated on a floodplain. The areas targeted were based on maps from the EA,

which highlights the low level of awareness among property owners. Awareness of any risk is a key condition of responding to it; therefore, a lack of awareness of flood risk will impede efforts by property owners to strengthen resilience. On the other hand, a related question indicated that they were informed during the legal process of acquiring the property, as flood risks were identified during the surveys. This is indicated in Table 12 **Are you in a flood-prone area?**, reporting answers to the question of whether flood searches were made when they purchased the property.

Table 12 Are you in a flood-prone area?

Are you in a flood prone area? * Were flood searches made? Crosstabulation

Count

		Were flood searches made?			
		Yes	No	I don't know	Total
Are you in a flood prone area?	Yes	34	8	23	65
	No	5	9	3	17
	Don't Know	0	1	1	2
Total		39	18	27	84

The purpose was to establish whether the potential danger of flood risk was picked up through official legal channels. As indicated in Section 2.3.2.2.2, the purchase of property involves solicitors going through a series of legal checks before ownership passes to the client. These checks include a series of searches for various risks, such as coal mining. Such searches are made on the basis of records and exposure to risks, including flood risk, with solicitors obliged to conduct flood searches should there be a risk of such a hazard and to report this to their clients. Respondents to the questionnaire indicated that flood searches were conducted and that they were informed of the potential risk of flooding. This correlates with the distribution of questionnaires to regions selected as being shown on EA maps as flood prone. Thus, Table 12 demonstrates that the majority of respondents living in the targeted floodplain regions had had flood searches conducted. This shows that whilst awareness of flood prone regions may be limited among property owners, the legal process serves to highlight this risk.

Figure 27 highlights the role of legal processes and searches in bringing about awareness of flood risk.

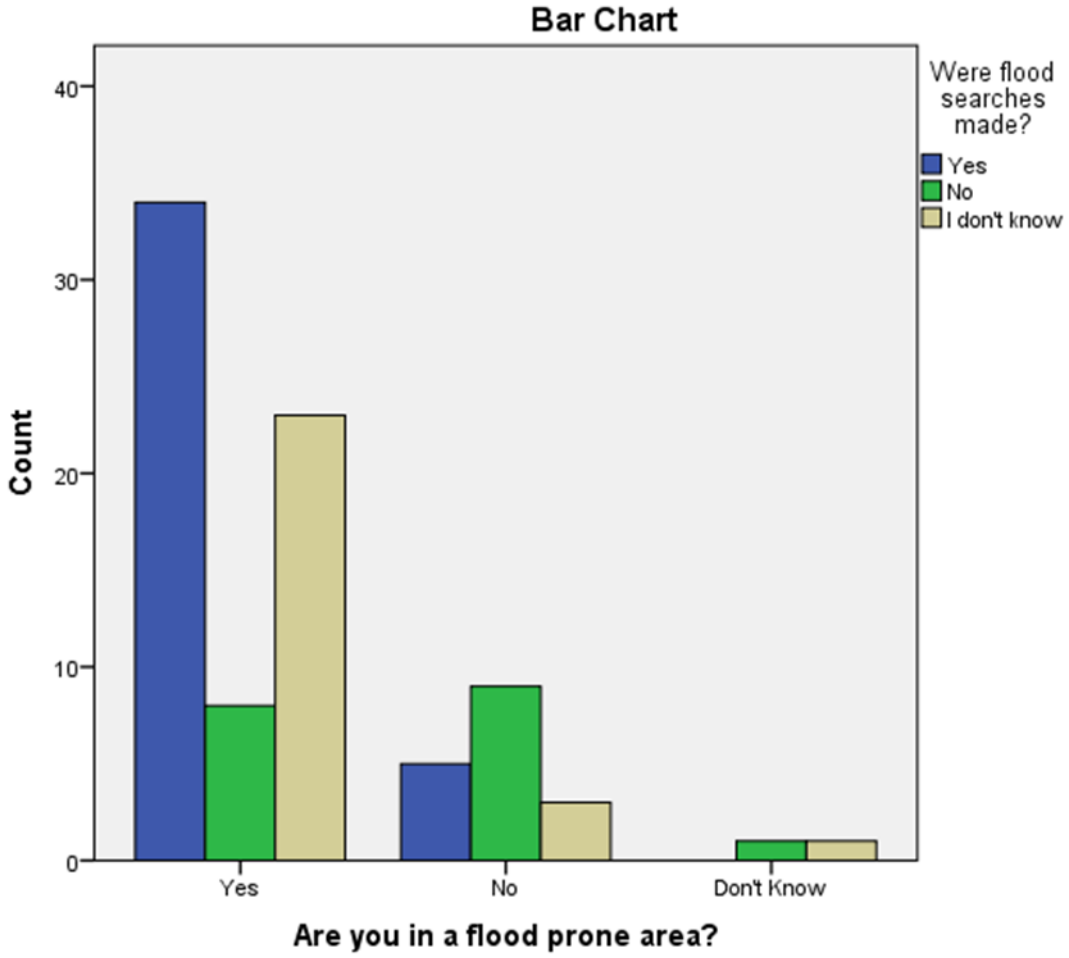

Figure 27: Flood search correlation

The question asked of respondents was designed to ascertain whether flood searches were conducted as part of the standard checks when purchasing a property. Thus, it largely targeted homeowners rather than those who were renting premises. The majority of responses indicated that searches had been conducted, thus conveying potential risk to the owners. The majority of respondents replied affirmatively, indicating that they had become aware of the level of risk upon purchase. In cases where the answer was 'No', this showed that the conveyancer did not register any flood risk in the area and that no search therefore needed to be conducted. From these responses, it can be concluded that property owners were made aware of flood risk through the use of legal searches.

The following question shown in Figure 28 was asked to determine whether necessary flood adaptations had been made to the properties that would have made them more resistant to cases of future flooding. The majority of responses were negative, showing that there were no flood adaptations or features that were integrated in the property to make the area resilient. A smaller

number of respondents living in older properties, however, did reply that these had some level of adaptation.

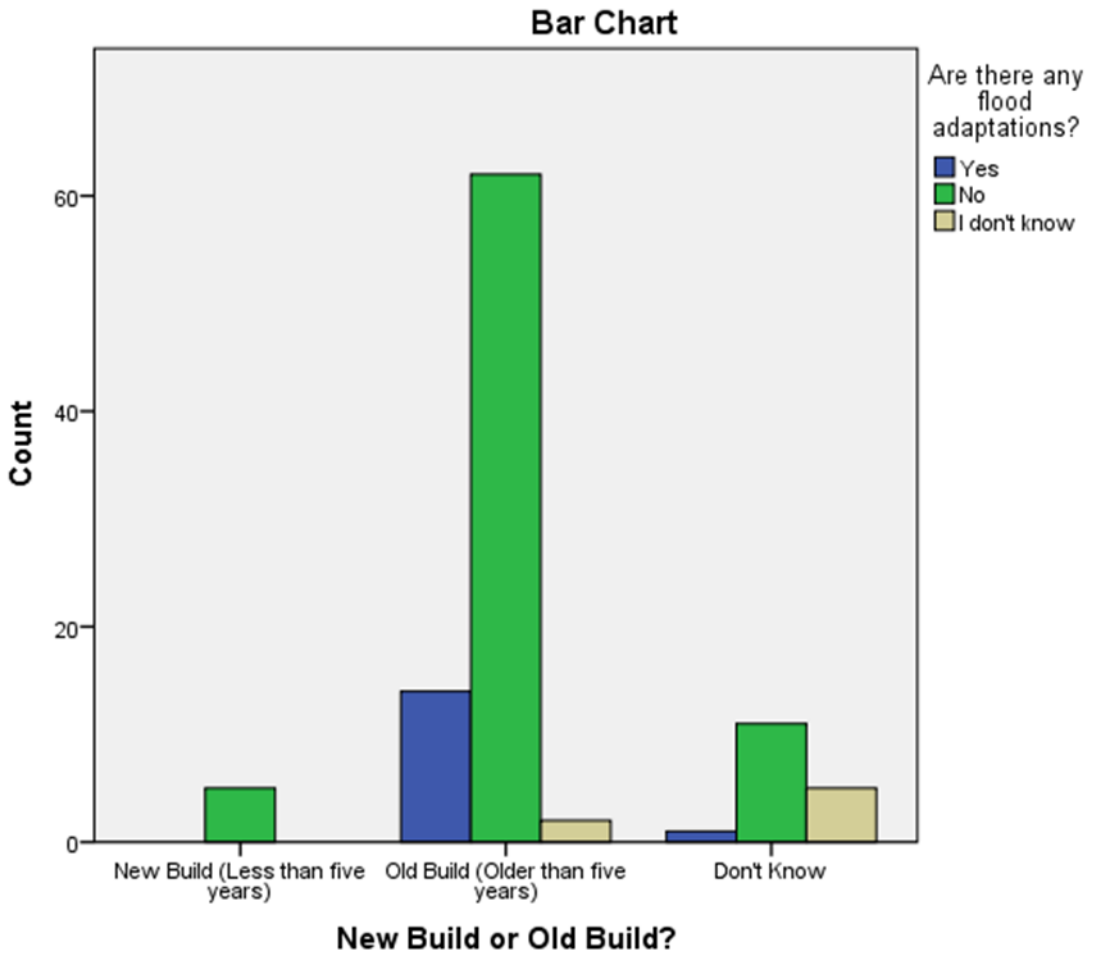

Figure 28: Adaptation of properties

Comments left by these respondents indicated that they had invested in flood adaptations after a flooding incident, although some came to feel that these were not taken into account by financial recovery systems such as insurance. Thus, there was little incentivisation of flood adaptation.

The extent to which respondents had made such adaptations is indicated in Table 13**: Flood adaptations to properties**. They were asked whether there were adaptations to their properties that could mitigate damage caused by flooding and a majority replied that there were none. When asked to state the reasons for not adapting their properties to combat flooding, several identified cost as a significant issue and others reported a lack of guidance or support on the matter. A number whose properties did have adaptations stated that their insurance providers did not take these into account. Therefore, the owners bore the cost of adaptation in addition to that of flood

response while gaining nothing financially from this investment. This is consistent with the interview data reported above, the experts having called for adaptation measures to be better incentivised by insurers. Instead, current flood insurance systems did not appear to acknowledge this fact and thus the costs were born solely by the property owners. In fact, a number of questionnaire respondents reported having been discouraged by this state of affairs. Thus, the current framework had the opposite effect to that of encouraging resilience.

Table 13: Flood adaptations to properties

Are there any flood adaptations?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	15	14.9	15.0	15.0
	No	78	77.2	78.0	93.0
	I don't know	7	6.9	7.0	100.0
	Total	100	99.0	100.0	
Missing	System	1	1.0		
Total		101	100.0		

This questionnaire item having established the nature of adaptations prevalent in properties, the next investigated the correlation between properties that had been flooded and those to which adaptations had been made. Analysis of the responses is illustrated in Figure 29, showing that the majority of properties lacked any form of adaptation and that the majority had suffered from at least one flood event. Thus, insufficient resilience measures had been taken in these developments that could have reduced the impact of flooding. As noted above, the reasons for the lack of flood adaptations varied among the occupiers. A small percentage referred to the fact that these premises were either rented or did not belong to the occupier. However, the majority were owned by the residents, who reported a lack of support in relation to adaptations. This was more prevalent in those properties that had experienced multiple flood events, as some respondents had even engaged in resilience efforts at personal cost but stated that this was not reflected in the cost of insurance. These findings are consistent with those of the semi-structured interviews with experts and of the literature review.

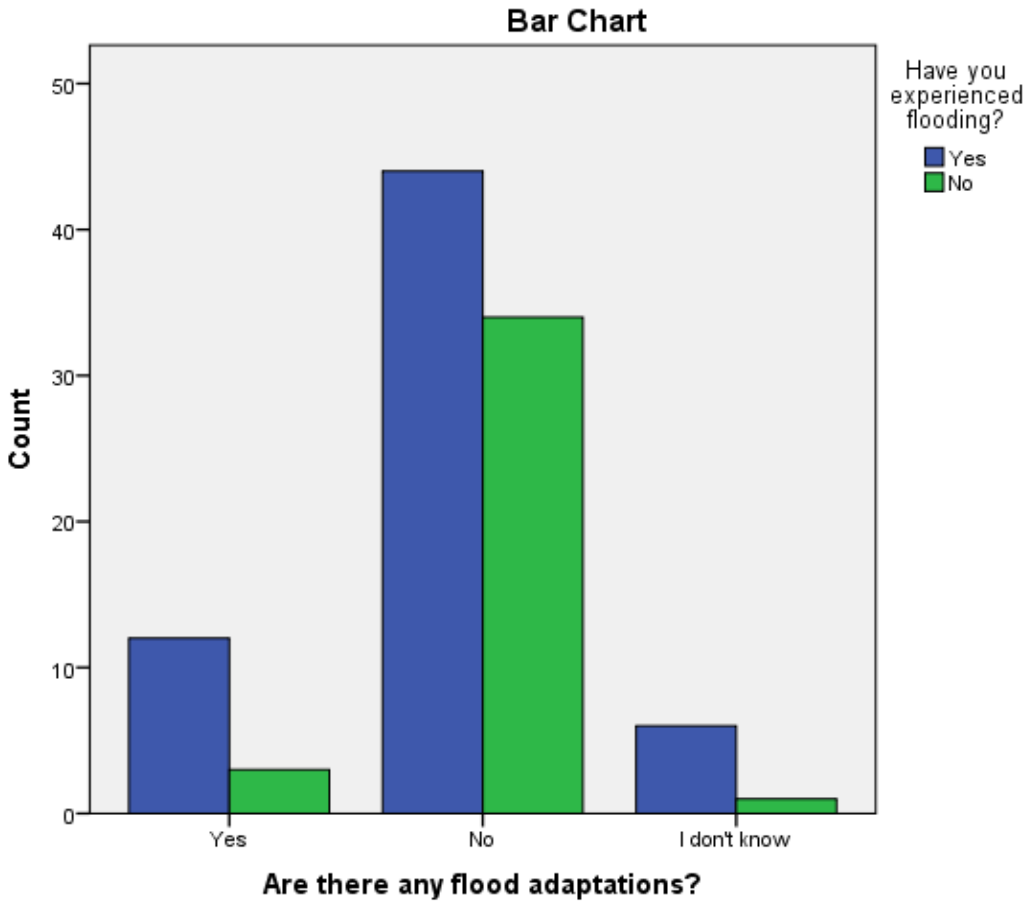

Figure 29: Flooding and flood adaptation correlation

Table 14 shows the correlation of flooding with adaptation, searches and insurance.

Table 14: Flood adaptation/insurance/search correlation

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Are there any flood adaptations? * Have you experienced flooding?	100	99.0%	1	1.0%	101	100.0%
Were flood searches made? * Have you experienced flooding?	84	83.2%	17	16.8%	101	100.0%
Do you have insurance covering for flooding? * Have you experienced flooding?	97	96.0%	4	4.0%	101	100.0%

The majority of properties lacked adaptations, but the owners had become aware of flood risk. They had also taken insurance in order to mitigate the impact of flooding. These responses reinforce the finding that people had not made adaptations because of the cost element, including the failure to reflect adaptations in insurance costs. This is related to the next question, that sought to determine awareness of flooding and whether properties had suffered from flooding.

Table 15: Flood awareness correlation

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Are you in a flood prone area?	101	1.32	.564	.056
Are you aware that it is a flood prone area?	68	1.59	.496	.060
Have you experienced flooding?	101	1.38	.487	.048

Table 15 shows that the majority of respondents had experienced flooding and were aware that they were in a flood-prone region. As indicated by a number of experts, this exposure tended to lead to a greater awareness of flood risk. Most participants were not initially aware that it was a flood-prone region but eventually came to learn of the danger, either through the legal process of acquiring the property or by direct exposure to flooding during a disaster event. Individuals who were frequently exposed to flooding hazards took more active measures to combat the flood risk. This demonstrates the importance of identifying a disaster as the first step in responding to it. Again, this finding is consistent with literature review and the expert interviews. The literature review indicates that exposure leads to the affected residents taking measures to mitigate flooding. This view was expressed by Interviewee 3, who lived on a floodplain and had experienced multiple flood events, indicating that one of the primary factors leading to awareness of flood risk is actual exposure.

Figure 30 shows that most participants reported having experienced flooding of their properties. The majority had taken flood insurance in an effort to mitigate the loss. This shows that one practical response to flooding for property owners is to buy insurance in order to help them recover from any flood damage.

