Flood Risk Regulations 2009 – Preliminary Flood Risk Assessment

Preliminary Assessment Report

Cumbria County Council Preliminary Assessment Report

Executive Summary

This report has been prepared by Cumbria County Council to help manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009). Cumbria County Council is defined as a Lead Local Flood Authority (LLFA) under the Regulations. The Preliminary Flood Risk Assessment (PFRA) which comprises of this document, the supporting spreadsheets and GIS layers, represents the first stage of the requirements of the Regulations.

The PFRA process is aimed at providing a high level overview of flood risk from local flood sources, including surface water, groundwater, ordinary watercourses and canals. As a LLFA, Cumbria County Council must submit their PFRA to the Environment Agency for review by 22nd June 2011. The methodology for producing this PFRA has been based on the Environment Agency's Final PFRA Guidance and DEFRA's Guidance on selecting Flood Risk Areas, both published in December 2010.

The Environment Agency has used a national methodology, which has been set out by DEFRA, to identify indicative Flood Risk Areas across England. Of the ten indicative Flood Risk Areas that have been identified nationally, none are located in Cumbria.

Cumbria is a large rural county bordered by Lancashire and Yorkshire to the south and east, Northumberland and Durham to the east and Scotland to the north. The Irish Sea, including Morecambe Bay and the Solway Firth, forms the western boundary. The county is split into 6 districts and boroughs; Allerdale; Barrow; Carlisle; Copeland; Eden and South Lakeland. The County contains the Lake District National Park and part of the Yorkshire Dales National Park. It is well known for its mountainous terrain and high annual rainfall.

Following a successful bid to the DEFRA Early Action fund Cumbria County Council were given funding to develop a Surface Water Management Plan (SWMP). The SWMP is designed to identify which parts of the county are at greatest risk of flooding from surface water and to establish a strategy to best manage those risks. The SWMP is still underway and has included an extensive data collection exercise in order to establish the extent of historic flooding from local sources. The PFRA has used the information collected in the SWMP process where appropriate.

The historic flooding details have been used to help establish what represents a ‘significant’ flood event in the context of Cumbria.

Consideration of future flood risk was done using the National datasets provided the EA, certain local datasets provided by members of the SWMP steering group and from the outputs of the SWMP itself. Based on national surface water modelling approximately 23,500 properties are estimated to be

at risk from flooding to a depth of 0.3m during a rainfall event with a 0.5% chance of occurring in any one year. Where future flood events pose a significant harmful consequence they have been added to Annex 2.

Contents

Glossary

Acronym	Definition
ABC	Allerdale Borough Council
AStGWF	Areas Susceptible to Ground Water Flooding
AStSWF	Area Susceptible to Surface Water Flooding
BBC	Barrow Borough Council
CBC	Copeland Borough Council
CcC	Carlisle City Council
CCC	Cumbria County Council
CFMP	Catchment Flood Management Plan
DEFRA	Department for the Environment, Food and Rural Affairs
EDC	Eden District Council
FAS	Flood Alleviation Scheme
FEO	Flood Event Outlines
FMfSW	Flood Map for Surface Water
FWMA	Flood and Water Management Act
JBA	Jeremy Benn Associates
LDNPA	Lake District National Park Association
LLFA	Lead Local Flood Authority
MSfW	Making Space for Water groups
PFRA	Preliminary Flood Risk Assessment
PVA	Potentially Vulnerable Areas (SEPA)

RBD	River Basin District
RMA	Risk Management Authorities
RFCC	Regional Flood and Coastal Committee
SAC	Special Area of Conservation
SEPA	Scottish Environmental Protection Agency
SLDC	South Lakeland District Council
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SWMP	Surface Water Management Plan
WHS	World Heritage Site

1 Introduction

1.1 Scope of the Report

1.1.1 Cumbria County Council is a Lead Local Flood Authority (LLFA) and is required by the Flood Risk Regulations 2009 to produce a Preliminary Flood Risk Assessment (PFRA).

1.1.2 The Flood Risk Regulations 2009 established four stages of a flood risk management cycle, scheduled for completion in June 2015. The PFRA is the first stage. The aim of this Regulation is to manage both the likelihood and the consequence of flooding.

1.1.3 This PFRA is an assessment of the local flood risk across Cumbria County Council. To complete this report the following flood risks have been considered:

- Surface water;
- Ordinary watercourses;
- Groundwater;
- Canals (short section of the Lancaster Canal South of Kendal).

1.2 Aims and Objectives

1.2.1 The following aims and objectives have been written to guide Lead Local Flood Authorities through the PFRA process.

Aim

- The aim of this PFRA is to provide an assessment of local flood risk across the study area, including information on past floods and the potential consequences of future floods.

Objectives

- To collect information on historic and future (potential) floods and flood risk;
- To assemble the information in the PFRA report template;
- To determine where in Cumbria there is significant flood risk from local sources;
- To establish good professional partnership arrangements.

1.2.2 The PFRA will represent a sound platform from which to develop Cumbria's Local Flood Risk Management Strategy, particularly when combined with the finding of the SWMP.

1.3 Introduction to the study area

1.3.1 Cumbria County Council is the second largest county in the country covering an area of approximately 2600 sq miles and has a population of just under 500,000. Over the course of a year over 20 million tourists visit the county, hugely increasing the local population. All information collated for this study is for areas within CCC boundaries. Cumbria contains all the mountains in England over 3000 ft. and is widely regarded for its landscape value.

1.3.2 Cumbria's geography means it has high annual average rainfall; the wettest place in England is Seathwaite at the southern end of Borrowdale. Seathwaite's annual average rainfall total is approximately 3500 mm. During the floods of November 2009, 314 mm of rain fell in a 24 hour period.

1.3.3 High rainfall totals, shallow soils and steep hillslopes mean that rain water runs off the land quickly resulting in flashy watercourses (water levels rise and fall quickly) and even sheet flow where rain water runs directly off the land without entering a watercourse. There is an extensive coastal plain to the North West which experiences lower annual rainfall totals but does suffer from flooding as a result of poor drainage and tidal locking of watercourses.

2 Lead Local Flood Authority responsibilities

2.1 Governance and partnership arrangements

2.1.1 Flood risk management and governance has changed markedly as a result of the FWMA 2010. The formation of LLFA s introduced unitary authorities and county councils into the established framework for flood risk management across England. The remit for the LLFA s has been clearly established but it does require them to incorporate themselves into existing and new partnerships in order to contribute to the successful management of flood risk from all sources. These partnership arrangements need to operate internally and externally. Flood risk management does not necessarily fall comfortably within the existing internal structures at upper tier level. Input is required across technical and policy functions and can extend to emergency response and resilience. Cumbria has well established partnerships between existing flood risk management authorities. The County Council will need to incorporate itself into these as appropriate. The Pitt Review (many of the recommendations of which were incorporated into the FWMA 2010) made it clear that success in reducing the likelihood and impact of future floods will depend on greater coordination and cooperation between local partners.

2.1.2 The SWMP process required the establishment of a steering group. This has included UU, representatives from the Local Authorities, the EA and CCC. The MSfW groups include representatives from all parties and as such there are strong links with existing local flood risk problems.

