Northumberland County Council

Level 1 Strategic Flood Risk Assessment

Final Report
September 2010

Prepared for:

NORTHUMBERLAND
COUNTY COUNCIL

Revision Schedule

Level 1 Strategic Flood Risk Assessment

Final Report
September 2010

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	August 2009	Interim Draft Level 1 SFRA	**Gemma Costin** Assistant Flood Risk Specialist	**Jon Robinson** Associate Director	**Les Orange** Associate
02	November 2009	Draft Level 1 SFRA	**Gemma Costin** Assistant Flood Risk Specialist	**Jon Robinson** Associate Director	**Les Orange** Associate
03	April 2010	Final Draft	**Srimali Abeyrathne** Graduate Engineer	**Sally Atkinson** Principal Engineer	**Les Orange** Associate
04	August 2010	Final Report	**Srimali Abeyrathne** Graduate Engineer	**Sally Atkinson** Principal Engineer	**Les Orange** Associate
05	September 2010	Final Report	**Srimali Abeyrathne** Graduate Engineer	**Sally Atkinson** Principal Engineer	**Les Orange** Associate

Scott Wilson
Victoria House
159 Albert Road
Middlesbrough
TS1 2PX

Tel 01642 218476
Fax 01642 223582

www.scottwilson.com

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Abbreviations

AA	Appropriate Assessment
AAP	Area Action Plan
ABI	Association of British Insurers
AMR	Annual Monitoring Report
ASCCUE	Adaptation Strategies for Climate Change in the Urban Environment
BHS	British Hydrological Society
BW	British Waterways
CAMS	Catchment Abstraction Management Strategy
CBHE	Chronology of British Hydrological Events
CFMP	Catchment Flood Management Plan
CLG	Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
DPD	Development Plan Document
EA	Environment Agency
EU	European Union
FRA	Flood Risk Assessment
FZ	Flood Zone
GIS	Geographical Information System
HA	Highways Agency
HMA	Housing Market Area
HMSO	Her Majesty's Stationary Office
LDD	Local Development Document
LDF	Local Development Framework
LDS	Local Development Scheme
LP	Local Plan
LPA	Local Planning Authority
MDSF	Modelling and Decision Support Framework
MoD	Ministry of Defence
NC	Northumberland County Council
NE	Natural England
NWL	Northumbrian Water Limited
OFWAT	Office of Water Services
PCPA	Planning and Compulsory Purchase Act 2004
PDL	Previously Developed Land
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
PUA	Principal Urban Area

RBD	River Basin District
RBMP	River Basin Management Plan
RFRA	Regional Flood Risk Appraisal
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
SA	Sustainability Appraisal
SCP	Sustainable Communities Plan
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SFRM	Strategic Flood Risk Mapping
SoP	Standard of Protection
SP	Structure Plan
SPG	Supplementary Planning Guidance
SRS	Sub Regional Strategy
SuDS	Sustainable Drainage Systems
SW	Scott Wilson
SWMP	Surface Water Management Plan
WCS	Water Cycle Study
WFD	Water Framework Directive

Executive Summary

Local Planning Authorities (LPAs) are required to produce Local Development Frameworks (LDFs), which are a portfolio of Local Development Documents (LDDs) that collectively deliver the spatial planning strategy for the authority area. The LDDs undergo a Sustainability Appraisal (SA) which assists LPAs in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions and are a component of the SA process. Therefore, SFRAs should be used in the review or production of LDDs.

Planning Policy Statement 25: Development and Flood Risk (PPS25) and its Practice Guide (December 2009) recommend that SFRAs are completed in two stages. The Level 1 SFRA enables application of the Sequential Test by the LPA, and the Level 2 SFRA increases the scope of an SFRA for development sites where the Exception Test is required (i.e. those which have not passed the Sequential Test). The Sequential Test is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. Where this is not possible, due to wider sustainable development issues, to locate the development in a low flood risk area, a sequential approach within the Flood Zone is required and the Exception Test should be applied where necessary. This Executive Summary and the accompanying SFRA report constitute 'Level 1' of the Northumberland SFRA, which has been commissioned by Northumberland County Council (NCC).

Flood related planning policy at national, regional and district levels has been collated. This serves to highlight the fact that flood risk is taken into account at every hierarchical level within the planning process and also helps to demonstrate how the SFRA will feed into NCCs LDF process. NCC have not yet identified site specific strategic development locations and the SFRA is designed to inform this decision-making process.

The main source of flood risk policy and strategy within the sub-region are Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs) and Flood Risk Management Strategies (FRM). As well as highlighting the flood risks within a catchment, these documents also outline policies for dealing with flood risk management at various locations within a catchment.

PPS25 requires that, as part of any SFRA, all sources of flooding are identified. In order to assess the risk of flooding, the Environment Agency (EA) has provided data and has been closely involved with the NCC SFRA. In addition, other key stakeholders have been consulted and those that have provided data include Northumbrian Water (NWL). From historical flood records, and using other sources of flood risk information, six main sources of flood risk were identified: fluvial flooding, tidal flooding, sewer flooding, surface water flooding, groundwater flooding and flooding from artificial sources.

The catchments of the Rivers North, South and Main Tyne, and the River Coquet, River Wansbeck, River Blyth, River Rede, River Tweed and River Till are the main hydrological influences of the study area. However, the coastal frontage settlements also fall within the flood zone of the North Sea. In order to present the best available flood information, SFRA Flood Zones were derived using a variety of existing sources of data. Where detailed numerical hydraulic modelling of rivers has been undertaken and the flood outlines mapped, these have been used in preference to broad-scale modelled flood outlines. The result is a single map for each Flood Zone using a variety of data. All SFRA Flood Zones are based on information provided by the EA and prescribed methodologies in PPS25.

The SFRA Flood Zones show that the areas that are potentially at risk of flooding are along narrow strips of land immediately adjacent to watercourses, which is due to the well-defined channels of the watercourses, their general steepness and relatively small sizes, and the coastal and estuarine flood frontages. Urban locations within the study area that are potentially affected by flooding include parts of Morpeth, Warkworth, Blyth, Ponteland, Hexham, Alnwick, Berwick upon Tweed, Amble, Belford, Wooler and Rothbury. In addition, there are numerous smaller settlements in the study area that have areas at risk of fluvial flooding.

Sewer flooding was identified using historical records from the NWL (sewer flooding) DG5 database, which details the total number of flood events that have affected properties both internally and externally. The number of recorded sewer flooding events varies across the region with specific areas with issues being Morpeth, Cramlington, Hexham, and Amble.

There are instances of groundwater flooding recorded in Spittal and the Darras Hall estate in Ponteland. EA groundwater vulnerability maps show the study area to be underlain by mainly minor aquifers of varying vulnerability. BGS mapping shows the area to be underlain by carboniferous limestones, small areas of igneous rocks, coal measures and mudstones which have limited permeability. There is therefore the possibility of groundwater vulnerability.

Consultation with the EA and NCC has confirmed that there are structures and embankments (either purpose built or natural) that contribute to flood risk management, although these may not all be depicted graphically on the mapping carried out for this SFRA, as National Flood and coastal Defence Database NFCDD (and hence the EA Defences Geographical Information System (GIS) layer) is continuously being updated. The EA maintain and keep records of many of the flood risk management structures in the study area, though it should be noted that there are a great deal more 'private' or 'non-maintained' structures and embankments that may provide a level of protection to areas. The standard of protection for flood risk management structures within the study area varies markedly, specific schemes having a Standard of Protection (SoP) of between 20% (1 in 5 years) and 1% annual probability (1 in 100 years) events.

CFMPs have identified an increased level of flood risk to the study area over the next 25 to 100 years as a result of climate change. Firstly, as a result of wetter and warmer winters, an increase in large fluvial flood events is likely to affect the rivers and watercourses in the study area, although the naturally steep and constrained nature of the floodplains of many of the watercourses implies that increases in spatial extent of Flood Zones due to climate change is likely to be limited. Secondly, extreme rainfall events are likely to become more frequent leading to a greater storm intensity and duration. This is likely to lead to more runoff causing surface water flooding and overwhelming of the urban sewer networks in particular.

To attempt to counteract this increase in runoff in local areas, the use of Sustainable Drainage Systems (SuDS) is becoming more important. In addition to the more usual attenuation and infiltration systems, providing more 'green' spaces within the urban environment can also help to reduce runoff and also increase wildlife habitat. These areas can sometimes be most effective when placed alongside development in water corridors (e.g. along canals and watercourses).

Using information and analysis gathered during the planning policy and flood risk reviews, a strategic overview of flood risk was carried out to identify potential conflicts between development pressures and flood risk now and in the future.

Detailed maps were produced covering growth points and key development towns within the Northumberland administrative area.

These assessments present the available flood risk information and are accompanied by a narrative. The purpose of the detailed maps is to identify where future strategic level development sites could potentially be located. In addition, the maps can be used to identify the requirements for, and also inform, site-specific FRAs for future development. Guidance on undertaking site-specific FRAs is provided in the report.

This SFRA was completed using the PPS25 climate change recommendations. However during the lifetime of this document it is quite likely that climate change levels may alter. As a result, future site-specific FRAs may have to adapt to these changes in line with current guidance in response to continuing research into climate change.

The NCC SFRA has been completed in accordance with PPS25 and the current guidance outlined in the PPS25 Practice Guide (December 2009). The SFRA has been developed by building heavily upon existing knowledge with respect to flood risk within the study area. These documents have an intended lifespan of 6-10 years. Therefore it should be noted that although up-to date at the time of production, the SFRA has a finite lifespan and should potentially be updated or revised as required by the LPA. As a result, it is recommended that the SFRA be adopted as a 'Living' document and should be reviewed regularly and, if necessary, updated with new flood risk or planning policy data.

Northumberland County Council, Level 1 Strategic Flood Risk Assessment, Final Report September 2010

Addendum

The Northumberland County Council, Level 1 Strategic Flood Risk Assessment, Final Report September 2010 should be read in conjunction with the following additions/amendments. These additions/amendments are shown in *italic text.*

Chapter 1

Section 1.3.1 – Level 1 SFRA

4th paragraph, page 3 – following additional paragraph to be added after the 4th paragraph

"*At the time of undertaking fluvial mapping work for the Level 1 SFRA study area, the EA data did not delineate functional floodplain in tidal areas and/or remove floodplain behind defences. Further work was not undertaken to make these changes and therefore, for those areas, flood zone 3a has been considered as a proxy to represent the functional floodplain until such a time that more detailed information is available, such as the Level 2 SFRA (where necessary), an EA Strategic Flood Risk Mapping (SFRM) study or a site-specific FRA. For further explanation of the functional floodplain mapping process undertaken and data, refer to section 4.5.2. (Page 57)"*

Chapter 2

Section 2.23 – Northumbrian Water

1st paragraph, page 6 – amend to read "NWL is responsible for storm and foul water *in the public sewerage system* across the NCC administrative area".

Section 2.3 – Historical Flooding

3rd sentence, 2nd paragraph, page 7 – amend to read "In addition, DG5 *sewer flooding* data received from NWL indicates that parts of the study area have been affected by flooding from sewers.

Section 2.5.5 – Flooding from Sewers

1st paragraph, page 12 – amend to read "All *public* sewers ~~*built*~~ *put forward for adoption by developers* in the last 30 years should have been designed utilising guidance detailed in 'Sewers for Adoption' (SFA). The Sewers for Adoption provides standard industry technical guidance for developers and designers of sewer network and assets. The SFA was developed originally by Water Authorities to ensure a consistent approach was taken in sewer construction *and hydraulic design standards".*

6th paragraph, page 13 – amend to read "The *surface water* sewers designed based on earlier editions of SFA such as the 3rd edition were actually designed to surcharge during storms which were greater than the relevant storm return periods but would not spill from manholes until much greater return periods.

1st sentence, 8th paragraph, page 13 – amend to read "The majority of *surface* sewer systems are currently designed to spill from the manholes during storm events with a return period greater than 1 in 30 years (e.g. 1 in 100 years).

9th paragraph, page 13 – following additional sentence to be added to end of paragraph "*This flooding is almost exclusively related to the older combined sewer network rather than new sewers built within the past 30 years."*

1 Introduction

1.1 Background

The Planning and Compulsory Purchase Act (PCPA) (HMSO, 2004) requires Local Planning Authorities (LPAs) to produce Local Development Frameworks (LDFs) to replace the system of Local Plans (LPs), Structure Plans (SPs) and Unitary Development Plans (UDPs). LDFs are a portfolio of documents (Local Development Documents (LDDs)) that collectively deliver the spatial planning strategy for the authority area. The PCPA (2004) requires LDDs to undergo a Sustainability Appraisal (SA) which assists LPAs in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments (SFRAs) are one of the documents to be used as the evidence base for planning decisions; they are also a component of the SA process and should be used in the production or review of LDDs.

The release of Planning Policy Guidance Note 25: Development and Flood Risk (PPG25) in July 2001 introduced the responsibility placed on LPAs to ensure that flood risk is understood and managed effectively using a risk-based approach as an integral part of the planning process.

PPG25 was superseded by Planning Policy Statement 25: Development and Flood Risk (PPS25) in December 2006. PPS25 re-emphasises the active role LPAs should have in ensuring that flood risk is considered in strategic land use planning. PPS25 encourages LPAs to undertake SFRAs and to use their findings to inform land use planning. In December 2009, the updated PPS25 Practice Guide was released, which supersedes the earlier version of PPS25 Practice Guide published in June 2008. The PPS25 Practice Guide sets out the requirements of an SFRA and a recommended approach, which has been adhered to by this SFRA.

To assist LPAs in their strategic land use planning, SFRAs should present sufficient information to enable LPAs to apply the Sequential Test to their proposed development sites:

"The Strategic Flood Risk Assessment is at the core of the PPS25 approach. It provides essential information on flood risk, taking climate change into account, which allows the local planning authority (LPA) to understand the risk across its area so that the Sequential Test can be properly applied." (PPS25 Practice Guide, 2009:49)

In addition, where development sites cannot be located in accordance with the Sequential Test as set out in PPS25 (i.e. to steer development to low risk sites), there is a need to apply the Exception Test. In which case:

"…the scope of the SFRA should be widened. This increased scope SFRA is referred to as a Level 2 SFRA. ..." (PPS25 Practice Guide, 2009:53)

In addition to forming a tool for use in strategic land use planning, an SFRA should be accessible and provide guidance to aid the general planning process of the LPA.

1.2 The Northumberland SFRA

Northumberland is a predominantly rural area located in the North East of England to the north of Newcastle and south of the Scottish border, and its administrative area covers approximately 5020km^2. The previous district and borough councils of Castle Morpeth, Blyth, Wansbeck, Tynedale, Berwick and Alnwick have been amalgamated to form the unitary authority of Northumberland. It should be noted that for the purposes of the NCC SFRA, Northumberland National Park (NNP) remains a separate planning authority; however, relevant data covering this area has been collated as part of the SFRA data collection process.

The main urban areas in Northumberland are shown in Table 1-1.

Table 1-1 Main Urban Areas in Northumberland

Main Urban Areas in Northumberland	
Alnwick	Cramlington
Amble	Haltwhistle
Ashington	Hexham
Berwick	Morpeth
Blyth	Prudhoe

Northumberland is covered by the North East Regional Spatial Strategy (RSS). A Core Strategy is being developed for Northumberland County Council (NCC) following its recent establishment as a unitary authority, as part of the Local Development Framework (LDF). The Core Strategy is currently being prepared and is expected to be adopted in 2012. Once adopted, it will replace the current planning policy framework for Northumberland, (which is a mixture of previous former district local plans, a more up to date local plan for the former Wansbeck district and Core Strategies for the former Blyth Valley, Tynedale and Alnwick districts).

The spatial planning of any proposed development must be considered with regard to the current and future risk of flooding from a number of sources, including fluvial, surface water, artificial sources and groundwater.

It is therefore important that flood risk is considered at a strategic scale to inform land allocations and future developments proposed by the emerging LDF.

1.3 The SFRA Structure

The PPS25 Practice Guide recommends that SFRAs are completed in two stages; this follows the iterative approach encouraged by PPS25 and provides LPAs with tools throughout the LDF and SFRA process sufficient to inform and update decisions regarding development sites. The two stages are:

- Level 1 SFRA – Enables application of the Sequential Test,
- Level 2 SFRA – Increases scope of SFRA for sites where the Exception Test is required.

The results of the SFRA will enable NCC to review the potential development sites and to inform the scope of the SA.

1.3.1 Level 1 SFRA

A Level 1 SFRA should present sufficient information to enable the LPA to apply the Sequential Test to potential development sites and assist in identifying whether the application of the Exception Test will be necessary.

The objective of the Level 1 SFRA is to collate and review available information on flood risk for the study area. Information has been sought from a variety of stakeholders including the Environment Agency (EA), NCC, Northumbrian Water (NWL), and the Highways Agency (HA). In addition to the collection of data and consultation with local stakeholders, the Level 1 SRFA also considers any available data needed to meet the requirements of a Level 2 SFRA. Where necessary the report identifies works beyond the critical scope that may benefit the assessment.

The information presented in a Level 1 SFRA should not be considered as an exhaustive list of all available flood-related data for the study area. The Level 1 SFRA report is a presentation of flood sources and risk, which is based on data collected following consultation with and input from the LPA and relevant stakeholders, within the timeframe available. The Level 2 SFRA will enable the relationships developed with key stakeholders in the undertaking of the Level 1 SFRA to continue to assist in providing data and information for the Level 2 SFRA.

The Level 1 SFRA should be used by the LPA, together with other evidential documents to undertake Sequential Testing. This will help to identify where sites can be located in areas with lesser flood risk and this may require further investigation through a Level 2 SFRA.

1.3.2 Level 2 SFRA

The Level 2 SFRA will provide sufficient information to facilitate the application of the Exception Test, where required. This will be based on information collected for the Level 1 SFRA and additional works where necessary.

1.4 The SFRA Aims & Purpose

In accordance with PPS25, the PPS25 Practice Guide and the Scott Wilson (SW) proposal for undertaking the NCC Level 1 SFRA (dated March 2009), the main aims and purpose of the Northumberland SFRA are listed below:

- Collection of data pertaining to all flood sources including:
    - Flooding from rivers,
    - Flooding from the sea,
    - Flooding from land,
    - Flooding from groundwater,
    - Flooding from sewers,

- Flooding from reservoirs, canals and other artificial sources,
- Contextualise the Level 1 SFRA with regard to national, regional and local planning policy,
- Creation of SFRA Flood Zones that use the best available information. The Flood Zones will be a hybrid of outlines derived from detailed EA modelling studies where available and where these are not available, broadscale EA modelling studies. In addition, the functional floodplain (FFP) will be redefined in agreement with the EA and in accordance with the definition given in the PPS25 Practice Guide,
- Determination of existing flood risk management infrastructure, including the location and standard of infrastructure (as defined in the EA's National Flood and Coastal Defence Database (NFCDD)) and the coverage of EA flood warning systems,
- Guidance on the preparation of site-specific Flood Risk Assessments (FRAs),
- Guidance on the likely applicability of sustainable drainage systems (SuDS) techniques for managing surface water run-off,
- Identification of potential requirements for Level 2 SFRAs.

2 Northumberland County Council

2.1 Study Area

The study area covers a total area of 5020 km^2 Figure 2-1, comprising of the former districts of Wansbeck, Blyth, Castle Morpeth, Tynedale, Alnwick, Berwick Upon Tweed and part of Northumberland National Park (NNP). It must be noted that NNP retains its statutory planning powers. The study area is characterised by upland moorland, hills, valleys and coastal lowlands and estuaries. The county is sparsely populated, with the larger urban areas being Morpeth, Cramlington, Hexham, and Berwick. Approximately 25% of the county is designated as part of the Northumberland National Park.

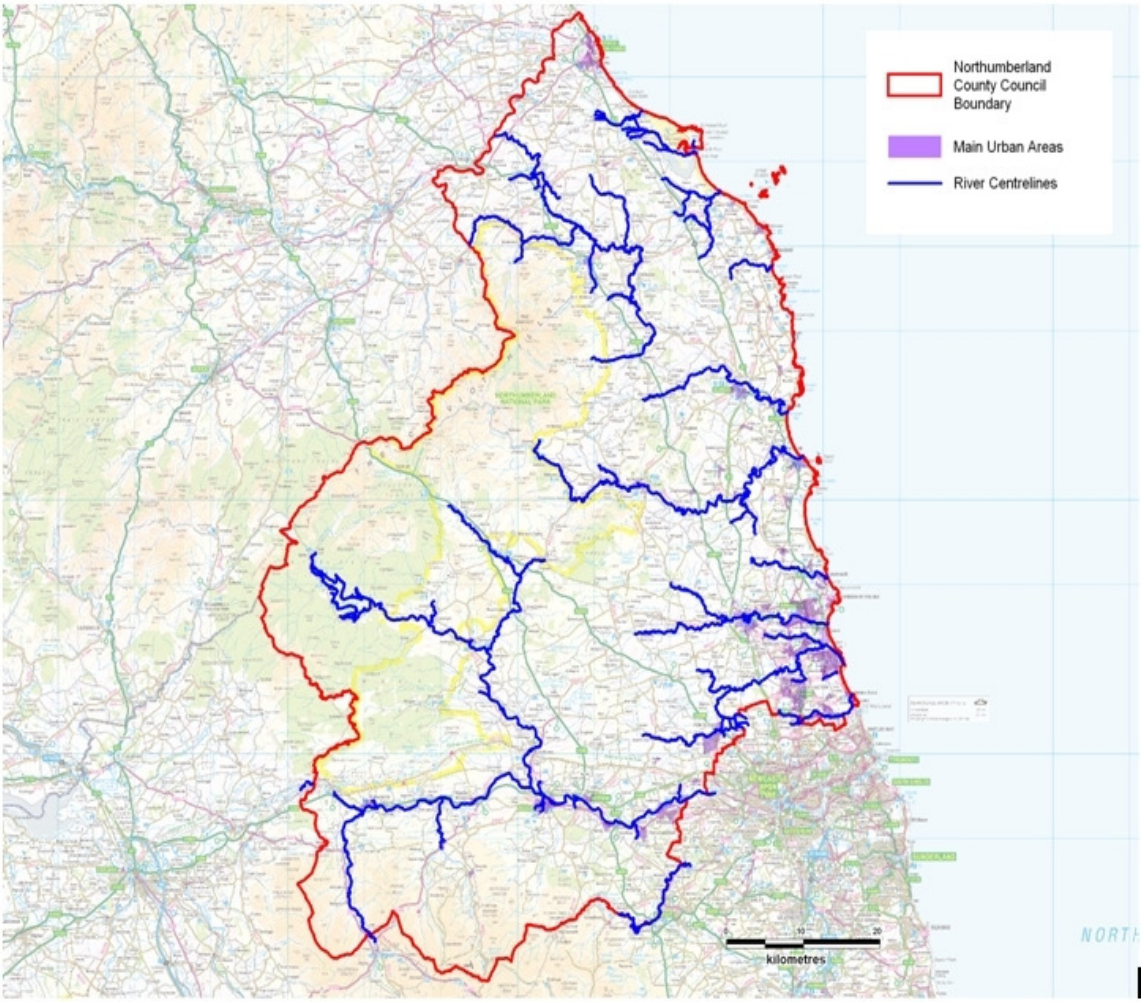


Figure 2-1: Study Area

2.2 Administrative Bodies

2.2.1 Northumberland County Council

The study area lies within the administrative area of NCC although a substantial portion of Northumberland is situated within NNP and the NNP retains planning powers over this area. NCC is required to deliver planning strategies that manage and reduce the risk of flooding, and to consult the EA when preparing planning documents and determining applications.

Being a unitary authority, NCC takes on all local government administrative roles and duties including responsibility for producing appropriate plans for responding to flooding. The primary role of the authority in the event of an emergency is to provide care for people affected by the emergency.

The NCC Highways Department has a duty to maintain the structure of public roads, bridleways and footpaths so that the public's right to pass along public highways is protected. The authority has powers to install and maintain drainage systems to prevent flooding to a highway and where this is necessary, the authority may be obliged to provide such measures. The authority may also take action to address problems related to the drainage of adjoining land, where this would otherwise threaten a public highway.

Since there are no Internal Drainage Boards (IDBs) in Northumberland, NCC has discretionary powers for land drainage within the study area. These powers include regulating activities along smaller watercourses and undertaking works to alleviate flooding or recurrent flooding in areas not within the responsibility of the EA. In some cases, NCC will also have responsibilities as a 'riparian' owner, through its management of parks and open spaces and as a significant landowner.