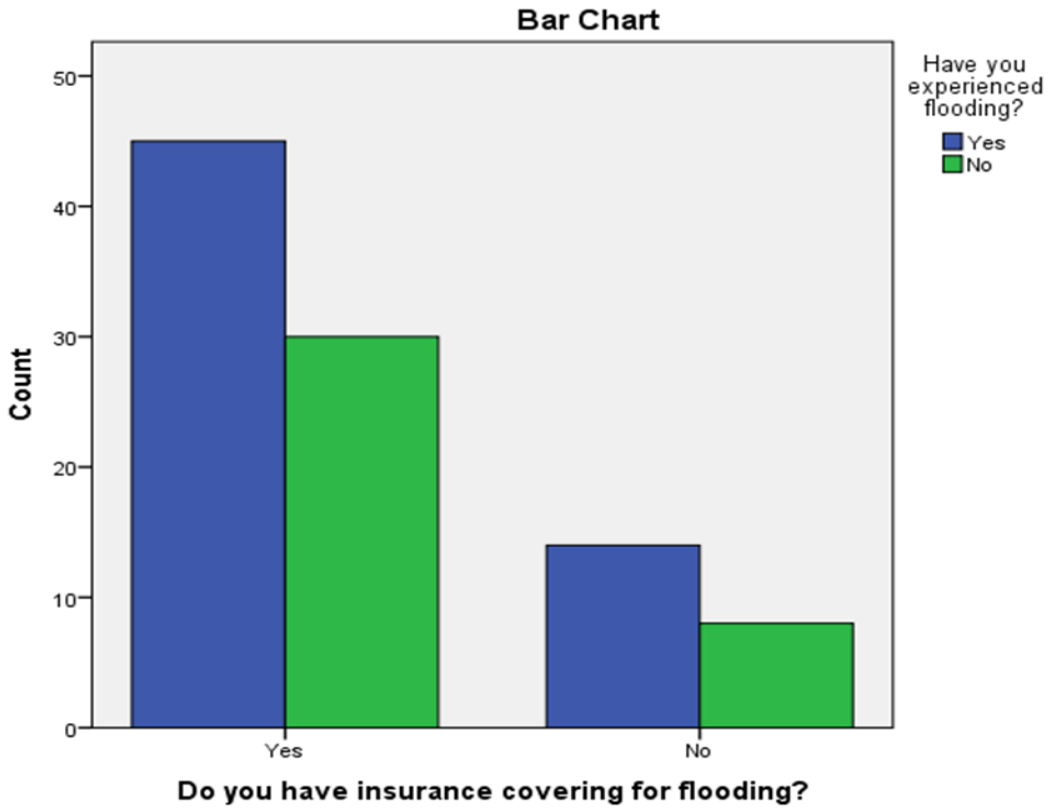

Figure 30: Flood insurance/experience correlation

An issue that the questionnaires sought to determine was the impact of multiple flood events on insurance-based schemes. Thus, the next item asked whether respondents had experienced a rise in their insurance costs as a result of a prior claim; Table 16 shows that a majority had.

Table 16: Rise in flood insurance costs

Have you experienced a rise in insurance cost post-flooding? * Do you have insurance covering for flooding? Crosstabulation

Count

		Do you have insurance covering for flooding?		
		Yes	No	Total
Have you experienced a rise in insurance cost post-flooding?	Yes (A lot)	18	2	20
	Yes (A little)	17	1	18
	No (Remained the same)	3	11	14
	Not Sure	7	0	7
Total		45	14	59

The increases reported in Table 16 are evenly split between ‘a lot’ and ‘a little’, but positive responses predominate, showing that most had experienced some post-flooding rise in insurance costs. This reflects an increase in the level of perceived risk from the viewpoint of the insurer, thus highlighting the assumption that the risk of future flooding remained high and warranted increased insurance premiums for property owners. Thus, within the floodplain communities surveyed in this research, many residents who had insurance cover also suffered from added financial costs due to prior flooding.

Once more, these findings are aligned with elements from the literature review and expert interviews which indicated that repeated flood events led to rising insurance costs being experienced by property owners, leaving them facing the danger of finding flood-related insurance cover to be unaffordable. This was found to be due to the projected increased flood risks in the future, as the result of climate change. Thus, claiming on flood insurance had a financial cost for property owners both in the form of their current premiums and in terms of a potential rise in future insurance costs. This is illustrated in Figure 31.

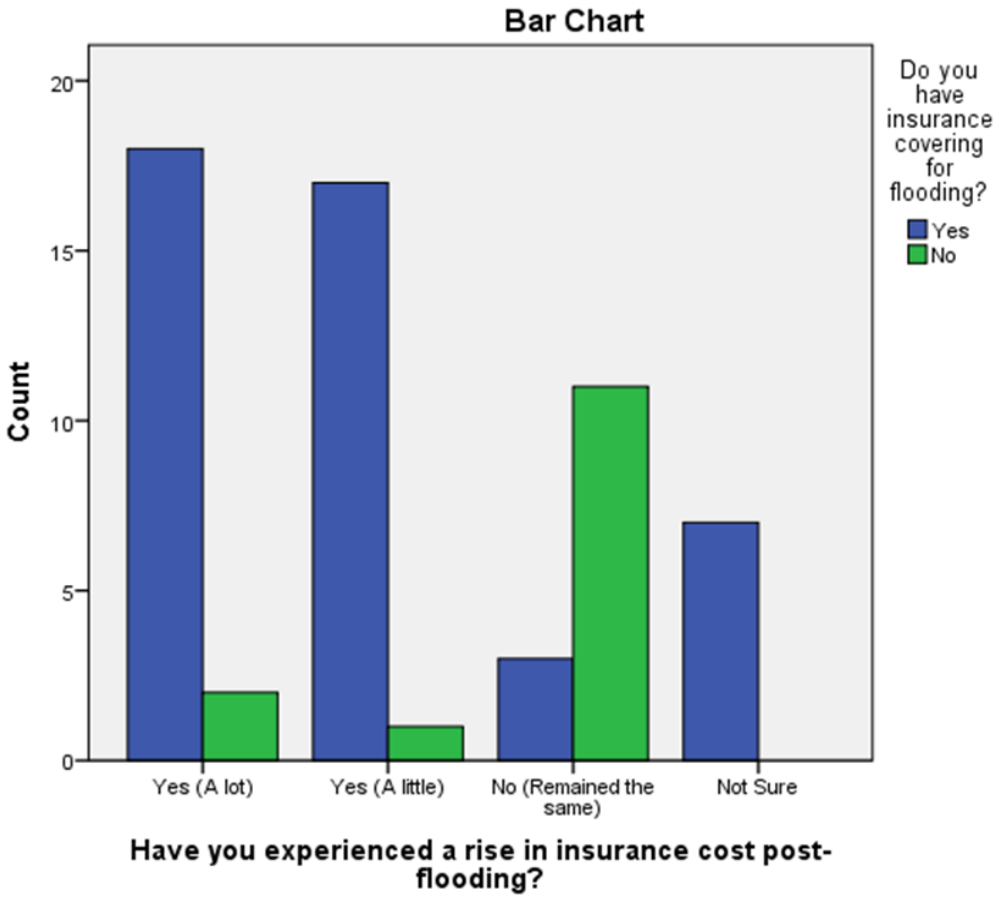

Figure 31: Flooding impact on insurance

The bar graph shows that the majority of property of property owners had experienced a rise in insurance costs as a result of flood events. In some cases, costs had risen multiple times per flood event, emphasising not only that these floodplain locations had experienced flooding but that they had suffered from multiple such events in a short period of time. As a result, owners had been forced to be reliant on their flood insurance measures on multiple occasions. The subsequent insurance claims had led to a rise in their insurance costs. Some participants provided additional information in the free text boxes, where they highlighted the costly nature of multiple flood events, in line with the expert opinion elicited during the semi-structured interviews regarding the rising cost of insurance post-flooding. This highlights an element of the discussion, namely that affordable insurance alone was not seen as an effective means of managing flood risk, as costs incurred would rise until they became unaffordable. The largest factor was thus the encouragement of resilience.

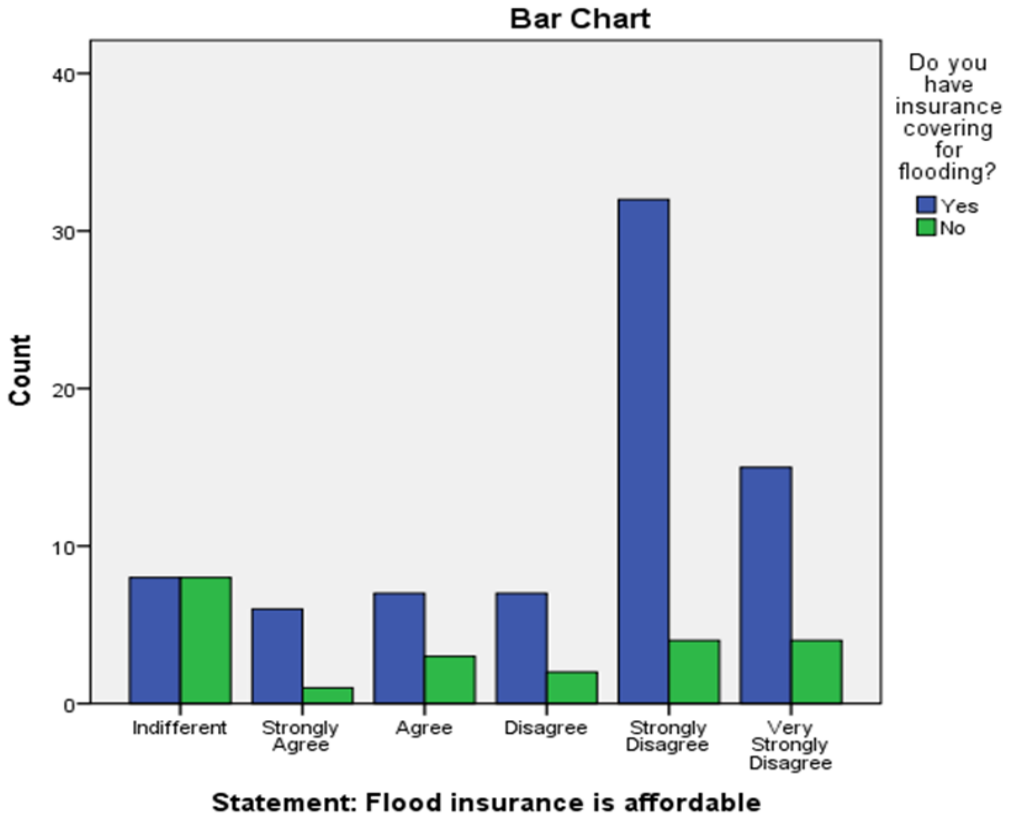

Figure 32: Flood insurance affordability

Figure 32 illustrates participants' responses as to whether they believed insurance mechanisms were affordable. The consensus was that they did not feel that insurance systems were affordable. This is related to the earlier question as to why participants did not take part in resilience measures such as adaptation or insurance.

Table 17: Awareness - correlation to climate change

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Are you aware that it is a flood prone area?	68	1	2	1.59	.496
Statement: Flooding is due to climate change	100	0	6	2.28	2.084
Statement: Flooding is a natural disaster that cannot be prevented	101	0	6	2.57	2.238
Valid N (listwise)	67				

The correlation shown in Table 17 provides an in-depth look at aspects such as awareness of flooding and respondents' views on flooding as a natural disaster. The majority believed that flooding was the result of climate change, which correlates with the findings of both the literature review and the expert interviews. Respondents expressed the general view that the nature of flooding meant that it could not be prevented, although this left open the possibility that its effects could be mitigated. This is linked to the nature of flood risk management, in that it seeks to control the level of damage.

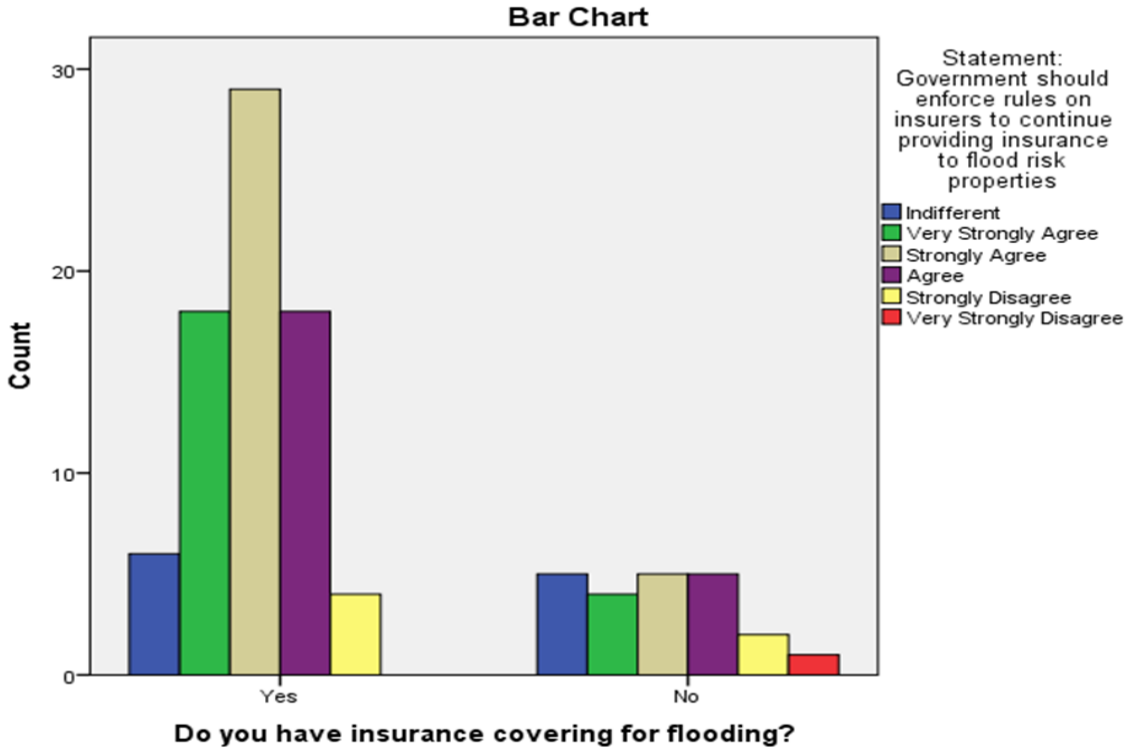

Figure 33: Governmental role in flood insurance

Finally, Figure 33 reveals that participants largely believed that government efforts were needed to help in making insurance available to floodplain occupants, the majority more or less strongly agreeing that the government should oblige insurers to continue providing such cover. This indicates that floodplain occupants within the sample areas believed that the government had a key role in flood insurance. Thus, governmental aid was needed in providing insurance to flood-risk properties, according to the majority who had flood insurance cover, while only a few disagreed with the statement. These largely consisted of people lacking any insurance cover for their properties, which would have protected them from flooding.

4.3.2. Analysis of Interview Findings

As noted in Section 3.7.2.2, the small size of the sample of expert interviewees allowed the data to be analysed manually. A number of common themes emerged from this process. As indicated in Section 4.2.2.1, the threat of flooding was expected to increase in the future. Thus, all of the experts were in agreement that factors such as climate change had increased the threat of flooding and that the danger needed to be managed to prevent exposing communities to the risk. This correlates with the findings of the literature review reported in Chapter 2:of a rising threat of flood risk and that policy guidelines operated on the basis of managing the danger. Similarly, the experts all commented on the rise of floodplain developments within the UK. The data gathered correlates with findings from the literature review which show that factors such as population pressures and ease of planning have led to increasing numbers of houses being built in areas at significant risk of flooding. However, the experts differed in the nature and level of response. Some highlighted the need for planning guidelines to steer developers away from building on floodplains, whereas others felt that the central issue was not the location of buildings but rather adapting properties to better manage flood risk. However, the experts broadly agreed on the nature of the regulations and the existing framework for the management of flood risk. Interviewee 7 noted that policy guidelines could even be used to help rectify any barriers to flood risk management within the UK. In fact, one of the key findings from the questionnaire survey concerned insurance, consistent with the view expressed by Interviewee 7 that factors such as resilience and affordability could be enshrined better in the regulatory framework.

The expert interviewees had a common position on the nature of insurance and its role as a tool of flood risk management. As stated in Section 4.2.2.4, a theme emerging from these discussions was that of a growing danger that repeated acts of flooding would mean more

claims and therefore increased insurance premiums and costs, leading insurers eventually to stop offering cover for those properties at risk. Thus, whilst insurance was still available, it was no more than a temporary means of addressing flood risk. The main issue that interviewees identified with this tool was that it did not effectively improve the resilience of affected properties to future flooding. As for adaptations, which were brought up as another tool that was used in flood management, experts warned that their adoption was not always employed as a means of reducing flood risk. The reasons varied: Interviewee 2, for example, noted that in some cases, owners felt that it affected the resale value of their property, while Interviewee 6 raised an issue linking adaptation with the role of insurers, namely that an aim of insurance should be to improve the resilience of properties and that this should be a goal of flood risk management. This response is consistent with the need, highlighted in the literature review, to make communities better able to manage flood risk. Interviewee 1 noted that that the current Flood Re system aimed to make insurance more affordable, but warned that this was only temporary and that the goal of achieving resilience had failed. This view was shared by Interviewee 6, who stated that without resilience being achieved, Flood Re was only a temporary solution and only for properties that qualified for insurance cover.

The majority of responses on the matter of flood defences indicate that the experts were largely in agreement. They acknowledged that the UK had strong flood defences in place, the only critique being that they needed to be updated to match the current scale of flood risk. Interviewee 2, in fact, stated that the level of engineering meant that the UK could build on areas at significant risk of flooding, so long as measures were made to reduce the harm to properties built there. Indeed, there was a general consensus that adequate adaptations and defences being in place could protect communities from flooding. As to the issue of funding, however, the experts differed somewhat. A number felt that funding was not an issue but that more focused funding efforts should be directed to more vulnerable areas. An issue raised by Interviewee 1 was that the danger of flooding tended to be forgotten and became a matter of concern only when new floods occurred. This reflected a systemically reactive attitude to flooding, whereas what was required were more proactive measure which would promote and reinforce flood resilience.

This analysis has identified a number of challenges and barriers in relation to flood risk management, which are enumerated and discussed in the following section.

4.4. Challenges and Barriers Identified

Many of the challenges and barriers to improved and sustainable flood risk management in the UK emerging from the above analysis can be seen to correspond with the findings of the literature review detailed in Section 2.5. It was established that the same regulatory tools that were used to manage flooding faced impediments to their ability to operate. Similarly, the data collection established that the three main challenges were in relation to floodplain development, adaptation and insurance.