2.1.3 It is anticipated that the SWMP steering group will form the Cumbria Flood Risk Management Group. There will be a closer connection formed with the existing Cumbria Resilience Forum. Cumbria has a small number of people dedicated to flood risk management. It is possible that there could be duplication of personnel across the three tiers of flood risk management outlined below. For this reason there will have to be an appreciation of the time and resource burdens that this could result in. This issue will require a focussed approach and careful programming in addition to clear lines of communication and terms of reference. By using these dedicated individuals there is the opportunity to create a number of well informed individuals who can enhance an already sound grasp of flood risk across the county.

Environment Agency	Forecasting and mapping flood risk from main rivers and the sea, providing warnings, advising on development in the floodplain, building and keeping defences in good order and taking part in emergency planning and response
Lead Local Flood Authorities	Lead on local flood risk from surface water, groundwater and ordinary watercourses. They also lead in emergency planning and handling the recovery of areas that have been effected by flooding
Internal Drainage Boards (none in Cumbria at present)	Land drainage and flood risk in areas of special drainage need. These are mostly low-lying areas that need active management of water levels
RFCC s	Decision about the annual programmes of improvement and maintenance work

Table 1; Responsibility for Flood and Coastal Risk Management

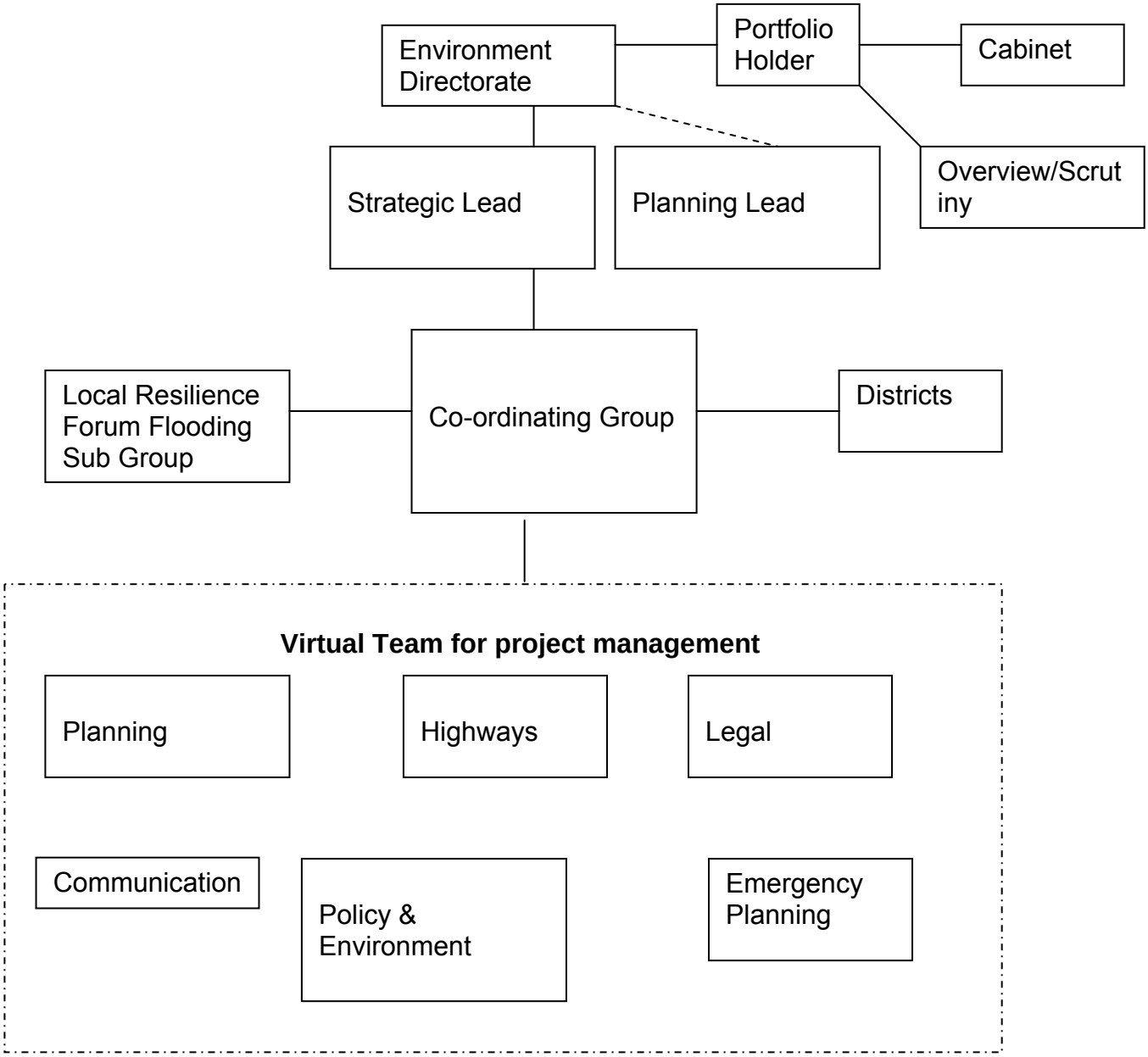

Fig 1 Cumbria County Council Flood Risk Management Structure

Group Name	Group membership
Cumbria Flood Risk Steering Group	Chair
	Rep from Co-ordinating Group
	Members of virtual team as required
	EA
	UU
	District Drainage Representative
	EPU
Cumbria Flood Risk Management Group	Chair
	Co-ordinating team
	Members of virtual team as required
	EA
	UU
	MsFW representatives
	EPU

Table 2 Cumbria flood risk management groups and their make up

Cumbria Flood Risk Steering Group

2.1.4 The purpose of this group is to develop a professional partnership that provides strategic leadership for flood risk management across Cumbria.

2.1.5 Its role is to:

- Identify and agree strategic objectives in relation to the Flood Risk Regulations 2009 and the Flood and Water Management Act 2010
- Set strategic priorities for flood risk management work programmes across Cumbria and its neighbouring authorities.
- Ensure an effective multi-agency approach to flood risk management, which enables the safe and effective sharing of data, information and resources
- Review skills and develop options to build technical capacity, including advice to Elected Members on succession planning and future resource needs
- Act as link to local authority decision making processes and other key groups such as the North West Flood and Coastal Committee, neighbouring LLFA s, SEPA, and the Cumbria Resilience Forum

Cumbria Flood Risk Management Group

2.1.6 This group is guided by and reports to the Cumbria Flood Risk Steering Group and also serves as the professional, multi-agency partnership overseeing the operational delivery of flood risk management across Cumbria.

2.1.7 Its role is to:

- Interpret the requirements of flood risk legislation and guidance, and to develop work programmes based on the latest assessment and understanding of flood risk.
- Lead on the development of data sharing arrangements to enable the safe and effective pooling of information and use this as an evidence base to inform decision making and investment planning.
- Identify opportunities to align partner work programmes, so that investment can be maximised to improve collective understanding and management of flood risk.
- Provide a holistic approach to flood risk management, by ensuring that interrelationships between different sources of flooding are understood and used to inform a comprehensive local flood risk management strategy.