Data relating to flood risk, historical flooding and planning was provided by their planning and GIS teams.

2.2.2 Environment Agency

The study area is covered by the EA's North East Region. The EA has discretionary powers and is a statutory consultee on flood risk for planning allocations and applications under the Town and County Planning Act under the Water Resources Act (1991) for all Main Rivers and their associated flood risk management structures within the study area.

The EA has provided a large amount of data for the purposes of the SFRA, including data relating to flood risk management, flood risk policy and historical flooding.

2.2.3 Northumbrian Water

NWL is responsible for storm and foul water management across the NCC administrative area. In addition, private individuals may be responsible for drainage systems that operate prior to discharge either into a watercourse or into a public (adopted) sewer network.

2.3 Historical Flooding

There have been numerous recorded historical flood events in the Northumberland administrative area and it is widely recognised that there is a long history of river flooding within the River Tyne, Tweed, Coquet and Wansbeck catchments. These events are summarised by catchment in Appendix A, with the dates, causes and effects presented where available. In addition, Catchment Flood Management Plans (CFMPs), the British Hydrological Society Chronology of British Hydrological Events (BHS CBHE) database[1] and internet searches were also used to find historical flood events within the study area.

There are many historical records of fluvial flooding within the study area. However, it is also evident that the study area has suffered from surface water flooding in the past. In addition, DG5 data received from NWL indicates that parts of the study area have been affected by flooding from sewers. Sewer flooding data is presented in Appendix B.

2.4 Existing Assessment of Flood Risk

Four of the former Local Authorities had undertaken SFRAs for their administrative areas. A key part of this study is to review these reports and assess their appropriateness and to identify any critical data gaps key to the Level 1 and Level 2 SFRA.

Table 2-1: Extract from Regional Flood Risk Assessment (JBA, 2009)

Local Authority	Date Produced	Produced By	PPS 25 or PPG 25	Relevancy
Berwick	March 08	Jacobs	PPS	Appropriate
Castle Morpeth	August 08	Jacobs	PPS	Draft
Alnwick	September 08	Jacobs	PPS	Appropriate
Tynedale	January 09	JBA	PPS	Appropriate
Wansbeck	Outstanding			Not Started
Blyth Valley	Outstanding			Not Started

2.5 Flood Sources

2.5.1 Flooding from Rivers

The majority of the study area falls within the catchment of the River Tyne, River Coquet and River Tweed Catchments. The numerous larger watercourses that are located within the study area are listed in Table 2-2, though this is not an exhaustive list. There are many other smaller streams (usually known locally as burns) which pose considerable flood risk to areas within the County.

[1]British Hydrological Society, Chronology of British Hydrological Events, Online Database, University of Dundee. http://www.dundee.ac.uk/geography/cbhe/

Table 2-2: Local Watercourses

North Tyne	River Blyth
South Tyne	River Pont
River Coquet	River Font
River Aln	River Glen
River Tweed	River West Allen
River Till	River Lyne
River Rede	River Wansbeck
River East Allen	Wooler Water
River Breamish	River Alwyn

As noted in the River Tyne, Till and Breamish, North East Northumberland and Wansbeck and Blyth CFMPs, fluvial flooding mechanisms in upper catchments, including the settlements of Wooler, Haltwhistle and Rothbury, are characterised by water levels of small rivers and streams rising quickly in response to rainfall events. This is as a result of the steep slopes, modified field drainage and often impermeable geology and soils that characterise upper catchments. The time to peak flows are typically less than two hours, often giving the local population insufficient time to react and reduce the consequence of flooding.

River Tyne Catchment (including North and South Tyne, River Rede and East and West Allen)

The River North Tyne has its source on the Scottish border, to the north of Kielder Reservoir and flows through Kielder Forest before flowing in a south to south-easterly direction passing through several small settlements including Falstone, Bellingham, Redesmouth and Wark to its confluence with the River South Tyne just upstream of Hexham. There is another significant confluence with the River Rede at Redesmouth. The catchment of the North Tyne is predominantly rural, with a large part of the catchment covered by Kielder Forest. The catchment is underlain by carboniferous limestone. Due to the steep and largely impervious nature of the underlying geology and superficial deposits, together with a direct steam network which efficiently conveys flow to the main watercourse, the river is considered flashy, typically responding quickly to rainfall events. The floodplain of the North Tyne is effectively an extension of the channel and does not attenuate flows to any significant effect. Upstream of Kielder reservoir, response times are typically 2-5 hours. Flows are heavily attenuated by Kielder Reservoir downstream.

The River Rede has its source on the Scottish Border and is one of the slowest responding rivers in the Tyne catchment and joins the North Tyne at Redesmouth. It flows through a largely rural catchment passing through the settlement of Otterburn. It is a meandering river with wide floodplains which provide some attenuation of flows. It has a less steep catchment than most of the other tributaries and also has a more indirect stream network further attenuating flows. Catcleugh reservoir provides further attenuation.

The River South Tyne rises outside of the study area at Alston Moor in Cumbria. It flows in a northerly direction to Haltwhistle where it is joined by the tributaries of Tipalt Burn and Haltwhistle Burn and then turns 90 degrees to flow in an easterly direction through Redburn and Haydon Bridge to its confluence with the North Tyne upstream of Hexham to form the main River Tyne.

The catchment is steep with largely impervious underlying geology with thin soils which provide little attenuation of flows, together with a direct steam network which efficiently conveys flow to the main watercourse leading to a flashy hydrology and runoff rates in excess of 50%. A typical response time is 2-5 hours. The South Tyne has another major confluence with the River Allen at Whitechapel. The River Allen is also a fast responding flashy river, one of the fastest responding watercourses in the Tyne catchment.

The River Allen is formed at the confluence of the Rivers East and West Allen at Cupola. It is a very flashy river due to the steep gradient of the catchment and impervious geology. The catchment is however largely rural in nature, the only significant sized settlement being Allendale Town on the East Allen.

The River Tyne CFMP states that the main flood risk areas on the fluvial Tyne are in the Middle reaches between Hexham and Wylam, and also at Haydon Bridge, Haltwhistle, Bellingham and Otterburn.

There is a long history of fluvial flooding in the Tyne catchment. Appendix A details notable flood events. It is clear that snowmelt and heavy rainfall are the main causes of flooding in the catchment, although there have been several significant summer flood events, particularly on the smaller burns. The timing and distribution is critical to the likelihood of fluvial flooding.

River Wansbeck Catchment

The main River Wansbeck has two main tributaries, the River Font and Hart Burn which join the Wansbeck upstream of Morpeth. The River Wansbeck has its source at Sweethope Loughs and flows in an easterly direction passing through the settlements of Kirkwhelpington, Mitford, Morpeth, and Ashington to the North Sea. The catchment is underlain by carboniferous limestone in the west and coal measures in the east, separated by a band of Millstone Grit. The bedrock is overlain by largely impermeable glacial till. The Wansbeck and Blyth CFMP states that the River Wansbeck responds to rainfall events typically within 8 hours, although the smaller tributaries respond much quicker and may pose a flood risk to the town prior to the main River Wansbeck flood wave reaching Morpeth. Flooding may be exacerbated if flooding occurs on the River Font and Hart Burn as they can peak at the same time as the River Wansbeck. The River Font and Hart Burn typically respond to rainfall in 4-6 hours.

Morpeth is the main settlement at risk of flooding in the Wansbeck catchment; it is at risk of flooding from the River Wansbeck, and the three tributaries that join the River at Morpeth - Cotting Burn, Church Burn and Postern Burn. There are flood defences at Morpeth, however there is a long history of fluvial flooding in the town, most notably in 1963 and September 2008.

River Blyth Catchment

The River Blyth has one main tributary, the River Pont which has its confluence with the Blyth just upstream of the A1 road bridge. According to the Wansbeck and Blyth CFMP, the River Blyth typically has a response time of 13 hours. There are few historic records of fluvial flooding on the River Blyth and its tributaries, however 1992 and 2000 saw serious flooding in Ponteland. There are flood defences on the River Pont at Ponteland and Eland Haugh, however the Eland Haugh defences were overtopped during the floods in 2000.

Coastal Streams

The coastal stream consists of five smaller lowland watercourses; the River Lyne, Newsham Burn, Meggies Burn, Seaton Burn and Brierdene Burn and these are covered by the Wansbeck and Blyth CFMP. Each of these catchments is underlain by coal and till. There is little recorded hydrological data for these small watercourses however it has been estimated that the River Lyne has a response time of approximately 15 hours and the smaller burns being steeper are flashier and have shorter response times.

River Coquet Catchment

The River Coquet rises in the Cheviot Hills and flows in an easterly direction to the North Sea at Amble and is covered by the North East Northumberland Rivers (NEN) CFMP. It flows through the settlements of Thropton, Rothbury, Harbottle, Felton, and Warkworth where it has its tidal limit at Warkworth dam. Its tidal reach continues to its mouth at the North Sea in Amble. Its western reaches are underlain by basalt, granite and other igneous rocks, and have a steep gradient and narrow floodplain. These characteristics make for a very flashy flood regime. Coplish Burn has a time to peak of 2.5 hours and it joins the River Coquet at Rothbury. Downstream of Holystone to the west of Rothbury, the gradient is shallower and the rainfall response time lessens and the floodplain widens, although it may be disconnected from the channel by flood defences. The main settlements at risk of fluvial flooding in the River Coquet catchment are Rothbury, Hepple, Longframlington, and Felton. Flooding has been regularly experienced in the River Coquet catchment, most notably in 1982, 1998, 2000, and 2008 and severe flooding was narrowly avoided in Rothbury in July 2009 following recent EA improvements and maintenance of channel structures.

River Aln Catchment

The River Aln is covered by the North East Northumberland CFMP. The upper catchment is very steep and underlain by impermeable basalt which gives rise to rapid runoff rates and a flashy flood regime. Its middle reaches are underlain by cementstone, sandstone and limestone which are more permeable. The lower Aln catchment is lower lying with a gentler gradient and is more permeable. Typical response time to peak of the Aln catchment is 15 hours. The main areas of fluvial flood risk on the River Aln are Alnwick, Whittingham, Lesbury and Alnmouth, although tidal flood risk poses a greater risk to the latter settlement than fluvial flooding.

River Tweed (including the River Till/Breamish)

The River Tweed rises at Tweedsmuir, and drains the entire Borders area. The main tributary in the study area is the River Till (known as the River Breamish in its upper reaches). The River Tweed forms the boundary between Northumberland (and northern England) and Scotland. It flows past the settlements of Norham, Horncliffe and Berwick upon Tweed to the North Sea.

Other Fluvial Flood Risk Areas

Belford Burn and Wooler Water have a long history of flooding and pose significant flood risk to the settlements of Belford and Wooler. There are also numerous small watercourses which tend to be very flashy in nature which pose a flood risk to settlements.

2.5.2 Tidal Flooding

There are several tidal reaches of rivers alongside a long North Sea coastline at risk of tidal flooding. Tidal flooding has been recorded at:

- Amble;
- Warkworth;
- Berwick Upon Tweed;
- Blyth;
- Seahouses;
- Bamburgh;
- Alnmouth.

Particularly notable events are recorded in 1876, 1890, 1921, 1953, 1954, and 1999 when the whole of the east coast experienced a tidal flood event. A combination of a high spring tide and severe gales caused a storm tide. In combination with a tidal surge of the North Sea the water level locally exceeded 5.6 metres above mean sea level. The flood and waves overwhelmed sea defences and caused extensive flooding.

2.5.3 Flooding from Land (Overland Flow/Pluvial Flooding/Surface Water Flooding)

During periods of prolonged rainfall events and sudden intense downpours, overland flow from adjacent higher ground may 'pond' in low-lying areas of land (without draining into watercourses, surface water drainage systems or the ground). Within the study area, there are numerous historical flood events listed in Appendix A attributed to pluvial/surface water flooding following prolonged intense rainstorms. Previous assessments of flood risk have noted that in parts of the study area, particularly urban areas, surface water flooding is a greater risk than fluvial flooding. One of the main issues with this type of flooding is that in areas with no history of flooding, relatively small changes to hard surfacing and surface gradients can cause flooding (i.e. garden loss and reuse of brownfield sites). As a result, continuing development could mean that pluvial/surface water flooding becomes more frequent. The SFRA for Tynedale and Northumberland National Park produced mapping giving an indication of potential surface water flooding depths for Hexham, Haltwhistle and Prudhoe showing depths up to 2.5m.

The Environment Agency has recently published their Areas Susceptible to Surface Water Flooding Maps. These maps were published with the accompanying guidance document entitled Guidance for LPAs in England for land use planning and other purposes[2].

According to the guidance the maps have been produced using a simplified method where a single rainfall event has been used to analyse the surface water flooding. The method also excludes any underground sewerage and drainage systems, smaller over ground drainage systems and buildings. Therefore, the maps only provide a general indication of areas that are more likely to overwhelm from surface water flooding. It should also be noted that these maps do not show the susceptibly of individual properties to surface water flooding. A copy of the maps has been provided by NCC as part of the data collation process for the SFRA and has been used to analyse the effect from surface water flooding to the identified growth points & development towns.

The accompanied EA guidance document advise on keeping these maps separate to the fluvial and tidal maps; therefore separate maps have been produced for the growth points & development towns to indicate the effect from surface water flooding. The Areas Susceptible to Surface Water Flooding maps are presented in Appendix B of the report.

2.5.4 Flooding from Groundwater

EA groundwater vulnerability maps (Appendix G) show the study area to be underlain by a minor aquifer of varying vulnerability. BGS mapping shows the area to be underlain by carboniferous limestone, igneous rocks and sandstones which have limited permeability. Large parts of the bedrock covering the study area is overlain by relatively impermeable glacial till further reducing the likelihood of groundwater flooding.

Groundwater flooding is however very localised in nature and flooding events have been recorded in Spittal, near Berwick and Darras Hall in Ponteland. Following discussions with the EA, consideration should be given to potential minewater intrusion in the former coal mining settlements on the coast.

The Department for Food and Rural Affairs (DEFRA) Strategy for Flood and Coastal Erosion Risk Management study (2004)[3] did not show any recorded instances of groundwater flooding in the study area. This does not mean that groundwater flooding has not occurred, or that it will not occur in the future, but that no incidents have been recorded in the EA records.

2.5.5 Flooding from Sewers

All sewers built in the last 30 years should have been designed utilising guidance detailed in ‘Sewers for Adoption’ (SFA). The Sewers for Adoption provides standard industry technical guidance to developers and designers of sewer networks and assets. The SFA was developed originally by Water Authorities to ensure a consistent approach was taken in sewer construction.

[2] Guidance for Local Planning Authorities in England for land use planning and other purposes (not emergency planning) v1 July 2009

[3] Defra Strategy for Flood and Coastal Erosion Risk Management Groundwater Flooding Scoping Study (LDS 23) (May 2004)

This consistent approach was necessary to enable the Water Authorities and later Water Companies to take ownership or 'adopt' assets which would be of an adequate design standard and workmanship.

Due to the age of settlements within Northumberland the majority of sewers were constructed prior to SFA guidance during the early part of the 20th century and therefore have unknown design capacity and condition.

The sewers that were built during the timescale of SFA have been installed to increasingly onerous design standards. This occurred as the guidelines evolved over time and changes were made during subsequent editions.

For example the 3rd edition of SFA (1990) required sewers to be designed to cope with the following storm return periods without surcharging.

- Sites with average ground slopes greater than 1% - 1 Year;
- Sites with average ground slopes 1% or less - 2 Years;
- Sites where consequences of flooding are severe (eg basement developments adjacent to new development) - 5 Years.

The sewers designed based on the earlier editions of SFA such as the 3rd edition were actually designed to surcharge during storms which were greater than the relevant storm return periods but would not spill from manholes until much greater return periods.

Later versions of SFA introduced the 3.3% annual probability (1 in 30 year) design criteria. The most recent SFA (6th editon,2006) introduced the need to design for exceedence, whereby the developer must provide evidence that they had considered the routing of flood water away from properties.

The majority of sewer systems are currently designed to spill from the manholes during storm events with a return period greater than 1 in 30 years (e.g. 1 in 100 years). Also surcharging at storm events of around 1 in 2 years is allowed for in design but the storm water is retained within manholes.

The SFRAs carried out for the former individual districts were reviewed to identify potential areas of sewer flooding. Sewer flooding has been identified as an issue in the following locations:

- Alnwick;
- Amble;
- Belford;
- Berwick;
- Blyth;
- Ellingham;
- Haltwhistle;

- Ponteland;
- Widdrington.

NWL has provided DG5 sewer flooding data within the study area. The data has been provided as the number of properties affected by internal and external flooding as a consequence of only hydraulic incapacity within broad drainage areas. This is due that some flooding events known to the Councils may have been as a consequence of "other causes" i.e. blockage or collapse. The data identifies that internal and external sewer and drainage flooding has occurred throughout the study area, with a particular clustering of high risk of sewer flooding in the broad areas of Morpeth, Cramlington, Hexham and Amble.

The DG5 register defines internal flooding as flooding which enters a building or passes below a suspended floor; whilst external flooding is defined as flooding which is not classed as internal. Properties at risk are defined as properties that have suffered or are likely to suffer internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant period. All flooding incidents should be registered by the water company irrespective of the severity of the storm. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.

The Pitt Report (June 2008) highlights sewer and drainage flooding as a key issue requiring further investigation. This should be addressed in any future site specific FRAs, or informed by any emerging Surface Water Management Plan (SWMP). Any relevant additional data should be incorporated into the SFRA during future updates.

In addition, one of the recommendations of the PPS25 Practice Guide is to undertake a Water Cycle Study (WCS). This would include an assessment of any potential issues with the sewer and drainage network such as flooding hotspots and network capacity, and would provide a more holistic view of water issues within the study area. Draft guidance currently being produced by the Environment Agency suggests that a Water Cycle Study should be undertaken if:

- The scale of growth proposed by regional or local planning is significant when compared to the existing urban development. At present, significant refers to a 5% increase in new housing stock during the LDF period.
- The Environment Agency raise concerns about the environmental capacity of the water cycle to cope with proposed development.
- The Water Company identifies there are problems with funding, or putting new systems in place to meet the development framework.
- The development area is a proposed eco-town.
- It is a Growth Point status condition.
- It is a condition of the RSS or LDF.

It should be noted that NCC are undertaking a Scoping and Outline WCS in parallel with the SFRA.

Following a review of historical flooding data and keeping in line with recommendations of the Pitt report, it is recommended that a SWMP is undertaken for areas where surface water flooding is a known issue. This may be undertaken as part of a detailed WCS or as a standalone document. The SFRA has highlighted key areas where it would be prudent to undertake a SWMP are primarily the urban areas of Morpeth, Berwick, Belford, Ponteland, Hexham, Haltwhistle, Cramlington, Amble and Blyth.

A SWMP[4] is a framework through which key local partners with responsibility for surface water in their area work together to understand the causes of surface water flooding and agree the most cost effective way of managing surface water flood risk. The purpose is to make sustainable surface water management decisions that are evidence and risks based, whilst taking climate change into account, and are inclusive of stakeholder views and preferences (Defra, 2010). The Pitt Review (2008) recommends SWMPs be adopted where surface water flood risk is high.

The Pitt Review on SWMP:

Recommendation 18: “Local Surface Water Management Plans, as set out in PPS25 and coordinated by local authorities, should provide the basis for managing all local flood risk.”

"Surface Water Management Plans (SWMPs) are referred to in PPS25 as a tool to manage surface water flood risk on a local basis by improving and optimising coordination between relevant stakeholders. SWMPs will build on Strategic Flood Risk Assessments (SFRAs) and provide the vehicle for local organisations to develop a shared understanding of local flood risk, including setting out priorities for action, maintenance needs and links into local development frameworks and emergency plans.”

2.5.6 Flooding from Reservoirs and other Artificial Sources

There are several reservoirs within the study area and within the river catchments upstream of the study area that fall under the Reservoirs Act (i.e., greater than 25,000 m^3 capacity), including Kielder Water, Catcleugh Reservoir and Fontburn Reservoir. In addition, there are numerous smaller reservoirs and lakes within the study area.

Reservoirs carry with them an inherent flood risk as they have a potential risk of breaching or overtopping. Where development sites or site allocations are located downstream of a reservoir, the residual risk of reservoir breach or overtopping should be considered as part of a site specific FRA or Level 2 SFRA respectively (under review of a panel engineer).

2.6 Flood Risk Management

2.6.1 Flood Risk Management Infrastructure

There are several flood risk management schemes in operation throughout the study area. These offer varying standards of protection (SoP) across the county. The CFMPs note that EA maintained flood risk management structures within Northumberland provide varying SoPs.

[4] Defra Surface Water Management Plan Technical Guidance (March 2010).

The main areas of defences in the Tyne catchment are on the main fluvial Tyne between Hexham and Ovingham, on the River South Tyne at Haydon Bridge, Alston and Haltwhistle, and on the River North Tyne at Lanehead, Bellingham and Otterburn. There are also EA maintained defences at:

- Wooler Water (Wooler);
- River Glen (Westnewton – confluence with Wooler Water);
- River Till (Newton, Crookerton);
- River Breamish (New Berwick);
- North Low (Goswick);
- South Low (Haggerston);
- Ross Low;
- River Coquet (Holystone, Rothbury, East Thurston);
- River Rede (Burdhope, Stobbs, Otterburn);
- River Pont (North Ponteland);
- River Wansbeck (Morpeth);
- River Blyth (Stannington Bridge, Kirkley Mill –Belasis Bridge.

In addition to formal flood defences a number of routine asset maintenance activities are carried out along 40% of main rivers. Annual activities normally comprise general clearance, including grass cutting, trimming of trees and shrubs. More specific routine activities include: the clearance of culverts or bridges, which is carried out at least twice yearly and is most prevalent along watercourses passing through urban areas; clearance of inlet/outlet flaps and the maintenance of joints in flood walls; vermin control, which is carried out twice yearly and is most common along the main River Tyne.

It should be noted that flood risk management schemes are built to a certain design standard and have a certain design life. One predicted effect of climate change is an increase in peak flow and as a result the SoP is likely to decrease alongside the natural deterioration in standard over the course of its lifetime due to wear and tear. In order to maximise the SoP, it is necessary to carry out regular maintenance and inspection of any flood risk management structures in the study area.

In addition to 'hard' flood risk management infrastructure, the study area also contains 'soft' flood risk management infrastructure including a coastal managed realignment scheme – the 4Shores project. This scheme is being carried out in phases and the first phase commenced in 2006 when two flood banks protecting pastureland were breached adjacent to the River Aln near Alnmouth. By making space for water, this scheme is promoting and restoring natural coastal processes to create naturally protective saltmarsh and mudflats and represents a more sustainable approach to flood risk management in the area.

Other 'softer' techniques include trial tree-planting and field scale storage in the upper catchment of Belford Burn which aim to reduce peak flows through the town of Belford which regularly experiences severe flooding following heavy rainfall and rapid runoff from adjacent fields.

2.6.2 Flood Warnings

The Civil Contingencies Bill (2004) requires that the EA 'maintain arrangements to warn the public of emergencies'. The EA are responsible for issuing flood warnings to the public based on 24 hour monitoring of rainfall, river levels and sea state (where applicable). This data is combined with weather data and tidal reports from the Met Office, including the use of radar to track storms and rainfall intensity, and data from the national tide gauge network. The warnings are issued by local radio, supplemented by direct dial telephone systems, (Floodline Warnings Direct), on www.environment-agency.gov.uk/floodwarnings which is updated every 15 minutes, and other local systems as appropriate. The EA also endeavours to raise awareness of flooding in areas prone to flooding and suggest that people living in vulnerable areas make preparations in advance.

The EA has general supervisory and other statutory duties for flood defence and flood warnings in Northumberland. The work carried out to meet these duties includes:

- Maintaining main river channels and flood risk management structures,
- Providing and operating a flood warning service.

The existing warning service provided by the EA applies only to flooding from rivers and the sea. Some parts of the country benefit from a nominal groundwater flood warning service. There is no obligation on water companies to provide warnings of flooding from sewers or drains.

The degree of advance warning that can be provided is critical to the amount of action that can be taken to prevent damage. A minimum of 2 hours advance warning is the standard currently used in England and Wales for river flooding. The ability to provide this depends on the geography of an area, the intensity of the rainfall and the type of weather systems causing the rain as these variables can act together to produce an unlikely and therefore unpredictable event.