1. **Floodplain development**: Participants in the study fell broadly into two groups in respect of their opinions regarding the matter of floodplains. The majority of questionnaire respondents, all of whom were floodplain residents, shared the general view that floodplain developments should cease, as indicated by quantitative analysis of their responses. This opinion is in line with the indication in the literature that there are a growing number of developments on floodplains and that such developments go against official guidelines on avoiding such sites. As to the expert interviewees, their opinions varied, with some giving responses which indicated that building on floodplains was a valid option so long as the appropriate engineering measures were in place, whereas others expressed the opinion that floodplain development should be discouraged, concurring with the national strategy of avoiding such locations. Thus, floodplain development can be identified as a significant challenge or barrier to flood resilience, because any increase in developments on floodplains will expose more properties to flood risk.
2. **Adaptation**: On the matter of adaptation, the data indicate rather less diversity of opinion between the two groups of participants than on development. Among the questionnaire respondents, there was general concern over the failure to promote adaptation sufficiently strongly, an issue to some extent connected with that of insurance, discussed below. According to a number of responses, there was little encouragement of flood-resilience adaptation. In some cases, property owners had made adaptations at their own expense and these did little to aid them following multiple flood events. The literature indicates that the primary flood risk management strategy is the promotion of resilience, while the apparent failure to encourage adaptation represents a barrier to resilience experienced by floodplain occupants. The expert interviewees concurred that there was little incentive for owners to make adaptations to their properties and they too linked this to the question of insurance.

3. **Insurance**: Analysis of the data collected for this research thus identifies insurance as the third major barrier to achieving flood resilience. Questionnaire respondents mostly reported having flood insurance in place, but many complained of rising costs and there was widespread disagreement among this sample of floodplain residents that premiums were affordable. The rising cost of insurance in the face of the growing risk of flooding due to climate change is also identified as an issue in the literature, with contributors noting, as discussed in Chapter 2, that while restoring a flood-damaged building to its pre-disaster condition can be seen as a measure of recovery, true resilience can be achieved only by improving it so that it is better able to withstand the next flood event. Thus, by failing to recognise this distinction, the insurance sector was seen by a majority of the expert interviewees as erecting a barrier to the creation of resilience. There was a consensus among them that insurers were not encouraging resilience and that there was no systemic mechanism for establishing resilience to flood risk.

The data analysis allows further refinement of the identification of the barriers identified above and permits deeper reasoning of the mechanisms by which they obstruct effective flood risk management. Questionnaire responses indicate the failure of insurance companies to consider flood adaptations to properties as a factor partially determining premiums, thus discouraging owners from performing adaptation work. There were also concerns over affordability among floodplain occupants, while some expert interviewees regretted the lack of a holistic approach to flood risk management. The analysis of both datasets suggests that flood risk is likely to increase in the future and that floodplain communities are inadequately protected from the consequences.

4.5. Chapter Summary

In conclusion, the fieldwork conducted for this study has gathered rich primary data on the nature of flooding and on practical aspects of its consequences and prevention. This can be seen to complement the secondary data acquired by means of the literature review. The questionnaire survey offered a view into the experiences of the residents of floodplains and of the practical difficulties and challenges they experienced after flood events. The analysis has linked these data with the expert opinions elicited during interviews with people working in the flood risk management sector, providing not only an overview of the challenges and barriers to flood resilience but also some indication of potential solutions. Although the target was to conduct ten interviews, the data gathered from seven interviewees can be considered sufficient,

falling within acceptable guidelines for adequate data collection. Furthermore, the interviews can be seen as having reached a level of data saturation, since the later interviewees tended to repeat much of the information given in earlier interviews, leading the researcher to decide to stop gathering data by this means. The findings of the data analysis depict floodplain residents' experiences of flooding, which serve as the basis for a discussion of the challenges and barriers to successful floodplain regulation and management in the UK. This concluded that factors such as insurance and adaptation had not been fully addressed and that resilience must be the end goal of any flood risk response. According to the experts, it was determined that the means of achieving this would be to use policy to help enshrine resilience within the regulatory framework.

This exercise has confirmed the existence of barriers to the implementation of a robust flood risk management framework identified in the literature review. The research has shown that a more holistic approach to flood risk could be achieved through changes to the law. Legislation underpins flood response in practice and plays a key role in the management of flood risk. Some of these points were made by expert interviewees who showed themselves to be open to the idea of using law and policy to respond to any weaknesses in the framework. The next chapter presents a discussion aimed at producing recommendations for improving the regulatory framework in order to address these weaknesses, with the goal of producing a more effective flood risk management system.

Chapter 5: Discussion

The literature review conducted for this research has established flooding as one of the most common disasters to affect the UK. It is considered a major risk according to the National Risk Register (Cabinet Office, 2013; Surminski, 2014). In addition, it is recognised as among the costliest of natural disasters to impact the UK (Harries, 2013; Surminski, 2014). In fact, the threat of flooding is said to be increasing over the last few decades across the world, because of factors such as population growth, urbanisation and the effects of climate change (Bates et al., 2008; Steinführer et al., 2009; IPCC, 2012; Kundzewicz, 2012; Arnell and Gosling, 2013; Guha-Sapir et al., 2013; UN, 2014; Ward et al., 2015; Kundzewicz et al., 2016; Driessen et al., 2016). The danger posed by flooding is expected to continue, this persistence being attributed to climate change and socio-economic developments (IPCC, 2012). Annually, flood events are the most disastrous of hazards that extensively impact human wellbeing, economies and ecosystems around the world. Research indicates that the effects of flooding may be more extreme than previously estimated when taking into account the potential increases in rainfall volume and intensity and risk of extreme sea-level rise (Evans et al., 2008). As such, the danger posed by flood risk is likely to increase in the future. This affects floodplains in particular, as these areas are naturally prone to flooding and therefore suffer from a higher degree of flood risk. Floodplains are also among the most densely populated areas in the world and are seen as particularly well suited for development (Kron, 2005). However, environmental changes alongside wider societal changes could potentially alter the likelihood of human exposure to hazards and the susceptibility of people to their impacts (Few, 2007). It has been noted that crucial changes in flood risk management have two salient aspects, the first being a shift from reliance on physical power to one on social power and the second being that no single organisation has the power to affect change (Pender, 2011). This reflects the views of participants in this research as evidenced by responses to the questionnaire survey and in the semi-structured interviews reported in Chapter 4:.

Multiple sources of data have been employed to highlight the experiences of floodplain residents and the views of experts in flood risk management in the UK and to triangulate these data with existing knowledge reported in the literature to provide the basis for the discussion which follows. The five main sections of this chapter cover successively the UK flood risk management framework, governance, economic instruments, a holistic approach to flood management and verification. The discussion begins by revisiting the final main topic of

Chapter 4, namely the challenges and barriers to the effectiveness of the existing flood risk management framework.

5.1. The UK Flood Risk Management Framework

5.1.1. Challenges and Barriers

The literature review reported in Chapter 2 and the data analysis in Chapter 4 have established the existence of a number of barriers to effective flood risk management within the UK, which are addressed specifically, in their respective contexts, in Sections 2.5 Challenges and Barriers Identifiedand 4.4. The regulatory framework refers to a number of tools designed to respond to flood risk. However, it lacks evidence of a holistic approach to flooding, as some of the tools operate independently and without correlation with one another. The result is that the framework is impeded in its ability to operate effectively. This is exemplified by the fact that the aim of insurance seems to be to simply restore damaged property to its state prior to flooding, rather than encouraging flood-resilient adaptations to buildings. Thus, insurance has failed to make these properties resilient to future flooding incidents. These challenges are correlated with the level of flood risk, which is set to increase in the future. Unless they are addressed, the flood risk management framework cannot operate effectively.

5.1.2. Findings on Flood Risk

In terms of flood risk management, there have been notable improvements to the regulatory framework. Since the implementation of the EU Flood Directive, there has been greater transparency and easier access to flood risk information, so that members of the public in many European countries now have access to information on legislation and policy relevant to flood risk. Thus, the outcome of the Pitt Review was largely a success, as it forms the basis of the current framework, having addressed shortcomings in flood response at the time. However, a number of challenges and barriers to the effectiveness of the current framework remain in place. A common theme emerging from the interviews was the awareness of flooding by the public and society as a whole. According to several interviewees, property owners do not take measures against flooding unless they have experienced at least one such event. Thus, previous exposure to flooding is correlated with a stronger perception of the risks (Burningham et al., 2008; Grothmann and Reusswig, 2006; Plapp and Werner, 2006). Therefore, this personal exposure causes property owners to make personal efforts to combat the risk (Wachinger et al., 2013). Afterwards, they begin to consider the potential options for managing the risk of future

flooding. In some cases, this takes the form of signing up for flood alerts, whilst in others it means making flood adaptations or taking out insurance. However, it was mentioned that a number of property owners felt that the responsibility to combat flooding was left to others such as the government. Interviewee 1 noted that property owners sought flood resistance rather than flood management, the difference being that they did not want to allow any water to approach their property, which goes against the concept of flood risk management. The same interviewee explained that ultimately, flooding cannot be stopped but must rather be managed. This is consistent with the assertion in the literature that the approach to flooding has gradually shifted from the concept of flood defence to that of flood risk management.

Figure 34: Flood risk management goals of government *(Source: Defra, 2018)*

Figure 34 shows flooding as one of six areas of priority risk within the UK requiring further action over a five-year period. Its position at the head of the list and its high-risk magnitude status highlight the urgent need for further action and research in order to improve flood risk management in the country. Among the questionnaire respondents, there was a general consensus on a lack of certainty about managing the hazard and its effects on their homes. This finding matches reports in the literature of flood events being associated with feelings of uncertainty (Sharp, Burns and Bass, 2008; Pitt, 2008). National government often receives the blame for any failures in managing flood risk (Rothstein et al., 2006). The concept of flood risk management has gradually gained in importance over the years, thus substituting the earlier views on flood defence. Similar findings emerged from the interviews, with Interviewee 1 observing a shift in focus from flood defence to flood management. They also acknowledged

the existence of a regulatory framework but argued that coordination was in need of improvement. As such, rules come into effect as they create the boundaries on the use of power. According to Pender (2011), *"legal frameworks are the archetypal systems of formal rules, whilst governments are the archetypal setters of formal rules"*. Interviewee 4 called for a more holistic approach to flood management, while Interviewees 1, 2 and 3 warned that the danger posed by flooding was likely to rise in the future and that steps needed to be taken to improve flood management. Similarly, a large proportion of survey respondents agreed that flooding was a danger caused by climate change and that measures were needed to manage the risk. An important element of flood risk management is resilience. The Pitt Review (2008) defines resilience in the context of flooding as the capacity of an individual to anticipate, cope, resist and recover from a flood event. In 2019, calls were made for the government to review recent flooding and to examine possible responses including flood defence funding, insurance and mitigation of climate impacts (House of Commons, 2020).

An area of growing importance is flood governance, which concerns decisions taken in relation to flooding, including by nongovernmental actors such as civil society and private sector bodies, operating in conjunction with one another to create a cooperative form of governance.

5.2. Flood Governance

It is not feasible in every location at risk to use flood defences as a means of flood prevention. Instead, there has been a shift towards flood risk management, to make the environment socially, economically and environmentally more sustainable. As discussed above, there are many tools that can aid in bringing about flood resilience. Flood risk management is said to require both structural and non-structural solutions in order to minimise both the physical and non-physical impacts of flooding (Defra, 2005; Defra, 2011a). One of these is the use of flood governance. An aspect of the present study is legal research, which offers a means of interpreting legislation and laws, because legislation and policy guidelines are among the tools of flood risk management. A degree of legal certainty is needed, yet legislation should remain flexible in order to adapt to foreseeable changes in the future. By expressing clear flood governance principles, a sense of certainty has been achieved, thus providing clarity on the responsibilities of public bodies and communities. The EU Flood Directive offers a degree of flexibility to member states in matters of policy and in the design of national flood risk management frameworks. In the Netherlands, there are legally binding principles in relation to safety standards that provide clear guidelines on governmental responsibility for flood

protection (Driessen et al., 2018). In contrast, some countries lack such robust standards, leaving it to individuals to determine the level of protection for their respective properties. In addition, they have had to interpret policy documents in order to determine the scope of responsibility of the private sector in flood protection. However, Driessen et al. (2018) argue that clear definitions are essential for an effective and coherent flood risk governance framework which clarifies the division of roles and responsibilities, allowing for the effective implementation of flood risk management initiatives.

Within Europe, the EU Flood Directive (2007/60/EC) emphasised prevention, mitigation and preparedness and created a procedural approach that allowed member states policy discretion when designing flood risk management. It required them by 2015 to set out *"appropriate objectives for the management of flood risk and [reduce] potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity"* (EC, 2007). Its aim, along with national obligations linked to it, was to promote flood risk reduction. In France, the constitution defines a role for national solidarity in the face of natural disasters. Furthermore, it favours measures to respond to the consequences of flooding with a dual emphasis on physical interventions and on financial measures such as compensation for victims of flooding. There has been a shift in France towards increased use of prevention as a means of combating flooding (Larrue et al., 2016; Driessen et al., 2018). Meanwhile, in Sweden, flood risk governance has taken a localised approach whereby municipalities and civil contingency agencies have adopted a dominant role in flood response (Ek et al., 2016; Driessen et al., 2018). In Germany, the law places an emphasis on individual responsibility for adopting flood mitigation measures (Hartmann, 2016). This has encouraged the floodproofing of properties and promoted flood insurance, paid for by the individuals at risk, while landowners upstream have the duty to reduce runoff. The government of the Netherlands has a constitutional duty to defend the country from natural disasters including coastal flooding, given that much of the territory is below sea level.

Eks et al. (2016) give England and Sweden as examples of countries where planning legislation is required to consider the effects of climate change. In England, s.7 of the Flood and Water Management Act (2010) cites the national flood risk management strategy of the EA regarding *"the current and predicted impact of climate change"*. The history of flood-related legislation is detailed in Section 2.3.1.1 of the literature review. Significantly, flood management in the UK relies on national guidance and local discretion, with decisions based on negotiation rather than legally binding land-use plans (Campbell et al., 2000; Cullingworth et al., 2004; Janssen-

Jansen and Woltjer, 2010). For many years, England has taken a holistic approach to flood risk management. In fact, it has been described as relatively diversified and balanced, although some specific approaches are said to be in need of improvement to their effectiveness (Hegger et al., 2016; Driessen et al., 2018). Such improvements would include a range of options such as encouraging property-level protection, community flood action plans and strategies for mitigation, as well as flood response. An example is the flood risk management measures that allow local authorities to conduct work on ordinary watercourses, under a duty detailed in the Land Drainage Act (1991) as amended by the Flood and Water Management Act (2010).

According to Keessen and van Rijswick (2012: 40-41), the promotion of resilience by legal measures depends on a number of factors, including:

1. Striking a balance between legal certainty and flexibility in order for rules to better respond to change without becoming arbitrary;
2. Improving adaptability of rules by allowing for the capacity to learn through iterative processes and decision making;
3. Providing an open system and opportunity for participation in the decision-making process;
4. Offering multilevel governance on a bio-regional level; and
5. Ensuring the effectiveness of the legal framework by providing conditions for its implementation and enforcement.

A study by Eks et al. (2016) divides legal rules into three categories: a) administrative rules, concerning e.g. licensing processes and supervisory roles, b) substantive rules, concerning environmental and safety standards and the establishing of liability, and c) property rules, addressing rights concerning water and flood defence infrastructure. Others have suggested that when many communities are affected by a phenomenon, regional or national government should react by adapting legislative or financial frameworks to contribute to flood risk management (Hartmann, 2011; Wiering et al., 2017). These examples show how governments can use governance to deliver more effective change in response to perceived risks. Interviewee 6 similarly said that strong flood governance through legislation could clarify the definition of roles and responsibilities, asserting that this was not true of bodies subject to the existing regulatory structure, such as the EA and local authorities. Thus, they were part of the wider group of bodies involved in the flood risk management process, including aspects such as insurance, adaptations and the actions of floodplain communities.

Current UK legislation and policy do not state that resilience is an end goal of flood risk management. Therefore, effective governance is lacking, as policy guidelines are unclear and there is legal uncertainty. As such, clear definitions are needed in order to ensure the effective implementation of a flood risk governance framework (Keessen and Van Kempen, 2010; Keessen and van Rijswick, 2012). In order to promote resilience, flood governance could be used by expressing the end goal of flood risk management measures, namely, to make areas more resilient to flooding in the future. Clarification could be achieved by defining duties and responsibilities for both governmental bodies and public authorities, enshrining these as end goals in law. Such measures could be achieved through a variety of additional tools operating within the flood risk management framework. This point was made by Interviewee 6, who asserted that a clear legal basis could provide goals for insurance and compensation schemes. In terms of paradigm shifts, the approach represented by the Making Space for Water programme can be seen as a means of achieving a more holistic view of flood risk management (Defra, 2005). Johnson and Priest (2008) see this as a way of achieving a 'softer' form of flood risk management in comparison to the traditional approach of building hard engineered defences to keep water out. Despite the growing expectation among policymakers of collaboration from the private sector in delivering public policy goals in a climate of budgetary constraints, Surminski and Oramas-Dorta (2011) warn that barriers to achieving this have become important factors in areas at high risk of flooding such as floodplains.