2.1.8 The group also prepares reports for the Cumbria Flood Risk Steering Group which provide:

- assurances that liaison is working and that partners are fulfilling commitments;
- progress towards achieving strategic objectives
- updates on the Group's work programmes and key issues for review and endorsement
- recommendations for action
- requests for support on sticking points, support from other partners, or obtaining resources to invest in improvements.

Making Space for Water Groups

2.1.9 These groups already exist and are carrying out good local flood risk management work all over Cumbria. It is anticipated that they will form an important element of Cumbria's flood risk management structure in the future, representing as they do the existing knowledge base for many of the local flood risk issues.

2.1.10 It is hoped that in the future these groups, guided as appropriate by the Cumbria Flood Risk Management Group, will meet in each District with the purpose of developing integrated multi-agency partnership working in water management at a district level, in order to:

- provide accurate assessments of the risk, nature and scale of local flooding
- identify and bring forward solutions to reduce the risk of flooding from local sources
- investigate and mitigate the effects of flooding incidents
- For these groups all references to flooding include river, sewage, drainage, groundwater and surface water run-off unless otherwise stated.

2.1.11 Their role is to:

- Seek and create opportunities for more effective integrated water management as directed by the Cumbria Flood Risk Management Group, and in line with the national and local flood risk management strategies prepared by the EA and LLFA s respectively.
- Ensure good communication, knowledge sharing, problem solving and operational working between organisations
- Create a common understanding of roles, responsibilities and limitations of organisations
- Review and respond appropriately to the UK Making Space for Water strategy
- Review and respond appropriately to the EU Water Framework Directive
- Review and respond appropriately to the development and implementation of strategic flood management plans (CFMP's, SMP's and SFRA's)

2.1.12 This group also prepares reports for the Cumbria Flood Risk Management Group or other relevant sources, which provide:

- assurances that liaison is working and that partners are fulfilling commitments;
- updates on the Groups' work programmes and key issues for review and endorsement
- recommendations for action
- requests for support on sticking points, support from other partners, or obtaining resources to invest in improvements.

2.1.13 The above role description has not been formally agreed at present.

2.1.2 Cross Border Arrangements

2.1.2.1 Cumbria is partially within the Solway Tweed River Basin District. The Solway Tweed RBD crosses the English Scottish border. The European Union has made provision for RBD s which cross national boundaries in the Flood Risk (Cross Border Areas) Regulations 2010. The EU Cross Border Areas Regulations require that SEPA, the EA and the LLFA when producing flood risk assessments, maps and plans must;

- Consider how the impact of flood risk on one side of the border is affected by actions and inactions on the other side of the border
- Take into account the preliminary flood risk assessments, flood hazard maps, flood risk maps and flood risk management plans produced for an adjacent cross border area
- Give consideration to the advice given by a Cross Border Advisory Group (CBAG)

2.1.2.2 A CBAG has been established for the cross border area. There are representatives of Cumbria County Council on the CBAG. Membership and the terms of reference for the CBAG have been established and a meeting held in early May 2011.

2.1.2.3 It has been agreed nationally that for the English part of the cross border area the LLFA will report to the EA and use the EA guidance in developing the PFRA. On the Cumbrian side of the border there are very few local flood risk problems. It is not anticipated that any PVA s (SEPA's equivalent of the Indicative Flood Risk Areas in England) will be located adjacent to the Cumbrian border on the Scottish side.

2.2 Communication with partners and the public

Public Engagement

2.2.1 It is recognised that members of the public may have valuable information to contribute to local flood risk management across Cumbria. Due to the strategic nature of the assessment, and the timescales involved, there has been no direct contact with the public in the PFRA process.

2.2.2 It is intended to undertake some public engagement when formulating the Cumbria SWMP as this will help to inform future levels of public engagement. This will be undertaken such that CCC follow the guidelines outlined in the EA's 'Building Trust with Communities' document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

Partner Engagement

2.2.3 The means by which partner organisations have been involved in the PFRA process has been via the SWMP. This has enabled straight forward access to a lot of local flood risk information. There have been specific instances where LA engineers have been contacted directly for more detailed site specific advice and information. General agreement from the LA s has been sought for the 'locally agreed surface water information' and an appropriate threshold for 'locally significant historic events'.

2.2.4 The EA will collate all LLFA PFRA s into one document for England and Wales and report this to the EU. It is possible that CCC will wish to make this document available on its own website also although this has yet to be confirmed.