Owing to the nature of the upper catchments of many of the watercourses in the study area, the time to the peak river flow is typically less than two hours, therefore giving limited time to issue flood warnings. In addition, the difficulties of issuing effective warnings of possible flood risk management infrastructure failure poses a significant challenge and in some cases it will not be practical to provide a reliable or timely flood warning service to an area because of the rapidity or unpredictable nature of flooding.

When conditions require, the EA provide local forecasts on the possibility of flooding and determine which flood risk management structures to operate and when, closing moveable systems features if necessary.

The role of flood warnings in flood risk and residual risk reduction can be either a standalone measure or in combination with built flood risk management structures.

Flood warning as a stand-alone measure can reduce the consequences of flooding to properties by enabling reactive action to protect life and reduce the effect of flooding on property. Flood warning in combination with built flood risk management structures can protect life and reduce damage in the event of the defence level being exceeded by the severity of the flood.

Approximately 75% of the properties in the Tyne Catchment are signed up to receive flood warnings. The local topography consists of steep sided river valleys with generally narrow floodplains. The steep nature of the catchments means it responds quickly to rainfall and the time available to provide warning of floods is short.

Table 2-3 below shows areas that currently receive flood warnings.

Table 2-3: Areas Receiving Flood Warnings[5]

Berwick, Quay Walls	River South Tyne at Lambley
Berwick, Pier Road	River South Tyne at Haltwhistle
Berwick, Bridge End South Bank	River South Tyne at Brigwood and Middle Lipwood, Haydon Bridge
Berwick Riverside Road and between Bridges	River South Tyne at Temple Houses, Haydon Bridge
Berwick, Main Street and Berwick Dock	River South Tyne at Haydon Bridge
Berwick, Lifeboat Station	River South Tyne at Warden Riverside
Wooler Water at South Road Wooler	River South Tyne at Warden
Wooler Water at Wooler	River Tyne at Kingshaw Haugh (Hexham)
Waren Burn at Waren Mill Riverside	Cockshaw Burn at Hexham
Waren Burn at Waren Mill	River Tyne at Tyne Green and Foundary Industrial Estate.
Waren Burn at Upper Waren Mill	River Tyne at Wellbank Riverside, Corbridge
River Coquet at Thropton	River Tyne at Well bank, Corbridge Wellbank
River Coquet at Rothbury	River Tyne at South Bank, Corbridge
River Coquet at Brinkburn, Weldon and Felton	River Tyne at Bywell
River Coquet at Warkworth	River Tyne at Prudhoe Riverside
River Font at Longshaws Mill	River Tyne at Ovingham and Low Prudhoe
River Wansbeck at High Stanners, Mitford Road	Holy Island Herring House Area
River Wansbeck at High Stanners, Morpeth Town Centre, Middle Greens and Low Stanners	Seahouses Monks Houses
Morpeth Riverside	Seahouses Harbour Road
River Pont at Kirkley Mill and Ponteland	Beadnell Harbour Road (West)
River Pont at Fairney Edge at Ponteland	Beadnell, Car Park and Harbour Road (South)
River Pont at Ponteland	Alnmouth Riverside Road

[5] Table 2.1.19 Northumberland Flood Index Tool, Northumberland Flood Action Plan, Consultation Draft Version 1.0 (September 2009).

Rivers Wansbeck at Bothal and Sheepwash	Amble Coquet Yacht Club
River Rede at Otterburn Mill	Amble, Riverside Park
River Rede at Redesmouth	Amble Lifeboat Station
River North Tyne at Kielder Buttery Haugh	Amble, Amble Marina and Broomhill Street Area
River North Tyne at Falstone	Warkworth, The Butts
River North Tyne at Bellingham	Blyth Town Centre
River North Tyne at Chollerford	Blyth Estuary, North Blyth and Cambois
River South Tyne at Slaggyford	Blyth Quayside

2.7 Flooding Mechanisms

2.7.1 Overtopping

Overtopping occurs when water passes over a flood defence. When flow exceeds the capacity of the conveying channel, the water level will rise in that channel until its banks are overtopped. Water will then spill over the channel banks and onto adjoining land. With an upland river the adjoining land is its natural floodplain, which will generally be of limited extent and fairly well defined. In a downstream river where the gradient flattens the floodplain can be much wider. Flood risk management and urban development can significantly alter natural flow paths within the floodplain and affect the dispersion of floodwater.

Flood risk management structures are usually designed with a degree of 'freeboard', the height by which the crest level of the structure exceeds the design flood level. Main river flood risk management structures and tidal embankments are designed to have a constant freeboard above their design level so, in theory, when they are overtopped the overflow should be small in volume and of uniform depth along the full length of the crest, occurring during the highest water levels at the peak of the flood. In reality the freeboard varies from point to point due to the natural subsidence and wear of flood risk management structures over time, and water heights can vary locally. Even so, the crest of the structure acts like a weir limiting the rate of flow and volume over the crest and limiting flooding velocities and volume to the immediate area.

2.7.2 Breaching

Breaching of flood embankments is one of the main causes of major flooding in lowland areas. Breaches can occur in any situation where there is a crest raised above adjacent land levels. An earth embankment may be breached as a result of overtopping, which weakens the structure through erosion, eventually creating a breach. Breaches in embankments are more likely during high water level events. A fluvial breach in an embankment will result in the dispersal of floodwater from the channel resulting in a lowering of the water levels and flow through the breach. A notable example of this form of flooding occurred in recent years following a breach of the flood embankment on the south bank of the main River Tyne at Corbridge.

The time taken for a breach to be sealed can have a major effect on the extent and depth of flooding.

In addition to the flood risk associated with a breach event, there is an implied flood hazard. The highest hazard exists in the period immediately following a breach, and usually, but not necessarily, in the areas closest to the breach. Floodwater flowing through a breach will be of high velocity and volume, dissipating rapidly across large low-lying areas, and possibly affecting evacuation routes. Flooding as a result of a breach can be life threatening with far reaching consequences.

Where there is a breach in the flood defence (i.e. Kirknewton) functional floodplain could lie behind defences.

Should potential development be proposed behind flood risk management structures, detailed hazard mapping may be required during any Level 2 SFRA.

2.7.3 Mechanical or Structural Failure

Flooding may result from the failure of engineering installations such as land drainage pumps, sluice gates and floodgates. Hard flood risk management structures may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement and toe protection or the failure of ground anchors. Such deterioration is often difficult to detect, so that failure when it occurs is often sudden and unexpected. Failure is more likely when the structure is under maximum stress, such as extreme fluvial events when pressures on the structure are at its most extreme.

2.8 Potential Development Pressures

Northumberland is bordered by Scotland to the north and west, Cumbria to the west, County Durham to the south and North Tyneside to the south-east. Northumberland's topography has a major influence on the type and amount of development, both historically and currently, and therefore the county's character is heavily influenced by this.

Northumberland County Council is a newly formed (as of 1 April 2009) unitary authority that merges together the seven Local Planning Authorities (LPA) of Alnwick; Berwick-upon-Tweed; Blyth Valley; Castle Morpeth; Tynedale; Wansbeck and Northumberland County in the North East of England to form a single LPA for Northumberland. Northumberland is the sixth largest county in England and covers an area of 500,000 hectares[6]. It has a population of 310,600 but is the least densely populated county in England. Over half of the population lives within the urbanised south east of the County which covers 5% of the total County area. Consequently, there is a very low population density in the rural north and west.

The south east of the county, which comprises Wansbeck and Blyth Valley districts and the eastern coastal villages of Castle Morpeth District, contains the three largest towns of Ashington, Blyth and Cramlington. The rural north and west comprise the former districts of Alnwick, Berwick-upon-Tweed, north and west Tynedale and the rural west of Castle Morpeth. These areas contain the four market towns of Alnwick, Berwick-upon-Tweed, Hexham and Morpeth, and many smaller dispersed towns and villages.

[6] Northumberland County Council Annual Monitoring Report 1 April 2007 to 31 March 2008, Northumberland County Council, December 2008. http://www.northumberland.gov.uk/idoc.ashx?docid=8519a951-5cf9-4095-86dc-5593e8cd0da6&version=-1

The population figures (2001 and 2007) are provided in; Table 2-4 this shows that Northumberland has seen a steady increase in its total population with the district of Alnwick seeing the biggest increase in population.

Table 2-4: Population and Dwellings in Northumberland in 2007 (Source: Northumberland County Council[6])

	Total Population 2001 Census	Total Population 2007 Estimates	Population Chang 2001 – 2007 (%)	Total No. Dwellings (2007)
Alnwick	31,033	32,300	3.92%	15,731
Berwick-upon-Tweed	25,948	26,000	0.20%	14,164
Blyth Valley	81,265	81,300	0.04%	36,101
Castle Morpeth	49,011	49,800	1.58%	21,727
Tynedale	58,805	59,500	1.17%	26,697
Wansbeck	61,124	61,700	0.93%	28,312
Northumberland	307,186	310,600	1.10%	142,732

Source: Census 2001/ONS mid-year estimates for 2007.

2.8.1 Housing Land and Potential Development Areas

The Regional Spatial Strategy (RSS) for the North East of England[7] ('The North East of England Plan') was published in July 2008 and set targets to guide the scale and location of growth in Northumberland up to 2021.

Within Northumberland, both South East Northumberland and Berwick have been identified as key development areas within the County. South East Northumberland was designated as a New Growth Point (NGP) by the Communities and Local Government in July 2008[8]. NCC is currently preparing the Berwick Town Eastern Arc Area Action Plan (AAP) which will provide a detailed planning framework for the area's regeneration. Alongside the South East Northumberland and Berwick, it is anticipated that the main market towns of Northumberland will also continue to be the focus for new development.

The North East of England RSS sets a total of a minimum of 15,725 dwellings and an employment land allocation target of 535 hectares of which 55 hectares is for key employment locations between 2004 and 2021.

Taking into account the proposed regeneration of the area and the proposed demolition and replacement of existing housing stock, this equates to a target of 14,960 new dwellings within Northumberland between 2004 and 2021 (Table 2-5). Nearly a third of the proposed growth is planned for the district of Blyth Valley, and South East Northumberland (comprising Blyth Valley, Wansbeck and Castle Morpeth) will provide two thirds of the proposed new dwellings. Additionally, as part of its NGP status, South East Northumberland is expected to build an additional 1,179 dwellings between 2008 and 2016/17.

[7] North East of England Plan – Regional Spatial Strategy to 2021, Government Office for the North East, July 2008.
[8] Second Round Growth Points: Partnerships for Growth, Communities and Local Government, 16 July 2008. http://www.communities.gov.uk/publications/housing/partnershipsforgrowth

Table 2-5 Housing Development in Northumberland (2004-2021)[9]

	Dwelling Build Rate (Annual Average)				Total Dwellings
	2004-2011	2011-2016	2016-2021	2004-2021	2004-2021
County Growth					
Northumberland Dwellings RSS Target	945	930	900	925	15,725
Demolished Dwellings	70	35	55	55	935
Replaced Dwellings	45	35	50	45	765
Northumberland Dwellings RSS Target (Net Total) i.e. New Dwellings	**900**	**895**	**850**	**880**	**14,960**
District Growth (Net)					
Alnwick	105	95	85	95	1,615
Berwick-upon-Tweed	85	85	75	80	1,360
Blyth Valley	250	290	290	275	4,675
Castle Morpeth	140	130	120	130	2,210
Tynedale	140	115	100	120	2,040
Wansbeck	180	180	180	180	3,060
Northumberland (Net Total)	**900**	**895**	**850**	**880**	**14,960**

The Northumberland Core strategy needs to provide planning for 15-years worth of housing stock, and therefore with the strategy being adopted in 2012, growth up to 2026 will need to be assessed, at least in terms of broad indicative location(s). Assuming an annual dwelling build rate of 880 dwellings per year[10], a further 4,400 dwellings will need to built in the period 2021 to 2026, taking the total to built between 2004 and 2026 to 19,360.

Table 2-6 provides an indication of the location and scale of potential development within Northumberland.

2.8.2 Employment Land

The RSS states that Northumberland has an employment land allocation target of 535 hectares of which 55 hectares is for key employment locations between 2004 and 2021

[9] North East of England Plan – Regional Spatial Strategy to 2021, Government Office for the North East, July 2008.
[10] The RSS states the following for provision of housing stock post 2021 *"To plan for the continuous delivery of housing for at least 15 years from the date of adoption, the first round of Local Development Documents should make the assumption that the annual average rate of provision during the early years after 2021 will be the same as the average for 2004 to 2021."*

Table 2-6: Potential Development Areas

Former District	Core Strategy?	Proposed Growth						
		District Growth (2004 - 2021) (RSS)	Additional Growth (2021 – 2026)	Town	%	Growth (2004 - 2021)[1]	Growth (2021 - 2026)[1]	Total Growth (2004 - 2026)[1]
Alnwick	Completed	1,615	475	Alnwick	33%	535	155	690
				Amble	33%	535	155	690
				Rothbury	10%	160	50	210
				Sustainable Village Centres	24%	390	115	505
Berwick	Preferred Options Core Strategy	1,360	400	Berwick-upon-Tweed	60%	815	240	1,055
				Belford	8%	110	30	140
				Seahouses	12%	165	50	215
				Wooler	12%	165	50	215
				Sustainable Rural Communities	8%	110	30	140
Blyth Valley	Completed	4,675	1,375	Blyth	67%	3,135	920	4,055
				Cramlington	23%	1,075	315	1,390
				Seaton Valley	10%	470	140	610
Castle Morpeth	Preferred Options	2,210	650	Morpeth	35%	775	230	1,005
				Ponteland	10%	220	65	285
				Coastal Villages	40%	885	260	1,145
				Rural West	15%	330	100	430
Tynedale	Completed	2,040	600	Hexham	18%	370	110	480
				Prudhoe	18%	370	110	480
				Haltwhistle	18%	370	110	480
				Allendale	4%	80	25	105
				Bellingham	4%	80	25	105
				Corbridge	4%	80	25	105
				Haydon Bridge	4%	80	25	105
				Smaller Villages	30%	610	180	790
Wansbeck	Local Plan	3,060	900	North of River Wansbeck (Ashington & Newbiggon by the Sea)	85%	2,600	765	3,365
				South of River Wansbeck (Cambois & Bedlington)	15%	460	135	595
Total		**14,960**	**4,400**					

2.9 Climate Change and Future Flood Risk

PPS25 and the accompanying Practice Guide include for an increase in the peak rainfall intensity of up to 30%. This will significantly affect smaller urban catchments, leading to rapid runoff to watercourses and surface water flooding, surcharging of gullies and drains and sewer flooding.

The CFMPs have also considered flood risk for the next 50-100 years and taken into account the flood risk drivers of climate change, urban development and changes in land use. Catchment models and the Modelling and Decision Support Framework (MDSF) software were used in the CFMPs to test sensitivity to the flood risk drivers across the catchments in the study area.

To account for climate change in Northumberland, modelled flood outlines for Flood Zone 3a including the effects of climate change were provided by the Council for a few watercourses. Where there are no modelled climate change results available, an estimate of the impacts of climate change on flood outlines is required. To this end, Flood Zone 2 outlines were used as a proxy. This is not to say that Flood Zone 3a will necessarily increase to Flood Zone 2, but rather that one would expect the depth and extents of flooding to increase to somewhere between the Flood Zone 3a and Flood Zone 2. This is a conservative approach designed to help strategic planners identify where increased detail and resolution in the flood outlines is needed at either the Level 2 SFRA or Site Specific FRAs.

Sewer and surface water flooding are likely to become more frequent and widespread under urbanisation and climate change scenarios as the amount of impermeable surfaces and runoff increase, highlighting the importance of SuDS.

The location of future urban developments and flood risk management structures within a catchment can heavily influence flood risk in the area and has the potential to further increase flood risk at sites downstream of such developments. Impacts include the lowering of the SoP offered by flood risk management structures and the carrying capacity of culverts, drains, sewers and open channels. This potentially leads to areas being at risk of flooding that were previously not at risk and highlights the increasing conflicts and pressures that are emerging between climate change scenarios and future development aspirations.

The Planning Policy Statement 1: Delivering Sustainable Development (PPS1) and the Supplement to PPS1 sets out important objectives in order to tackle climate change, sea level rise and avoidance of flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding. Following this guidance, it should be possible to mitigate against increased flood risk through incorporating ‘flood proofing’ measures such as raised finished floor levels into the development design, and/or development of compensatory storage and flood storage basins.

The Adaptation Strategies for Climate Change in the Urban Environment (ASCCUE) project is a study undertaken collaboratively by the University of Manchester, The University of Cardiff, University of Southampton and Oxford Brooks University. The project aims to further the understanding of the impacts and risks of climate change on towns and cities through three ‘exposure units’ of human comfort, urban green space and the built environment.

One of the aspects examined was surface water runoff during extreme rainfall events. With an increase in development, there comes an increase in the amount of impermeable areas thus leading to increased runoff during storm events. In one of the worst-case modelled scenarios, (large urban centre), an increase in rainfall of 56% by 2080 led to an increase in runoff of 82%. This highlights the increasing conflict and pressures that are emerging between climate change scenarios and future development aspirations.

2.9.1 Fluvial Flood Risk

There is a potential for increased peak river flow as a result of climate change, as identified in PPS25 and Table 2-7, and an increase in peak flow results in a greater floodplain envelope. Some of the watercourses have detailed hydraulic models which have produced the flood outlines for the 100 year event plus an allowance for climate change. Previous SFRA's have however noted that due to the constraints of topography, increase in fluvial flood risk due to climate change is limited.

For watercourses where no detailed hydraulic model outlines were available for the 1 in 100 year event plus climate change, the approach was taken to use the Flood Zone 2 outlines as a substitute until such a time that modelled data is available. The methodology is explained further in Section 4.5.2.

Table 2-7: Peak Rainfall Intensity Increases and Peak River Flow Increases

Parameter	1900 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		

2.9.2 Surface Water and Sewer Flooding

The potential increase in peak rainfall intensity (Table 2-7) is likely to lead to an increase in surface water flooding, surcharging of gullies and drains and sewer flooding. Issues on surface water flooding are localised and should be considered at the site-specific FRA stage or as part of a SWMP.

2.9.3 Tidal flooding

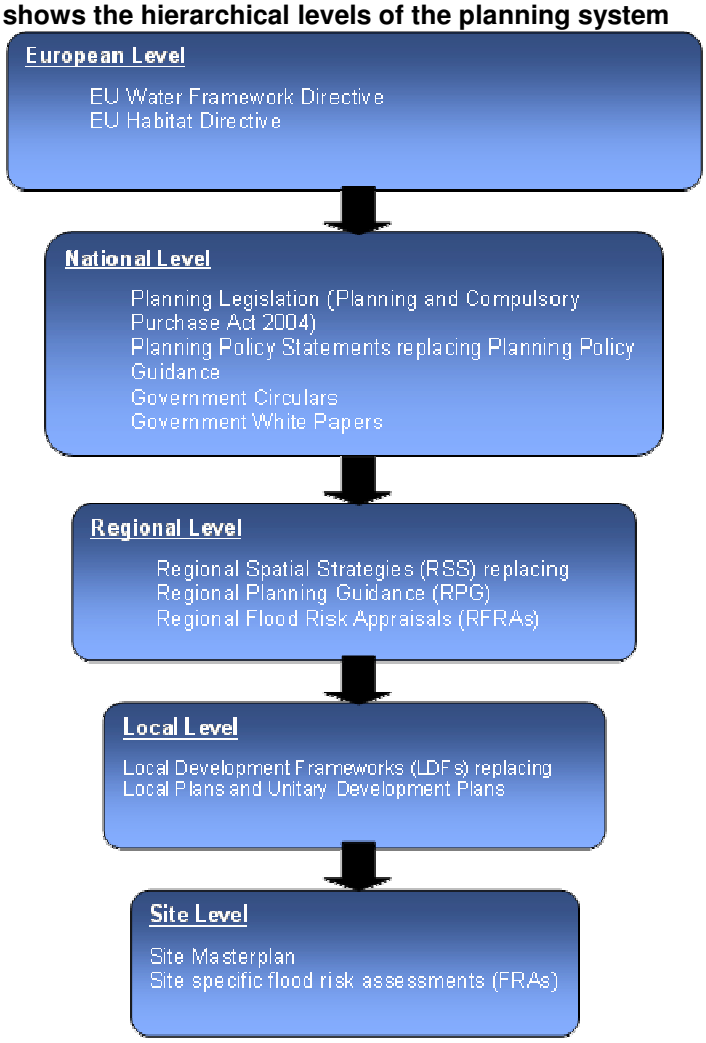
Northumberland has a long and varied coastline and consequently, some settlements at the coast are at risk of tidal flooding from the North Sea and estuary tidal flooding. There is a history of tidal flooding in the study area. Sea level rise will affect tidal reaches of rivers as well as the coastline itself. Table B-1 in PPS 25 recommends the following allowances for sea level rise are taken into account for the North east of England.

Epoch	1900 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Sea Level Increase	2.5mm	7mm	10mm	13mm

3 Policy Review

This section provides an overview of the planning policy framework relevant to NCC. This Level 1 SFRA report conforms to National and Regional Planning Policy. Information contained in the SFRA will provide evidence to facilitate the preparation of robust policies for flood risk management. The SFRA should be used to inform the LDDs and will enable informed decisions to be made relating to land use and development allocation within the respective DPDs.

Figure 3-1: shows the hierarchical levels of the planning system



3.1 Planning Policy

The planning policy review collates and summarises all planning policy and guidance, relevant to flood risk in the NCC administrative area. Firstly, PPS25 was reviewed as the key flood risk and development policy at a national level, followed by the recently published RSS for the North East. The review also looks at local planning policy.

The policy review covers policies pertaining to flood risk and development in flood risk areas. It also expands to review key strategic development pressures, such as targets for housing provision, as set out by the RSS, as these need to be taken into consideration when assessing flood risk.

3.2 European Policy

3.2.1 Water Framework Directive (December 2000)

The Water Framework Directive (WFD) is a substantial piece of European Community (EC) legislation and the largest directive related to water to date. The directive came into force in December 2000, and establishes a new, integrated approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The directive requires that all member states manage their inland and coastal waterbodies so that a 'good status' is achieved by 2015. This aims to provide substantial long-term benefits for sustainable management of water.

The Directive introduces two key changes to the way the water environment must be managed across the EC:

1. Environmental and Ecological Objectives. The WFD provides for Protected Areas and Priority Substances to safeguard uses of the water environment from the effects of pollution and dangerous chemicals. In addition, important ecological goals to protect, enhance and restore aquatic ecosystems are set out, and
2. River Basin Management Plans (RBMPs). RBMPs are the key mechanism to ensure that the integrated management of rivers, canals, lakes, reservoirs and groundwater is successful and sustainable. RBMPs aim to provide a framework in which costs and benefits can be properly taken into account when setting environmental and water management objectives.

Each RBMP must apply to a 'River Basin District' (RBD) (a geographical area which is defined based on hydrology – see Annex 1, DEFRA & WAG River Basin Planning Guidance (RBPG), August 2006). The river basin planning process involves setting environmental objectives for all groundwater and surface water (including estuaries and coastal waters) within the RBD, and designing steps and timetables to meet the objectives. The EA is responsible for implementing the WFD in England and Wales and have now completed the draft RBMPs for each RBD in England and Wales.

According to Defra and Welsh Assembly Government River Basin Planning Guidance (WAG) (August 2006), an RBMP should be a strategic plan that gives all stakeholders within an RBD some confidence about future water management in their district. It should also set the policy framework within which future regulatory decisions affecting the water environment will be made.

Although RBMPs specifically address sustainable water management issues, the WFD also requires that other environmental considerations and socio-economic issues are taken into account. This ensures that the policy priorities between different stakeholders are balanced to ensure that sustainable development within RBDs is achieved.

As a result of the strategic nature of RBMPs, they are inherently linked to and can both influence and be influenced by planning policy within their areas. The following sections are extracted from the DEFRA and WAG River Basin Planning Guidance (August 2006).

3.2.2 Spatial Plans Influencing RBMPs

Emerging development plans will be an important source of information on future water management pressures that can inform the EA and refine its understanding of the current status of waterbodies, and how this might change if no action was taken. The RBPG stresses the importance of taking into account the continuation of sustainable human development (including ports, recreational uses, water storage and flood risk management schemes) within RBDs and the setting of water management frameworks.