5.2.1. Floodplain Development and Planning

Interviewee 2 described the current UK flood management system as a strong one that served as an example to other nations and stated that the EU Flood Directive had stimulated development in regional and national flood risk management, with cooperation on transboundary lines (Priest, 2016; Suykens, 2017). It thus serves as a means of good practice in creating a comprehensive review of flood risks to make decision makers and the public aware of the hazard. It has been incorporated into the Water Framework Directive, which is reviewed every six years as part of a coordinated and synchronised implementation strategy. This allows it to adapt and learn from past mistakes, thus promoting resilience. In the UK, national policy sets guidelines on floodplain development and *"strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed"*. The planner's approach, common in countries such as Germany and France, treats hazard maps and vulnerability as key components of flood risk management. However, Tromans (2012) warns

that the approval process for floodplain development is not sufficiently transparent or accountable. Potter et al. (2016) add that planning pressures over the decades have seen further relaxation of the strict guidelines regarding floodplain development. Interviewee 4 similarly spoke of the need for greater transparency with regard to floodplain management, while Interviewee 3 believed that any such approach to flood management must be driven by the needs of the community and should focus on them. They highlighted that the EA knew the outcome of only 65% of planning applications to which it had objected.

In 2015, the Committee on Climate Change reported that around 1,500 new homes were built annually in areas of high flood risk, along with 3,100 in medium flood risk locations (CCC, 2015). Despite these risks, a recent parliamentary report states that local authorities in flooded regions had planned to build 11,410 properties in areas at risk of flooding, which would expose them to danger (House of Commons, 2020). Researchers have recommended that a balance be struck between the competing demands of the environment and housing development (Borrows, 2006; Gallent, 2008). They call for development in high flood risk areas to be curtailed, because any new such developments would increase flood protection costs as well as the risk of damage. This view is shared by insurance companies, which desire better control of floodplain development and an increase in funding for flood defences (Crichton, 2012). The government has rejected these recommendations as inappropriate, asserting that the existing planning process addresses the management of flood risk inherent in building in such locations if necessary (HM Government, 2015). The interviews delivered findings consistent with this position, with a number of experts stating that current engineering and flood risk management efforts could allow for development even in areas at high risk of flooding. According to Interviewee 2, for example, the UK's engineering efforts and the size of its rivers make floodplains much more manageable than in some other countries. However, Interviewee 3 warned of the dangers of living on a floodplain at high risk of flooding, including financial difficulties arising from repeated losses and the danger that affected properties would be impossible to sell. Indeed, Interviewee 3 went so far as to recommend that people should not live on floodplains, given the inherent dangers of doing so. Questionnaire responses reflect a similar concern regarding floodplain developments, with many stating that these should be curtailed.

The expert interviewees gave varying responses on this matter, however. The majority were of the opinion that developments on floodplains could be allowed so long as they were properly assessed and measures were taken to reduce the level of flood risk. Interviewee 2 expressed the

view that developments could be allowed even in areas of high flood risk, as current engineering technology had advanced to the point of being able to better manage the flood risks posed by the UK's relatively small rivers, whereas Interviewee 3, as noted above, insisted that all such developments should be refused, adding that life on a floodplain was one of constant fear and stress. Responses to the questionnaire show that many participants had been not aware that they were moving onto a floodplain but became aware of it at some point afterwards. A number of them cited the danger inherent in building in such locations, which some felt should be disallowed.

Policy guidelines thus seek to influence the nature of development by promoting resilience. At the same time, they discourage development in areas at high risk unless flood risk management measures are in place. These include not only construction but also additional management tools such as elements of insurance and systems designed to promote mitigation of flood damage. Among the available means of influencing development is the use of economic instruments, which the next section discusses in detail.

5.3. Economic Instruments

Economic instruments are defined as *"fiscal and other economic incentives and disincentives to incorporate environmental costs and benefits into the budgets of households and enterprises"* (OECD, 2001). These include the use of subsidies, taxes and insurance as options for managing risk and adapting in response to climate change. In this regard, they serve to share and alleviate risk by providing financial or market-based incentives. Economic instruments have been used to promote the economic efficiency of water resources, with recommendations for their use in the Water Framework Directive (Gómez-Limón and Martín-Ortega, 2013). The goal of economic instruments is to use administrative mechanisms in order to achieve a more economically efficient distribution of resources and bring about a change in behaviour of economic agents through incentivisation. This can be achieved through pricing mechanisms or by making certain options economically attractive. As such, economic instruments have a role in encouraging damage mitigation measures. The failure to integrate economic instruments in water reforms in Europe has been acknowledged as a reason for the under-achievement of the Water Framework Directive's objectives (EC, 2012). In fact, there is evidence of less than optimal levels of adaptation in response to present and future hazards created by climate change (Agrawala and Fankhauser, 2008; IPCC, 2014), highlighting the need for better integration of economic instruments into mitigation efforts in order to bring about effective change.

Such instruments offer a 'price signal' for risk management in order to incentivise behavioural change (Bräuninger et al., 2011). Thus, instruments that reflect resilience could influence policy, such as leading to changes in planning systems and building regulations. In relation to climate adaptation, researchers have placed an emphasis on the use of economic instruments and criteria (Hellegers and van Ierland, 2003; Fankhauser et al., 2008; Filatova 2014; Mees et al., 2014). Agrawala and Fankhauser (2010) note that the various kinds of economic instrument are tailored for different sectors, such as insurance schemes (all sectors), price signals (water), financing schemes (flood defence), regulatory measures (building and planning) and research incentives. Bräuninger et al. (2011) specify that they have a role in disaster mitigation but a more minor role in adaptation. This distinction was reflected in the interview responses elicited in the course of this research. A comprehensive legal framework could improve the effectiveness of economic instruments in flood management.

5.3.1. Funding

Funding arrangements are important in determining how a country responds to flood risk by allocating the necessary funding for flood defences and flood management initiatives. European nations vary in their funding arrangements in relation to flooding. Garrelts and Lange (2011) found that funding for coastal protection schemes in Germany was split evenly between central and regional government. Meanwhile, in the Netherlands, the culture of national solidarity ensures a high degree of protection and flood defence involving large expenditure on maintaining flood risk management. In fact, Van Rijswick and Havekes (2012) report an annual expenditure of approximately €6.5 billion on water management, of which only a small proportion is generated through general taxation, the majority of the funding being made available through the regional water boards (Penning-Rowsell and Priest, 2015). In Austria, flood risk management authorities have spent €220 million annually on flood protection (Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 2006; Penning-Rowsell and Priest, 2015). These facts reflect the differing approaches to the priority of flooding in different countries.

In the UK, most flood management funding comes from the taxation of individuals and businesses, distributed through Defra to the EA (Penning-Rowsell and Pardoe, 2014). The funding scheme was redesigned some years ago, with the adoption of an integrated and holistic approach to flood risk management and the allocation of funds for flood protection schemes (Defra, 2005). This involved a focus on vulnerability and publicly-funded strategies for

communities at risk, requiring priority to be given to those most vulnerable to flooding. Part of the objective was to fund local self-help adaptation strategies, as large-scale investments were unable to justify local flood risk management strategies. Johnson et al. (2007) note that this tended to avoid favouring high-value areas in the country when selecting flood risk management strategies. As a result, it encouraged local actors to become more involved in the decision-making process, so that all stakeholders and members of the public would participate in flood risk management. This demonstrates how funding can have a role in effective flood risk management, including by enabling local government to take on some of the responsibilities previously exercised by national government (Thaler and Priest, 2014; Begg et al., 2015; Thaler and Levin-Keitel, 2016).

Figure 35 details the sources of funding and the division of responsibilities between bodies concerned with flood risk management in the UK.

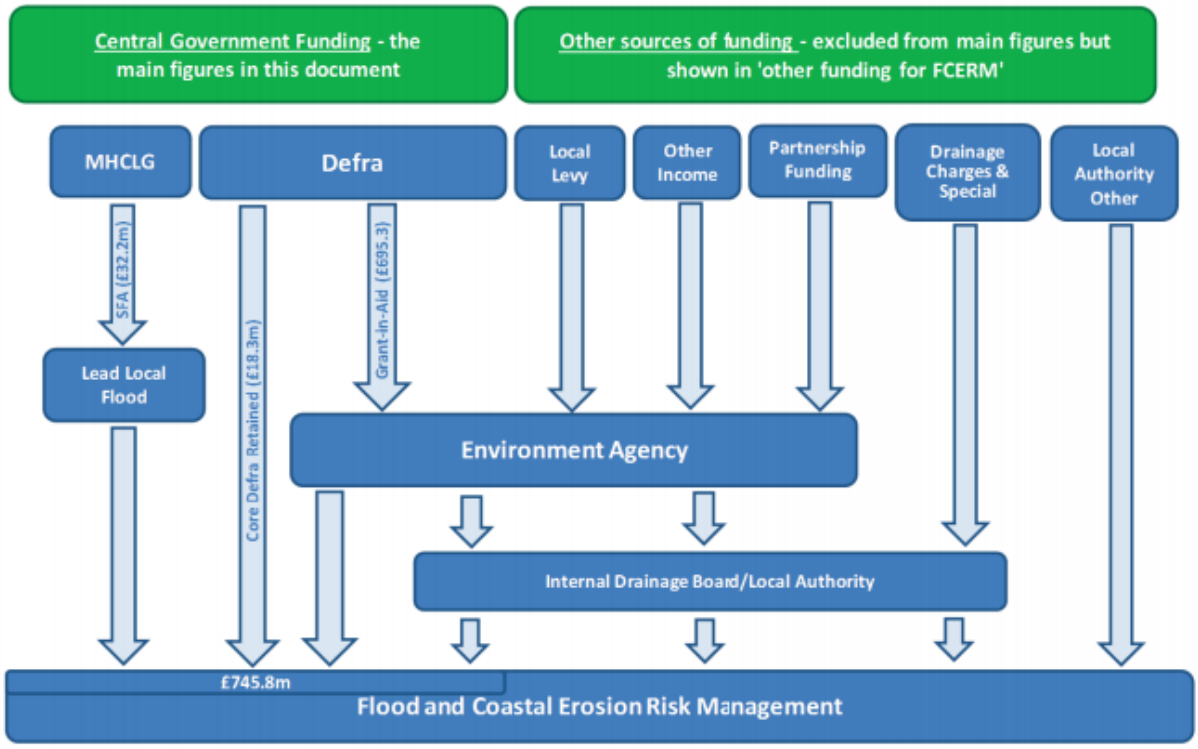

Figure 35: Flood risk management funding *(Source: Defra, 2019)*

The figure reveals the existence of numerous routes of funding for flood risk management, both from central government and from other sources such as through levies or other means. These include levies, special levies, drainage charges and partnership funding (Defra, 2018b). The Environment Agency is responsible for administering grant-in-aid on behalf of Defra for works to reduce the risks of flood and coastal erosion. Thus, current flood risk management policy

seeks to promote partnership funding, whereby funding is raised in some at-risk areas and spent locally to complement central government's grant-in-aid funding (Defra, 2011; Penning-Rowsell and Pardoe, 2014). The objective of such funding is to encourage the strong involvement of non-state actors such as local citizens in flood risk management discussions (Thaler and Priest, 2014; Begg et al., 2015; Thaler and Levin-Keitel, 2016). This change in funding shows how funding has affected governance, reflecting a shift of power away from central government (Penning-Rowsell et al., 2013). The EA follows a long-term investment strategy for flood and coastal risk management in England that determines the level of funding for various initiatives. A local authority can apply for investment from the EA in order to create either new or improved management infrastructure in response to risk from groundwater or surface water.

There has been some criticism of the funding arrangements and in particular of the distribution of funding. In 2015, for example, the Committee on Climate Change found that in the previous four years there had been underinvestment in flood and coastal risk management in England, leading the CCC to expect greater annual flood damage in the years ahead (CCC, 2015). Furthermore, funding tended to be released only after flooding had occurred, making it more reactive rather than precautionary. Mehryar and Surminski (2020) criticise this approach as defeating the purpose of resilience, a view echoed by some expert interviewees participating in this research, who described it as counterproductive to attempts at achieving resilience. Therefore, a clearer system of guidelines with a sharp focus on resilience would be beneficial. It would promote the improvement of the flood risk management framework and encourage more proactive measures. This shows that at a government level there is a lack of focus on resilience in terms of funding. However, this is only one element of flood risk management policy. The next subsection deals with another type of economic instrument, namely the use of insurance.

5.3.2. Insurance

As noted in Section 2.5.2, insurance is a key means of protecting against the risk of flooding. It offers a financial means of protection by providing cover for properties for any damage caused by a flood event. This allows owners to claim on their insurance to rectify any such damage to their properties. The UK government offers no public flood insurance, which is provided instead by private insurance companies (Banba & Shaw, 2017). However, insurance cannot be the only tool to respond to flood risk and is only one element in achieving flood

resilience, with risk-reduction measures making an essential contribution to making future flood insurance affordable. Lammond et al. (2011) found that insurance companies had argued for more risk management and investment in risk resilience in order to maintain affordable flood insurance. Their concern was that increasing risk would cause premiums to rise to the point where flood insurance was unsustainable (Penning-Rowsell, 2015). The UK government has since pledged to work more closely with stakeholders to achieve the goals of flood risk management and resilience (Brown, 2018; OECD, 2019). Nonetheless, there appears to be a public perception of flood insurance as increasingly unaffordable, according to the survey data gathered for this research and analysed in Section 4.3.1, participants having reported the difficulties they had experienced in using insurance as a tool to manage flood risk.

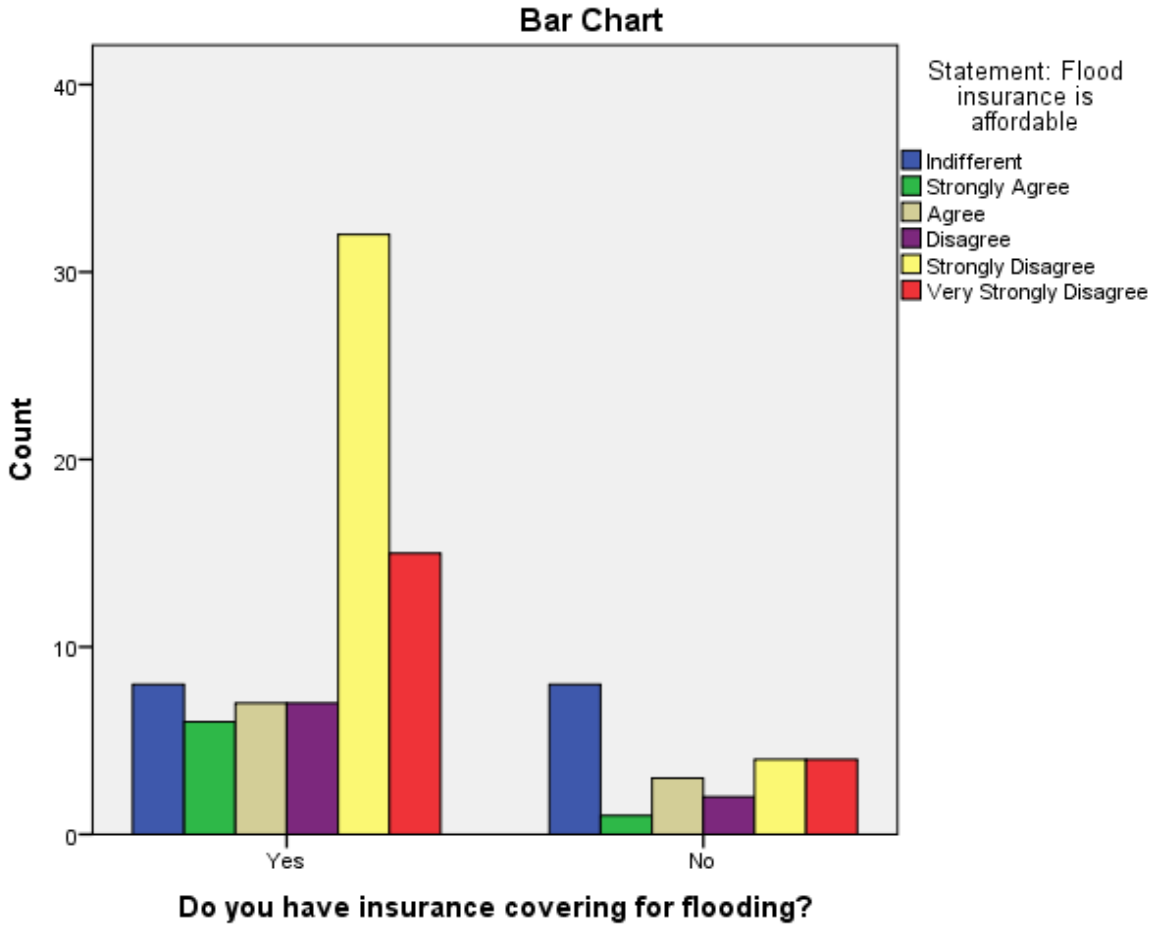

Figure 36: Floodplain residents' views on flood insurance affordability

Respondent's views on the affordability of insurance are illustrated graphically in Figure 36, which shows that many had access to insurance cover but felt that it was not affordable for them. However, flood insurance can be seen to play an important role in providing economic incentives, allowing people either to relocate or to take precautions against flooding, thus

facilitating rapid economic recovery following a flood event. Insurance has been deemed to be a mitigation measure that could limit the extent of damage during times of flooding and could be complementary to traditional forms of flood protection (Botzen et al., 2009). In countries such as the UK and Germany the central government has no strict legal duty to provide assistance to those suffering flood damage, the main source of funding for the reinstatement of flooded properties being private flood insurance (Thieken et al., 2006). In the Netherlands, Botzen et al. (2009) found that a majority of homeowners were willing to make investments in flood risk reduction if this led to a reduction in their premiums. Similarly, Thieken et al. (2006) found that insured households in Germany were more likely than uninsured ones to undertake risk reduction measures. This suggests that flood insurance offers an incentive for policyholders to take action (Surminski and Eldridge, 2015). The majority of interviewees in the present study mentioned that the operation of the UK insurance system does not take flood resilience into account. This is consistent with the identification by Surminski and Eldridge (2015) of a number of known barriers preventing flood insurance from supporting the goal of risk reduction, including the fact that the insurance sector was not at that time fully integrated with a flood resilience strategy. Flood insurance can be seen, however, as a potential means of changing behaviour prior to flooding. Such is one of the goals of the Flood Re scheme, offering affordable insurance with the goal of prompting owners to make their properties more resilient.