3 Methodology and data review

3.1 PFRA Process

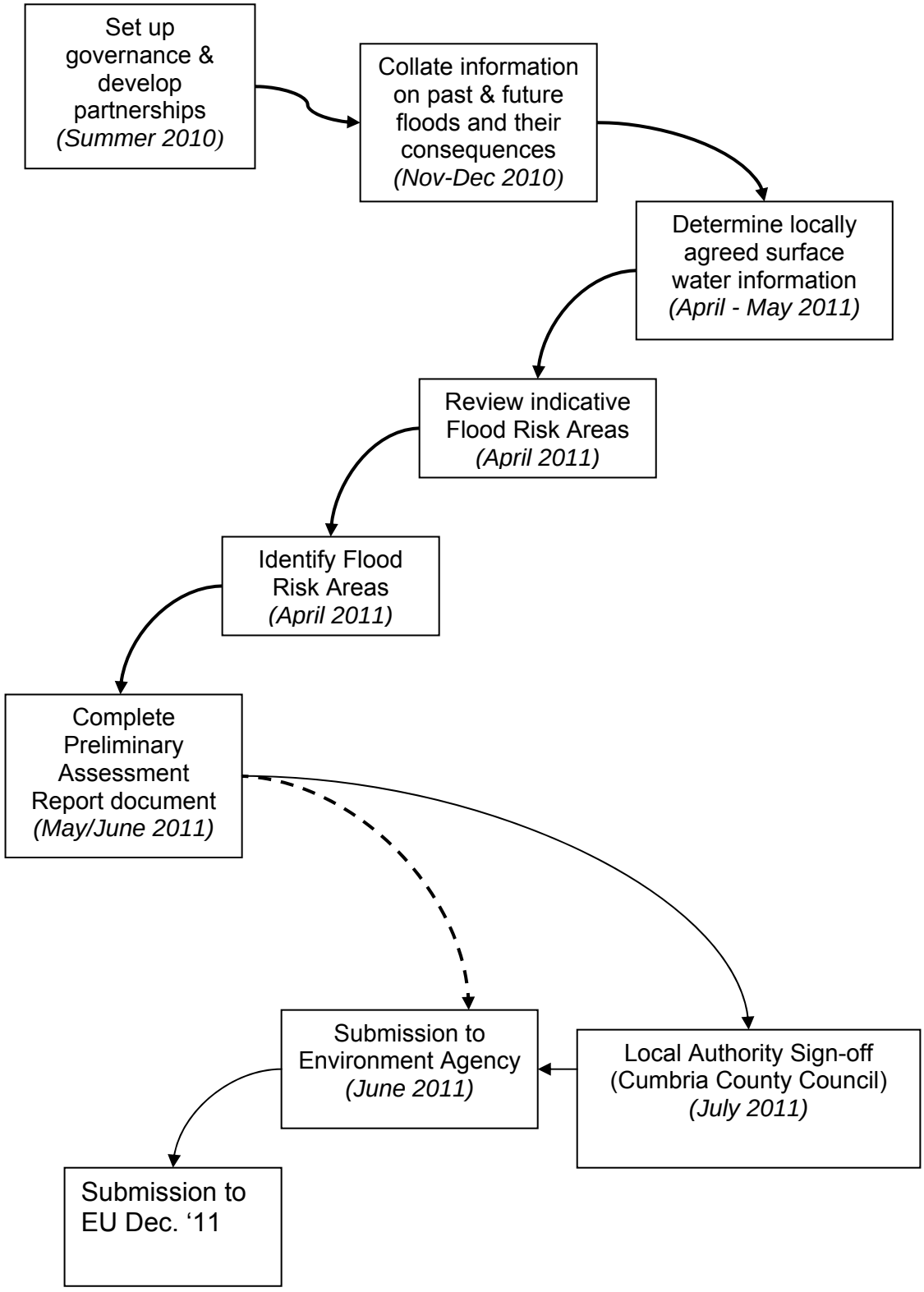

Fig. 2 The PFRA process

3.1.1 Much of the work described above was actually undertaken as part of the SWMP process. The setting up of local partnerships and governance has taken place through the SWMP and FWMA processes as opposed to through the PFRA process specifically.

3.2 Data Collection

3.2.1 The SWMP has been the source of the majority of the data for the PFRA. The SWMP historic flooding data collection exercise has taken data from the following groups and organisations;

- Making Space for Water groups (MSfW) – all six districts in Cumbria have a MSfW group comprising representatives from LA engineers, Cumbria Highways, United Utilities and the EA. These groups have already established lists of flooding hotspots.
- LA data – all six LA s have provided a range of historic flooding data. The quantity and quality of this data varies. Sources include call out registers and information which was used to help compile the SFRA s and CFMP s.
- EA historic flood outlines – include details of date, location and nature of property flooded, source / mechanism and a flood outline of historic floods recorded by the EA.
- Cumbria Fire Service – the Fire Service log all flood related emergency calls. This data is geo-referenced and dates back to April 2000. Data includes date and time, location and incident summary (how it was resolved as opposed to flooding mechanism). Data does include man made sources of flooding and as such should be used with appropriate caution in the PFRA.
- Cumbria Highways – information provided by road users and highways inspectors. This information has been geo-referenced. Depth of flooding is recorded as is whether or not any property flooded.
- United Utilities – past sewer flooding incidents have been provided as has the DG5 register (property flooding; internal or external). UU also provided two databases that record sewer incidents – Wastewater incident Register System (WIRS) and Sewerage Incident Register System (SIRS). 'Incidents' doesn't necessarily refer to flooding, it could pollution etc., so those specifically relating to flooding have been filtered out. WIRS has superseded SIRS and includes details of the cause of flooding (capacity, pump failure, collapse etc.).

3.2.2 The above data has been put into a data register. This register identifies the source of the data, includes a description of what the data is and has a comment on the quality of the data. The historic flooding data varies in quality and extent. Some data from local authorities contains hundreds of entries while others have far fewer. Much of the data provided is now geo-referenced which makes establishing the location a more straight forward process. Actual flood event outlines have been available in small number of instances.

Organisation	Dataset	Description
Environment Agency	Flood Map	Shows the areas across England and Wales that could be affected by flooding from rivers/from the sea/from rivers and, or the sea
	Main Rivers	Watercourses shown on the statutory main river maps held by the EA, the Department of Environment, Food and Rural Affairs (in England) and the Welsh Assembly Government (in Wales)
	Historic Flood Map	Historic Flood Map is the maximum extent of all recorded individual Historic Flood Events Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England & Wales
	Detailed River Network	The Detailed River Network (DRN) is the only large-scale, accurate and fully attributed digital river centreline covering England and Wales
	National Receptor Dataset	The National Receptor Dataset (NRD) is a collection of risk receptors primarily intended for use in flood and coastal erosion risk management. It is available for use by Local Planning Authorities, the EA and our contractors
	Catchment Flood Management Plans	Present a good understanding of the watercourses and the hydrology, and drive the long term policy for flood risk management at a catchment scale
	Areas Susceptible to Groundwater Flooding	Land susceptible to flooding from groundwater
District and borough Councils	SLDC Historic Flooding Records	Records from SLDC. Includes mechanism e.g. blockage and type e.g. sewer system.
	Local Authority Historic Flooding Records	GIS data showing historic flooding locations, drainage issues and reports where available.

	Making Space for Water group hotspots.	Includes prioritisation and short description. Allerdale includes options assessment.
	Strategic Flood Risk Assessments	All LPA s (inc. LDNPA) Can contain useful information on historic flooding, but many use the national Flood Map as the source of flood risk information. The Cumbrian SFRA s do include details of some hotspots of local flooding
Parish Councils		
United Utilities	United Utilities DG5 'at risk register'	DG5 register and any other general records of flooding incidents.
	Wastewater incident Register System (WIRS)	Database that records sewer incidents -those specifically relating to flooding have been filtered out. WIRS has superseded SIRS and includes details of the cause of flooding (capacity, pump failure, collapse etc.).
	Sewerage Incident Register System (SIRS)	Database that records sewer incidents -those specifically relating to flooding have been filtered out.
Cumbria Highways	Highway flooding and drainage records.	Call out data provided from Cumbria Highways from 2004 to 2009.
Highways Agency	Overview on Highways Agency flood work	Includes information on flooding data and contingency plans (emergency planning)
Cumbria Fire and Rescue	Cumbria Fire Service flood-related incidents.	Flood events detailed by the Fire service. 12 figure grid references going back to 1/4/2000, attribute data can include the date, time and incident summary plus a location description.
	Supplementary local	A list of receptors which if affected would give rise to significant consequences

Cumbria County Council	data on receptors	
	Potential future development allocations	CCC provided proposed housing, preferred sites, all sites and nuclear power sites.

Table 3 Relevant information and datasets

3.3 Data Availability and Limitations

3.3.1 The majority of the information used in the PFRA is taken from the SWMP. In order to prepare the PFRA it was a fairly straight forward procedure to access the relevant information from Cumbria's data servers or to request the relevant information from the consultants commissioned to undertake the SWMP, JBA.

3.4 Data Storage and Future Access

3.4.1 The PFRA process has utilised the data register produced by JBA as part of the SWMP process. JBA have a web based data storage and sharing facility called JBarn. All members of the SWMP steering group were provided with log in details to access this data. During the PFRA process appropriate data sets have been transferred from JBarn to the CCC servers. Future access to JBarn will be something to negotiate between the steering group, CCC and JBA as there will be a cost implication. If the data sharing facility ends with the completion of the SWMP then it may be that the data would be available to all parties by request to CCC.