The EAs Catchment Flood Management Plans (CFMPs) and Catchment Abstraction Management Strategies (CAMS) are examples of such high-level planning tools that can inform development of RBMPs. Using CFMPs, the Regional Flood Risk Assessments (RFRA) and SFRAs will build upon existing flood risk and planning information to present current and potential future development within RBDs in relation to flood risk. In addition, policies that emerge from these studies (for example SuDS, Flood Risk Management procedures and mitigation options) will inform the development of the water management frameworks in RBMPs.

3.2.3 RBMPs Influencing Spatial Plans

As well as being informed by various spatial and catchment wide plans and strategies, RBMPs should produce strategic and regional policy information that is necessary to feed into the spatial planning process such as LDFs. For example, where RBMPs have a direct affect on the use and development of land they will have to be material considerations in the preparation of statutory development plans for the areas they cover. It will also be necessary for planning authorities to consider WFD objectives at the detailed development control stage (not least to consider the requirements of Article 4(7) of the WFD in relation to new physical modifications).

To allow local authorities to incorporate WFD objectives into their various statutory development plans, the EA will provide local authorities with information such as CFMPs, CAMS and other catchment-wide guidance and strategies, to enable effective integration of the water management framework within statutory development plans. In order to address the fact that these plans have different planning cycles and are at different stages in their development, RBMP policies that affect the development and use of land must be considered in the monitoring and review of statutory spatial plans.

In addition, some of the measures necessary to achieve WFD objectives will be delivered through land use planning mechanisms. For example spatial planners can make major contributions to WFD objectives by including appropriate planning conditions and planning obligations in relevant planning permissions for new developments, or by restricting some forms of development. Delivery of these measures is more likely to take place if they are included in LDFs by land use planners. As stated above, the Northumberland SFRA should inform the RBMPs and, as a result, the LDF being prepared by NCC should already include policies and recommendations relating to flood risk management and development within catchments.

3.3 National Planning Policy

3.3.1 Planning Policy Statement 25: Development and Flood Risk (March 2010)

PPS25 (March 2010) is the main key national policy in relation to flood risk and is the starting point for any policy review on flood risk. PPS25 is supported by a Practice Guide (December 2009) and builds on the principles set out in PPG25 (July 2001). PPS25 seeks to guide the preparation of SFRAs and the location of development in order to avoid and manage flood and residual risk. PPS25 also aims to reduce flood risk to and from new development through policies on layout and design. PPS25 reaffirms that all forms of flooding and their impact on the natural and built environment are imperative planning considerations.

PPS25 sets the following minimum requirements for the appraisal, management and reduction of flood risk:

- Identify land at risk from flooding and the degree of risk,
- Prepare RFRAs / SFRAs as appropriate, either as part of the SA or as a freestanding assessment,
- Frame policies for the location of development which avoid flood risk to people and property where possible and manage any residual risk, taking into account climate change,
- Reduce flood risk to and from new development through location, layout and design, including sustainable drainage approaches,
- Use opportunities offered by new development to reduce flood risk,
- Only permit development in areas of flood risk when there are no suitable alternative sites elsewhere and the benefits outweigh the risks from flooding,
- Work with the EA and other stakeholders to ensure that best use is made of their expertise and information in informing planning decisions,
- Ensure spatial planning supports flood risk management and emergency planning.

3.3.2 A Risk-Based Approach

PPS25 presents a three-tier approach to flood risk assessment at the regional, strategic and site-specific levels. At the regional level this will be in the form of a RFRA and at the district level in the form of an SFRA. Policies and proposals should be established on the basis of FRAs.

PPS25 indicates that the Regional Planning Body should take flood risk into consideration when determining strategic planning considerations in the RSS. The RSS, guided by the RFRA, should identify broad locations and establish locational criteria for development in the region. This in turn will inform SFRAs and consequently LDDs at the local level.

PPS25 identifies key requirements for SFRAs:

- SFRAs will refine information on the probability of flooding, taking into account all sources of flooding and the impacts of climate change. SFRAs should have regard to catchment-wide flooding issues that affect that area,

- The SFRA should provide the foundation from which to apply the Sequential and Exceptions Tests in the development allocation and development control process. Where decision-makers have been unable to allocate all proposed development and infrastructure in accordance with the Sequential Test, taking account of the flood vulnerability category of the intended use, it will be necessary to increase the scope of the SFRA to provide the information necessary for application of the Exception Test,
- SFRAs should be prepared in consultation with the EA, emergency response and drainage authority functions of the LPA,
- Development should not add to flood risk and should, where possible, reduce it.

SFRAs should identify the four Flood Zones in Table 3-1:

Table 3-1: Flood Zone Classification

Flood Zone	Category	Assigned Annual Flood Risk Probabilities
1	Low Probability of Flooding	Land having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)
2	Medium probability of Flooding	Land having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% - 0.1%) in any year.
3a	High Probability of Flooding	Land having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
3b	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 SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.

Minimum requirements (set out in Annex E of PPS25) for site-specific FRAs are that they should:

1. Be proportionate to risk and appropriate to the scale, nature and location of the development,
2. Consider risk of flooding to the development and risk arising from the development,
3. Consider the impacts of climate change,
4. Be undertaken early, by competent people,
5. Consider adverse and beneficial effects of flood management infrastructure and consequences of failure,
6. Consider vulnerability of those occupying the development, taking account of the Sequential and Exception Tests, the vulnerability classification and safe access arrangements,
7. Ensure that assessments are fit for purpose by ensuring that different types of flooding are considered and quantified. Flooding should be considered from natural and human sources and joint cumulative effects should also be considered. Flood risk reduction measures should be identified,

Further:

1. The effects of flooding events (including extreme events) on people, property, the natural and historic environment and river and coastal processes should be considered,
2. The remaining residual risk reduction measures should be included. It should be demonstrated that this is acceptable for the particular development/land use,
3. The ability of water to soak into the ground may change with development and this should be considered, as should how the proposed layout of the development may affect drainage systems,
4. Assessments should be supported by appropriate data and information including historical data on previous events.

Annex E (of PPS25) also identifies that there may be considerable benefits to LPAs within a catchment area of high development pressure or a designated development area, joining together to undertake a sub-regional SFRA. This will assist LPAs to consider the issues raised by flooding on the wider scale, and enable them to contribute to, and take account of, the RBMPs, which have been published by the EA. Paragraph 2.21 of the PPS25 Practice Guide, states that where sub-regional SFRAs are undertaken, these will provide more detailed information on the broad spatial distribution of flood risk within extensive areas of Flood Zone 3, where development is to be considered, but here it will be necessary to apply the Exception Test.

3.3.3 PPS25 in Context

It is important that PPS25 is considered as part of a wider integrated approach to spatial planning. Flood risk should be considered alongside other spatial planning concerns such as the delivery of housing, economic growth, management of natural resources, regeneration and the management of other natural hazards. There are clear links to other Planning Policy Statements that may not be explicit in PPS25, but which are necessary to achieve its objectives. The most obvious link is with the draft supplement to PPS1.

3.3.4 Latest Changes to PPS25

A revised version of the PPS25 was issued in March 2010. The main changes introduced were;

To clarify the definition of Flood Zone 3b, the 'functional' floodplain, in Table D.1, to make clear that the identification of this zone in SFRAs should take account of local circumstances, and that '1 in 20' annual flooding probability parameter should be the starting point for consideration and discussion.

Four further amendments were also introduced for Table D-2:

- Water treatment and sewage treatment plants currently shown as 'less vulnerable' would be moved to the 'essential infrastructure' category, plus a clarification to the definition of this category.
- Insertion of additional text providing for police, ambulance and fire stations which are not required to be operational during flooding to be treated as 'less vulnerable'.

- Insertion of additional text in the 'highly vulnerable' category to clarify that where there is a need to locate bulk storage facilities requiring hazardous substances consent with port or other waterside facilities; or installations requiring hazardous substances consent that are associated with energy infrastructure which need to be sited in coastal locations or high flood risk areas, these facilities and installations should be classified as 'essential infrastructure', rather than 'highly vulnerable'.
- Clarification that wind turbines for generating renewable energy should be treated as 'essential infrastructure'.

3.3.5 PPS1 Supplement 'Climate Change and Sustainable Development'

PPS1 is the Government's overarching statement on the purpose of the planning system. Paragraph 3 of PPS1 makes clear that 'sustainable development is the core principle underpinning planning'. The PPS1 Supplement sets out important objectives in order to tackle climate change, sea level rise and avoid flood risk. The purpose of design policies should be to ensure that developments are sustainable, durable and adaptable to natural hazards such as flooding.

PPS25 is clearly a key part of the Government's programme of responses to the challenge of climate change. If climate change is not stabilised (mitigated) then this will have two impacts on flood risk. Projected sea level rises would suggest that the risk of flood risk management structures being overtopped would increase. Second, climate change is likely to create higher rainfall in winter, and consequently to increase the risk of flooding along river catchments. An increased frequency of intense rainfall events is also likely to increase the numbers of urban and flash floods, and will also mean increases in the extent of flooding from rising groundwater. Therefore, the implementation of this PPS1 supplement is crucial in mitigating for flood risk now and in the future.

3.3.6 PPS3 Housing

Planning Policy Statement 3 Housing (PPS3) sets out the Government's broad policy objectives for planning for housing and those policies it considers will help to realise those objectives, including the efficient use of land, variety of household types and supply, affordability and designing for quality. Through the consideration of climate change and flood risk, PPS3 aims to deliver housing policies that seek to minimise environmental impact.

PPS25 strongly supports the strategy for housing set out in PPS3. In meeting the objective of increasing housing supply the assessment of flood risk is crucial. Through the incorporation of local flood mitigation measures such as SuDS, and good quality design and site layout, it is possible to build safely and to manage flood risk.

3.3.7 PPS7 Sustainable Development in Rural Areas

Planning Policy Statement 7 Sustainable Development in Rural Areas (PPS7) sets out the Government's planning policies for rural areas, with the protection and enhancement of the natural and historic environment, the quality and character of the countryside and existing communities all of crucial importance. PPS7 states that any development in rural areas should consider flood risk at all stages of the planning process in order to reduce future damage.

3.3.8 PPS9 Biodiversity and Geological Conservation

The Government's planning policies on the protection of biodiversity and geological conservation via the planning system are outlined in Planning Policy Statement 9 Biodiversity and Geological Conservation (PPS9). Crucially, many protected sites fall within Flood Zones and it is also an imperative to consider the impact of removing woodland on carbon sinks and on flooding.

There is also a risk that if land is used for development because its value in respects other than productive capacity is limited, the pressure on less productive land for production may increase in the future. In the case of increased flood risk, any adverse affects arising from the development of land should be avoided rather than minimised.

3.3.9 PPS12 Local Spatial Planning

Planning Policy Statement 12 Local Spatial Planning (PPS12) sets out the Government's policy on the preparation of LDDs, which together comprise the LDF. Key issues include the consideration of climate change and the need to identify local areas at risk from flooding and to highlight the geographical location of such areas on the adopted proposals map. The preparation of all local development documents must be informed by an SA. Gathering information on flood risk is an important element of assembling the baseline information for these assessments and for formulating local policy within the LDF.

3.4 Regional Planning Policy

3.4.1 North East of England Plan – Regional Spatial Strategy to 2021

The Regional Spatial Strategy (RSS) for the North East of England[11], published in July 2008, set targets to guide the scale and location of growth in Northumberland up to 2021. Flood risk is a key consideration within the RSS as is the need to adapt to climate change in order to minimise the threats from natural factors such as flood risk. This is supported elsewhere throughout the document, with climate change being considered an important issue. It also includes spatial policies relating to water and flooding which are forming part of the driver for the SFRA. Those of particular mention are Policy 2, 34 and 35 (Table 3-2).

[11] North East of England Plan – Regional Spatial Strategy to 2021, Government Office for the North East, July 2008.

Table 3-2 Water Related Policies in North East of England RSS[11]

Policy	Description
Policy 2: Sustainable Development **2.1 Environmental Objectives**	*"Planning proposals and Local Development Frameworks should support sustainable development and construction through the delivery of the following environmental objectives:* *a. to ensure good local air quality for all;* *b. to protect and enhance the quality of the Region's ground, river and sea waters;* *c. to protect and enhance the Region's biodiversity, geodiversity and soil quality;* *d. to reduce the amount of waste produced and increase the amount recycled;* *e. to make better use of our resources, including the built fabric;* *f. to mitigate environmental and social costs of developments, and encourage efficient resource use;* *g. to protect and enhance the quality and diversity of the Region's rural and urban land and landscapes;* *h. to prevent inappropriate development in flood plains;* *i. to reclaim and reuse derelict land to make more productive use of land;* *j. to protect and enhance the Region's cultural heritage and diversity; and* *k. to promote the concept of green infrastructure, a network of linked, multifunctional green space in and around the Region's towns and cities.*
Policy 34: The Aquatic & Marine Environment	*"Strategies, plans and programmes, and planning proposals should:* *a. ensure that any schemes involving the transfer of water between catchments have consideration to the impacts on environmental and recreational assets of areas both nearby and upstream of the transfer base, particularly in relation to Kielder Water;* *b. integrate the objectives of emerging and existing plans and strategies which consider the wider management of water bodies, groundwater and coastal / marine areas;* *c. ensure that the construction and use of new development along river corridors takes account of its potential polluting effects; any opportunities for improvements and conservation of water quality; the possibility of flooding onsite and elsewhere along the watercourse; the availability of water resources; biodiversity; the impacts of climate change and the incorporation of necessary adaptation and mitigation measures, and the risk from minewater pollution;* *d. ensure, where appropriate, that Sustainable Drainage System techniques are adopted;* *e. set a positive policy framework for delivering plans for Integrated Coastal Zone Management, River Basin Management, Shoreline Management and Catchment Flood Management for the Region's coastal, estuarine and near-shore zones by adopting an ecosystem based approach to promote the recovery and conservation of marine eco-systems, including designated sites, favouring the evolution of the coast, estuaries and near-shore zones through natural processes wherever possible and seeking to safeguard the conservation of marine heritage features;* *f. take into account, and where possible plan to ameliorate, the risk of "coastal squeeze" having an impact on internationally designated nature conservation sites; and,* *g. promote appropriate water-based recreational and leisure opportunities, particularly at Kielder Water and along the Region's coastline."*
Policy 35: Flood Risk	*"A. Strategies, plans and programmes should adopt a strategic, integrated, sustainable and proactive approach to catchment management to reduce flood risk within the Region, managing the risk from:* *a. tidal effects around estuaries and along the coast including the implications of the latest Government predictions for sea level rise;* *b. fluvial flooding along river corridors and other significant watercourses resulting from catchments within and beyond the Region and other sources of flooding; and,* *c. flooding resulting from surface water runoff and capacity constraints in surface water drainage systems.* *B. In developing Local Development Frameworks and considering planning proposals, a sequential risk-based approach to development and flooding should be adopted as set out in PPS25. This approach must be informed by Strategic Flood Risk Assessments prepared by planning authorities in liaison with the Environment Agency to inform the application of the Sequential Test and, if necessary, the Exception Test, in development allocations in their LDDs and consideration of planning proposals."*

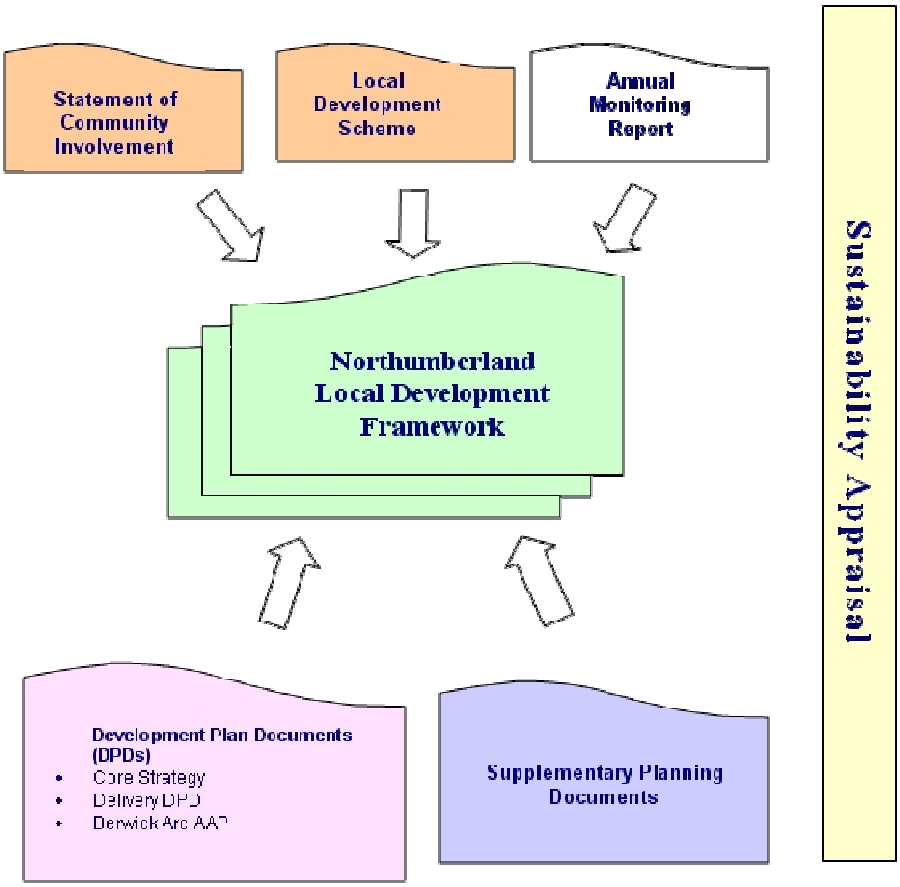
3.5 Local Planning Policy

Work is in progress on the preparation of Northumberland's Local Development Framework (LDF), a suite of planning documents that will set out the Council's future planning policies and eventually replace the extant Local Plans and LDF documentation of the former District LPAs. The Saved Policies of the Local Plans and LDF Documents will remain the statutory development plan until the new LDF is formerly adopted.

The Local Development Scheme (LDS) is a document that sets out the programme of work for the preparation of the LDF.

The (LDF) for Northumberland is the statutory spatial development plan, that comprises a portfolio of documents including the Core Strategy and the supporting Delivery Development Plan Documents (DPDs). The LDF will set out the spatial strategy, policies and proposals to guide the future development and use of land in Northumberland up to the year 2026. Northumberland County Council must ensure it coordinates and prepares LDF documents and policies, including preferred development locations, infrastructure and delivery plans that have had regard to the intent and steer from national policies, the RSS, as well as local aspirations, needs and demands. Figure 3-2 illustrates the key documents that feed into the LDF.

Figure 3-2 Local Development Framework Key Documents



The Core Strategy is the overarching DPD that provides the strategic framework for the other DPDs and Supplementary Planning Documents (SPDs), and sets out the vision, objectives and strategy for the spatial development of Northumberland. In particular, the Delivery DPD guides the future location of new development, contains proposals for new development and supports regeneration initiatives. The Berwick Town Eastern Arc Area Action Plan (AAP) sets out the integrated policies including site specific regenerative opportunities and strategic links in transport, urban design and townscape for the future regeneration and development of four areas. All these Plans must conform to the Core Strategy and help to deliver its strategic objectives and policies. The Council will also produce SPDs that provide further guidance to support policies in the DPDs.

It is essential that these are all informed using the findings and advice from a sound evidence base that examines economic, social and environmental needs and constraints. A critical element is therefore to consider in greater detail, the risks associated from all forms of flooding and the potential risk posed to new development and from new development.

Due to this, the findings of the SFRA will be important in future alterations to the LDF – particularly the Core Strategy, Delivery DPD ans the Berwick Arc Area Action Plan.

Table 3-3 provides the anticipated completion dates for the key DPDs and Supplementary Planning Documents in the Northumberland LDF. Please note that the Core Strategy is behind schedule and is now likely to be adopted 2012.

Table 3-3 Local Development Framework Timeline[12]

	Document	Anticipated End Date
Development Planning Documents	Statement of Community Involvement	Sept 2009
	Core Strategy – Proposals Map Part 1	2012
	Northumberland Delivery DPD: Delivering Sustainable Communities + Proposals Map Revised	June 2014
	Berwick Town Eastern Arc Area Action Plan	February 2012
Supplementary Planning Documents	Affordable Housing	Nov 2011
	Alnwick Landscape Character Appraisal	Feb 2009
	Alnwick Planning for Renewables	May 2009
	Blyth Central Conservation Area Management Strategy	May 2010
	Blyth Cowpen Quay Community Plan	Nov 2009
	Bedlington Conservation Area Management Strategy	Feb 2009
	Newbiggin-by-the-Sea Conservation Area Management Strategy	Feb 2009
	Wansbeck Provision for Sport and Plan	Feb 2009

The former districts within NCC reached different stages in the completion of their Core Strategies before the amalgamation of the districts into NCC.

[12] Local Development Scheme, Northumberland County Council, December 2008.
http://www.northumberland.gov.uk/idoc.ashx?docid=5a24d2bc-c4d6-4e21-a4d4-eba667904a72&version=-1

A summary of the development of the individual core strategies and the relevant saved local plan policies at the time of the amalgamation is provided below:

Alnwick Core Strategy – Adopted in October 2007

Alnwick Core Strategy adopted in October 2007, addresses the possible consequences of climate change to the former Alnwick district. As a coastal district in Northumberland the effect of global warming could raise many issues in the district including rise of sea levels, coastal erosion and localised flooding in urbanised areas. The Alnwick development strategy sets out the Policy S2 to prevent the unnecessary loss of valuable open land to developments as open land can be important for the functional floodplain and ground water protection.

Policy S2 has been set out to translate the regional sequential approach into the Alnwick LDF. This sequential approach applies to all site allocations and development proposals within the district. The policy identifies the importance of adapting the RSS sequential approach to prioritise the land use in sustainable village centres through the increase use of developed land compared to greenfield sites adjacent to the main rural service centres. For the purposes of the sequential approach the main rural service centres and secondary service centre plus the sustainable village centres are defined as the district's 'urban areas'.

The Policy S2 of the Alnwick Core Strategy sets out the approach below to select locations for new developments:

Policy S2 - The sequential approach to development

1st	Previously developed land and buildings within the urban areas of Alnwick, Amble, Rothbury and sustainable village centres;
2nd	Other suitable sites within the urban areas of Alnwick, Amble and Rothbury and sustainable village centres not identified as land to be protected for nature or heritage conservation or recreational purposes;
3rd	Suitable sites adjoining Alnwick, Amble and Rothbury, particularly where this involves the use of previously developed land;
4th	Other suitable sites adjoining sustainable village centres;

Furthermore, the Alnwick Core Strategy set outs Policy S3 which focuses on the wider sustainable issues including the effect from flooding to new developments. Before allocating sites and granting planning permissions, the council requires new development proposals to satisfy the following sustainable criteria set out in the Policy S3;

Policy S3 – Sustainability criteria

1. That the development is accessible to homes, jobs, shops, services, the transport network and modes of transport other than the private car;
2. That there is adequate existing or planned capacity in the physical and community infrastructure or that additional capacity can be provided, without compromising sustainability objectives, in time to accommodate the development;
3. Any physical and environmental constraints on the development of the land as a result of contamination, or land stability can be mitigated;
4. The potential implications of flood risk have been assessed having regard to the relevant flood zones*, as defined by a strategic flood risk assessment;

5. That there would be no significant adverse effects on the natural resources, environment, biodiversity and geodiversity, cultural, historic and community assets of the district;
6. That new development in settlements would help to build communities by sustaining or providing community services and facilities, or through the provision of affordable housing to meet identified local need

In exceptional circumstances, when economic, social or environmental benefits to the district clearly outweigh sustainability shortcomings, it may be necessary to allow development which does not meet one or more of the above sustainability criteria. In such cases it will be appropriate, through the use of conditions and / or agreements, to secure adequate mitigation measures or, if these are not possible, compensatory measures to offset any negative impacts.

Berwick Local Plan and Berwick Core Strategy – Reached preferred options stage before work was curtailed due to Local Government Reorganisation.

The Berwick-upon-Tweed Borough Local Plan was adopted in April 1999 and the saved policies of the Berwick Local Plan should be read in context. Where policies were originally adopted some time ago, it is likely that material considerations, in particular the emergence of new national and regional policy and also new evidence, will be afforded considerable weight. Examining the saved Local Plan Policies, there is no relevant policy. The emerging Berwick Core Strategy however recognised that parts of the Borough are known to be prone to flooding. It identifies the importance of the sequential approach in allocating and permitting use of land for developments. The policy SSP5 below illustrates the emerging approach the former Berwick district proposed for land allocations.