Several of the expert interviewees observed that UK insurers operate under a different system to that of the EA in terms of both costs and mapping. Furthermore, a suggestion common to all of the interviews was that the value of flood resilience measures taken by property owners should be reflected in insurance premiums. It was noted that insurers do not currently take account of flood resilience measures such as adaptations to properties, but continue to charge high premiums to all policyholders whose properties stand on a floodplain. Offering incentives such as reduced premiums or excess to those who implement flood resilience measures would encourage more homeowners to do so. Insurance cannot prevent flood events, but the adoption of flood resilience measures would be in line with an overall flood management and floodplain development strategy. This could serve as a useful means of providing incentives and encouraging flood resilience, not only underwriting the reinstatement of damaged property but supporting improvement work to protect against future flooding. Interviewee 3 claimed that this strategy would be cost effective in the long run but was not currently being considered. Some of these findings are reflected in the survey data gathered for this research. The majority of questionnaire respondents indicated that they had taken out flood insurance. However, a

larger number stated that they had not made flood-related adaptations to their properties and some commented that adaptations were expensive, or that they had them but they had not helped when flooding occurred.

Insurance operates by covering unexpected losses specified by the insurance provider but it does not prevent flooding from recurring. Thus, participants stated that risk reduction was an important element in combating flooding. This could be achieved through the use of an effective planning policy, along with flood risk management, which plays an even more important role in the framework. Thus, Interviewees 2, 3 and 4 expressed the view that insurance is meant to operate in the interim while property owners undertake flood resilience measures. However, property owners tended not to implement such measures, as they did not believe that they would be flooded again in the future. As a result, they failed to adopt effective means of mitigating the impact of future flooding. There was also the matter of affordability, the questionnaire survey having shown that a large majority of participants who had flood insurance cover nevertheless did not consider it to be affordable.

Table 18: Affordability of insurance

Statement: Flood insurance is affordable * Do you have insurance covering for flooding? Crosstabulation

Count

		Do you have insurance covering for flooding?		
		Yes	No	Total
Statement: Flood insurance is affordable	Indifferent	8	8	16
	Strongly Agree	6	1	7
	Agree	7	3	10
	Disagree	7	2	9
	Strongly Disagree	32	4	36
	Very Strongly Disagree	15	4	19
Total		75	22	97

The correlation in Table 18 shows that the majority of participants with flood insurance did not believe it was affordable. This highlights the fact that insurance companies are primarily business entities; the insurance sector operates so as to maximise its profit and therefore has little incentive to encourage resilience as an end goal for its customers. However, an option available to encourage insurers to collaborate on flood response is to invoke corporate social responsibility. Property-level measures are largely funded by private companies or by property owners themselves, who carry the burden of financing risk mitigation in the absence of action

by regional or national government. This view is acknowledged by researchers and other contributors to the literature (Penning-Rowsell and Priest, 2015). Risk reduction has been identified as one of key principles for any future flood insurance (Defra, 2011), yet insurers have undertaken insufficient measures to strengthen flood mitigation. Interviewee 7 remarked that insurance companies lacked commitment to the goal of resilience and instead appeared to see this as a government responsibility. Lamond et al. (2009) have also described the insurance sector as ineffective in encouraging policyholders to engage in flood mitigation efforts. Ball et al. (2013) offer the explanation that property-level measures are difficult for insurers to assess and thus do not factor in calculating premiums. Bräuninger et al. (2011) similarly note a lack of standardised assessment insurance policies, affecting the effectiveness of mitigation measures.

European countries differ in their national risk financing systems, such as private flood insurance mechanisms. Despite this variety, insurance cover rates are typically lower than in the UK. Furthermore, these mechanisms require the support of government systems (Prettenthaler et al., 2017). Similarly, the UK Government sees insurance schemes such as Flood Re as merely part of a wider solution (HM Government, 2015). Consistent with this finding, Interviewee 7 asserted that insurance systems require close collaboration and cooperation with wider government initiatives and depend on community-level support. This discussion of the role of insurance would be incomplete without a detailed examination of Flood Re, the UK government's flood reinsurance scheme designed to promote resilience through the provision of affordable insurance for property owners in areas at high flood risk.

5.3.3. Flood Re

Flood Re has been designed to provide temporary support to the insurance market for properties at high risk of flooding. At the end of 25 years from the date the Water Act 2014 received Royal Assent (May 2014), Flood Re will have been wound up and the subsidy provided through the scheme removed. (Flood Re, 2016: 11)

The above declaration makes it clear that Flood Re is intended to act as a stopgap rather than a permanent solution to flood risk, with the expectation that alternative measures will be in place by the time the scheme has ended. The ABI's Director of General Insurance Policy has also made it clear that for the insurance sector, *"Flood Re is not a solution to the problem of flooding and flood risk"* (ABI, 2017). A report by the Bank of England (2015) on the impact of climate change on insurance notes that increasing levels of physical risk can produce challenges in

insurance arrangements, along with associated risks. Thus, Flood Re could be affected by climate change via its effect on flooding risk, yet there have been no active efforts to deliver widespread resilience for floodplain communities. The experts interviewed for the present research concurred that Flood Re had not led to an increase in resilience efforts among property owners. Flood Re (2015) claims that property owners who had taken out cover were given information on ways to adapt their homes against future flooding, but the interviewees stated that that despite the goal of achieving resilience, not many owners had made such efforts. A further critique was that the system did not encourage property owners to take mitigation measures.

An additional weakness is that there are exclusions to the cover offered by Flood Re (Christophers, 2019). Categories of property at risk of flooding but not covered include privately rented homes or leasehold properties that are commercially insured, all properties in council tax band H and those built since January 2009. The purpose of excluding these newer properties from the scheme is to discourage floodplain development. The British Property Federation has identified around 800,000 properties at risk of flooding which do not qualify for Flood Re, 70,000 of these being deemed at high risk (Palmer, 2015). Thus, Flood Re favours existing properties at high flood risk while discouraging the emergence of new flood risks. The government intended that the scheme would provide incentives for both households and insurers to improve resilience measures (HM Government, 2015). The literature indicates, however, that it has failed in its goal, since it neither enhances flood management policy nor incentivises property resilience (Jenkins et al., 2016). The findings of the expert interviews support these criticisms.

Flood Re has been criticised as not encouraging any form of self-help risk mitigation (Penning-Rowsell and Priest, 2015). In fact, Surminski and Eldridge (2014) state that risk reduction was not its central aim. In addition, it has been noted that there is no exclusion from the pool, allowing owners to make repeat claims, meaning that those at higher risk of flooding are able to benefit from repeated cover from the pool at the expense of those whose risk is lower. Furthermore, the system is such that while there are subsidies for high-risk premiums, cover is not affordable for certain households, obliging them to manage without insurance cover. Thus, the burden of any recovery efforts will fall on some victims of flooding who may not be able to afford the costs involved. Penning-Rowsell and Priest (2015) note that Flood Re does not subsidise resilience measures, placing a heavy burden on homeowners (Surminski, 2017). Jenkins et al. (2017) conclude that Flood Re is likely to cause increasing division between

subsidised premiums and technical risk price, a problem with the potential to worsen in the long term, unless efforts are made to incorporate resilience into the model.

Discussion of Flood Re has tended to emphasise the concept of affordability, failing to recognise that this is only one aspect of flood risk management. The true goal of the scheme should be to encourage resilience and risk mitigation efforts. Any flood reinsurance scheme is capable of addressing barriers to making properties more flood resilient. According to Surminski and Eldridge (2014), Flood Re fails to address a number of issues, including the lack of a formal scheme to build capacity for risk reduction, the need for compulsory risk reduction, the absence of a programme of resilient reinstatement techniques following flooding and limited commitment to flood risk reduction on the part of government. Interviewee 7 offered similar criticisms, stating that insurance should encourage mitigation efforts by incentivising property owners to take part in flood risk measures. Thus, Flood Re appears to have been a missed opportunity to establish a mechanism for flood risk reduction (Surminski, 2014). Surminski and Eldridge (2015) suggest that risk reduction would need to be an official aim of any new insurance scheme. This could be achieved through regulation and guidelines that stress risk reduction as the end goal of resilience efforts.

5.3.4. Shared Responsibility for Flooding

The use of the term ‘governance’ implies that responsibility for flood management resides wholly with the central government, but it is better seen as a shared duty across national and regional levels (Priest, 2019), given that flooding affects every sector including local government, the insurance market, businesses and individuals. There are multiple bodies that play their part in flood risk management, in addition to the EA and LLFAs. These include companies in the insurance sector and those that specialise in adaptation or provide products to defend against flooding. In addition, there are community-led groups such as flood action groups and even individual property owners with roles in the flood risk management process. Each of these thus makes a contribution flood risk management and could play a role in furthering resilience. There have been calls for a more integrated flood risk management structure to be adopted to reflect the changing nature of risk management (EU, 2007; 2013; World Meteorological Organisation, 2009). One aspect of the risk management framework is to include these related bodies. By integrating them, one could achieve a more effective risk management structure. The insurance sector and companies that provide flood defences and adaptations also have a role in flood response. Businesses typically operate on a profit basis

and would therefore not operate under a system of environmental and community improvement. However, business have long had a role in aiding communities and there have been schemes that benefit companies, thus incentivising their involvement.

As such, businesses have a role to play in the flood risk management and regulatory framework. This was highlighted by the interviewees, who saw flood management as an activity encompassing all sectors. Analysis of their responses reveals a set of factors that need to be considered within the scope of flood risk management and response.

Figure 37: Key words from expert interviews

Figure 37 depicts the key terms gathered from the semi-structured interviews and highlights the common factors in the management of flood risk, identified by examining the collated interviews and searching for common terms used by the experts. These were then placed in a diagram where size represents how frequently each word was used by the interviewees. Research has shown that both private and public sector organisations are able to adapt to the adverse effects of climate change in order to bring about benefits to society; however, there is evidence that many societies are not optimally adapted (Agrawala and Fankhauser, 2008; IPCC, 2007). This can be seen in the use of corporate social responsibility (CSR) as a means of encouraging insurance companies to promote flood resilience as part of their insurance schemes. Within the private sector, the aim is for businesses not to limit their activities to their clients, suppliers and employees, but to extend their concern to other groups as well in order to further societal goals (UN, 2000). These are regarded as stakeholders in the company whose

interests influence the behaviour of the company outside its normal operations. As such, CSR can be defined as *"a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis"* (Commission of the European Communities, 2001). The private sector is thus heavily involved on a commercial basis in disaster reduction. At a governmental level, CSR is seen as a means whereby businesses can contribute to sustainable development. Within the EU, CSR is a concept that integrates social and environmental goals into the operation of businesses through their interactions with stakeholders on a voluntary basis. In the case of insurance companies, these financial mechanisms are able to play a role in flood risk mitigation.

This is part of a wider argument that companies can play a role in resolving major social and environmental problems (Carson et al., 2015). Whilst they are capable of playing a part, there is some debate as to whether companies should take responsibility for such matters. Friedman (1970) holds the view that the only duty a business has is to increase its own profits, whereas French (1979) argues that companies are capable of playing the part of a moral person. In addition, they are said to act as corporate citizens (Zadek et al., 2001; Matten et al., 2003). In fact, Zadek et al. (2001) argue that businesses have an extended responsibility to contribute to sustainable development. In terms of flood risk management, efforts have been made to incorporate flood response into the wider response strategy. This can be seen in the Flood Re scheme whereby the government and private sector work together to provide affordable flood insurance. However, any strategy must take into account that the goal of any such efforts is to promote resilience. Thus, the flood governance strategy must include businesses and insurers in order to bring about a more efficient flood risk management system. This issue was raised by Interviewee 4, who reflected the concern among certain communities post-flooding that independent companies specialised in providing flood response tools simply sold their wares, driven purely by the profit motive and with no concern for flood resilience. Conversely, establishing a special registry of companies that worked with the central flood risk management strategy would help to create resilience.

It has been noted that there is a culture of blame regarding responsibility for flooding, with householders, the EA and the insurance sector each criticising the others (Christophers, 2019). There is a consistent level of blame towards the government for not producing more flood defences, rather than blaming insurers for increasing their premiums (Meek, 2008). A similar point was raised by Interviewee 7, who argued that a lack of clear guidelines for all relevant parties had led to a sense of uncertainty over flood responsibilities, while Interviewee 6

observed that various bodies seemed to blame others, such as the Environment Agency, for deficiencies in flood risk management. Thus, clear policy guidelines for such related groups would help to better integrate them into the flood risk management framework. Currently, they operate separately, with blame being attributed to government bodies engaged in flood risk management, when it should be acknowledged that responsibility would be better shared at a societal level. By addressing this issue within guidelines and policy, it would be possible to achieve a more holistic approach to flooding and one that resulted in stronger collaboration and cooperation with other flood-related groups.

5.4. Holistic Approach to Flood Management

The above discussion establishes the existence of certain challenges and barriers to the operation of the flood risk management framework, requiring remediation by means of measures in such areas as funding, insurance, adaptation and resilience. This view was shared by a number of the experts interviewed during this study, who identified problems such as the insurance sector not making use of the same flood mapping system as the EA. Thus, the insurance companies do not determine the levels of risk depicted on official maps, potentially obliging property owners to absorb the high financial costs of flood protection or leaving them without flooding cover. Similarly, a number of questionnaire respondents indicated that the costs of their insurance had risen per flood event. This largely stemmed from the fact that after a flood, properties were not being adapted to become more resilient. Resilience appears not to be adequately addressed in legislation and regulations, whose focus is rather on response. Conversely, a shift of focus from defence to resilience has the potential to spur a more holistic approach to flooding. It has been noted that flood risk management in England has undergone a paradigm shift away from the concept of defence, seeking to ‘keep water out’, towards the idea of ‘making space for water’ in managing the risk (Defra, 2004; Johnson and Priest, 2008). This shows that society could better respond to flooding by attempting to manage it, rather than using hard defences against it. In the UK, there exists a flood management framework. Mehryar and Surminski (2020) emphasise the role of national legislation in supporting community efforts to achieve resilience. However, there is little recognition of the role played by legislation in achieving resilience. Legislation serves to deliver guidance via policy and regulation that assigns duties and creates bodies responsible for managing flood risk, including the EA and the LLFAs. However, there are additional bodies, including insurance companies, businesses that specialise in adaptation and community organisation such as flood action groups. All of

these bodies together constitute the overall flood risk management framework, operating as part of the flood response strategy. The structure of the framework is illustrated in

Figure ***38***.

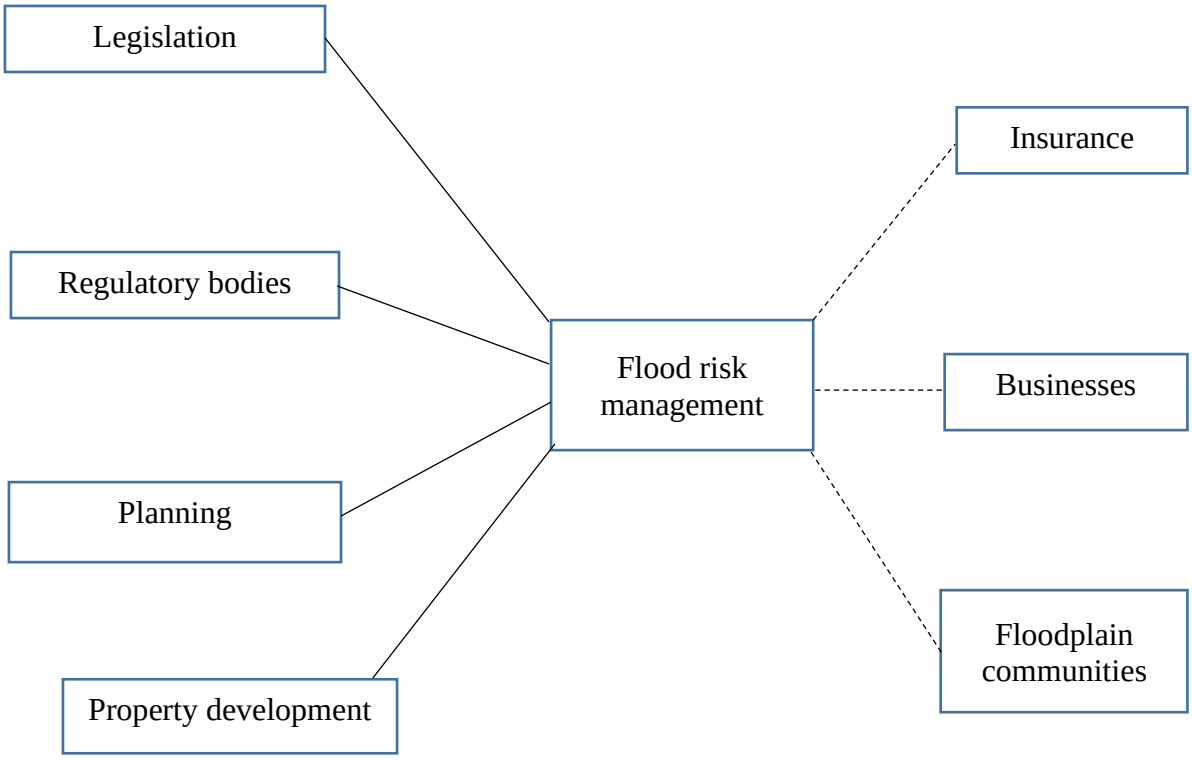

Figure 38: Flood risk management sectors

The flood risk management framework depicted here is founded on legislation, regulatory bodies, planning and property development. Legislation serves as the embodiment of the strategy, taking the form of the Flood and Water Management Act (2010) along with related regulations. These determine policy guidelines and provide a clear division of responsibilities from the EA to the LLFAs. Whilst related to flood risk management, elements such as insurance, businesses and floodplain communities operate somewhat separately from the strategy. Interviewee 7 observed that there was a 'disconnect' between the sectors that impeded the central flood risk management strategy, while Interviewee 4 argued that any attempt to bring these together would symbolise a more holistic approach to flood risk. However, these groups currently operate somewhat independently of central policy guidelines. By means of closer alignment with flood risk management strategy, these independent bodies could be incorporated into a more holistic and therefore more effective response taking greater account of resilience. An example can be seen in Japan, where in 2000 the benefit of adjusting to

flooding was recognised in the use of land use zoning, flood-proof housing and flood insurance (Lamond and Booth, 2011). This shows the value of a range of approaches beyond simple engineering as a means of managing flood risk.