3.5 Quality Assurance

3.5.1 The SWMP data register includes a comment on data quality and gaps in data. Where gaps in data and knowledge existed an informed judgement was made as to the likely missing information. Where there was confidence in this judgement the gap was filled and the data used in the PFRA, where there was limited confidence the data wasn't used in the PFRA. The data in the SWMP data register had gone through an initial data quality assurance screening process prior to being used in the PFRA.

3.5.2 In order to add confidence to the National surface water flooding datasets a number of site visits and telephone conversations with District Drainage Engineers were also undertaken. These provided details of specific historic flood events which have been incorporated in to the locally agreed surface water information as appropriate.

3.6 Data Security, Licensing and Restrictions

3.6.1 Most data provided for the PFRA was stored on a password protected website, JBarn. Some data was taken from CCC's servers, again password protected.

Organisation	Restrictions on use of data
United Utilities	Information provided by United Utilities is licensed for use in the PFRA only and is not to be passed on to third parties unless required by law. If a request is made for disclosure of the information under the Environmental Information Regulations 2004 then the recipient of the request should contact United Utilities for its views on relevant factors to take into consideration in deciding whether or not to release the information.
Environment Agency	The use of some data is restricted to Cumbria County Council for the preparation of the PFRA. The use of other data is unrestricted.

Table 4 Summary of data restrictions and licensing details

4 Past flood risk

4.1 Summary of past flood risk

4.1.1 Cumbria has had a number of well documented historic floods; Cockermouth November 2009 and Carlisle January 2005 are two recent examples. These have been on Main Rivers and as such are not included here. Flooding from 'local' sources has not taken place at a level which constitutes nationally significant.

4.1.2 An initial data collection exercise revealed over 250 past flood incidents across the area from local authority records. In addition, interrogation of the United Utilities Sewer Incident Record System (WIRS / SIRS) database uncovered a further 250 incidents of flooding due to the sewer system capacity being exceeded. The majority of these incidents related to flooding of minor roads or single properties.

4.1.3 Examination of this data shows clusters of flood risk in key locations around the area, most notably in Carlisle, Barrow in Furness, Whitehaven, Keswick, Kendal, Ulverston Penrith and Windermere. It should be noted that whilst flood risk in these areas is known, there are other areas where flooding is known but records do not reflect this local knowledge. In some of these areas this is due to the number and quality of flood records kept. In others, it is that the flooding experienced in the past has been predominantly from Main River and the sea. In these areas, the number of flood records is dramatically reduced when these events are removed. Locations that have experienced flooding historically are generally shown to be at risk from future flooding in the national future flooding datasets.

4.1.4 There are records of groundwater flooding to basements of properties along Lound Road and Aynam Road in Kendal. These are in close proximity to the River Kent and the groundwater flooding tends to happen when river levels are high. This suggests an interconnection with high water levels in the Main River, possibly through the permeable gravel deposits on the valley floor. Ground water flooding has also been recorded along Windermere Road, Grange Over Sands, again often associated with high water levels in local watercourses. The geology in this area is Limestone. High groundwater levels do not persist and tend to drop fairly quickly after a rainfall event. Flooding problems in Grange Over Sands are also compounded by tide locking as outfalls to the sea can be underwater during high tides.

4.1.5 There are no records of flooding reported from the short section of the Lancaster canal that runs through Cumbria, intermittently, from Kendal south to the Lancashire Border.

4.1.6 Cumbria has a number of nationally and internationally designated and protected environmentally sensitive sites; SSSI s, SAC s and SPA s.

Many of these are river systems such as the Eden and Kent. A large number of waterbodies such as lakes and estuaries are also designated, as are large upland areas such as parts of the North Pennines, the Lake District and coastal raised mires. Ecologically valuable habitats in Cumbria often reflect the wet climate and can tolerate flooding from local sources. The PFRA has found no records of past flooding from local sources which was detrimental to the status of an environmentally designated site.

4.2 Significant Harmful Consequences

4.2.1 As part of the PFRA process, there is a requirement to report only those past floods which had significant harmful consequences.
For looking at past flood events, the Environment Agency recommend using flood risk thresholds an order of magnitude less than those used for future flooding. The initial thresholds used for future flooding were:

- More than 200 people affected (i.e. 201 or more)
- More than one critical service affected (i.e. 2 or more)

These were applied to 1km squares before these were aggregated into clusters. The DEFRA/WAG guidance of what constituted 'significant' flood risk were applied to these clusters.

4.2.2 Cumbria is a sparsely populated county with few urban areas. For this reason it was felt that a lower threshold for historically significant flooding should be adopted. This should reflect the fact that in small communities even the flooding of a relatively small number of properties can have locally significant consequences.

4.2.3 Reducing the initial flood risk thresholds by roughly an order of magnitude would mean setting the threshold for past flooding at:

- More than 14 people affected.
- One or more critical service affected

14 people affected equates to roughly more than six properties.

4.2.4 Cumbria has over 15 million visitors a year. Many of these visitors stay on caravan and camp sites which, although scattered across the entire county, are often concentrated in the popular Lake District tourist centres. The topography of the Lake District makes it sensitive to flooding from local sources. For this reason Cumbria has assessed local flood risk at locations where it knows there are caravan and camp sites. For the purpose of the PRA it has considered caravan and camp sites as critical infrastructure. Defining caravan and campsites in this way means that if one or more caravan or camp site is located within an area that has experienced surface water flooding, or may

experience it in the future, then that should be documented in the PFRA. People staying in caravan and camping sites are particularly vulnerable to flooding, particularly if there are high velocities involved. The structures that they are in are not structurally robust and do not generally offer a 'safe haven' in the event of a flood. As visitors they are not familiar with possible flooding mechanisms. There would also be an economic impact on the county if caravan and camp sites were affected by flooding. There have been flood events associated with intense thunderstorms in many of the most popular Lakeland valleys, most memorably in Langdale Valley, Glenridding and Borrowdale. There are no records to confirm whether or not camping or caravan sites have been affected by flooding from local sources historically. Those that may be affected in the future are considered in section 5.

4.2.5 The table below provides a summary of those past floods, some of which are considered or known to have had significant harmful consequences. Figure 3 provides an illustration of the nature and extent of historic flooding data collected as part of the SWMP exercise.

Cumbria County Council Historic Flooding Records			
District	Locations with highest number of historic incidents reported	Predominant Record / source	Includes an event > threshold for locally significant historic event
Allerdale	Cockermouth	UU / Highways	
	Dearham	UU / Highways	
	Keswick	UU / Highways/ Fire Service	Y
	Workington	Fire Service	
Barrow	Askam In Furness	UU	
	Barrow in Furness	UU	
	Dalton in Furness	UU	
Carlisle City	Carlisle	L.A. / Fire Service / UU	
Copeland	Whitehaven and Parton	UU / LA	Y
Eden	Penrith	UU / LA	
South Lakeland	Ambleside	LA	
	Kendal	LA	
	Ulverston	LA	
	Windermere	LA	

Table 5 Predominant source / record of flooding in main towns across 6 districts in Cumbria

4.2.6 Any past flooding which has since been resolved has been excluded from this list if the likelihood of its re-occurrence is low. It is acknowledged that Cumbria's historic events are not significant at the EU reporting scale but have been included in the body of the PFRA in order to give an idea of the scale of historic events that have been experienced in the county. They have not been reported in Annex 1.