Policy SSP5

The potential implications for risk from flooding will be taken into account when meeting the development needs of the Borough. Developers will be expected to carry out an appropriate assessment of flood risk and development will not be permitted if it will:

1. Increase the risk from flooding, or;
2. Reduce the capacity of a flood plain to store flood water, or;
3. Increase the number of people or properties at risk from flooding.

Blyth Valley Core Strategy – Adopted in July 2007

The Blyth Valley Core Strategy set outs the sequential approach under Policy SS2. This provides a framework for the selection of sites in settlement based development plan documents for Blyth, Cramlington and Seaton Valley. Similar to the other district polices, this also identifies the importance of re-using previously developed land and reducing the unnecessary use of greenfield land and open countryside.

Below is an abstract of the "Policy SS2- the Sequential Approach and Phasing" from the Blyth Valley Core Strategy;

Policy SS2- the Sequential Approach and Phasing

- The Blyth, Cramlington and Seaton Valley development plan documents will plan for the release o f land for development over the following time periods: 2004 to 2011; 2011 to 2016; and 2016 to 2021.
- Development plan documents and proposals for new development will adopt a sequential approach to the identification of land for new development to give priority to previously developed land and buildings in the most sustainable locations. Locations for new development will be selected in the following priority order:

a) Suitable previously developed sites and buildings in the main towns of Blyth and Cramlington, and the secondary service centre of Seaton Delaval particularly where there is good access to public transport;
b) Other suitable locations within Blyth, Cramlington and Seaton Delaval;
c) Suitable sites in locations adjoining Blyth, Cramlington and Seaton Delaval particularly those that involve the use of previously developed land and buildings;
d) Suitable sites in villages, particularly those that involve the use of previously developed land and buildings.

- All sites will be in locations which are accessible to a range of services and a variety of modes of transport, particularly public transport, walking and cycling. Locations which have been identified as land to be protected for nature conservation or for recreational purposes will be avoided.
- There will be a presumption against development on greenfield land unless the site has been allocated in the Blyth, Cramlington or Seaton Valley development plan document in accordance with the sequential approach set out above.
- The council will review the phasing approach every five years or earlier if a need is indicated in the Annual Monitoring Report.

Following a similar approach to the Alnwick Core Strategy, the Blyth Valley Core Strategy requires the development proposals to meet the sustainable criteria set out in the Policy SS3.

Policy SS3 – Sustainability Criteria

Before allocating sites or granting planning permission for new development, the Borough Council will need to be satisfied that the following sustainability criteria are met:

1. That the development is accessible to homes, jobs, shops, services, the transport network and modes of transport other than the private car; and

2. That there would be no physical and environmental constraints on the development of the land as a result of contamination, flood risk, and/or land stability which could not be resolved without a detrimental impact on the environment; and

3. That there would be no unacceptable adverse impact on the natural environment, resources, biodiversity and geological conservation interests, landscape character, historic and cultural heritage and community assets of the borough and the maintenance, restoration and enhancement of these interests will be secured in new developments; and

4. That new development would help to build communities by sustaining community services and facilities, or through the provision of affordable housing to meet identified local need; and

5. That new development will reflect the principles of energy efficiency, water efficiency and conservation, sustainable design and construction, sustainable urban drainage schemes (SUDS), the hierarchy of waste management [waste minimisation, reuse of waste and recovery, which includes recycling] and secure by design. Applications for major developments will be expected to be accompanied by Transport Assessments and/or Green Travel Plans.

Policy DC19: Drainage and Flood Risk

The Council will apply the sequential approach in relation to flood risk when allocating sites for new development in settlement DPDs and when considering planning applications for development in flood risk areas. The sequential approach is set out in detail in Planning Policy Statement 25: Development and Flood Risk, which should be read in conjunction with 'Development and Flood Risk'; a PPS25 good practice companion guide.

Development proposals should make the most efficient use of water and enhance the sustainable use of the water environment. Development that incorporates sustainable drainage systems will be encouraged. The principles of sustainable drainage systems are set out in PPS25.

Castle Morpeth District Local Plan and Castle Morpeth Core Strategy – Reached Preferred Options/Submission stage before work was curtailed due to Local Government Reorganisation.

The Castle Morpeth District Local Plan was adopted in February 2003 and saved Local Plan Policy RE5 introduced the following measures to tackle Surface Water Run-Off and Flood Defences:

Policy RE5

Proposal for new development shall not be permitted in flood risk areas or where development may increase the risk of flooding elsewhere unless it can be demonstrated by means of a flood risk assessment and sequential test that:

A. There is no alternative option available no or at a lower risk flooding;
B. There will be no unacceptable risk of flooding;
C. There will be no unacceptable increase in risk of flooding elsewhere, as a result of the development ; and,
D. Appropriate mitigation measures can be put in place to minimise the risk of flooding and there measures can be controlled by appropriate planning conditions or a section 106 agreement can be secured.

The saved policies of the Castle Morpeth Local Plan should however be read in context. Where policies where originally adopted some time ago, it is likely that material considerations, in particular the emergence of new national and regional policy and also new evidence, will be afforded considerable weight. The Borough experiences major flood risk from the River Wansbeck and Pont which affects the main communities in Morpeth and Ponteland. Additionally, the coastal areas of the Borough experiences coastal erosion and flooding from rising sea levels. These issues were taken into account when allocating land use for future developments in the then emerging Castle Morpeth Core Strategy.

Tynedale Core Strategy – Adopted in October 2007

The Tynedale Core Strategy adopted in October 2007, sets out a number of general development principles that provides information on land allocation and the wider spatial planning in the district. The Policy GD1 below provides the principles that should be applied for location of all development sites in the former Tynedale area unless specifically covered by development plan policies;

Policy GD1

Main towns – Hexham, Prudhoe and Haltwhistle: the main focus for development and also where any large scale individual developments would be located.

Local centres – Allendale, Bellingham, Corbridge and Haydon Bridge: to a lesser extent the focus for development.

Smaller villages: small scale development only.

The open countryside: development limited to the re-use of existing buildings.

The Policy GD1 determines the appropriateness of a development in a particular town or a village based on its principle and general scale. Once the appropriate town or village has been determined for a development, the sequential approach to site selection should be applied. The sequential approach priorities previously developed land and existing buildings; this is set out in Policy GD2. For the purposes of this policy the definition of previously developed land includes that previously developed with agricultural buildings.

Policy GD2

When meeting development needs sites will be prioritised in the following order:

i. Previously developed land and buildings within the built up area of settlements
ii. Other suitable sites within the built up area of settlements
iii. Other suitable sites adjoining the built up area of settlements.

Settlements are as set out in Policy GD1.

In order to minimise the flood risk in the former Tynedale district, a precautionary approach has been adopted when allocating sites for development and considering development proposals. The Policy GD5 below set outs the approach adopted in the Tynedale Core Strategy;

Policy GD5

The potential implications for flood risk will be taken into account when meeting development needs. Developers will be expected to carry out an appropriate assessment of flood risk and development will not be permitted if it is likely to:

i. increase the risk of flooding; or
ii. reduce the capacity of flood plains to store flood water; or
iii. increase the number of people or properties at risk.

Wansbeck District Local Plan – No Core Strategy developed but adopted Local Plan in July 2007.

The saved polices of the Wansbeck District Local Plan introduced the following measures to tackle flood risk and erosion issues through Policy GP22;

Policy GP22

Developers are required to consider the risk to their development from flooding and erosion and to consider any possible effect of their development on flood risk or erosion elsewhere. Development in areas of flood risk will not be permitted unless a flood risk assessment has been carried out and it can be demonstrated that:

a. There is no reasonable alternative development option available which would involve no risk or a lower risk of flooding; and

b. The development does not increase the risk of flooding elsewhere; and

c. Satisfactory protection measures can be carried out at the expense of the developer and maintained for the lifetime of the development.

In coastal situations, work should not prejudice the ability of coastal features and processes to form natural sea defences.

Whilst these documents will be superseded by the new NCC LDF, until such time as the new LDF is produced and adopted, the existing plans offer guidance as to where new development is likely to be located within Northumberland CC.

For the purposes of the Level 1 SFRA, in addition to the Growth Point Status of several settlements within Northumberland which has an inherent need for development to be concentrated in these areas, the existing strategies have been used to provide an indication of where new development within the County is likely to be directed, and the expected volume of dwellings to be produced in each of the key development towns.

3.6 Non-Statutory National Planning Documents

3.6.1 Making Space for Water

During 2004, (DEFRA) undertook a consultation exercise, the object of which was to engage a wide range of stakeholders in the debate regarding the future direction of flooding strategy. The consultation document 'Making Space for Water' is part of the Governments overall approach to managing future flood risks and sets out the following aim:

'To manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as to:

- *Reduce the threat to people and their property;*
- *Deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles'*

(Making Space for Water 2004:1)

Thus, the aim of the strategy is to balance the main pillars of sustainable development, namely social, economic and environmental factors.

Making Space for Water examines the impact of climate change on flood levels. Experts consider that the primary impacts on flood risk will be from changes in precipitation, extreme sea levels and coastal storms. DEFRA and the EA will produce revised guidance for use by those implementing flood and coastal erosion risk management measures. The revised guidance, yet to be published, will ensure that adaptability to climate change through robust and resilient solutions becomes an integral part of all flood and coastal erosion management decisions.

Making Space for Water emphasises the Government's commitment to ensure that a pragmatic approach to reduce flood risk is adopted. However, the paper notes that 10% of England is already within mapped areas of flood risk. Contained within these areas are brownfield sites, which policy has identified as a priority for future development. The document asserts that over the past five years 11% of new houses were built in flood risk areas.

The plan advocates the use of European Union (EU) funding streams, such as INTERREG IIIB[13], to enable LPAs to undertake trans-national projects aimed at advancing knowledge and good practice in flood risk management.

The document also encourages integration with water management initiatives, in particular CFMP. The document proposes that RSSs and LDFs should take full account of SFRA and incorporate the sequential approach as set out in PPS25.

At the development control level, the document encourages LPAs to follow the existing guidance to require site-specific FRAs. In addition, the use of FRAs as supporting documents to planning applications in areas of flood risk is encouraged. The document proposes that if mitigating measures are shown to be required, they should be fully funded as part of the development.

3.6.2 Sustainable Communities Plan

The Sustainable Communities Plan (SCP) was launched by the Office of the Deputy Prime Minister[14] (ODPM) in February 2003. The main aims of the SCP include improving the overall quality of housing in England, a step change in housing supply to meet demand, encouraging new growth areas while maintaining and protecting the Green Belt. These objectives are to be achieved with sustainability at the centre to ensure a legacy of improved, liveable communities.

The challenge is to reconcile the SCPs requirement to identify sufficient land for large volumes of new homes whilst ensuring that the sites allocated satisfy sustainability criteria specifically with regard to the avoidance of flood risk.

3.6.3 Regional Flood Risk Appraisal

The North East Regional Spatial Strategy Regional Flood Risk Appraisal (RFRA) Scoping Report was released in January 2009. The RFRA covers the following main aspects:

- Identify issues for the RSS in relation to flood risk,

[13] INTERREG III is a EU Initiative to promote transnational co-operation on spatial planning by encouraging harmonious and balanced development of the European territory. The overall aim is to ensure that national borders are not a barrier to balanced development and the integration of Europe and to strengthen co-operation of areas to their mutual advantage. The Initiative ran from 2000 to the end of 2006.
[14] Now superseded by Communities and Local Government (CLG)

- Define objectives of the RFRA in relation to flood risk,
- Identify boundaries to the RFRA (including consideration of neighbouring regions),
- Identify key stakeholders,
- Review appropriateness of existing SFRAs,
- Identify potential flood risk components (i.e. possible sources, pathways and receptors),
- Identify initial flood risk indicators to be used,
- Decide baseline conditions for assessment,
- Confirm whether a more detailed flood risk appraisal is required and in what areas should it be applied to.

The Scoping RFRA highlights that SFRAs and spatial plans should take account of all forms of flooding and climate change. It recommends NWL should be contacted at an early stage in the SFRA process as there is a data gap concerning sewer flooding.

The Scoping RFRA has produced a series of maps that display the flood risk indicators used in the study and the probability of flooding of depths greater than 0.6m. It highlights Morpeth and Blyth as key locations with a high probability of flooding of depths greater than 0.6m.

The Scoping RFRA recommends a full RFRA after reviewing available flood risk data.

3.7 Catchment Flood Management Plans

A CFMP is a high-level strategic plan which is used to identify and agree long-term policies for sustainable flood risk management within individual river catchments. CFMPs undertake an assessment of flood risk to identify the causes, size and location of flood risk throughout the catchment and the various influences that can affect the probability and consequences of flooding. This enables the effect of potential changes in the catchment on flood risk to be identified. Each potential source of change can be influenced by land use planning policy, such as a changing policy approach towards greenbelt protection or the allocation of large Greenfield sites for housing development. Potential changes may include, for example:

- Development and land use change, such as new development or significant changes in the developed environment,
- Changes in the rural landscape, including large scale changes in land management,
- Loss of, or potential threat to, wildlife habitats or biodiversity,
- Climate change.

Flood risk management looks at the probability of a flood occurring and the potential resultant impacts. A spatial planning element also exists in flood risk management since it involves decisions on when, where and how to store or convey flood waters to minimise the risks to people, property and the environment.

CFMPs identify broad, long term (50-100 years) policies for sustainable flood risk management in the context of a particular catchment.

The planning period is therefore considerably longer than the period typically considered as being 'long-term' in land-use planning policy terms, which is usually 10 to 15 years. This potential conflict in planning timeframes should be taken into consideration, as a change to land-use policy can occur in a much shorter period of time than the CFMP may account for. There is also a potential conflict in that catchment boundaries do not necessarily relate to LPA boundaries and land use policy approaches may vary between LPAs, increasing the complexity for flood risk management decisions across the catchment.

CFMPs aim, amongst other objectives, to inform and support planning policies, statutory land use plans and implementation of the WFD, so that future development in the catchment is sustainable in terms of flood risk. Awareness of the role of CFMPs among land-use planners is in its infancy as these plans, along with SFRAs, are a relatively new requirement.

Preparing CFMPs involves carrying out a strategic assessment of current and future flood risk from all sources, understanding both the likelihood and impact of the risk and the effect of current measures to reduce that risk. The scale of risk is broadly measured in economic, social and environmental terms.

CFMPs identify opportunities and constraints within the catchment to reduce flood risk through strategic changes or responses, such as changes in climate, urban development, land use, land management practices and/or the flood risk management infrastructure and waterways.

CFMP policies, which are identified for each individual 'policy unit' (which relate to a specific geographical area), establish whether action should be taken to increase, decrease or maintain the current scale of flood risk. The CFMP does not identify specific ways of managing flood risk, which are the subject of subsequent, more detailed studies. A single policy is applied to each policy unit. Six policy options exist and may be applied:

Table 3-4: Generic CFMP Policy Options

Option	Policy
1	No active intervention (including flood warning and maintenance), continue to monitor and advise
2	Reduce existing flood risk management actions (accepting that flood risk will increase with time)
3	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
4	Take further action to sustain the current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change)
5	Take further action to reduce flood risk (now and/or in the future)
6	Take action to increase the frequency of flooding (where appropriate) to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, e.g. for habitat inundation)

In order to achieve the specified policy approach, a number of actions may be identified for each policy unit. It is expected that CFMPs will be used by regional and local government authorities to inform their spatial planning activities, SAs/SEAs and emergency planning.

There are four CFMPs that cover the study area, the Till and Breamish CFMP completed in December 2008 the Wansbeck and Blyth CFMP (December 2008), North East Northumberland Rivers CFMP (June 2009) and the River Tyne CFMP (June 2009).

All the CFMPs considered flood risk under climate change scenarios which involved scaling up the EA model inflows by 20%, and where necessary increasing rainfall by 30%. Urban growth scenarios were also considered by increasing the urbanisation factor in the model's hydrology to alter the amount of rainfall runoff and reduce the response time of the catchment. Afforestation and agricultural land use change with regards to drainage and intensification were also considered. Unsurprisingly, increases in flow due to climate change had the biggest impact upon flows and urbanisation had the least impact to do the mitigating impact of future SUDS systems.

A range of CFMP policies have been assigned to catchments within Northumberland. The policies are based upon a number of criteria including the level of flood risk in an area, the cost benefit ratio and land use.

Table 3-5: CFMP Policies by Policy Unit in Northumberland

North East Northumberland CFMP	
CFMP Policy Unit	**CFMP Policy Number Selected**
The Lows	1
Coastal Streams	1
Amble	1
Ross Low	2
Long Nanny	2
Upper Aln	3
Waren and Newlands Burn	3
Coquet	5
Rothbury	5
Lower Aln	6
Wansbeck and Blyth CFMP	
CFMP Policy Unit	**CFMP Policy Unit Selected**
Wansbeck, Font and Lyne	6
Morpeth Urban Area	5
Ponteland Urban Area	5
Blyth Urban Area	5
Upper Pont	3
Blyth and Coastal Streams	3
Upper Blyth	2
River Tyne CFMP	
CFMP Policy Unit	**CFMP Policy Unit Selected**
North Tyne and Rede	2
South Tyne	3

North East Northumberland CFMP	
Hexham and Acomb	3
Main Tyne	3
Till and Breamish CFMP	
CFMP Policy Unit	**CFMP Policy Unit Selected**
College Burn	1
Upper Glen	3
Lower Glen	3
Upper Wooler Water	3
Lower Tweed	5
Upper Till	5
Wooler	5
Lower Till	6

3.8 Flood Risk

3.8.1 Regional/National

Based upon PPS25, Scott Wilson recommends the following aspects relate to flood risk policy at the national and regional scales:

1. In accordance with PPS25, all sites should be allocated in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the Flood Zone classification,
2. FRAs should be undertaken for all developments within Flood Zones 2 and 3 and sites with identified flooding sources (according to PPS25 Annex E) to assess the risk of flooding to the development and identify options to mitigate the flood risk to the development, site users and surrounding area,
3. FRAs are required for all major developments (all sites over 1 ha) in Flood Zone 1 (according to PPS25 Annex E).
4. Flood Risk to development should be assessed for all forms of flooding (in accordance with PPS25 Annex E),
5. According to PPS25, it is recommended that where floodplain storage is removed, the development should provide “on site” level for level and volume for volume compensatory storage to ensure that there is no loss in flood storage capacity.

3.8.2 Sub-Regional/Local

The following aspects relate to flood risk policy at the sub-regional and local scales:

1. As stated in PPS25, surface water flooding should be investigated in detail as part of site specific FRAs for developments and early liaison with the EA and the relevant LPA for appropriate management techniques should be undertaken.

2. As stated in PPS25, Groundwater flooding should be investigated in more detail as part of site specific FRAs.

Through integration of these suggestions, the emerging LDF will comply with PPS25 and the aspirations and policies represented in following:

- River Tyne CFMP,
- North East Northumberland Rivers CFMP,
- Wansbeck and Blyth CFMP,
- Till and Breamish CFMP
- Northumberland Biodiversity Action Plan (BAP),
- The River Tyne Catchment Abstraction Management Strategy(CAMS),
- The River Till Catchment Abstraction Management Strategy(CAMS),
- The Northumberland Rivers Catchment Abstraction Management Strategy (CAMS).

3.9 Sustainable Drainage Systems

A SuDS map, methodology and guidance on the use of the SuDS map are provided in Appendix C. Based on PPS 25 guidance, Scott Wilson recommend Sustainable Drainage Policies should address the following issues:

3.9.1 Regional/National

The following aspects relate to SuDS at the national and regional scales:

1. PPS25 requires the use of SuDS as an opportunity of managing flood risk, improving water quality and increasing amenity and biodiversity,
2. SuDS are a requirement of the Building Regulations,
3. FRAs are required for all major developments (all sites over 1 ha) in Flood Zone 1 (according to PPS25 Annex E),
4. As stated in PPS25, runoff rates from new developments should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect,
5. It is recommended that runoff and/or discharge rates should be restricted to Greenfield runoff rates in areas known to have a history of sewer and/or surface water flooding.

3.9.2 Sub-Regional/Local

At the site-specific FRA level, the suitability of SuDS should be investigated for each development. Through integration of these suggestions, the emerging LDF will comply with PPS25 and the aspirations and policies represented in following:

- River Tyne CFMP,
- Wansbeck and Blyth CFMP,
- North East Northumberland CFMP,
- River Till and Breamish CFMP,
- The River Tyne Catchment Abstraction Management Strategy (CAMS),
- The River Till Catchment Abstraction Management Strategy (CAMS),
- The Northumberland Rivers Catchment Abstraction Management Strategy (CAMS).

3.10 Water Environment

3.10.1 Regional/National

The following aspects relate to water environment at the national and regional scales:

1. Development should not have a detrimental impact on the water environment through changes to water chemistry or resource,
2. Developments should look to incorporate water reuse and minimisation technology,
3. Following discussion with the EA, any development should not be located within the 5 metre Byelaw distance of the riverbank to ensure access for maintenance but amongst other things should ensure a riparian corridor for improvement of the riverine environment.

Through integration of these suggestions, the emerging LDF will comply with PPS25 and the aspirations and policies represented in following:

- The Water Framework Directive,
- River Tyne CFMP,
- The River Tyne Catchment Abstraction Management Strategy(CAMS),
- The River Till Catchment Abstraction Management Strategy (CAMS),
- The Northumberland Rivers Catchment Abstraction Management Strategy (CAMS).

4 Level 1 SFRA

4.1 Objective

As outlined in Sections 1.3 and 1.4, the objective of the Level 1 SFRA is to collate and review the information available relating to flooding in the study area. Once reviewed, and any data gaps have been resolved, the information is presented in a format to enable NCC to apply the Sequential Test to their growth areas and to identify potential development sites in Flood Zone 2 and Flood Zone 3, which would require the application of the Exception Test through a Level 2 SFRA. Gaps in the data/information have also been identified in order to ascertain additional requirements needed to meet the objectives of a Level 2 SFRA, where required.

4.2 Tasks

The sequence of tasks undertaken in the preparation of the SFRA was, in chronological order:

- Inception meeting with NCC,
- Determination of key stakeholders,
- Contact with key stakeholders to request data/information,
- Baseline Data Review and Meeting,
- Collation and review of data and population of data register,
- Presentation of available relevant information on flood sources and flood risk,
- Review of received data against SFRA objectives,
- Identification of gaps in data.

4.3 Stakeholders

The stakeholders that were contacted to provide the data/information for the SFRA were:

- Northumberland County Council,
- Environment Agency,
- Northumbrian Water.

4.3.1 Local Authorities

NCC provided information, advice and data on flood risk and planning issues across their administrative area and how their LDF programme is emerging. In addition to their planning and development aspirations, NCC was able to provide some details of flooding within their boundary.

The vast majority of the study area is located in the upper catchments of the watercourses. As such, development proposals in the neighbouring authorities are unlikely to exacerbate flood risk to the study area.

However, any proposed development within the study area should be designed so that is does not exacerbate flood risk to downstream parts of the catchment located in adjacent authority areas, e.g. Newcastle City Council and Gateshead Borough Council.

4.3.2 Environment Agency

The EA is the principal holder of flood risk data in England and Wales. The EA has discretionary powers under the Water Resource Act (1991) to manage flood risk and, as a result, are the holders of the majority of flood risk data available in the study area. Northumberland falls within the North East Region of the EA.

At the data meeting, discussions were held with the EA to determine what information could be made available for the SFRA and to discuss how to best use the data. A full list of the data provided by the EA can be found in Appendix D, but can be summarised as:

- Catchment Flood Management Plans (CFMPs) for,
- Catchment Abstraction Management Strategy (CAMS),
- Strategic Flood Risk Mapping (SFRM) outlines and supporting data,
- Groundwater Vulnerability Mapping,
- Locations of flood defence assets and flood warning areas.

The EA have also assisted in the production of the SFRA by providing expert advice and comment.

4.3.3 Northumbrian Water

NWL provide potable water distribution and wastewater collection for the Northumberland administrative area. NWL have provided a register of flood events that have affected properties (internal) and outside areas such as roads (external) in a particular drainage area. This information is provided to the regulatory body Office of Water Services (OFWAT) and is used to help define their works programme. The data is presented in Appendix B. It is advised that NWL are consulted as part of Level 2 SFRAs and site-specific FRAs in order to obtain more detailed and up-to-date information on the locations of sewer flooding incidents.