A key factor in bringing about effective flood risk management is the use of regulation and policy. These dictate the central goals and strategies that define the flood risk management framework. Such a framework consists of legislation that establishes the roles and responsibilities of bodies such as the EA. Such regulation currently exists and Interviewee 3 opined that the UK already had a strong flood risk management framework, so much so that other countries tended to see the UK as an example of effective flood response. It has been noted that the history of water management involves collective, cooperative and collaborative action (Wagret, 1967). The Flood and Water Management Act (2010) requires all risk management authorities to cooperate with one another and to act in a manner consistent with the goals of the flood risk management strategies developed by the LLFAs. While this requirement applies to a range of flood response authorities, there are bodies which remain outside its scope. Among these are insurance companies and businesses providing adaptation services to property owners, all of which operate somewhat independently of local authorities and the EA. The expert opinions expressed in the interviews underline this disjuncture. Interviewee 1, for example, described the insurance sector as using its own different data regarding flood risk. Furthermore, efforts made at making properties more resilient were not reflected in insurance costs. Thus, the operation of the insurance companies did not support the goal of promoting resilience. Nevertheless, interviewees recognised that the introduction of Flood Re represented a positive effort by government to cooperate with the insurance sector.

Notwithstanding the progress inherent in the Flood Re scheme, the empirical evidence is consistent with the finding of the literature review that the UK lacks a fully coordinated strategy for managing flood risk. Pender (2011) argues that a holistic approach to managing flood risk is needed to better cope with the impacts of flooding and climate change. The Office of Science and Technology Future Flooding project sought to develop a holistic thinking approach to flood risk (Evans et al., 2004; 2008; Pender, 2011). Similarly, Surminski and Eldridge (2015) note the absence of a long-term strategy in relation to managing flood risk, with flood insurance affordability being subject to a short-term perspective. In terms of flood risk governance, insurance is often cited in the literature as a factor reflecting a country's consideration of risk responsibility (Walker et al., 2010). Importantly, insurance cannot function in isolation, being but one tool *"amongst the many that are required for a holistic strategy on flood risk*

management" (Surminski and Eldridge, 2015: 12). As long as insurance companies and those specialising in adaptation operate separately from the central strategy, there can be no guiding principle of flood governance, whereas the implementation of integrated flood governance would result in them working alongside the existing flood risk management strategy. It should be stressed that adapting to the danger posed by flooding is not something for the government to face alone. This is indicated in the National Adaptation Programme regarding climate adaptation reporting (Defra, 2018b). The report emphasises that bringing about adaptation require cooperation and collaboration among actors in all sectors, including insurance, private individuals, public bodies, infrastructure providers and so on, with communication being a key requirement for promoting resilience. Such a collaboration would bring about the emergence of more 'round table' discussions. Interviewee 4 stressed the value of this more holistic approach to flood risk management, of which a key focus would be using resilience in regulation and policy to dictate the outcome of flood risk management. Adaptation leads to preventative measures being employed in order to mitigate the outcome of flooding by reducing the exposure of people and properties. This could lead to the prohibition or discouragement of building in areas at risk. However, Interviewee 3 argued that the UK's level of exposure to flooding hazards and technical feats meant that it would be safe to build even in areas at high risk, so long as the appropriate protective measures were in place.

Mitigation efforts at reducing the consequences of flooding operated through a range of alleviation measures in vulnerable areas, such as flood forecasting, warning systems, disaster management and evacuation plans. Flood risk management policy also includes reconstruction planning to make properties more resilient as well as financial tools such as compensation and insurance. The goal is to reduce flood hazard, exposure, vulnerability and the consequences of flooding, i.e. the components of flood risk. Kunreuther (1996) suggests, however, that people living in areas at high risk rarely adopt voluntary measures to reduce the effects of flooding. This has the consequence of making them more vulnerable to catastrophic flood events. Interviewee 7 agreed that people in such communities do not necessarily make the efforts to take part in resilience initiatives. However, Interview 6 suggested that this could be circumvented through better incentivisation. Questionnaire responses by floodplain residents indicate a feeling among many property owners of a lack of support, in that resilience measures were not factored into insurance costs. Thus, they felt burdened not only by the cost of insurance but by having to undertake resilience efforts themselves. To optimise flood risk management, a combination of strategies is needed, covering mitigation, preparation and

recovery. No single approach will be ideal for every location; rather, it should be tailored to local needs. Then, by aligning strategies together, one could achieve a more holistic approach and the recognition of which strategies were appropriate for each flood-prone area.

An emerging issue regarding hard flood defences is that they may encourage building in areas at high risk of flooding, such as floodplains. In France, a comprehensive recovery scheme was achieved through the Cat-Nat Fund, which served as a means of disincentivising development in flood-prone areas. Furthermore, recovery tools could also disincentivise flood risk prevention approaches. However, through smart urban planning, one could enhance flood preparation schemes. Furthermore, compensation and insurance could work to either incentivise or disincentivise flood risk reduction. Within England, risk reduction could take the form of property-level measures to differentiate risk, reducing insurance premiums for property owners who take the necessary mitigating measures. This might provide adequate incentivisation for property owners to adopt flood resilience and adaptations to their properties if they were rewarded in some manner. As such, responses to the various challenges and barriers must stem from a central goal of flood resilience, ensuring that property owners mitigate flood damage and are prepared for future flood risk. Legislation and policy do not specify resilience as the end goal of any work, but promoting resilience in law and guidelines would encourage the adoption of a clear strategy of making properties resilient to flood risk.

Figure 39 accordingly shows flood resilience at the centre of flood risk management strategy, linking the various factors contributing to the strategy.

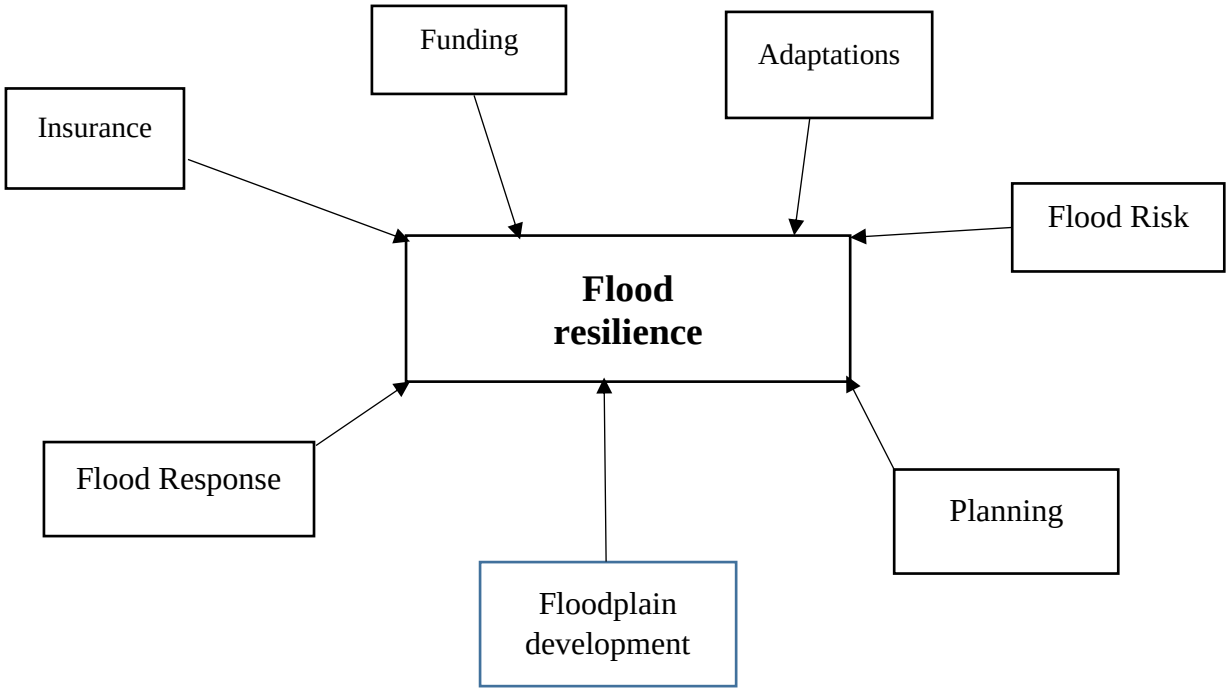

Figure 39: Flood resilience in flood risk management strategy

Interviewee 4 called for more discussion among the flood risk management community in order to bring about more effective change, identifying the need for round-table discussions to bring about a more holistic approach to flood risk management. Through policy guidelines derived from legislation, discussions could be encouraged between the various bodies connected to flood risk, such as flood risk management bodies, the insurance industry, companies specialising in adaptation and flood action groups. Currently, such bodies operate within the scope of the flood risk management framework, but do not all work towards the same objectives. Legislation should stress that resilience is the ultimate goal of the flood risk management strategy. By stating this end goal, policymakers could work more effectively with the insurance industry and companies supplying adaptations, engaging in round-table discussions to deliver more effective flood risk management.

Flood risk management involves *"a continuous process of making decisions about whether and how floodplain lands and waters are to be used"* (Thomas, 2012: 258). Thus, it has always been in the process of development and has evolved over time to address any shortcomings. As noted by Thomas (2012), this has taken into account present, near future and long-term effects, as well as the viability of the floodplains, which could affect residents. By utilising law as a lynchpin, policymakers could better enshrine resilience in the existing flood risk management framework. Thus, this research concludes that legislation is a means through which a more holistic approach to flood risk management could be achieved. The next section explains how this finding and the associated detailed recommendations were presented to two practicing flood risk managers in order to verify their soundness.

5.5. Verification

This research has identified a number of challenges and barriers to the effectiveness of flood risk management in the UK, involving such issues as perception of flood risk, insurance, adaptations and so on. These have been attributed to the absence of a holistic approach to the framework, affecting the use of tools to make properties more resilient to flooding. One tool that could aid in bringing about a more holistic approach and therefore a more effective flood risk management framework is the use of legal systems and regulations. By clearly defining resilience as the end goal of the framework, such tools could aid in ensuring that such policies were put into practice. This could lead to greater cohesion between the insurance industry and local authorities whilst encouraging cooperation among all stakeholders and parties in flood

response. Existing legislation has created a flood risk management framework encompassing bodies such as the EA and LLFAs which operate with the central goal of flood risk management in mind. In addition, there are private sector actors such as companies specialising in insurance and in adaptation which, although part of the framework, do not necessarily operate under the umbrella of the same strategy. In fact, they operate independently, so that despite efforts at cooperation, goals vary somewhat and this has had an impact on the effectiveness of the framework in managing flooding. Thus, the recommendation is to use legislation and regulation to enhance policy delivery by strengthening the links among these related bodies. This would serve to encourage the adoption of flood risk management strategies and bring about cooperation from other bodies in order to make the framework more effective. Clear guidance to all related stakeholders would thus help to encourage policy enforcement yet allow for flexibility. Table 19 lists the present study's detailed recommendations of ways to address the challengers and barriers identified earlier.

Table 19: Recommendations for effective flood risk management

1	In order to promote resilience, the terminology needs to be adopted within legislation, regulation and policy guidelines as an overarching theme and central component of flood risk management.
2	The insurance sector should cooperate with the Environment Agency with the goal of promoting resilience in properties affected by flooding.
3	Funding guidelines need to specify that the end goal is to encourage resilience in order to effect a shift from a reactive to a precautionary approach to flooding.
4	To better mitigate future flooding, flood insurance requires resilience to be a stated objective in order to better adapt properties post-flooding.
5	Those building new developments on floodplains that incorporate resilience measures should be rewarded by reduced costs of materials to promote this approach to combating future flooding.
6	Stakeholders such as flood action groups and private companies should be brought into the flood management process in order to promote resilience.
7	Clear policy guidelines are needed to foster cooperation among related flood response bodies in order to bring about a more holistic approach to flood risk management.

These findings were presented to parties in the two floodplain communities surveyed in this research. These validators were experts in flood risk management and were able to provide insight into the needs of their respective communities. As such, they were consulted about whether the findings of this research would improve the effectiveness of the framework. They noted that there had been many attempts at bringing about a more effective flood risk management system but that despite discussions there had been no concerted effort to put one into practice. When questioned on the use of law and regulation, they stated that this could be an effective means of putting policy into practice. Flood governance was seen as an important

tool in the promotion of flood response and flood risk management. The verification panel agreed on this, asserting that it could be a means of promoting resilience and that it could help to encourage policymakers in order to allow for action to be taken in flood risk management. By further defining roles and responsibilities, legislation and regulation could be used to clearly specify the duties of parties to the flood risk management process. An example would be that of the insurance sector working more closely with the EA and LLFAs with the dual purpose of providing affordable flood insurance and making properties more resilient to future flooding.

In relation to Flood Re, the discussion covered the nature of flood cover for those at high risk of flooding. The validators acknowledged that Flood Re had not achieved its purpose of making communities more resilient. They recognised that it had provided affordable insurance cover for areas at risk of flooding, but noted that this was only a temporary effect for a set period of time, after which the flood insurance sector would return to a market-led system, leaving owners of properties at risk of flooding to struggle once more to afford cover. In addition, the validators noted that a like-for-like insurance approach was not effective, but that resilience should be the end goal. In this regard, Flood Re had not worked alongside a strategy based on flood resilience, as per the findings of this research. A flood insurance scheme could be grounded in the use of law to impose the goal of resilience. Without such measures, there was no encouragement for to adoption of a more effective policy based on flood resilience.

The validators expressed the view that the research had merit in that it could encourage the parties to improve the effectiveness of flood risk management. Currently, they noted that flood risk management tended to be reactive rather than precautionary, responding to flooding after it had occurred. This criticism by the validators is fully consistent with the findings of the literature review and of the empirical research. Policymakers failed to consider the perception of flood risk and future flood risk, thereby reducing the ability to make regions more resilient to future flood risk. Thus, there was an element of the awareness and recognition of flood risk, while stakeholders other than the EA and local authorities tended to believe that ensuring flood resilience was the exclusive duty of the government sector.

5.6. Chapter Summary

In conclusion, it has been established from the literature review, research findings and discussion that there is an existing flood risk management framework in the UK that responds to flooding. This system utilises a number a number of tools to manage flood risk, including insurance, adaptations, defences and funding. These are used to mitigate the effects of flooding

in order to promote a number of measures such as mitigation, resilience, response and recovery. The framework has been shaped by a succession of laws that were consolidated to make the current flood risk management system. The study has identified a number of challenges and barriers to the effective operation of framework. These impediments include the rising costs of insurance, a failure to employ adequate adaptation measures, increased building on floodplains and a lack of strategic cohesion and collaboration. Prior research has proposed many conceptual models intended to address the issues impacting the framework. However, a holistic approach, which would bring about a more effective flood risk management framework, has been lacking. There has also been a division of roles and responsibility for flood risk. For example, there have been instances where the insurance sector has assumed that it is the exclusive duty of the government sector to manage flood risk. This view, widely shared among affected communities, fails to acknowledge that flood risk management is a collective responsibility of society, with every sector playing its respective role in. The perception that the government sector is uniquely responsible for managing flooding and for making properties resilient against it persists, with little or no effort being made to unify the different strategies and solutions. There have, however, been calls for a more holistic response to flood risk.

Thus, this research proposes that legislation and legal guidance could serve as tools to improve the effectiveness of the flood risk management framework. The literature review has shown their importance in the history and shaping of the existing framework, helping to form the basis of the current tools used in flood risk management. However, the residents of floodplains surveyed for the study reported that they had suffered from the rising cost of insurance due to repeated claims and that the insurance companies simply paid for affected properties to be restored to the state they were in prior to flooding. In interviews, expert participants noted that efforts to provide affordable flood insurance were designed to make properties resilient but that these had not yielded the desired results. Thus, factors such as climate change and increased building on floodplains exposed occupants to increasing levels of flood risk. To combat this, resilience must be factored into flood risk management as part of a more holistic approach. This could be achieved by legislating to make resilience an end goal, in order to empower flood response. Similarly, incorporating this goal in policy statements would enable bodies such as the EA and LLFAs to push a more holistic approach to flood management that included other sectors and stakeholders. Such an approach would be in line with existing regulations stating that cooperation and collaboration are active elements of risk management. This would bring them in line with the flood risk management framework, allowing for better incorporation of

resilience and preparedness in communities. Policymakers could then enforce aspects of flood risk management policy.