4.2.7 Applying the above criteria to the historic flood records collected leaves 2 flood incidents which would be regarded as having had locally significant harmful consequences.

4.3 Details of Past Floods with Significant Local Consequences

4.3.1 Local Authority Engineers at ABC and CDC outlined examples of flood events which met the requirements of the threshold described above.

4.3.2 In Allerdale an Ordinary Watercourse which drains an area to the south of Keswick resulted in extensive flooding of properties, roads and fields during the January 2005 flood event that affected Carlisle so badly. Up to 50 properties were flooded to different depths as a result of inadequate inlet capacity on a culverted section of this watercourse. Flow routes were established along residential streets leading eventually to the Main river River Greta to the north. There may have been some 'tide locking' of the culvert outlet as a result of high water levels on the River Greta. The problem was further compounded by surface water originating from the steeper streets to the east.

4.3.3 In Copeland flooding from an Ordinary Watercourse was experienced in Parton, a coastal village north of Whitehaven, in October 2004. Inlet capacity issues on a culverted section of the watercourse resulted in a flow route being established across agricultural land towards the village of Parton. The flow route through the village resulted in > 20 properties being flooded at varying depths.

Date	Location	Authority / District	Source	Watercourse
7th January 2005	Ambleside Road, Keswick	ABC	Ordinary Watercourse	Quarry Beck
4th October 2004	Main Street, Parton	CDC	Ordinary Watercourses	Lambhill Quarry and Foundry Road Culverts

Table 6 Past flooding with significant consequences

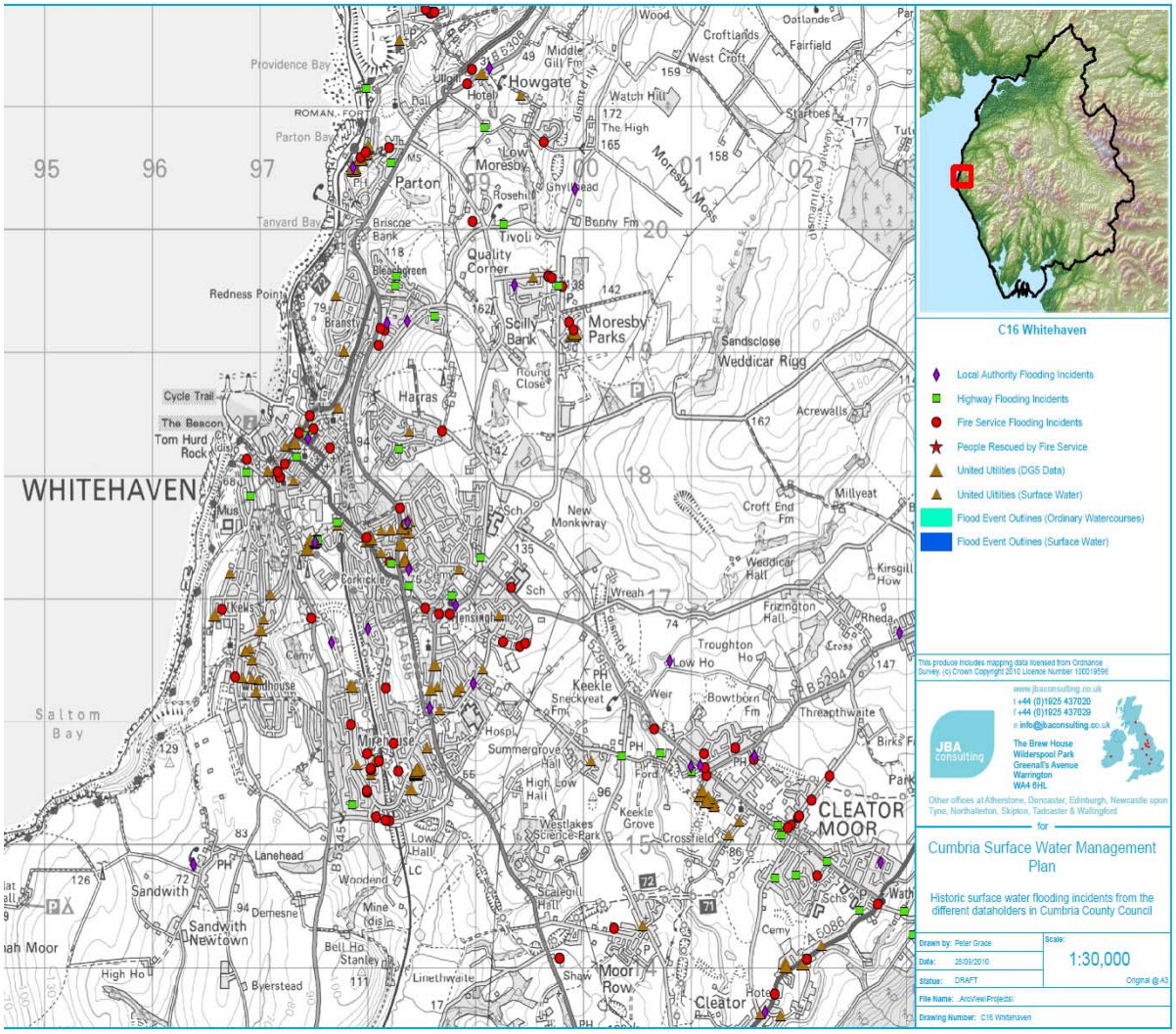

Fig 3 Excerpt from the Cumbria SWMP showing historic flooding data from all data holders for part of CBC

5 Future flood risk

5.5.1 Future flood risk has been assessed using the national FMfSW dataset outputs. This has been augmented by two FEO s, one for Keswick (Allerdale) and one for Parton (Copeland). This is essentially the locally agreed surface water information.

5.1 Locally Agreed Surface Water Information

5.1.1 The table below compares the number of people at risk from surface water flooding at key locations across Cumbria. It uses two datasets, the FMfSW and AStSWF, against the NRD V1.1.

Borough/District	Number of People at Risk		
	Town	Flood Map for Surface Water	Areas Susceptible to Surface Water Flooding
BBC	Barrow in Furness		4345
SLDC	Kendal	1973	3704
CcC	Carlisle	1423	3693
SLDC	Ulverston		2244

Table 7 Comparison of number of people at risk of surface water flooding between two national surface water flooding datasets

5.1.2 These two datasets have been analysed by the EA and the results of this analysis provided to the LLFA s. The FMfSW is the more recently produced dataset and there are subtle alterations in the way it was produced relative to the AStSWF. These include a consideration of the volume of water that might enter the drainage system in urban areas and some consideration of infiltration to the soil in rural areas. Despite these improvements there are some locations where the AStSWF is regarded as a more accurate representation of surface water flooding than the FMfSW. These areas tend to be low lying urban areas and are best represented by Hull and Liverpool. For hillier areas such as Cumbria the FMfSW is believed to be the more accurate representation. For this reason the LLFA recommended using the FMfSW as the 'locally agreed surface water information'. Districts confirmed that they were generally comfortable with this but did suggest specific locations where the outlines didn't match historic event outlines. These were subsequently mapped and will be incorporated into the 'Locally agreed flood map for surface water'.