The principal contacts and their associated details for the above stakeholders are presented in Appendix E.

4.4 Data/Information Collected

Data was requested from the above stakeholders. Received data was integrated with Scott Wilson's GIS system where possible, to facilitate a review. The data requested from the identified stakeholders was based on the following categories:

- Terrain Information,
- Mapping data (ordnance survey),
- Hydrology,
- Hydrogeology,

- Flood Defence,
- Environment Agency Modelled Flood Levels,
- Environment Agency Flood Zone Maps,
- Historical flooding,
- Sewer flooding problems,
- Planning related data and policies.

All data was registered on receipt and its accuracy and relevance reviewed to assess confidence levels for contribution to the SFRA. Details of all data collected at the time of production are presented in Appendix E.

Table 4-1: Method for qualitative confidence ranking of data received

		RELEVANCE		
		1 - VERY RELEVANT	2 - PARTLY RELEVANT	3 - NOT RELEVANT
ACCURACY	1 - EXCELLENT	**VERY GOOD**	**GOOD**	**GOOD**
	2 - GOOD	**GOOD**	**GOOD**	**FAIR**
	3 - FAIR	**GOOD**	**FAIR**	**FAIR**
	4 - POOR	**FAIR**	**FAIR**	**POOR**
	5 - VERY POOR	**FAIR**	**POOR**	**VERY POOR**

4.5 GIS, Flood Mapping and Application

Using the data collected a series of GIS layers were collated to visually assist NCC in their site allocation decisions and Development Control activities.

Broadly, the layers can be classified into planning policy, informative and flood risk categories. Appendix G includes a more detailed table highlighting the GIS layers that have been used and their limitations.

4.5.1 GIS Data Gaps and Assumptions

Some data that is necessary to satisfactorily complete an SFRA is either not available at all, or is not available in GIS format.

In order to present complete Flood Zones with the best available information for the NCC SFRA study area, it has been necessary to make certain assumptions, so that gaps in data could be filled; these assumptions have been outlined in the proceeding sections and Appendix F.

4.5.2 Flood Risk GIS Layers

The following sub-section is intended for use in conjunction with the Flood Zones presented in the detailed maps in Appendix B of this study. Planning guidance indicating what type of development is likely to be appropriate in certain Flood Zones is presented in Tables D.2 and D.3 of PPS25. These tables can then be viewed in conjunction with the SFRA Flood Zone mapping to inform planning decisions.

SFRA Flood Zone Mapping

Detailed maps present Flood Zone 1, Flood Zone 2, Flood Zone 3a and Flood Zone 3b (functional floodplain) in relation to current levels of flood risk. In addition some of these areas have also been mapped to take into account the climate change as recommended by PPS25. These maps are included in Appendix B and should enable NCC to undertake the Sequential Test as part of the SFRA.

In order to present the most up-to-date and relevant flooding information available, the Flood Zone maps have been created using a variety of existing sources of data. Data used in the creation of the SFRA Flood Zones were obtained from the EA and individual LPAs (as used within their individual Level SFRAs).

The Flood Zone 3a and Flood Zone 2 outlines were provided by the EA in July 2009 derived from broad-scale modelling. Further model outlines, identifying specific reaches of the Flood Zones derived from detailed hydraulic models, were also provided by the EA to present the best available information.

Flood Zone 1 refers to all areas that are considered to be at low risk of fluvial (or tidal flooding). Flood Zone 1 comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%), and consists of all areas that fall outside of Flood Zones 2, 3a and 3b. Whilst fluvial and tidal flooding is not a major concern in these areas, the risk of flooding from other sources, such as surface water, groundwater, sewers and artificial sources may still be an issue.

Flood Zone 2 is the extreme flood event outline. This flood outline comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year. This Flood Zone comprises EA broad scale modelling outlines.

Flood Zone 3a refers to all areas that are considered to be at high risk of fluvial (or tidal flooding). Flood Zone 3 comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. This Flood Zone is also the part of Flood Zone 3 that is outside Flood Zone 3b (the functional floodplain) and was created using a hybrid approach, combining EA broad scale modelling and detailed hydraulic modelling outlines provided by the EA.

The Flood Zone 3b and Flood Zone 3a plus an allowance for climate change were derived using a hybrid approach. Where detailed hydraulic modelling has been undertaken and flood outlines mapped, these have been used to represent the Flood Zone. However, broad-scale modelling is not available for these Flood Zones.

Therefore where detailed modelled flood outlines do not exist, the Flood Zone from a higher return period has been used as a proxy until such a time that this information is available (e.g. Level 2 SFRA, Strategic Flood Risk Mapping study, site-specific FRA).

The Flood Zone 3a plus an allowance for climate change outline was therefore created using a hybrid approach, combining specific reaches of detailed hydraulic modelled outlines for the 1 in 100 annual probability of river flooding (1%) plus an allowance for climate change provided by the EA, and the remaining reaches using Flood Zone 2 as a proxy.

The Flood Zone 3b outline was therefore created using a hybrid approach, combining specific reaches of detailed hydraulic modelled outlines for the 1 in 25 or 1 in 20 annual probability of river flooding (4% or 5%) provided by the individual LPAs, which were then updated with the latest outlines provided by the EA. Flood Zone 3a was used as a proxy for the remaining reaches of Flood Zone 3b.

Flood Zone 3b includes all surface water bodies (channels, lakes, reservoirs etc.) and land designated by the EA as Flood Storage Areas (FSA), and was trimmed to take into account 'areas benefiting from defences' (ABD) as designated by the EA.

The PPS25 Practice Companion Guide highlights the importance of considering existing land use when delineating areas that are to be treated as 'functional floodplain' for planning purposes. Therefore, due to the inevitable obstruction to overland flood flow paths posed by existing development within Flood Zone 3b (functional floodplain), existing buildings illustrated within urban areas should not be considered as falling within the functional floodplain.

Confidence Mapping

Inherent limitations exist for any Flood Zone, regardless of whether it has been derived by broad scale river models or detailed river models. Assumptions are built into both the hydraulic modelling software packages and the techniques used to calculate river flows (hydrology). As with any natural event, actual flood events occur as a result of numerous variables, all of which may have a significant impact on the location, extent and duration of flooding.

Consequently, Flood Zones are areas that are predicted to flood during a given return period event, whilst the area affected during that return period event may differ from the area shown to be within the Flood Zone.

For each reach and each Flood Zone, information on the data has been provided detailing the source of the data used to create the Flood Zone and the relative confidence in the data as a result of the modelling technique used in its creation.

The EA holds national broad-scale models of most watercourses and much of the coastline that are intended to broadly define the areas at risk of fluvial and coastal flooding in the UK. As part of more detailed river modelling studies undertaken by the EA (such as Strategic Flood Risk Mapping (SFRM) studies), Flood Zones have been refined along many watercourse reaches within Northumberland.

The Flood Zone Confidence Maps are intended to be used by planners as a tool for identifying areas of high, medium or low confidence in the data that has been used to derive fluvial Flood Zones across the county. The confidence assigned to a Flood Zone demonstrates the level of detail and the number of assumptions made when deriving the Flood Zones.

The maps can be used to determine reaches of river where further, more detailed work is required to refine Flood Zones and therefore where resources should be directed.

The maps should be used when allocating development sites and for Development Control activities. For example, if a site is being considered for allocation and is shown to be in an area of Flood Zone that has low confidence, work should be instigated to quantify and define the risk at that location in more detail.

As part of the SFRA, four hybrid SFRA Flood Zones were created:

- Flood Zone 2 (Medium Probability),
- Flood Zone 3a (High Probability),
- Flood Zone 3a (High Probability) plus an allowance for climate change,
- Flood Zone 3b (Functional Floodplain).

As part of the SFRA, hybrid SFRA Flood Zones were created covering the entire county. As described in SFRA Flood Zone Mapping section, the Flood Zones were derived using the best available information provided by the EA. As agreed with the EA, where detailed hydraulic river model outlines were available for a reach of river, these were used in preference to broad-scale model outlines. The SFRA Flood Zones presented the best available information at that time and therefore contain data from a number of different river modelling studies. Each section of Flood Zone was assigned a confidence level based on the method and level of assumptions used to derive that Flood Zone (Table 4-2).

Table 4-2: Flood Zone Confidence

	Confidence		
	High	**Medium**	**Low**
Flood Zone 2	Derived from detailed river modelling study	Derived from broad scale river modelling study	N/A
Flood Zone 3a	Derived from detailed river modelling study	Derived from broad scale river modelling study	N/A
Flood Zone 3 plus climate change	Derived from detailed river modelling study	N/A	Where no modelled data available, Flood Zone 2 used as a proxy
Flood Zone 3b	Derived from detailed river modelling study	N/A	Where no modelled data available, Flood Zone 3a used as a proxy

The confidence level is included in the metadata of the SFRA Flood Zone GIS layers and a thematic map has been created for each Flood Zone based on the assigned confidence level.

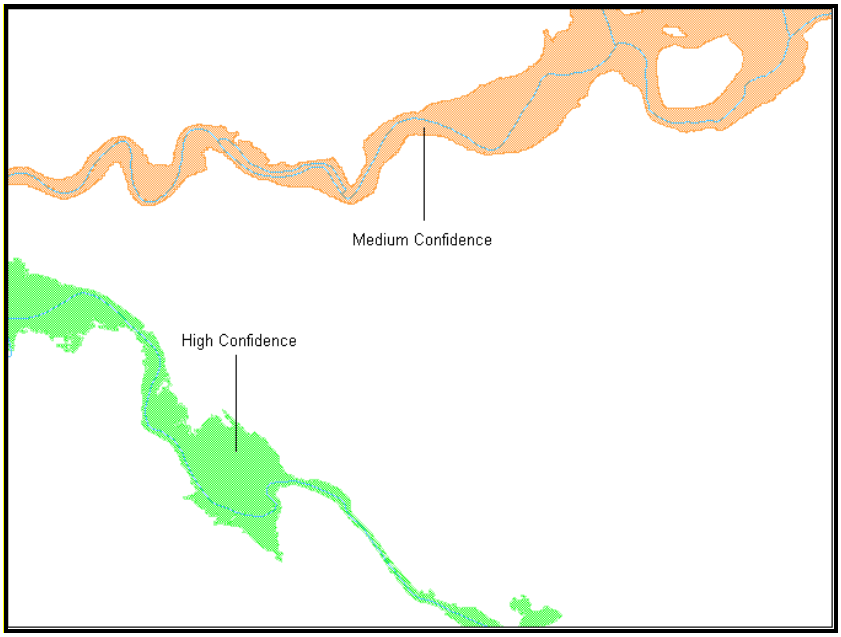


Figure 4-1: Example of Flood Zone Confidence Mapping (Flood Zone 2)

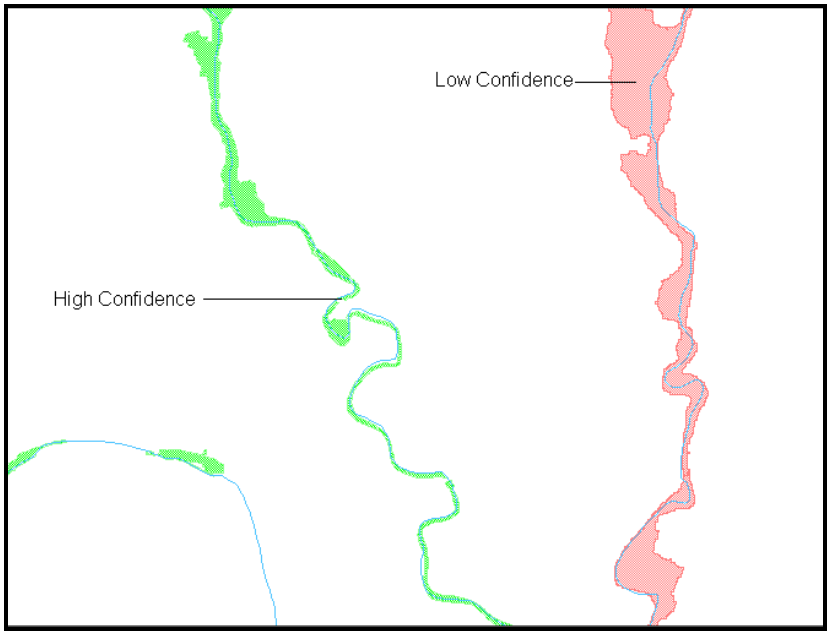


Figure 4-2: Example of Flood Zone Confidence Mapping (Flood Zone 3 plus climate change)

When assigning confidence to SFRA Flood Zones, it has been assumed that flood outlines derived from detailed river models are a more accurate representation of the area that would be affected by a flood during a particular return period event. In addition, the detailed river models used in the SFRA Flood Zones have been commissioned by the EA as part of the Strategic Flood Risk Mapping (SFRM) programme. A higher confidence is therefore assumed for Flood Zones derived from detailed river models.

The flood outlines derived from broad scale river models are intended to be viewed at a large scale and to show broad areas at risk of flooding. The EAs broad scale modelled outline is a national dataset based on a coarse topographic data (5m DTM grid). Consequently, there are areas where features such as railway embankments for example, or local variations in ground levels, that are either not represented or are misrepresented. This leads to uncertainties in the flood outlines based on broad scale modelling.

Another assumption made by the broad scale modelling is that water levels are "bank full" prior to the arrival of the flood. For the vast majority of watercourses in the country, this is a fair assumption. However, in highly urbanised areas, where river channels may be canalised and very deep, this can lead to additional uncertainties in flood outlines.

It has been assumed that broad-scale models are constructed using a greater amount of assumptions and therefore the flood outlines are less reliable than those from detailed river models.

The Confidence Maps are only intended to be used as an aid to assist planners in determining areas where further work is required to define Flood Zones. The Maps are not intended to disregard Flood Zones or be used, for instance, to ignore flood risk in an area shown to have low confidence.

Functional Floodplain

The functional floodplain (Flood Zone 3b) has the highest probability of flooding of all the Flood Zones defined within Table D.1 of PPS25. As outlined by Table 5-1 (Chapter 5, PPS25), there are only two appropriate land uses that should be permitted in this zone: water compatible land uses and essential infrastructure. Any planning applications for proposed appropriate development must be accompanied by a site-specific FRA that proves that the proposed development will not impede flood flows, will not increase flood risk elsewhere and will remain operational in times of flood. In light of the above, it is important that functional floodplain is illustrated by the SFRA in order for NCC to consider its location when preparing LDF documents and other strategic documents.

Under PPS25 and the Practice Guide Companion to PPS25 (living draft), the Functional Floodplain is defined as 'land where water has to flow or be stored in times of flood', including water conveyance routes and flood storage areas. The Practice Guide Companion to PPS25 ("living draft" February 2007) advises that, 'all areas within Zone 3 should be considered as Zone 3b (Functional Floodplain) unless, or until, an appropriate FRA shows to the satisfaction of the EA that it can be considered as falling within Zone 3a (High Probability)'.

For several watercourses within the study area, the EA hold detailed modelled flood outlines for the 1 in 25 year or 1 in 20 year (4% or 5% annual probability) flood events. Where this is the case, this data has been used to map the functional floodplain. Broad-scale models are not available for the functional floodplain and therefore where the 1 in 25 year or 1 in 20 year modelled flood outline is not available, Flood Zone 3a has been considered as a proxy to represent the functional floodplain until such a time that more detailed information is available, such as the Level 2 SFRA (where necessary), an EA Strategic Flood Risk Mapping (SFRM) study or a site-specific FRA. This is the approach recommended in the PPS25 Practice Guide. This is not to say that the entire area used as a proxy is FFP, moreover that the boundary of the FFP falls somewhere within that area as recommended by the EA.

The application of this methodology has highlighted specific areas where there are inconsistencies between previously mapped FZ3b and the FZ3b proxy. Further evaluation as part of a site specific FRA for any detailed development proposal would be required for such areas, which include (but are not limited to):

- Goswick,
- east of Haggerston,
- east of Ross/Kirkley Hill,
- Cockley Knowes,
- Annstead,
- north of Wooler, and
- Hexham.

Flood Zone 3b and its proxy outline have only been trimmed to take into account specific, formal 'areas benefiting from defences' as defined by the EA.

The Effects of Climate Change

To ensure sustainable development now and in the future, PPS25 requires that the effects of climate change should be taken into account in an SFRA and that flood outlines delineating climate change should be presented. Where possible, modelled outlines for Flood Zone 3a including the effects of climate change have been presented.

Flood Zone 3a has been determined with an allowance for climate change. For fluvial reaches, this Flood Zone is calculated by adding a net increase of 20% over and above peak flows to the 100 year flood event. Where modelled information is not available, the Flood Zone 2 outline has been used as a proxy until such a time when more detailed information is available (i.e. an EA hydraulic modelling study or hydraulic modelling study undertaken for a site-specific flood risk assessment). This is not to say that the entire area used as a proxy is Flood Zone 3 plus an allowance for climate change, moreover that the boundary of Flood Zone 3 plus an allowance for climate change falls somewhere within that area.

Modelled outlines do not exist for the Flood Zone 2 plus climate change. It must be assumed that the extent of flood event would be greater than the existing outlines. As there are limitations, and extensive uncertainties, in deriving the floodplain for such an extreme event, it is not practical to use a proxy dataset or make assumptions to produce the Flood Zone 2 plus climate change outline. It is therefore suggested that any proposed development adjacent to the existing Flood Zone 2 is supported by a detailed FRA which examines the location and extent of the Flood Zone 2 plus climate change.

Sewer and Storm Water Flooding

Information regarding incidents of sewer flooding has been provided by NWL in the form of DG5 data. The location of incidents of sewer flooding is presented in a map in Appendix B and shows the number of incidents per drainage area over. This map helps to highlight to NCC that there are certain areas where the drainage network can be overwhelmed during periods of high intensity rainfall and therefore new development in these areas should take account of this.

Flood Risk Management Structures

The EA flood risk management structures layer presents information from the NFCDD for the study area. The layer shows lengths of maintained channels, raised flood risk management structures (man-made), natural channels and culverted channels. It also provides details on the approximate SoP offered by flood risk management structures and assets.

Groundwater Vulnerability Mapping

The EA's groundwater vulnerability maps have been presented in a thematic map (Appendix G) to highlight areas that overlie aquifers with a high vulnerability. Major Aquifers with a high vulnerability tend to have a more permeable surface geology. Groundwater vulnerability relates to the potential for contamination to groundwater and thus is a useful tool to determine the potential suitability of sustainable drainage (SuDS) techniques.

British Geological Survey Geology Mapping

British Geological Survey (BGS) maps were assessed as part of the Level 1 SFRA. The data has been used to undertake the SuDS map and review in Appendix C. Geology maps for the area are shown in Appendix G.

4.6 Flood Risk Review Summary

4.6.1 Summary

In line with PPS25, the Sequential Test should be applied at all stages of the planning process. The aim of this is to direct new development towards areas that have a low probability of flooding. The mapping provided in Appendix B indicates the geographical extent of Flood Zone 2, Flood Zone 3a and Flood Zone 3b for the study area.

The Flood Zone maps in Appendix B clearly show that fluvial flood risk across Northumberland is generally quite low. This is mainly due to steep topography and flood plains that are confined to associated narrow and incised valleys. There are however exceptions to this general rule and certain areas of the County that have been affected by flooding. These are namely Morpeth, Ponteland, Rothbury, Hexham, Belford and Wooler which have a long history of fluvial flooding and the maps included in Appendix B indicate the extent of the main fluvial flood risk.

Perhaps more significantly is the presence of many smaller settlements in steep flashy catchments that are susceptible to flash flooding in so-called 'rapid response catchments'. Very often the time to peak of the flood wave is so small (less than an hour in some instances) that it is not possible to offer a warning to such settlements. These settlements include Bellingham, Kielder (Buttery Haugh) and Coplish Burn in Rothbury. There are also areas with a history of tidal flooding and these include Berwick upon Tweed, Blyth and Alnmouth.

Surface water flooding remains a key issue, and has been highlighted by the Pitt Report and UKCIP as the type of flooding that is likely to get worse. According to Areas Susceptible to Surface Water Flooding maps in Appendix B, the Surface water flooding is most serious in urban areas such as Hexham, Morpeth and Cramlington.

Consultation with NWL has revealed that sewer flooding is an issue in Morpeth, Cramlington, Hexham, Amble and Haltwhistle as indicated in the Sewer Flooding map in Appendix B.

Due to limitations of available data, the SFRA has highlighted that the key elements requiring further investigation are sewer and surface water flooding issues. The potential for breach of defences and the impact on flooding should also be considered. The Level 2 SFRA should investigate these areas in detail as more data is made available.

The detailed maps (Appendix B) clearly show that, whilst flood risk exists in areas of the study area, it does not pose a widespread issue. Where potential development sites are at risk from flooding, NCC must determine their suitability based on the Sequential Test and vulnerability classifications presented in Tables D1 and D2 of PPS25. Where possible NCC should seek to direct development to lower probability Flood Zones. Where this is not possible, development should preferably be located in Flood Zone 2 and where this is not possible, sites in Flood Zone 3 may be considered. The maps clearly show that the key areas with high flood risk are Morpeth, Rothbury, Hexham, Blyth, Belford, Haydon Bridge, Haltwhistle, Alnmouth and Berwick.

Dependent on the vulnerability of the proposed development (as classified in Table D2 of PPS25), some development sites that are either wholly or partly situated in Flood Zone 2 or Flood Zone 3 may require the application of the Exception Test. Those development areas requiring application of the Exception Test will require further assessment in a Level 2 SFRA. Information on the application of the Sequential Test, guidance on strategies for managing flood risk, guidance on the potential use of SuDS and guidance on site-specific FRAs are provided in Section 5.2, Chapter 6, and Appendix C.

4.6.2 Growth Point Area Summary

Growth Point Area	Flood Risk Review	Mitigation Measures
Blyth Estuary Growth	The Blyth Estuary Growth Point Area is at risk of both fluvial and tidal flooding and has flooded in the past. There are large areas of Flood Zone 3 in the town centre which could present restrictions on the development type that can be permitted (see Table D-1, PPS 25). Previous studies have also shown there to be sewer flooding issues within Blyth.	Developments should be steered away from Flood Zone 2 and 3. Where this can not be achieved suitable mitigation measures (i.e. flood defences) must be in place to protect the developments. However detailed assessments should be undertaken to ensure that the mitigation measures are not likely to increase flood risk elsewhere. In addition the developments should incorporate flood resilience and resistance measures to reduce any residual risk to protect developments from an event that breaches the defences. Potential developments should seek to ensure the effective use of SUDS techniques.
South West Sector (SWS)	The South West Sector Growth Point Area including Cramlington has some small areas of Flood Zone 2 and 3 associated with Horton Burn and Seaton Burn. Sewer flooding and surface water flooding is a known problem in the area	Developments should be steered away from Flood Zone 2 and 3. Where this can not be achieved suitable mitigation measures (i.e. flood defences) must be in place to protect the developments. However detailed assessments should be undertaken to ensure that the mitigation measures are not likely to increase flood risk elsewhere. In addition the developments should incorporate flood resilience and resistance measures to reduce any residual risk to protect developments from an event that breaches the mitigation measures. Developments should seek to ensure the effective use of SUDS techniques to minimise runoff and therefore reduce pressure on the surface water drainage system.
Ellington/ Lynemouth	The Ellington/Lynemouth Growth Point Area has areas of fluvial and tidal flood risk and development should be steered away from these	Developments should be steered away from Flood Zone 2 and 3. Where this can not be achieved suitable mitigation measures (i.e. flood defences) must be in place to protect the developments. However detailed assessments should be undertaken to ensure

Growth Point Area	Flood Risk Review	Mitigation Measures
	areas. Development should seek to ensure the effective use of SUDS techniques.	that the mitigation measures are not likely to increase flood risk elsewhere. In addition the developments should incorporate flood resilience and resistance measures to reduce any residual risk to protect developments from an event that breaches the mitigation measures. Developments should seek to ensure the effective use of SUDS techniques.
East Ashington	The East Ashington Growth Point Area has an area of Flood Zone 2 and 3 to the south of the River Wansbeck	Developments should be steered away from Flood Zone 2 and 3. Development should seek to ensure the effective use of SUDS techniques to minimise runoff and therefore reduce pressure on the surface water drainage system.
Cambois Growth Point	The Cambois Growth Point Area has some tidal and fluvial flood risk associated with the River Wansbeck to the north and Sleek burn to the south.	Development should be steered away from the flood risk areas where possible. In addition, should seek to ensure the effective use of SUDS techniques to minimise runoff and therefore ease the pressure on the surface water drainage system.
St Georges, Morpeth	The St Georges, Morpeth Growth Point Area has small areas of Flood Zone 2 and 3 associated with How Burn and Cotting Burn. Morpeth is also known to have experienced surface water and sewer flooding following heavy rainfall.	Developments should be steered away from the flood risk locations, particularly the areas known to be very flashy in their flood response. Developments should seek to ensure the effective use of SUDS techniques to minimise runoff and therefore reduce pressure on the surface water drainage system.