Chapter 6: Conclusion and Recommendations

In the course of this research, it has been determined that flooding is one of the leading forms of natural disaster to affect the UK. This danger is likely to increase in the future for a variety of reasons including climate change and continued building on floodplains. This has led to communities suffering risk as a result of exposure to flooding hazards. Floodplains are particularly vulnerable due to their proximity existing bodies of water. This is factored into the system of flood risk management, consisting of a variety of legislation, directives and regulations whose aim is to manage the risk of flooding in order to reduce its harmful effects. Although the system is partly effective, there has been a growing risk of flooding caused by a variety of factors. The Committee on Climate Change has warned that *"severe flooding somewhere in England in any given year is almost to be expected"* (RIBA, 2018). In recent years, flooding has impacted the country and resulted in £1.1 billion of damage. There have been calls by the insurance sector to curtail floodplain developments because these increase flood risk. Furthermore, there have been issues in obtaining affordable flood insurance cover. These are among the factors most seriously reducing the effectiveness of the UK's flood risk management framework. Their existence provides justification for this research to highlight the challenges and barriers to the effectiveness of flood risk management in the UK. In particular, the present study has revealed the absence of a holistic approach to flooding, with actors such as insurance companies, businesses and communities operating independently of a central flood risk strategy. Ways to address this issue could include the use of legislation, policy and regulation to provide clear guidance while helping to integrate these different aspects of the flood risk management structure, the aim being to promote resilience by way of regulation in order to improve the effectiveness of the framework.

This concluding chapter begins with a synthesis of the aim and objectives of the study, detailing how each objective has been met. The remaining sections then deal in turn with the recommendations arising from the research, its contributions to knowledge, theory, policy and practice, its limitations and suggestions for further research.

6.1. Synthesis of Research Aim and Objectives

The aim of this research has been to generate recommendations for improving the regulatory framework of flood risk management, in response to the growing risk of flooding. Among the most vulnerable communities in the UK are those residing on floodplains, because they are

naturally prone to flooding and thus suffer from increased flood risk. The more specific aim of this research has therefore been to facilitate the improvement of the said framework with regard to floodplain development in the UK. In order to achieve this aim in a systematic manner, the following objectives were developed and examined in the course of the literature review and the field investigation (reproduced from Chapter 1, Section 1.3):

- Defining flooding, floodplains and the means by which they are identified.
- Exploring the development of flooding legislation in the UK and offering an overview of duties conferred by the law.
- Examining the regulatory bodies responsible for enforcing the regulations and highlighting their powers.
- Determining the challenges and barriers present within the regulatory framework in relation to flood risk management on floodplains.
- Developing and validating recommendations for improving the flood risk management framework in relation to properties on floodplains.

In pursuit of these objectives, the researcher adopted a pragmatic stance consisting of the use of a mixed methodology that included a survey and case study strategy along with a literature review. The questionnaire survey was used to gather largely quantitative empirical data from floodplain residents reflecting their experiences relevant to flooding. The case study strategy made use of semi-structured in-depth interviews with experts in flooding in order to collect qualitative data. The two sets of data were then analysed with reference to the existing body of knowledge on flooding illuminated by the literature review in order to develop the findings. A central theme which emerged was that floodplain management has been subject to a continuous process of development, affecting the way in which decisions are made in water management and floodplain development in the UK. The data analysis took account of future and long-term effects of flooding, along with the viability of the floodplains and the impact on communities.

The following subsections examine the findings systematically by considering how each of the objectives has been met, thus addressing gaps identified by the literature review whilst also suggesting ways to overcome the challenges and barriers to the effectiveness of the flood risk management framework.

6.1.1. Objective 1

Defining flooding, floodplains and the means by which they are identified

Objective 1, concerning the nature of floodplains, was largely met by reviewing the relevant literature. The characteristics of floodplains are detailed in Chapter 2, Section 2.2.4.1, which notes that the definition of a floodplain requires an understanding of the nature of flooding as one form of natural disaster that can impact an area and its resident community. A flood is a non-typical event temporarily covering land by water (Munch Re, 1997). Floods may occur for a variety of reasons, involving either excessive rainfall, which creates surface water flooding, or proximity to a body of water, such as a river or sea. The immediate causes may thus be rain, a storm, a tidal surge or a breach in a reservoir. These create the components of a disaster, as the probability of a damaging flood event leads to the creation of a flood hazard. This, in turn, leads to risk, as the flood disaster could impact society. There is thus the potential for loss of life, harm to health and livelihoods, damage or loss of assets and services, along with disruption to a community over an unknown length of time (UNISDR, 2009). Another definition is that the probability of the hazard occurring could lead to a loss (Smith and Petley, 2008). Flood disaster risk is the intersection between a hazard and vulnerability (Wisner, 2004; UNISDR 2004), while vulnerability is the capacity and sensitivity towards exposure to a hazard (IPCC, 2012).

Fluvial floodplains are particularly prone to flooding, being low-relief surfaces adjacent to rivers composed primarily of sedimentary deposits (Naiman et al., 2005; Stanford, 2004). They could either be frequently flooded, making them active floodplains, or were formerly flooded, making them morphological floodplains which remain an integral part of a catchment (Tockner, 2010). Such locations are naturally prone to flooding as part of their lifecycle, but are, for a variety of reasons, attractive regions for development. According to Schanze (2006), flood risk management involves a combination of comprehensive and continuous societal analysis, along with assessments and interventions, with the goal of reducing flood risk. The Environment Agency provides flood maps that detail the flood risk in a given area, categorising the level of risk by way of a flood zone area classification system under which areas designated as Flood Zone 1 are situated outside a floodplain with little to no risk of flooding, Flood Zone 2 areas are at low-to-medium flood risk and Flood Zone 3 are at the highest risk of flooding. The traditional approach to flooding was based on flood defence; however, this has shifted in recent years to flood risk management, the idea being to manage the level of risk.

6.1.2. Objective 2

Exploring the development of flooding legislation in the UK and offering an overview of duties conferred by the law

The second objective was to explore the development of UK flooding legislation and regulation. This was met by the literature review, which examined the use of law to better regulate and manage flood-related activities. Prior to 2010, such legislation was spread across multiple laws including the Highways Act (1980), the Building Act (1984), the Town and Country Planning Act (1990), the Water Resources Act (1991), the Drainage Act (1991), the Environment Act (1995), the Water Act (2003) and the Civil Contingencies Act (2004). Each was subject to various amendments over the years, which a review by a parliamentary committee found to have created a level of uncertainty. The committee stressed the need for greater clarity in flood-related legal provisions and noted that the existing law did not specify the duties of the various flood response bodies. This review resulted in the passing of the Flood and Water Management Act (2010), with the express purpose of highlighting duties and powers in relation to flood defence. The Act addresses a key recommendation of the review committee, namely the passing of a single unifying piece of legislation to address the various forms of flooding whilst defining the duties of the different authorities in facilitating flood risk management. Following royal assent in 2010, the Act was implemented by means of various ministerial orders.

Another legal instrument related to the regulatory framework is the EU Floods Directive (2007/60/EC), requiring member states to protect communities from the risk and impact of flooding at a catchment level. Under Article 4 of the Directive, each EU member state must undertake a preliminary flood risk assessment for its territory, while Article 6 requires it to prepare flood hazard and flood risk maps to show areas of significant flood risk. With this information, each EU member was then required to enact Article 7 of the Directive by preparing flood risk management plans which highlighted flood hazards in the most significant flood risk areas whilst taking steps to manage the risks identified.

Statutory bodies were assigned a number of duties to respond to flooding, such as enacting the Strategic Planning Policy Statement along with PPS 15. These aimed to prevent any new development in regions at risk of flooding or where development could increase the risk of flooding somewhere else. The guidelines require risk assessments to be made in any area facing

development, detailing how it might affect the surrounding area, as outlined in Planning Policy Statement 25: Development and Flood Risk.

6.1.3. Objective 3

Examining the regulatory bodies responsible for enforcing the regulations and highlighting their powers

Objective 3 follows from Objective 2, being concerned with the statutory bodies established by legislation. Defra has overall responsibility for managing flood risk in England, where it functions through numerous operational arms to deliver government policy (Johnson and Priest, 2008). These bodies include the EA, internal drainage boards, local authorities and other related bodies, as detailed in Section 2.3.2 of the literature review. The general supervisory role is afforded to the EA in matters relating to flood defence. It exercises a series of powers granted by legislation, with a flood risk management framework being created as a result. This role was further refined through the introduction of the Flood and Water Management Act (2010), which further specifies the duties of the other operational authorities to respond to the different sources of flooding.

Under the 2010 Act, the EA has a role in the planning process, responding to planning applications by listing any concerns regarding proposed developments. As specified by PPS25, any location facing development must be subject to a strategic risk assessment of the level of flood risk affecting the site and the surrounding area.

6.1.4. Objective 4

Determining the challenges and barriers present within the regulatory framework in relation to flood risk management on floodplains

Objective 4 concerned part of the research problem, namely identifying the challenges and barriers present within the flood risk management framework. This was achieved through a mixture of the literature review and analysis of the interview and questionnaire data. The objective is addressed particularly in sections 2.5, 4.4 and 5.1.1, where barriers to effective flood risk management arising from weaknesses in the regulatory framework are specified. These are further highlighted in the analysis of themes emerging from the interviews and expanded upon in the subsequent discussion. The resultant challenges and barriers have had an impact on the regulatory framework, impeding its effectiveness in relation to floodplain

development. This research has found that among the wider issues facing residents of floodplains is the increasing level of flood risks. Members of the two communities investigated in the case study were shown to have experienced multiple flood events over the years, affecting their daily lives and causing damage to their properties. Key factors, according to the experts interviewed for the study, were the increasing cost of insurance cover and the fact that the nature of flooding was ignored by the insurance companies. Among the experts, it was said that flood mapping used by the EA was not consulted by the insurance sector. Instead, the insurance companies utilised their own maps, which adopted stricter definitions of flood risk. A business manager complained that a town centre with a river running through it was seen as a flood risk and that a number of businesses located in the vicinity were denied insurance cover, forcing their owners to trade at their own risk.

Expert interviewees argued that a more holistic approach to flood risk management was required in order to take into account factors such as insurance. The introduction of the Flood Re scheme was acknowledged to be a positive development, but some experts asserted that it had not produced the intended results, being no more than a stopgap measure. It had been designed to promote the adoption by property owners of resilience measures, but had not had this effect, making it likely that once the scheme expired, insurance premiums would not be affordable for many floodplain residents. Flood Re had thus failed to achieve its goal, serving conversely as a barrier to a more effective flood regulatory framework.

6.1.5. Objective 5

Developing and validating recommendations for improving the flood risk management framework in relation to properties on floodplains

In pursuit of Objective 5, concerning the development and validation of recommendations designed to improve the flood risk management framework, the findings were used as the basis to create model based on the concept of flood governance. This approach emphasises legislation as a means of unifying policy guidelines to pursue a more resilience-based end goal, allowing parties to drive policy with the support of the law. Once developed, this concept was discussed with key individuals associated with the case study floodplains, namely flood risk managers, who were consulted about whether the use of flood governance could improve the flood risk management framework. These validators went through the findings of the research and provided their feedback, as discussed in Chapter 5. They first stated that the current framework had undergone any significant improvements; discussions had taken place but there

had been no progress towards adopting better flood risk management policies. They therefore welcomed the use of alternative tools that might introduce a more holistic approach to flood risk management, commenting that flood governance might improve the system of preparedness and resilience in order to bring about a more goal-oriented approach among the parties to the framework.

Clarifying these roles through regulation and guidelines would encourage the adoption of resilience as the ultimate aim of such measures, so that repairs to flood-damaged properties under insurance schemes would be made so that they were resilient to future flooding and this would be reflected in the costs. This change would promote resilience and make such properties better able to survive future flood events. In addition, central government funding guidelines should stress the promotion of resilience, thus making it clearer for the authorities implementing such schemes. Enshrining resilience in legislation would make it clear to all stakeholders that this was a prime component of flood risk management, thus making it easier for regulatory bodies such as the EA to achieve their common goal. This more holistic approach to flood response, with stakeholders working towards a shared purpose, would be greatly preferable to the current situation where they tend to operate independently of one another.

6.2. Recommendations

This section presents the final recommendations of this research. The current flood risk management framework consists of a system derived from legislation that creates policy guidelines and regulatory bodies. The key recommendation is that legislation and policy should be used to address the challenges and barriers to the effectiveness of the existing framework. This would include specifying resilience as an end goal, defining it in terms of preparedness, early warnings, adaptations and other such measures. As explained in Chapter 5, Section 5.5, when the recommendations were presented to experts in the industry for verification, they supported the use of legislation as a means of ‘mainstreaming’ resilience, linking this to the concept of a more precautionary approach to flood risk management. However, they questioned the idea of reducing construction costs by subsidising materials used to make new developments on floodplains more resilient, because the National Planning Policy Framework includes a sequential and exception-testing measure to ensure that new developments are located away from floodplains whenever possible. Thus, any new developments on a floodplain would have to be adapted in order for the necessary planning permission to be granted.

Furthermore, subsidisation would encourage development on floodplains, which would be at odds with existing policy guidelines.

The revised recommendations listed in Table 20 therefore differ from the provisional list in Table 19 (Chapter 5, Section 5.5) by the omission of Recommendation 5 on the cost of materials.

Table 20: Final recommendations

1	In order to promote resilience, the terminology needs to be adopted within legislation, regulation and policy guidelines as an overarching theme and central component of flood risk management.
2	The insurance sector should cooperate with the Environment Agency with the goal of promoting resilience in properties affected by flooding.
3	Funding guidelines need to specify that the end goal is to encourage resilience in order to effect a shift from a reactive to a precautionary approach to flooding.
4	To better mitigate future flooding, flood insurance requires resilience to be a stated objective in order to better adapt properties post-flooding.
5	Stakeholders such as flood action groups and private companies should be brought into the flood management process in order to promote resilience.
6	Clear policy guidelines are needed to foster cooperation among related flood response bodies in order to bring about a more holistic approach to flood risk management.

Enshrining a more resilience-oriented goal in legislation would facilitate the effective implementation of strategies and policies to improve flood risk management in the UK. It would encourage the adoption of preparedness as an approach in order to make properties more resilient to future flooding. This would represent a change from a reactive stance on flood response measures to a more precautionary approach to flood risk management. Without such reinforcement, there would be little impetus to encourage the adoption of resilience, leaving the policy unenforced.

6.3. Contributions

This section outlines the contributions made by the present research to knowledge, theory, policy and practice in the field of flood risk management.

6.3.1. Contribution to Knowledge and Theory

This research offers a range of contributions to the knowledge base on flood risk management. On an academic level, it contributes to the literature on disasters, risk, flooding and flood risk, presenting a detailed examination of natural disasters and the technical scope of flooding,

including the definition of flood risk. It is expected that the research will contribute to the existing body of knowledge in the area of flooding and floodplain development in the UK. This includes an account of how floodplains are identified and the planning process to which floodplain developments are subject, as well as an examination of the flood risk management framework and how it operates through law. It is the link between regulation and practice that is thus highlighted, as is the role of legislation in bringing about effective flood risk management. In terms of theory, the contribution is the finding that regulation and legislation can play a role in improving the flood risk management framework. This underlines the role of law in disaster management regulations, as it serves as the basis of policy guidelines. In addition, it highlights some of the challenges and barriers to the effectiveness of the regulatory framework. Thus, this framework is expected to improve legal measures such as enforcement, promote policy and make the guidance more streamlined in its implementation. This was achieved by the consolidation of legislation into a single piece of legislation, the Flood and Water Management Act (2010). Thus, regulations have a role to play in promoting resilience.

6.3.2. Contribution to Policy and Practice

This research has also contributed to policy and practice. Analysis of the empirical data revealed how the various challenges and barriers referred to above were experienced in practice by the individuals affected. The practical contribution of this research is in improving the floodplain regulatory framework. It offers law as a potential tool of flood risk management and highlights its importance as an alternative to hard engineering options. Thus, it offers clearer distinctions in the use of resilience for insurance and adaptations to properties, along with clear guidelines on how funding can help to improve flood risk management. Directing the financial support offered to floodplain communities towards resilience is identified as preferable to responding to disaster by merely repairing damage; funding is better spent on making properties resilient to the next flood disaster event. This represents a more holistic and proactive approach to flood risk management, which the study has shown to be superior to the existing reactive post-disaster response. If enacted, these recommendations will improve both policy and the regulatory framework, thus reducing the risk to properties on floodplains.

6.4. Limitations

The present research has employed three principal methods: a questionnaire survey, a set of interviews and an extensive literature review. However, time and cost implications meant that

it could only be conducted over a limited area. Two floodplain communities were selected and the target number of 150 floodplain residents as participants was not achieved, for a variety of reasons: some people invited to participate failed to respond and a number of the responses which were received had to be discarded because they were from people not resident on a floodplain. However, 101 valid questionnaire responses were received, representing a minimal sample size with 10% margin of error. The small size of the sample meant that a primarily descriptive form of analysis had to be conducted. Similarly, the target of 10 interviews was not achieved, although there was an element of saturation with responses from candidates being repeated. Furthermore, the data elicited from the seven expert interviewees were sufficient to identify common themes and to construct an overview of the research matter.