5.1.3 The locally agreed surface water map is the FMfSW with two small FEO s at specific locations as described in section 4.3 'Details of past floods with significant consequences'. At the whole LLFA scale these FEO s are not visible on a plan.

5.1.4 The SWMP has adapted the FMfSW further in order to better represent the geographical and meteorological conditions experienced in the North of England. Again the adaptations have been around the capacity of the sewerage system (higher than National average) and the percentage run off in rural areas (again higher than national average in order to be better represent catchment steepness and soil types). These results are not yet available but should be incorporated into the next PFRA.

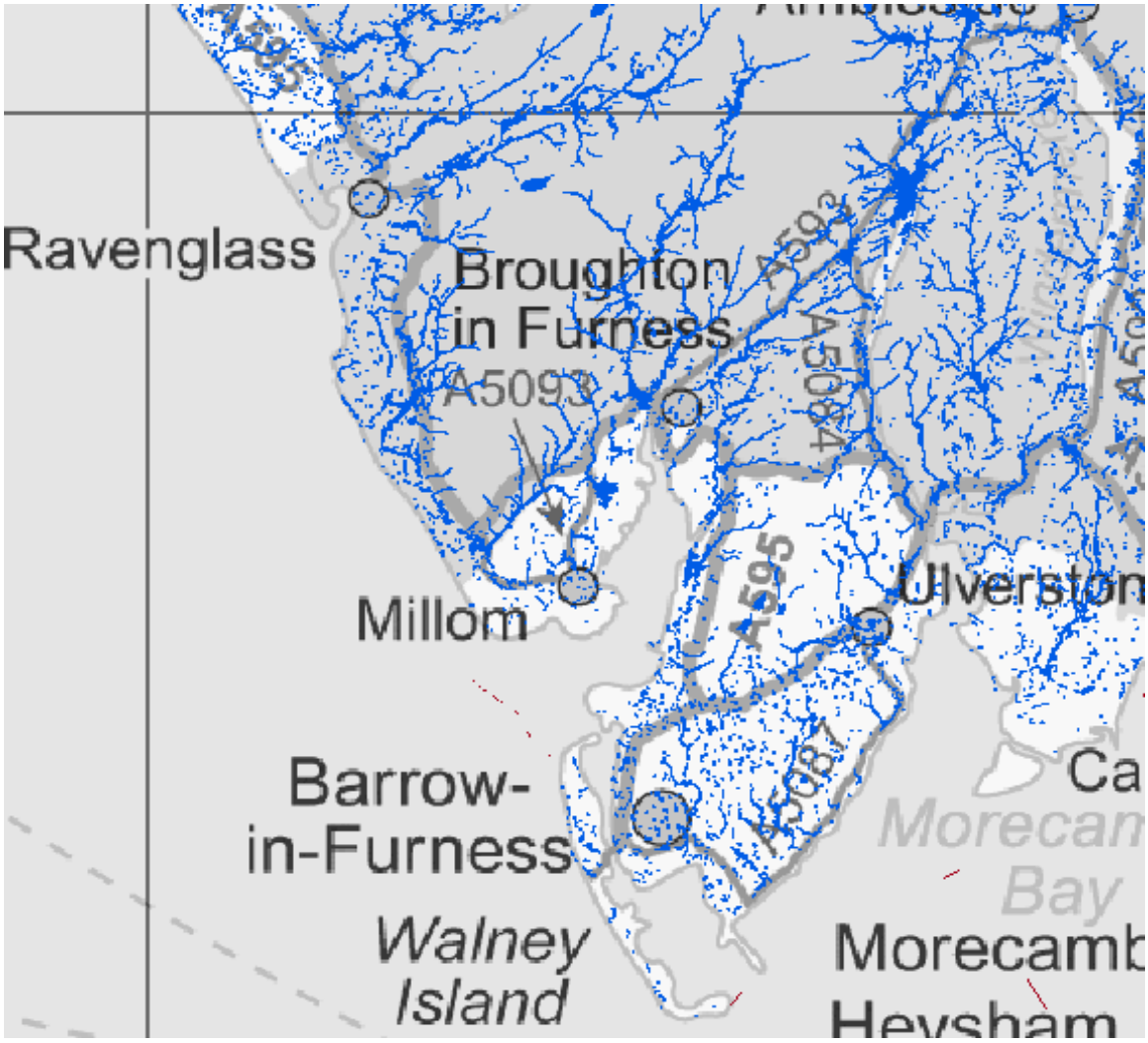

Fig. 4 Example of 'Locally agreed surface water information' for BBC, parts of SLDC and parts of CBC

5.2 Caravan and Campsites

5.2.1 Using caravan and camping site shown on OS maps the number of sites sitting within the FMfSW has been counted.

District	Number of Campsites within FMfSW	Nearest settlement
Allerdale	6	Blitterlees
		Allonby
		Braithwaite
		Seatoller
		Naddle Valley
Barrow	2	Walney Island
		Askam in Furness
Carlisle	1	Blackford
Copeland	2	Lamplugh
		Eskdale
Eden	22	Alston
		Asby
		Dacre
		Kirkby Stephen
		Martindale
		Morland
		Ousby
		Penrith
		Ravenstonedale
		Skelton
		Stainmore
		Warcop
		Yanwath
SLDC	4	Hawkshead Village
		Canny Hill, Newby Bridge
		Burrow House, Storrs
		Bowness on Windermere

Table 8 Caravan and campsites located in FMfSW outlines in Cumbria

5.2.2 This work has been carried out for the reasons outlined in the section 4 on past flood risk. This information will not be reported in Annex 2 of the PFRA but does provide information in relation to local flood risk. It will provide a useful starting point for considering the risk to these facilities and the people that use them in the Local Flood Risk Strategy which the LLFA will be undertaking in the near future.

5.3 Local Drainage Infrastructure issues

5.3.1 The SWMP has included an assessment by UU of the local drainage capacity. This has provided good information in relation to the state of the existing sewer capacity in various locations across the county.

Borough/District	Location	Sewer Model?	UU comment on capacity
Allerdale	Workington	Y	No strategic issues, recently completed pumping stn. Church St.
	Cockermouth	Y	Problems on Gote Road
	Dearham	Y	26 DG5 incidents (small village)
	Keswick	Y	UU's main surface water flood risk location – scheme proposed at Elliot Park
Barrow	Barrow in Furness	Y	Minor tide locking issues. New storage tank has been constructed to accommodate these
	Askam in Furness	Y	No specific issues
	Dalton in Furness	Y	No specific issues
Carlisle	Carlisle	Y	Major UU investment post 2005 flood event. Local problems remain however
	Brampton	N	No specific issues
Copeland	Whitehaven	Y	Tide locking in Parton and combination problems in Pow Beck Valley
	Millom	Y	No specific issues
	Egremont	Y	UU has re-sewered Egremont
Eden	Penrith	Y	Thacka FAS should help relieve problem
South Lakeland	Ambleside	Y	Fluvial flooding to pumping infrastructure problematic
	Ulverston	N	UU have invested a lot of money but surface water problems remain
	Windermere	Y	Drainage problems here – sewers at or near capacity, at times every manhole surcharging.