5 The Sequential Test

5.1 The Sequential Approach

The sequential approach is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to areas at higher risk. It can be applied at all levels and scales of the planning process, both between and within Flood Zones. All opportunities to locate new developments (except water-compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

The Sequential Test refers to the application of the sequential approach by LPAs. This allows the determination of site allocations based on flood risk and vulnerability (Table 5-1 and Table 5-2). Development should be directed towards Flood Zone 1 wherever possible, and then sequentially to Flood Zone 2 and Flood Zone 3. A flow diagram for application of the Sequential Test from the Practice Guide to PPS25 is provided (Figure 5-1).

The application of the sequential approach aims to manage the risk from flooding by avoidance. This will help prevent the promotion of sites that are inappropriate on flood risk grounds. The application of the Exception Test through a Level 2 SFRA will ensure that new developments in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability drivers and mitigation measures are provided.

The LPA must demonstrate that it has considered a range of possible sites in conjunction with the Flood Zone information from the SFRA and applied the Sequential Test and where necessary the Exception Test (see Appendix D of PPS25) in the site allocation process. In cases where development cannot be fully met through the provision of site allocations, LPAs are expected to make a realistic allowance for windfall development based on past trends.

PPS25 acknowledges that some areas will be at risk of flooding from flood sources other than fluvial. All sources of flooding must be considered when looking to locate new development. Other sources of flooding that require consideration when situating new development allocations include:

- Surface Water,
- Groundwater,
- Sewers,
- Artificial Sources.

As highlighted in Section 2.5 these flood sources are typically less understood than fluvial sources. Data primarily exists as point source data or through interpretation of local conditions. In addition, there is no guidance on suitable return periods to associate with floods arising from these sources. For example modern storm water drainage systems are constructed to a 1 in 30 year (3.3% annual probability) standard. Any storm event in excess of the 1 in 30-year return period storm would be expected to cause flooding. Contact with NWL needs to be maintained as part of the SFRA updating process to ensure that any sewer models or data on sewer flooding incidents is incorporated into the SFRA.

PPS25 recommends that site specific FRAs should undertake detailed drainage and surface water investigation. It is recommended that such findings are collated on an ongoing basis to ensure the full extent of such issues is highlighted to the County.

If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

5.2 Using the SFRA to Apply the Sequential Test

The Sequential Test should be undertaken by the LPA and accurately documented to ensure decision processes are consistent and transparent. The Sequential Test should be carried out on potential development sites, with a view to balancing the flood probability and development vulnerability of sites throughout the LPA area.

The recommended steps required in undertaking the Sequential Test are detailed Figure 5-1 and Table 5-4. The recommendations are based on the Flood Zone and Flood Risk Vulnerability and is summarised in Table 5-3. The use of the SFRA maps, data and GIS Layers in the application of the Sequential Test is detailed in Sections 5.2 and 5.4.

Table 5-1: Flood Zones definitions (see Table D1, Annex D of PPS25)

Flood Zone	Definition		Probability of Flooding
	Fluvial	Tidal	
1	< 1 in 1000 year (< 0.1%)	< 1 in 1000 year (< 0.1%)	Low Probability
2	Between 1 in 1000 year (< 0.1%) and 1 in 100 year (1%)	Between 1 in 1000 year (< 0.1%) and 1 in 200 year (0.5%)	Medium Probability
3a	> 1 in 100 year (> 1%)	> 1 in 200 year (> 0.5%)	High Probability
3b	Either > 1 in 20 (5%) or as agreed by the EA and LPA	Either > 1 in 20 (5%) or as agreed by the EA and LPA	Functional Floodplain

Percentages refer to the annual probability of a flood event occurring in any year

Table 5-2 Flood Risk Vulnerability Classification (from PPS25, Appendix D, Table D2)

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable	• Police, ambulance and fire stations which are **not** required to be operational during flooding. • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable' and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do **not** need to remain operational during times of flood. • Sewage treatment plants (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, **subject to a specific warning and evacuation plan**.

Table 5-3 Flood Risk Vulnerability and Flood Zone 'Compatibility' (from PPS25, Appendix D, Table D.3)

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
1	✓	✓	✓	✓	✓
2	✓	✓	Exception Test Required	✓	✓
3a	Exception Test Required	✓	×	Exception Test Required	✓
3b	Exception Test Required	✓	×	×	×
(✓ - Development is appropriate, × - Development should not be permitted)					

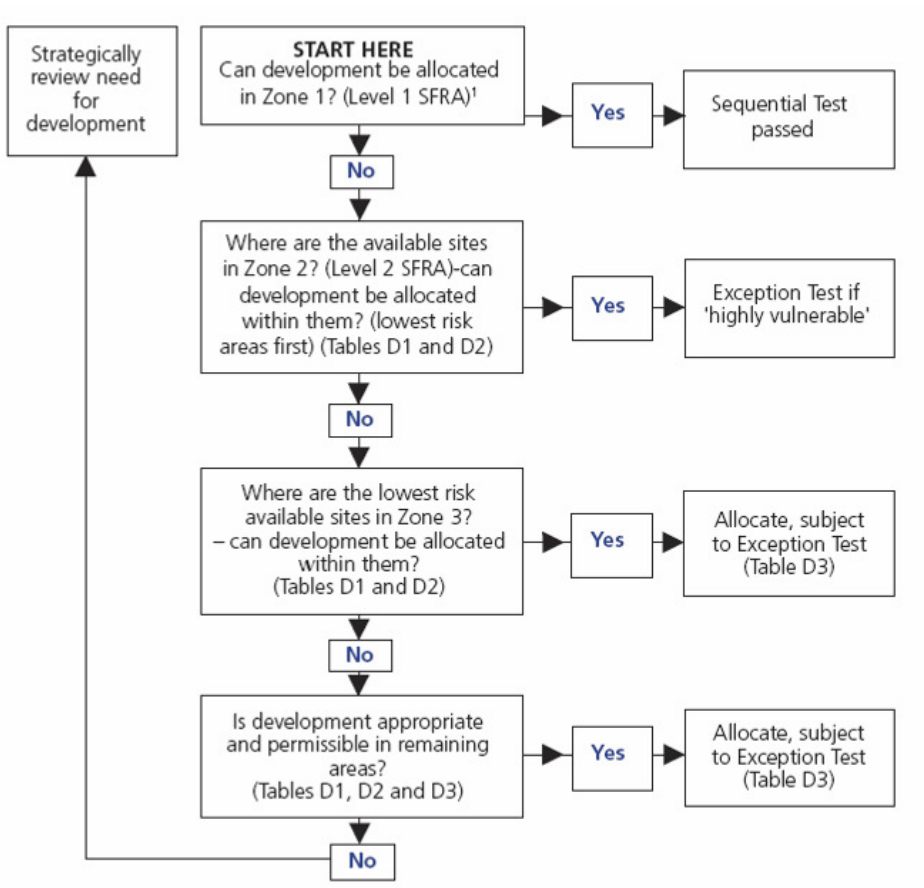


Figure 5-1: Application of the Sequential Test at the Local level for LDD preparation (Taken from PPS25 Practice Guide, Figure 4.1)

Table 5-4 Sequential Test Key - A Guide to using the GIS Layers

Category	GIS Layer	Example Questions
Flood Zone Classification	SFRA combined fluvial & tidal FZ2, FZ3a & FZ3b layers. Also examine historical floodplain and take into consideration climate change outlines.	**Question 1** – Through consultation of the SFRA flood zone maps, is the development site located in Flood Zone 1?
		Question 2 - Through consultation of the SFRA flood zone maps, is the development site located in Flood Zone 2?
		Question 3 - Can the development be located in Flood Zone 1?
		Question 4 - Through consultation of the SFRA flood zone maps, is the development site located in Flood Zone 3a?
		Question 5 - Can the development be located in Flood Zone 1 or 2?
		Question 6 - Through consultation of SFRA flood zone maps, is the development site located in Flood Zone 3b?
		Question 7 - Can the development be located in Flood Zone 1, 2 or 3a?
	Watercourse networks.	**Question 8 -** Is the site located within 8m of a watercourse?
Development Vulnerability if located in Flood Zone 2, 3a or 3b	Not applicable refer to Table D2 in PPS25	**Question 9** – Is the proposed development defined as 'highly vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 10 - Is the proposed development defined as 'more vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 11 - Is the proposed development defined as 'less vulnerable' according to Table D2 in Planning Policy Statement 25?
		Question 12 - Is the proposed development defined as 'essential infrastructure according to Table D2 in Planning Policy Statement 25?
		Question 13 - Is the proposed development defined as 'water compatible development' according to Table D2 in Planning Policy Statement 25?

Table 5-4 Sequential Test Key - A Guide to using the GIS Layers (continued)

Category	GIS Layer	Example Questions
Other Flood Sources	SFRA combined fluvial and tidal FZ3 & FZ2 outlines plus climate change	**Question 14 –** Is the site impacted by the effects of climate change?
	Sewer Flood Layer & Historical Flood Outlines	**Question 15** - Is the site in an area potentially at risk from sewer flooding?
	Historical Flood Outlines, Parish Council data, GEZ, CEH stream network (BFI) and groundwater vulnerability maps	**Question 16** - Is the site in an area potentially at risk from overland flow flooding?
		Question 17 - Is the site located in an area of rising groundwater levels?
		Question 18 - Does the site have a history of flooding from any other source?
Flood Risk Management	Flood Defence Layer (NFCDD), Flood Warning Layer, Areas Benefiting from Flood risk management structures Layer, Parish Council data	**Question 19** - Does the site benefit from flood risk management measures?
		Question 20 - Can the development be relocated to an area benefiting from flood risk management measures or of lower flood risk?

Table 5-5 Flood Risk Vulnerability and Flood Zone Compatibility

Use Category	Development	FLOOD ZONE			
		1	2	3a	3b
		FRA[1]	FRA	FRA	FRA
Essential Infrastructure	Essential Transport Infrastructure, Strategic Utility Infrastructure, Electricity Generating Power Stations	A	S ⇩ A	S ⇩ E ⇩ A	S ⇩ E ⇩ A
Highly Vulnerable	Police Stations, Ambulance Stations, Fire Stations, Command Centres and telecoms installations required to be operational during flooding, Emergency dispersal points, Basement dwellings, Caravans, mobile homes and park homes intended for permanent residential use, Installations requiring hazardous substances consent	A	S ⇩ E ⇩ A	N	N
More Vulnerable	Hospitals, Residential institutions (care homes, children's homes, social services homes, prisons and hostels), Dwelling houses, Student halls of residence, Drinking establishments, Nightclubs, Hotels, Non-residential health services, Nurseries, Educational establishments, Landfill sites, Sites used for waste management facilities for hazardous waste, Sites used for holiday or short-let caravans and camping (subject to a specific warning and evacuation plan)	A	S ⇩ A	S ⇩ E ⇩ A	N
Less Vulnerable	Shops, Buildings used for financial, professional and other services, Restaurants and cafes, Hot food takeaways, Offices, General Industry, Storage and distribution, Non-residential institutions (unless identified as more vulnerable), Assembly and Leisure, Land and buildings used for agriculture and forestry, Waste treatment (except landfill and hazardous waste), Minerals working and processing (except for sand and gravel workings), Water treatment plants, Sewage treatment plants (if adequate pollution control measures are in place)	A	S ⇩ A	S ⇩ A	N
Water Compatible Development	Flood control infrastructure, Water transmission infrastructure and pumping stations, Sewage transmission infrastructure and pumping stations, Sand and gravel workings, Docks, marinas and wharves, Navigation facilities, MOD defence installations, Ship building, repairing and dismantling, Dockside fish processing and refrigeration, Activities requiring a waterside location, Water based recreation (excluding sleeping accommodation), Lifeguard and coastguard stations, Amenity open space, Nature conservation and biodiversity, Outdoor sports and recreation, Essential facilities such as changing rooms, Essential ancillary sleeping or residential accommodation for staff required for water compatible development (subject to a specific warning and evacuation plan)	A	A	A	A
To be read in conjunction with Table D.1 and Table D.2 in PPS25. Table 5-5 seeks to highlight what development is appropriate in flood zones and where FRAs are required.					

Table 5-5 - Key

A: *Appropriate use*
S: *Use only appropriate if it passes the sequential test*
N: *Use should not be permitted* ***E:*** *Use only appropriate if it passes the exception test*
⇩: *If passed proceed*

FRA[1]: Flood risk assessment should be carried out for sites of 1 hectare or more in FZ 1, to consider the vulnerability of flooding from sources other than river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off.

FRA: Flood risk assessment required for all developments.

Note: Even where development is found to be acceptable through the application of the Sequential and Exception Tests further flood resistance/resilience may be required in the design and construction of specific developments. Such a test should be based on the SFRA.

Sequential Test: Development should be steered first towards the lowest risk areas. Only where there are no reasonably available sites should development on suitable available sites in higher risk areas be considered taking into account flood risk vulnerability and applying the Exception Test where required.

Exception Test: Exceptionally, development whose benefits outweigh the risk from flooding may be acceptable. For this test to be passed, the development should demonstrably provide wider sustainable benefits to the community, should be on developable previously-developed land (unless there are no reasonably available sites on developable previously-developed land), and should be demonstrably safe without increasing flood risk elsewhere and where possible reducing flood risk overall.

5.3 Recommended Stages for Application of the Sequential Test

The information required to address many of these steps is provided in the accompanying GIS layers and maps presented in Appendix B. The recommended stages for the application of the Sequential Test by the Council are as follows:

1. Assign potential developments with a vulnerability classification (Table D-2 PPS 25). Where development is mixed, this should be moved to the higher classification,
2. The location and identification of potential development should be recorded,
3. The Flood Zone classification of potential development sites should be determined based on a review of the EA Flood Zones and the Flood Zones presented in this SFRA for fluvial and tidal sources. Where these span more than one Flood Zone, all zones should be noted,
4. The design life of the development should be considered with respect to climate change:
    - 60 years – 2072 for commercial/ industrial developments,
    - 100 years – 2112 for residential developments,
5. It should be noted that for the purposes of the Sequential Test, Flood Zones with no consideration of flood risk management structures should be used i.e. the SFRA flood zones,
6. Highly vulnerable developments should be located in those sites identified as being within Flood Zone 1. It should be noted at this stage that Flood Zone 1 represents any area that is not determined as Zone 2 or Zone 3. If these cannot be located in Flood Zone 1 because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area,
7. Once all highly vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as more vulnerable. In the first instance more vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate more vulnerable development, sites in Flood Zone 3a can be considered. More vulnerable developments in Flood Zone 3a will require application of the Exception

Test. More vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain,

8. Once all more vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as less vulnerable. In the first instance less vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then 3a. Less vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain,
9. Essential infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is fulfilled,
10. Water compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. They do not require the application of the Exception Test,
11. On completion of the sequential test, the LPA may have to consider the risks posed to a site within a Flood Zone in more detail in a Level 2 Assessment. By undertaking the Exception Test, this more detailed study should consider the detailed nature of flood hazard to allow a sequential approach to site allocation within a Flood Zone. Consideration of flood hazard within a Flood Zone would include:
    - Flood risk management measures,
    - The rate of flooding,
    - Flood water depth,
    - Flood water velocity.

Where the development type is highly vulnerable, more vulnerable, less vulnerable or essential infrastructure and a site is found to be impacted by a recurrent flood source (other than fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test. This should be discussed with the EA to establish the appropriate time for the assessment to be undertaken, (i.e. Exception Test through a Level 2 SFRA or assess through a site specific FRA).

The maps presented in Appendix B are designed to assist NCC in determining the flood risk classification for each site and in completing the Sequential Test.

This will aid the determination of the most suitable type of development for each site based on development vulnerability and flood risk. Certain sites have been identified as lying within Flood Zones 2 and 3 and, if the sites cannot be relocated, it will be necessary to undertake an Exception Test.

5.4 Using the SFRA Maps, Data and GIS Layers

Table 5-4 highlights which GIS layers and SFRA data should be used in carrying out the Sequential Test. The table poses some example questions that are not exhaustive, but should provide some guidance for a user of the SFRA.

Appendix H summarises the steps required to maintain and update the SFRA together with a revision schedule.

This should be checked prior to the SFRA being used at a strategic land allocation scale or on a Development Control level to ensure the most current and up-to-date version of the SFRA is being used. In addition, close consultation with some of the key stakeholders, in particular the EA, may highlight updated flood risk information that may reduce uncertainty and ensure the Sequential Test is as robust as it can be.

As identified in Section 2, some watercourses in the study area do not have Flood Zones associated with them or do not have all Flood Zones defined. This is not to suggest these watercourses do not flood, but that modelled data is not currently available. Therefore, allocations adjacent to un-modelled watercourses or watercourses where all Flood Zones have not been defined cannot be assessed against all aspects of the Sequential Test using the existing data.

To overcome this gap in the data and to enable NCC to proceed with the application of the Sequential Test the following criteria should be considered:

- For watercourses where no Flood Zones have been defined – If a site is within 20m of a watercourse and promoted for development further investigation should be undertaken to determine the suitability of the site for the proposed development. If outside of 20m of a watercourse and no Zones are present, the site should pass the Sequential Test but developments may be subject to a surface water FRA depending on site size. For application of the Sequential Test the site should be considered as lying within Flood Zone 3b until proven otherwise. If following further investigation the site is found to lie within Flood Zone 3b the development may not be appropriate against the policies presented in PPS25.
- For watercourses where Flood Zone 3b (functional floodplain) has not been defined – If a proposed development site is located in Flood Zone 3, there is a possibility it may also fall within Flood Zone 3b. Further investigation should be undertaken to define Flood Zone 3b for the local water course(s). According to the PPS25 Practice Guide, when applying the Sequential Test the site should be considered as lying within Flood Zone 3b until proven otherwise. If following further investigation the site is found to lie within Flood Zone 3b the development will not be appropriate unless the development is water compatible and/or Essential Infrastructure.
- For watercourses where the effect of climate change on Flood Zones has not been defined - For any development located in or adjacent to a Flood Zone boundary, there is a possibility that the effects of climate change may increase flood risk. For example if a site is clearly identified to be in Flood Zone 3a, the effects of climate change may be that the site lies within Flood Zone 3b. For application of the Sequential Test, where sites are located in Flood Zone 3 or at the boundary of Flood Zone 2 and 3 and the effects of climate change are not defined, sites can be considered to lie within the current Flood Zone. However, the effects of climate change should be investigated further. If, following further investigation, the site is found to lie within a different Flood Zone due to the effects of climate change the Sequential Test should be re-applied to determine if the proposed development is appropriate.

It should be noted that adopting this approach requires NCC to accept an element of risk when reviewing and allocating their development sites. For example, should NCC identify a site in Flood Zone 2 as acceptable for more vulnerable development, when considering the effects of climate change on Flood Zone definition the site may be found to be located in Flood Zone 3 and therefore require application of the Exception Test.

Similarly location of more vulnerable development in Flood Zone 3a may be inappropriate if further work identifies those parts of Flood Zone 3a to be redefined as Flood Zone 3b with consideration of climate change.

As part of the SFRA update process, new modelled watercourse outlines should be incorporated into the SFRA mapping. New modelled outlines may become available as part of a site specific FRA or as part of ongoing EA updated modelling.

6 Site Specific Flood Risk Assessment Guidance

6.1 Introduction

The assessment of flood risk is a fundamental consideration for new development or redevelopment regardless of its scale or end-use. Understanding the flood risk posed to and by a development is key to managing the risk to people and property thereby reducing the risk of injury, property damage or even death. The effects of climate change may exacerbate future flood risk. Current predictions indicate that milder, wetter winters and hotter, drier summers will be experienced in the future and there will be a continued rise in sea levels. These changes will potentially lead to changes to the magnitude, frequency and intensity of flood events. Some areas currently defended from flooding may be at greater risk in the future due to the effects of climate change or as the defence condition deteriorates with age.

Opportunities to manage flood risk posed to and by development exist through understanding and mitigating against the risk. The location, layout and design of developments should be considered to enable the management of flood risk through positive planning. This positive planning approach must consider the risks to a development from local flood sources and the consequences a development may have on increasing flood risk to the surrounding areas. Early identification of flood risk constraints can ensure developments are sustainable whilst maximising development potential.

A Level 1 SFRA should present sufficient information to assist LPAs to apply the Sequential Test and identify where the Exception Test may be required. These documents are predominately based on existing data. The scale of assessment undertaken for an SFRA is typically inadequate to accurately assess the risks at individual sites within the study area as, for example, the EA and SFRA Flood Zone Mapping do not account for all watercourses within the study area and may show a specific site to be within Flood Zone 1 when it may be adjacent to a watercourse. Therefore individual applications will be required to submit individual FRAs.

Site-specific FRAs are required to assess the flood risk posed to and by proposed developments and to ensure that, where necessary, appropriate mitigation measures are included in the development.

The guidance presented in the following sections has been based on:

- The recommendations presented in PPS25 and the Practice Guide,
- The information contained within this SFRA report.

At the time of writing this document no site-specific allocations had been finalised, therefore pending the finalisation of the LPA allocations, the development areas were used to identify the flood risks to potential growth and development areas. If on completion of the preferred options there are any allocations that fall outside these growth areas, then the Sequential Test and potential exception test for these sites will need to be explored at that time. The following recommendations are made by way of an indication of how to proceed with the SFRA process once the preferred options allocations are finalised:

- The LPAs should apply the Sequential Test to the potential development sites and identify those sites they consider will be necessary to apply the Exception Test,

- If sites require the Exception Test, the LPAs should provide responses to all parts (a, b and c) of the Exception Test for each of the allocation sites proposed in an area considered to be at risk of flooding as part of a Level 2 SFRA,
- Following completion of the Sequential Test and parts a, b and c of the Exception Test, the EA should be consulted to confirm their acceptance of the LPAs arguments and justification for progressing with sites that require the Exception Test.

6.2 Flood Risk Assessment Guidance

6.2.1 When is a Flood Risk Assessment required?

When informing developers of the requirements of an FRA for a development site, consideration should be given to the position of the development relative to flood sources, the vulnerability of the proposed development and its scale.

Based on advice from the EA and PPS 25 guidance, it is recommended that in the following situations a FRA should always be provided with a planning application:

- Development sites located in Flood Zone 2 or Flood Zone 3,
- Proposed development that is classed as a major development (all sites over 1 ha) and located in Flood Zone 1. Since the risk of fluvial or tidal flooding is minimal such FRAs should focus on the management of surface water,
- Development sites located in an area known to have experienced flooding problems from any flood source,
- Where a development site is located within 20m of the top of bank of a Main River, the EA should be consulted, regardless of Flood Zone classification.

6.2.2 What does a Flood Risk Assessment require?

Annex E of PPS25 presents the minimum requirements for FRAs. These include:

- Consider the risk of flooding arising from the development in addition to the risk of flooding to the development,
- Identify and quantify the vulnerability of the development to flooding from different sources and identify potential flood risk reduction measures,
- Assess the remaining 'residual' risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development,
- Demonstrate vulnerability of people that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification, including arrangements for safe access and egress,
- Consider the ability of water to soak into the ground, which could change with development, along with how the proposed layout of development may affect drainage systems,
- Fully account for current climate change scenarios and their effect on flood zoning and risk.

The Practice Guide to PPS25 advocates a staged approach to site-specific FRAs with the findings from each stage informing the next, and site master plans, iteratively throughout the development process.

The staged approach comprises of three stages outlined below.

6.2.3 Level 1 - Screening Study

A Level 1 Screening Study is intended to identify if a development site has any flood risk issues that warrant further investigation. This should be based on existing information such as that presented in the Level 1 SFRA. Therefore this type of study can be undertaken by a Development Control Officer in response to the developer query or by a developer where the Level 1 SFRA is available. Using the information presented in the Level 1 SFRA and associated GIS layers a Development Control Officer could advise a developer of any flooding issues affecting the site. A developer can use this information to further their understanding of how flood risk could affect a development.