A further limitation is that only a single expert on insurance was consulted for this research. The participation of more experts in this field would potentially have furnished a clearer view of the topic. However, the interview data did allow the goals of the research to be addressed. This aim was to highlight the importance of legislation and its role in flood risk management, in particular in the promotion of resilience. Further research is therefore needed into this matter, as discussed in the following section.

6.5. Further Research

This study has made a number of recommendations for improving the UK's flood risk management policy. However, there are aspects that could be developed further by future research. One such area requiring deeper examination is the nature of floodplain communities' relationship with flood insurance. Future research could explore the ties between legislation and the insurance industry needed to bring about resilience. Establishing resilience an end goal would help to achieve a more holistic approach to managing flood risk. To develop the framework further requires a detailed exploration of the different aspects of policy that could strengthen resilience by way of legislation. As one of the validators suggested, it would be valuable to discover how resilience can be adopted on a societal level. In addition, the validators questioned the value of subsidising material costs to make them more affordable when adapting properties to enhance resilience. They noted that reducing the cost of resilient materials might be seen as an incentive to build in flood-prone areas, whereas the central strategy is to discourage such developments. Therefore, future research could examine whether such an approach could encourage resilience without incentivising new developments on floodplains. This would need to be further validated by key figures within floodplain

communities as to whether it would bring about a more precautionary approach to flood risk management. Such measures would make flood risk management more effective for communities that are prone to flood risk.

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Legislation

- Building Act (1984)
- Civil Contingencies Act (2004)
- Climate Change Act (2008)
- Coastal Protection Act (1949)
- Drainage Act (1991)
- Environment Act (1995)
- Flood and Water Management Act (2010)
- Flood Risk Regulations (2009)
- Highways Act (1980)
- Land Drainage Act (1991)
- Town and Country Planning Act 1990
- Water Act (2003)
- Water Resources Act (1991)

Appendices

Appendix 1: Ethical Approval Letter

University of Salford MANCHESTER

Research, Innovation and Academic Engagement Ethical Approval Panel

Research Centres Support Team
G0.3 Joule House
University of Salford
M5 4WT

T +44(0)161 295 5278

www.salford.ac.uk/

26 September 2016

Dear Batoor,

RE: ETHICS APPLICATION ST16/135 – Improving the regulatory framework of floodplain development and management in the United Kingdom

Based on the information you provided, I am pleased to inform you that your application ST 16/135 has been approved.

If there are any changes to the project and/ or its methodology, please inform the Panel as soon as possible by contacting S&T-ResearchEthics@salford.ac.uk

Yours sincerely,

Prof Mohammed Arif
Chair of the Science & Technology Research Ethics Panel
Professor of Sustainability and Process Management,
School of Built Environment
University of Salford
Maxwell Building, The Crescent
Greater Manchester, UK M5 4WT
Phone: + 44 161 295 6829
Email: m.arif@salford.ac.uk

Appendix 2: Invitation Letter for Study

Dear Participant,

My name is [……] and I am a PhD researcher at the School of the Built Environment in the University of Salford. At this time, I am conducting research on "Improving the regulatory framework of floodplain development and management in the United Kingdom". The research is being supervised by [……] and [……].

Flooding is one of the most common natural disasters around the world. It can damage property, disrupt society and cause harm to people. The dangers posed by it are set to increase in the future due to a variety of factors such as climate change. One area that is vulnerable to flooding are regions situated on a floodplain. The floodplains are naturally prone to flooding and are subject to added risk. Thus, developments on floodplains suffer from flooding that can damage the property and harm the occupants. Recommendations offer guidance that developments should not be made on floodplains unless absolutely necessary. However, evidence has shown more developments are being made on the floodplains leading to the occupants exposed to flood risk. Thus, this research seeks to providing recommendations to the current regulatory framework with regards to floodplain management.

As such, I would like to invite you to participate in this survey where you are free to share your views and opinion with regards to floodplain management. The survey is essential in uncovering the following research objectives:

1. Identifying weaknesses present either within the regulations, regulatory bodies or practical issues created from their implementation in relation to floodplain development.
2. Determining the extent those weaknesses have affected the ability to manage against flooding in the floodplains.
3. Providing recommendations towards the creation of a regulatory framework to better improve flood risk management in relation to floodplain developments and determine best foreign practices that could be adopted by the UK.

Please click on the following link in order to participate the survey. The survey questionnaire should take between 10 to 15 minutes. Your participation would greatly aid in the research

study. You can also forward this survey to any colleagues or friends that may be interested in this topic.

Thank you very much for your consideration.

Profound regards,

[……]

Contact details:

If you have any questions about this study, you can contact the person(s) below:

Appendix 3: Invitation Letter for Interview Participants

Dear [……],

My name is [……] and I am a PhD researcher at the School of the Built Environment in the University of Salford. At this time, I am conducting research on "Improving the regulatory framework of floodplain development and management in the United Kingdom". The research is being supervised by [……] and [……]. This letter is to invite you to participate in the research due to your experience and expertise in the research area.

Flooding is one of the most common natural disasters around the world. It can damage property, disrupt society and cause harm to people. The dangers posed by it are set to increase in the future due to a variety of factors such as climate change. One area that is vulnerable to flooding are regions situated on a floodplain. The floodplains are naturally prone to flooding and are subject to added risk. Thus, developments on floodplains suffer from flooding that can damage the property and harm the occupants. Recommendations offer guidance that developments should not be made on floodplains unless absolutely necessary. However, evidence has shown more developments are being made on the floodplains leading to the occupants exposed to flood risk. Thus, this research seeks to providing recommendations to the current regulatory framework with regards to floodplain management.

If you accept, the next stage will involve an in-depth interview with yourself in order to talk about the flood management process. The data from the interview will be kept in the strictest confidence and anonymity will be maintained. Furthermore, participation for this research study is voluntary and you may withdraw at any stage. The data and time of the interview can also be arranged to be suitable for you. The contribution you make towards the research will be crucial for the study and your participation would be greatly appreciated.

To participate in this research, please kindly confirm by replying to this email to showcase your interest. Once participation is confirmed, further information on the research will be sent to you along with participation information, an informed consent form and an outline of the interview. After you have gone through the information, a suitable data and time for interview will be set.

I look forward to hearing from you.

Best regards,

[……]

Contact details:

If you have any questions about this study, you can contact the person(s) below:

Appendix 4: Participant Information Sheet

Title of the Research Study:

"Improving the regulatory framework of floodplain development and management in the United Kingdom"

Name of the Researcher: [……]

Names of the Supervisors: [……]

Invitation Paragraph:

You are being invited to take part in a research study being undertaken as a part of doctoral research project. This information sheet is intended to provide you with information about the research and your participation. It may help you in making decision regarding your participation in the research. There would be no payment or reward for your participation in this research as it is completely voluntary.

Aim of the study:

The aim of this study is to improving the current framework with regards to floodplain development in the United Kingdom.

Why have I been chosen?

The research focus is on the current floodplain management process in the United Kingdom. As such, the researcher seeks to gain further understanding of the regulatory framework to combat flooding and floodplain development. Your expertise and knowledge in this area makes you vital for this research study which will aid the researcher in achieving the research aim.

Do I have to take part?

Participation in this research is entirely voluntary and, as such, you can withdraw from the study at any stage. It is fully within your power to decide whether to participate or in this research. Further information can be provided to you if it aids in making a decision on participation. If you agree to participate, a consent form will be given to you to sign. As stated, you can still withdraw from the research at any time without giving any reason.

Should I decide to take part, what happens next?

If you agree to participate in the study, you will be provided with a draft interview guide. This will provide you with added detail of your involvement in the research and the type of questions the researcher will ask you. The researcher will happily answer any questions regarding the research. After the initial stage is completed, a suitable data, location and time for the interview will be arranged with yourself.

What am I supposed to do if I become involved in the project?

After agreeing to participate in the study, a data and time will be agreed with yourself that will be suitable for you in order to conduct an interview. On the day, a semi-structured interview will be used in the form of an open discussion in order to draw upon your knowledge in flood management. The interview will be approximately 1 hour long and will be audio recorded with your permission. The purpose of the recording is so that the content of the interview can be transcribed for data analysis at a later stage. For the purposes of anonymity, your real name will not be recorded. As such, you will be asked to print it on the consent before at the time of the interview

Will my taking part in this study be kept confidential?

The researcher is fully committed to maintain confidentiality and protecting any data as well as information. All the data obtained from the interview will be kept confidential and secure.

Your anonymity will be maintained. Codes and numbers will be allocated as identifiers but otherwise no information will be present that will identify the participant. No personal information of the participant will be used as an identifier. The interview will be transcribed anonymously with the content saved on a password protected computer that will only be accessed by the researcher. The collected data will then be used as part of the final thesis and any related publications. Access to the data will be available to the research supervisory team, however, the names will remain anonymous. After collection, the data will remain securely stored for up to 3 years after the PhD has been awarded. This is to comply with the University of Salford's data retention policy. After that period has passed, the data will be securely destroyed to comply with data protection guidelines and for the interest of maintaining confidentiality.

What are the potential benefits of participating?

Your knowledge and professional expertise in the field of flood management makes you a vital contribution to the development of a framework in improving the flood management system in the United Kingdom. Such improvement and recommendations will be beneficial in the area of flood management.

What will happen to the results of the research study?

The research results will be interpreted and compiled in order to develop a framework during the writing up stage of the PhD thesis. The findings will also be presented and published in related fields such as in academic journals, conferences and seminars. In addition, the findings will be shared with other researchers and practitioners. At any place the findings are used, the details will be kept anonymous unless written consent had been given to disclose the information.

Is there any risk involved?

The nature of the research means that participants will not be exposed to any form of risk in the study.

Will the participant get paid?

Participation in the research is voluntary and, as such, there is no financial incentive involved with the study.

Additional Information:

The researcher is a PhD student at the School of Built Environment, University of Salford. If you require any further information or you have any enquiries about this research or your participation, please don't hesitate to contact.

Contact details:

If you have any questions about this study, you can contact the person(s) below: Researcher: […….] abc@edu.salford.ac.uk

Supervisor: […….] abc@salford.ac.uk

I hope you will be interested in this research study and your participation will be very much appreciated. Thank you very much for your time and consideration.

Kind regards,

[……]

Appendix 5: Consent Form for Survey Participants

The purpose of this survey is to determine the barriers and challenges faced by occupants on the floodplains with regards to flooding incidents.

You are invited to participate in this study due to your experiences on living on the floodplain. Participation in this research is entirely voluntary and you can choose to not take part in the study However, your participation in the research will be beneficial. If you participate, you can withdraw from the research at any time of the study without giving any reason.

Participation in the research involves completing the online survey questionnaire that will take approximately 20-30 minutes. The responses will be held under strict confidential along with all personal information such as your name, email address and other secure data.

Survey questions will be about flood and floodplain management. This will involve the barriers and challenges faced with regards to responding to flooding.

All data obtained from the survey will be secured on a password protected computer and held on an electronic database. The results will be maintained for academic purposes and shared with the University of Salford where it will be held confidentiality.

If you have any further questions about the research, please do not hesitate to contact the researcher.

Consent Statement:

I have read and understood the information about the research and I consent to participate in this study *

Yes ☐

No ☐

Appendix 6: Consent Form for Interview Participants

Title of the Research Study: Improving the regulatory framework of floodplain development and management in the United Kingdom

Researcher's Name: **[…….]**

Supervisory Team: **[…….]**

Please tick the appropriate boxes	**Yes**	**No**
Taking Part		
I have read and understood the project information sheet dated DD/MM/YYYY.	☐	☐
I have been given the opportunity to ask questions about the project.	☐	☐
I agree to take part in the project. Taking part in the project will include being interviewed and audio – recorded.	☐	☐
I understand that my taking part is voluntary; I can withdraw from the study at any time and I do not have to give any reasons for why I no longer want to take part.	☐	☐
Use of the information I provide for this project only		
I understand my personal details such as phone number and address will not be revealed to people outside the project.	☐	☐
I understand that my words may be quoted in publications, reports, web pages, and other research outputs.	☐	☐
*Please choose **one** of the following two options:*		
I would like my real name used in the above	☐	
I would **not** like my real name to be used in the above.	☐	

_____	_____	_____
Name of participant [printed]	Signature	Date
_____	_____	_____
Researcher [printed]	Signature	Date

Project contact details for further information:

Researcher	[…….]	xyz@edu.salford.ac.uk
Supervisor	[…….]	xyz@salford.ac.uk

Appendix 7: Questionnaire

Section 1: Participant's Background Information

(Please circle the appropriate answer)

1. Name (Optional)

2. Gender (Optional)
   - Male
   - Female
   - Other
3. How old are you? (Optional)
4. Address (Optional)
5. What is your occupation? (Optional)
6. Do you reside in the United Kingdom?
   - Yes
   - No
7. Do you own the property or is it rented?
   - Owned
   - Rented
8. Is it a new build or an older existing property?
   - New build
   - Old build

   How old is the property?

9. What type of property do you reside in?
   - Flat
   - Terrace
   - Semi-Detached
   - Detached
   - Bungalow

- Other

10. How long have you resided in the property?

Section 2: Experience of Flooding

1. Do you live in a flood prone area?

- Yes
- No

2. Were you aware the property was situated on a floodplain?

- Yes
- No

3. Were you informed during the purchase process that the property was on a floodplain?

- Yes
- No

4. Were searches and surveys conducted during the conveyancing process?

- Yes
- No

5. Were there flood related adaptations to the property?

- Yes
- No

If yes, please provide details on the adaptations

6. Do you have building or content insurance?

- Yes
- No

7. Have you experienced flooding?

- Yes
- No

8. When did you experience flooding?

9. If you experienced flooding, how much of your property had been flooded?

- Not Applicable
- Road
- Garden
- Garage
- Ground Floor
- Upper Floor

10. What is your experience of the flooding? Please provide a detailed account (e.g. did you experience damage to the property? Did you have to vacate the residence?)

11. Have you experienced flooding prior to this event?

- Yes
- No

If yes, how many times?

12. Did you claim under any form of flood insurance?

- Yes
- No

If yes, please provide an account of your experience

13. Did you suffer any losses that were not covered by the insurance?

- Yes

- No
- If yes, please provide an account of your experience

14. After the flooding event, have you experienced any rise in insurance prices?

- Yes (Significant)
- Yes (Slight)
- No (Remained the same)
- Not sure

15. Have you taken any form of flood prevention measures after the flooding event?

- Flood Insurance
- Flood Adaptations (e.g. flood barriers, raised ground floors)
- Other
- None

If none, please provide details on why you did not consider any flood prevention measures

16. What barriers and challenges did you experience as a result of flooding? Please provide a detailed account

17. What suggestions do you recommend that would aid in combating flooding in the floodplain areas? Please provide a detailed account

Section 3: Opinions on Flooding

In recent years, the United Kingdom has been impacted by a number of flooding events with the danger set to increase in the future. An area that is particularly vulnerable are the floodplains. This section contains a series of questions to highlight the importance of current flood and floodplain management regulatory practices. Please circle your answer to indicate the range on how strongly you agree or disagree or circle 4 if you feel indifferent.

1. The recent years of flooding in the United Kingdom are the result of climate change
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
2. Flooding is a natural disaster with nothing capable of being done to stop it
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
3. People living in a flood risk area should expect their property to be flooded
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
4. The government should continue to enforce insurers to insure properties against flooding
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
5. More funding and resources should be spent on flood prevention methods
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
6. Flood insurance is affordable
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
7. Protection against flooding can be handled through funding of flood defences
    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree
8. Protection against flooding can be handled through regulation to eliminate inappropriate developments on the floodplains

- Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree

9. Planning permission for developments on floodplains is adequate

    - Strongly Agree 1 2 3 4 5 6 7 Strongly Disagree

10. Please rank the following according to their significance with regards to flood response (Number them with 1 being highest and 4 being lowest)

    - Floodplain Development Planning
    - Funding of Flood Defences
    - Insurance
    - Flood related adaptations to properties

11. Are there any further comments you would like to add on the issue of flooding and floodplain development? Please fill your answer in the space below

Appendix 8: Interview Guide

1. Participants position, professional background and experience in flood responses and floodplain management.
2. General overview of flooding, flood responses and floodplain management along with regulatory framework in the United Kingdom
3. Impacts of flooding on society, the economy and the environment
    - Overview of the impact of flooding
    - Key issues related to flood response
    - Effectiveness
    - Any need for improvements?
    - Recommendation for improvements
4. Thoughts and opinions of the existing regulatory framework with regards to flooding and floodplain management
    - Knowledge, experience, performance
    - Strategy for training and development of people
    - Quality of decision making
    - Co-ordination and collaboration; opportunities, possibilities, challenges and barriers
    - Strategic position on co-ordination and collaboration with other organisations involved
    - Recommendations for improvements
5. Flood risk increasing due to factors such as climate change
6. Challenges and barriers faced by the current regulatory framework with regards to flooding and floodplain management.
    - Increased developments on flooding
    - Funding
7. Improvements that could be adopted towards the flood and floodplain regulatory framework
    - Insurance
    - Adaptation
    - Flood Defences
    - Funding
8. Support given to properties that are already existing on the floodplain

9. Foreign practices that could be adopted by the United Kingdom
    - Central government involvement
    - Legislation
    - Insurance
10. Improvement of communication of flood potential to decision makers

Appendix 9: BBC Cumbria Radio