6.2.4 Level 2 - Scoping Study

A Level 2 Scoping Study is predominately a qualitative assessment designed to further understanding of how the flood sources affect the site and the options available for mitigation. The Level 2 FRA should be based on existing available information where this is available and use this information to further a developers understanding of the flood risk and how they affect the development. This type of assessment should also be used to inform masterplans of the site raising a developer's awareness of the additional elements the proposed development may need to consider.

6.2.5 Level 3 – Detailed Study

Where the quality and/or quantity of information for any of the flood sources affecting a site is insufficient to enable a robust assessment of the flood risks, further investigation will be required. For example it is generally considered inappropriate to base a flood risk assessment for a residential care home at risk of flooding from fluvial sources on Flood Zone maps alone. In such cases the results of hydraulic modelling are preferable to ensure details of flood flow velocity, onset of flooding and depth of floodwater is fully understood and that the proposed development incorporates appropriate mitigation measures.

At all stages, the LPA, and where necessary the EA and/or NWL should be consulted to ensure the FRA provides the necessary information to fulfil the requirements for Planning Applications.

6.2.6 Site-Specific Guidance

NCC should consider the consequences of including SuDS on development sites and the impact these can have on the developable area. In all cases the LPA should assess allocation sites in relation to geology and local issues to enable completion of the SuDS summary in Appendix C; National and local policies should be reviewed against local flood risk issues and objectives identified by the EA. Through completion of these recommendations the LPA will be able to transparently manage flood risk and ensure risk to their development sites and communities, now and in the future are mitigated.

National Flood Risk Guidance

PPS25 Methodology must be followed as detailed above.

EA guidance on sequential testing must be followed as detailed above.

Local Flood Risk Policy

Based on EA and PPS 25 guidance, where development is to be situated within a Flood Zone the following should be considered:

- The development should seek to reduce flood risk overall,
- Flood proofing/resilience measures should be incorporated into the design e.g. sockets located above flood level on walls, no carpet at ground floor level,
- Access and Egress routes must be at the 1 in 1000 year (0.1% annual probability) plus climate change or above level,
- Emergency Planning,
- EA Flood Warning Procedure should be adhered to,
- Flood action plans should be developed- these would consider Escape routes, a refuge room, adequate supplies of bottled water and food.
- Following the significant flood in September 2008, Morpeth Flood Alleviation Scheme has been developed to reduce the risk of flooding from the River Wansbeck and the main burns in the town. Developments situated within a Flood Zone in Morpeth and adjoining areas of the River Wansbeck should refer to the Scheme for further guidance and requirements.
- Site specific FRAs should ensure appropriate SuDS techniques are investigated according to local geology.

6.3 Residual Risk Management

Residual risk in a generic sense can be defined as being the remaining risk following the implementation of all reasonable risk avoidance, reduction and mitigation measures. In a flood risk context, this residual risk pertains to the flood risk that remains after flood avoidance and alleviation measures have been put in place. Examples of such residual risks include overtopping or breaching of flood walls or embankments.

Residual risk management therefore aims to prevent or mitigate the consequences of flooding that can occur despite the presence of flood alleviation measures.

Application of the Sequential Test as part of PPS25 aims to preferentially develop or relocate potential development sites into areas with low flood risk. Where this is not realistically possible, some development sites may be located in higher flood risk areas, such as PPS25 defined Flood Zones 2 and Flood Zone 3. As a result, such developments will require residual risk management to minimise the consequences of potential flooding, e.g. following a breach or overtopping of local flood risk management structures.

Ensuring properties are defended to an appropriate design standard reduces flood risk. However, further options are also available should the residual risk to a development prove unacceptable. This chapter presents some of the information and options available to understand and manage residual risk.

6.3.1 Potential Evacuation and Rescue Routes

In the event of a flood incident, it is essential that the evacuation and rescue routes to and from any proposed development remain safe. The EA deem evacuation routes safe if they fall within the white cells of Table 13.1 of the DEFRA/EA document FD2320 for a 1 in 100/200 year design event as a minimum, and the EA inform LPAs of the risk posed during the extreme event (1 in 1000 year). This allows the LPA to consult with the emergency services over the suitability of the access route. When considering plans for individual developments, emergency services should consider the potential for widespread flooding and the consequential impacts on their resources. If potential evacuation routes are likely to become inundated so that safe access/egress would not be possible, then the proposed development should be relocated. This may also be the case should the possible evacuation routes be particularly long or across difficult terrain.

A key consideration in relation to the presence and use of evacuation routes is the vulnerability and mobility of those in danger of being inundated. Development for vulnerable users e.g. disabled or the elderly should be located away from high-risk areas. The Sequential Test does not however differentiate between the vulnerability of the end users of the site, only the vulnerability of the intended use of the site. A proposed residential development for highly vulnerable end users will still fall under the 'More Vulnerable' classification in Table D.2 of PPS25 and the Sequential and Exception Tests will apply accordingly. Where development for highly vulnerable end users cannot be avoided, safe evacuation routes are essential.

6.3.2 Time to Peak of Flood Hazard

The time to the peak of the flood hazard relates to the amount of time it takes for a flood event to reach its maximum level, flow or height. The greater the time to peak, the greater the time available for evacuation. The time to peak can, for residual flooding, be very short. Should a defence structure breach then inundation can be rapid, resulting in a short time to peak for the areas local to the breach. Typically, areas immediately adjacent to a breach location will have a shorter time to peak than areas setback from the flood defence.

6.3.3 Methods of Managing Residual Flood Risk

The following sub-sections outline various methods available for the management of residual flood risk. The methods outlined will not be appropriate for all development types or all geographical areas. Therefore, they should be considered on a site-by-site basis. In addition, it is important that the use of such techniques do not exacerbate flooding elsewhere within the flood cell.

Recreation, Amenity and Ecology

There are many different ways in which recreation, amenity and ecological improvements can be used to mitigate the residual risk of flooding either by substituting less vulnerable land uses or by attenuating flows or both.

They range from the development of parks and open spaces through to river restoration schemes. In addition, they have wider ecological biodiversity and sustainability benefits.

The basic function of these techniques is increased flood storage and the storage or conveyance of rainwater. Typical measures include various guises of pools, ponds, and ditches. These all can have the added benefit of improving the ecological and amenity value of an area. These features can provide a haven for local wildlife. In addition, they can contribute to site amenity value both aesthetically and for recreation by providing attractive areas available for activities such as walking, cycling, water sports or wildlife watching.

Secondary Flood Risk Management Structures

Secondary flood risk management structures are those that exist on the dry side of primary flood risk management structures. Typically, their main function is to reduce the risk of residual flooding following a failure or overtopping of the primary flood risk management structures.

Secondary flood risk management structures can relocate floodwaters away from certain areas or reduce the rate of flood inundation following a residual event. Examples of secondary flood risk management structures include embankments or raised areas behind flood defence walls, raised infrastructure e.g. railways or roads and on a strategic level, canals, river and drainage networks. The latter are a form of secondary defence as they are able to convey or re-direct water away from flood prone areas even if this is not their primary function.

Land Raising

Land raising can have mixed results when used as a secondary flood alleviation measure. It can be an effective method of reducing flood inundation on certain areas or developments by raising the finished levels above the predicted flood level. However, it can result in the reduction in flood storage volume within the flood cell. As a result, floodwater levels within the remainder of the cell can be increased and flooding can be exacerbated elsewhere within the flood cell. On site 'Level for Level' compensation storage would be required by the EA where any loss of floodplain storage had occurred as a result of land raising or development within the floodplain.

Partial land raising can be considered in larger, particularly low-lying areas such as marshlands. It may be possible to build up the land in areas adjacent to flood risk management structures in order to provide secondary flood risk management structures. However, again the developer should pay due regard to the cumulative effects of flooding such as increasing flood risk elsewhere.

Finished Floor Levels

Where developing in flood risk areas is unavoidable, the most common method of mitigating flood risk is to ensure habitable floor levels are raised above the maximum flood water level. Finished Flood Levels (FFLs) should be considered at the same time as access and egress (Section 6.3.1) to ensure that residents are not trapped by flood water.

The EA must be consulted regarding acceptable FFLs for proposed developments. It is also necessary to ensure that roads levels are such that emergency access and evacuation routes are maintained.

This can significantly reduce the risk of the proposed development becoming inundated by flooding. As with the land raising option, it is imperative that any assessment takes into consideration the volume of floodwater potentially displaced by such raising.

In areas where significant depths of floodwater are predicted to inundate the site, development design can incorporate the use of non-habitable uses on the ground floor. These can include garage areas, utility or storage spaces. This method can be somewhat contentious as it can be difficult to ensure that the ground floor remains uninhabited for the lifetime of the development and emergency access can be difficult.

Flood Resilience

Flood resilience is a damage limitation measure to reduce the consequence of flooding and should not be used as justification for developing inappropriately in flood risk areas. The Association of British Insurers (ABI) in cooperation with the National Flood Forum has produced published guidance on how homeowners can improve the flood resilience of their properties (ABI, 2004). The guidance identifies the key flood resistant measures as being:

- Replace timber floors with concrete and cover with tiles,
- Replace chipboard/MDF kitchen and bathroom units with plastic equivalents,
- Replace gypsum plaster with more water-resistant material, such as lime plaster or cement render,
- Move service meters, boiler, and electrical points well above likely flood level,
- Put one-way valves into drainage pipes to prevent sewage backing up into the house.

Further advice on flood mitigation for homes and businesses is also given in the ODPMs 2003 report, 'Preparing for Floods' (ODPM, 2003b).

The Department for Communities and Local Government published 'Improving the Flood Performance of New Buildings' in 2007. This guidance document sets out design strategies to enable buildings to continue to perform during flooding. In Part 2 of the document there are two design strategies that have been detailed to improve the performance of buildings during flooding, namely flood avoidance and flood resistance/ resilience. The above sub-sections of this report have already illustrated several methods of flood avoidance design strategies. Therefore, the text below will illustrate several design strategies of flood resistance construction which have been abstracted from 'Improving the Flood Performance of New Buildings'.

The following flow chart abstracted from the guidance document demonstrates the overall rationale behind the design strategies for flood avoidance and flood resistance/resilience.

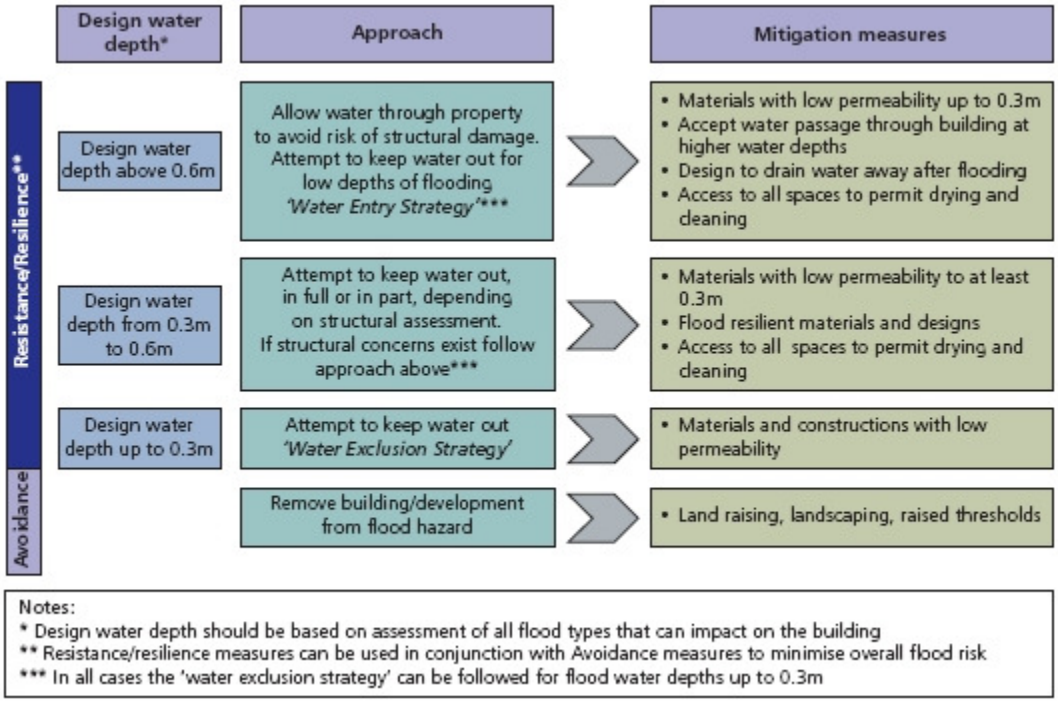


Figure 6-1: Summary of the overall rationale behind the design strategies[15]

The above flow chart categorises the various design strategies based on the flood level depth outside the buildings. Depending on the depth of flood level, water entry or water exclusion strategy should be considered when designing buildings in areas prone to flooding.

The following table has been produced based on the Department for Communities and Local Government guidance 'Improving the Flood Performance of New Buildings'. It details the various measures that should be considered when specifying materials/equipment or designing structural components so that buildings can be constructed to be more resistant and resilient to flooding.

[15] Defra - Improving the Flood Performance of New Buildings (2007)

Table 6-1: Flood Resistance/Resilience Measures

Resistance/ Resilience Measures	Guidance
Building materials	1. In general denser materials such as concrete and engineering bricks are found to have good resilience characteristics. 2. When choosing building materials consideration should be given to choose materials that have more resilience characteristics such as water penetration, drying ability and retention of pre-flood dimensions (integrity). 3. Individual development should be assessed carefully prior to choosing building materials depending on the level of resistance expected to achieve. 4. Building materials that are effective for "water exclusion strategy" include: engineering bricks, cement-based materials including water retaining concrete and dense stone. 5. Building materials that are suitable for "water entry strategy" include: facing bricks, concrete blocks, sacrificial or easily removable external finishes or internal linings.
Foundations	1. In general, ground condition of a site dictates the type of a foundation used in the design. However improvements can be made to increase the flood resilience characteristics of a foundation. 2. For most typical two-storey dwellings shallow footings are likely to be appropriate. 3. Laboratory work carried by CIRIA shows that groundwater can penetrate through the blockwork in cavity walls. Therefore, care should be taken to minimise the passage of water. 4. As a general principle, water exclusion strategy should be adopted in foundations when predicted flood depth is less than 0.3m above the floor level. 5. Similarly when flood water depth is greater than 0.3m, water entry strategy should be adopted for foundations. When the water entry strategy is adopted the foundation should be constructed using durable materials that will not be affected by water and should use construction methods and materials that promote easy draining and drying.
Floors	1. The behaviour of ground floors in floods can be influenced by water ingress from the ground and exposure to standing water. 2. From the above two situations, water ingress from the ground is potentially more sever as it is likely to affect the structural integrity of the floor. Hence calculations should be carried out ensure that floor has necessary strength to resist uplifting forces and deformations. 3. The following bullet points provides general design advice on water exclusion strategy; • Ground supported floors are the preferred option and concrete slabs of at least 150mm thickness should be specified for non-reinforced construction. • In shrinkable/ expandable soils suspended floors may need to be used as ground supported floors are not suitable. However, suspended floors are not recommended in flood-prone areas, particularly the timber floors as these can deform significantly due to flood water. Adequately treated reinforced concrete floors are suitable in these situations. • Damp proof membranes should be included in any design to minimise the passage of water through the floors. • Flood water can lesser the insulation properties of some insulation materials, therefore floor insulation should incorporate closed-cell type to minimise the impact of

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	flood water. • Suitable floor finishes include ceramic or concrete-based floor tiles, stone and sand/cement screeds. All tiles should be bedded on cement-based adhesive/bedding compound and water resistance grout should be used. • Use of ferrous materials for under floor services should be avoided. 4. The following bullet points provides general design advice on water entry strategy; • When adopting water entry strategy concrete ground-supported floors with concrete slabs of at least 100mm thickness should be used. • Suspended floors may need to be used in situations when ground conditions are not suitable for ground-supported floors. However, timber floors should not be used in areas prone to flooding; instead adequately treated suspended steel floors should be used. • There are two approaches to construct floor finishes in "water entry strategy" which include the use of sacrificial materials or reliance on high quality durable materials. • Sacrificial material includes timber flooring and carpets. Durable materials include ceramic or concrete based floor tiles, marble or stone.
Walls	1. Following the laboratory investigations carried out by CIRIA, wall components are categorised as good, medium or poor with regards to their water penetration, surface drying and structural integrity performance. Table 6.2 of the Communities and Local Government guidance provides information on the performance of various wall components under above categories. 2. The water exclusion strategy is applicable to design in flood depths of up to 0.3m or up to 0.6m, however during design stage a detailed structural assessment of the design should be carried out. 3. Masonry walls should be thoroughly filled to reduce the risk of water penetration. When using frogged bricks should be laid frog up so that filling becomes easier and provides more certain coverage. 4. Where possible use engineering bricks up to predicted flood levels plus another layer to provide freeboard if water exclusion strategy has been adopted. 5. Aircrete blocks allow less leakage than typical concrete blocks. Therefore Aircrete blocks are recommended in the design when water exclusion strategy is adopted. Concrete blocks dry more quickly hence suitable for the water entry strategy. 6. Solid masonry walls are a good option for the water exclusion strategy but will need to be fitted with internal or external insulation in order to comply with building regulations. 7. Cavity walls should be constructed with no insulation to promote rapid dry after a flood event. However, the requirements for insulation can be satisfied by external insulated render or internal thermal boards. 8. Timber framed walls are not recommended in "water exclusion strategy". Steel framed walls may offer suitable alternative option but specialist advice needs to be sought during the design stage. 9. Timber framed walls can be used in water entry strategy provided that a sacrificial approach has been adopted to promote rapid drying ability. 10. Where the frequency of flooding is high, reinforced concrete walls should be considered in the water exclusion strategy as these walls provides sufficient resisting

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	forces to the pressures generated by flood water. 11. External render should be used as a barrier to water penetration in water exclusion strategy. However structural checks are necessary to assess the stability if the flood depth outside the dwelling is likely to be greater than 0.3m. External render should not be used in water entry strategy as it is likely to generate difference in flood depth between inside and outside of the dwelling resulting in possible structural problems. 12. In both strategies external insulation is recommended rather than the internal insulation because it can be easily replaced if necessary. 13. In water exclusion strategy, cement internal renders are effective in reducing flood water leakage and assist rapid drying of the internal surface of the walls. Standard gypsum plasterboard should be avoided in water exclusion strategy as these are likely to disintegrate due to flood water. 14. In water entry strategy, cement internal render should be avoided as this can prevent effective drying ability of walls. Therefore standard gypsum plasterboard is recommended to use up to predicted flood levels (plus freeboard of 50mm) as a sacrificial material. For this purpose dado rail can be used to separate the above and below floodable area.
Doors & windows	1. The threshold of doors should be set as high as possible whilst complying with level access requirements. 2. Sealed PVC framed doors are the preferred material in areas prone to flood. However, if wooden doors are used should ensure that the doors are fitted to seal the frames using quality workmanship. 3. Windows and patio doors should also be constructed using similar methods to doors to seal the fabrics of the dwelling. 4. Care should be taken to use suitable air vents to prevent water ingress in to the property.
Fittings	1. General principle is to use durable fittings that can not be damaged due to flood water and can be easily cleaned. 2. Fittings should be placed above the predicted flood levels. 3. To prevent penetration of water behind fittings care should be taken to seal any joints between kitchen units and surfaces. 4. Use high quality workmanship in the application of fittings.
Services	1. Closed cell insulation should be used for pipes which are below the predicted flood level. 2. Non-return valves are recommended in the drainage to prevent back-flow of water. 3. Water, electrical and gas meters should be located above the predicted flood level. 4. Boiler units and ancillary devices should be installed above predicted flood level, preferably on the first floor. Under floor heating should be avoided in sites which are prone to flooding. 5. Wiring for TV, internet and telephone and other services should be protected by suitable insulation in the distribution ducts to prevent damage from flooding.

Flood Warning and Emergency Procedures

Flood warning and emergency procedures are typically higher-level management strategies and should not be considered as a solution for flooding problems or a way of avoiding provision for safe access and egress. In addition, when deriving flood warning and emergency procedures, the reluctance of residents to vacate premises upon receipt of a warning or during a flood event should not be under-estimated.

Emergency procedures typically include information such as warning, evacuation and repair procedures. Documents providing guidance on how to use flood resistance and resilience measures to limit damage caused by flooding, such as 'Improving the Flood Performance of New Buildings, (DCLG, May 2007), can also offer important guidance and should be referred to. When undertaking FRAs for developments within flood risk areas, the local flood warning and emergency response plans should be referred to.

Where these procedures already exist they should be updated to include the information generated by this SFRA. This will ensure that emergency plans are appropriate to the conditions expected during a flood event and that LPAs and emergency services are fully aware of the likely conditions and how this may affect their ability to safeguard the local population.

7 Recommendations for Level 2 SFRAs

7.1 What is a Level 2 SFRA?

The mechanism for undertaking a more detailed study of flood risk for a development area is defined in PPS25 and the Practice Guide as a Level 2 SFRA. A Level 2 SFRA will use information gathered during this Level 1 SFRA to concentrate on a potential development area to determine detailed information on the level of flood risk so that sufficient evidence can be provided for the Exception Test to be applied.

This approach continues the hierarchical approach to flood risk defined in PPS25 and will provide NCC with more information to ensure that development follows the sequential approach. If applicable, it will allow them to apply the Exception Test and determine possible site layouts or policies that ensure flood risk is minimised to new development.

It is important to note that a Level 2 SFRA is not a replacement for a site specific FRA. Its purpose is strategic in nature to inform planning and policy decisions within the NCC area. There is no clear definition of the scale at which a Level 2 SFRA should be undertaken in PPS25 or the Practice Guide. However, a Level 2 SFRA can concentrate on individual towns and settlements or large development or regeneration area.

7.2 Level 2 SFRA Approach

7.2.1 The Sequential Approach

As noted in Section 5.1, LPAs should use a Level 1 SFRA to identify and allocate sites suitable for development in areas of least flood risk. The Practice Guide also states that the sequential approach to development and flood risk should be demonstrated initially through the Sequential Test. Guidance on applying the Sequential Test is included in Section 5.

The approach highlighted in the PPS25 Practice Guide for identifying where a Level 2 SFRA is required is for the LPA to undertake sequential testing as part of their development allocations process. Following the sequential test, if an allocation is still located within a medium to high flood risk area, a Level 2 SFRA will be required to provide sufficient information for the Exception Test to be applied. Table 5-3 shows that there are four situations of vulnerability and flood zone placement where the Exception Test is required and therefore where a Level 2 SFRA is needed.

It is worth noting that, within PPS25 and the Practice Guide, guidance and examples for the Sequential Test are referred to in the context of Fluvial and Coastal flooding. However, it is recommended that the sequential approach is applied to other sources of flooding including artificial, surface water and overland flow, sewer flooding and groundwater flooding.

7.2.2 The ‘Hybrid’ Approach

In many instances, LPAs are aware of areas that are likely to come forward for development within their LDF prior to undertaking the PPS25 sequential test. Flood risk to these areas may have already been fully or partially defined within the Level 1 SFRA.

In these circumstances, LPAs can be better informed of the flood risk to an area if a more detailed study – effectively a Level 2 SFRA – is carried out prior to sequential testing.

This is not to say that the PPS25 sequential approach should be ignored during the allocation of sites or that the SFRA is being used to justify development within an area. The method could better inform the sequential approach recommended in PPS25 and allow NCC to consider vulnerability of development and flood risk to ensure that sustainable development with minimal flood risk is delivered. Following a more detailed study, the sequential approach is still followed with regards to development within and outside the area(s) of interest and, if necessary, the Exception Test is carried out.

7.3 NCC Level 2 SFRA Requirements

NCC has not yet completed the site allocations process and as a result it is not possible to identify sites that require Level 2 SFRAs. Due to the nature of the landscape within Northumberland, flood risk is mostly confined to the low laying valleys and coastal plains, which is where the larger settlements, e.g.of Morpeth and Blyth, are situated. Therefore, it is likely that some of NCC's development aspirations are located within flood risk areas and will require Level 2 SFRAs. However, the scope of Level 2 assessments will depend on the location of future site allocations and the nature of flood risk in that location. In some cases, it may be necessary for NCC to consider adopting a 'hybrid' approach to Level 2 SFRAs by carrying out the Level 2 assessment prior to undertaking the PPS25 sequential test.

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