			Environmental constraints. Catchment management option. Joint EA UU scheme being considered
	Kendal	Y	Sewer capacity issues in Burneside area
	Grange Over Sands	Y	Tide locking of surface water outfalls
	Grasmere	Y	Sewer capacity issues resulting in surface water flooding

Table 9 Local drainage capacity across key locations in all districts in Cumbria

5.3.2 The above sewer capacity table gives and indication of the extent of the problem across each district. Areas where sewer flooding problems exist include Keswick, Whitehaven, Windermere, Carlisle and Ulverston.

5.4 Future floods and their possible consequences

5.4.1 The EA has analysed the FMfSW against the NRD for England and Wales. In Cumbria Kendal and Carlisle come out as the locations with the greatest future risk of surface water flooding in Cumbria. The assessments carried out during the SWMP process may well revise these figures, either upwards or downwards. The National dataset generally reflects the pattern of historic flooding which adds some credence to the FMfSW outlines for future flooding in these locations.

Location	Number of Properties	No. People	Critical Services	Non – Residential properties	Length of Road and Rail (km s)
Kendal	843	1973	5	201	3.6
Carlisle	608	1423	4	140	3.6

Table 10 Analysis of consequences of future flooding from surface water in Kendal and Carlisle

5.4.2 There are many other locations across Cumbria that are vulnerable to surface water flooding. The absence of these locations in the table above is not an indication that there is no surface water flooding problem in these locations but that the problem did not exceed certain National thresholds identified by the EA and DEFRA. Other than the probability of the rainfall

event used in the modelling exercise, the National thresholds gave made no assessment of the frequency of flooding. The strategic nature of the PFRA means that it can only provide an indication as to where problems may be experienced in the future. The LLFA's task is to combine the on the ground knowledge of the RMA s with the outputs of more detailed studies such as the SWMP. The SWMP process will improve the understanding of the risk of surface water flooding across the County in the future; it will also provide an indication of the accuracy of the FMfSW.

5.4.3 The EA has provided LLFA s with maps showing areas susceptible to groundwater flooding. The mapping provided is at a strategic scale showing groundwater flooding areas on a 1km grid square. The data was produced by the EA to allow LLFA s to determine whether there may be a risk of flooding from groundwater. It is also provided so that LLFA s can obtain a broad feel for the wider areas which might be at risk from ground water flooding.

5.4.4 The vast majority of the county is shown as being vulnerable to ground water flooding. Despite the complex underlying geology of Cumbria it is the superficial deposits formed during glaciation that make flooding from groundwater a potential risk across the county.

5.4.5 The output shows the proportion of each 1km square where geological and hydrogeological conditions show that groundwater might emerge. In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only small isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

5.4.6 The dataset should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding, but may be of use to the LLFA s in identifying where, for example, further studies may be useful. Interestingly one location that is known to have suffered from groundwater flooding historically, Grange Over Sands, is not shown as being vulnerable to groundwater flooding on the EA dataset.

5.4.7 It is likely that this dataset will need to be augmented and improved as cases of groundwater flooding come to the attention of the LLFA.

5.5 Environmental and Cultural impact of future flooding

5.5.1 Cumbria has a number of nationally and internationally designated and protected environmentally sensitive sites; SSSI s, SAC s and SPA s. Many of these are river systems such as the Eden and Kent. A large number of water bodies such as lakes and estuaries are also designated, as are

large upland areas such as parts of the North Pennines and the Lake District and there are also a number of coastal raised mires. Ecologically valuable habitats in Cumbria often reflect the wet climate and can tolerate flooding from local sources. The PFRA has found no records of past flooding from local sources which was detrimental to the status of an environmentally designated site. Analysis of the National datasets has revealed flooding from local sources of environmentally designated sites.

5.5.2 Further analysis shows that the County's WHS, Hadrian's Wall, will be subject to surface water flooding. The Roman wall runs from the Solway Coast to the North Sea. The nature of this feature means that it is inevitably subject to some risk of surface water flooding. Often the mapping shows surface water flooding following small depressions and valleys which have watercourses in them. The wall is also vulnerable to flooding from rivers. The impact of flooding on the wall is not clear but as it has been standing for over a thousand years already this would suggest that it is capable of withstanding localised surface water flooding.

5.6 Impacts of Climate Change

The Evidence

5.6.1 There is clear scientific evidence that global climate change is happening now. It cannot be ignored. Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models. Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s. We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

Key Projections for North West River Basin District

5.6.2 If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

• Winter precipitation increases of around 14% (very likely to be between 4 and 28%)

• Precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 25%)

• Relative sea level at Morecambe very likely to be up between 6 and 36cm from 1990 levels (not including extra potential rises from polar ice sheet loss)

• Peak river flows in a typical catchment likely to increase between 11 and 18% Increases in rain are projected to be greater near the coast than inland.

Implications for Flood Risk

5.6.3 Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding especially in steep, rapidly responding catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Key Projections for Solway or Tweed River Basin Districts

5.6.4 If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

• Winter precipitation increases of around 11-13% (very likely to be between 2 and 26%)

• Precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 27%)

• Relative sea level very likely to be up between 4 and 35cm from 1990 levels (not including extra potential rises from polar ice sheet loss)

• Peak river flows in a typical catchment likely to increase between 9 and 18% Increases in rain are projected to be greater near the coast than inland.

Implications for Flood Risk

5.6.5 Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in wet spells may increase river flooding, especially in the rapidly responding catchments draining the east Lakes and north west Yorkshire Dales. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected. Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Key Projections for Northumbria River Basin District

5.6.6 If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

• Winter precipitation increases of around 10% (very likely to be between 0 and 23%)

• Precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 24%)

• Relative sea level at Tynemouth very likely to be up between 7 and 38cm from 1990 levels (not including extra potential rises from polar ice sheet loss)

• Peak river flows in a typical catchment likely to increase between 8 and 13% Increases in rain are projected to be greater near the coast than inland.

Implications for Flood Risk

5.6.7 Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in wet spells may increase river flooding in both rural and heavily urbanised catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected. Rising sea or river levels may increase local flood risk inland

or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Adapting to Change

5.6.8 Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits. Although the broad climate change picture is clear, we have to make local decisions against deeper uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

Long Term Developments

5.6.9 It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk. In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

5.6.10 Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

5.6.1 Locally Available Climate Change Information

Local Authority	CFMP	Location	Catchment	Change in Level
Allerdale	Derwent	Keswick	Keswick	+ 0.21m
		Cockermouth	Derwent	+ 0.24m
		Cockermouth	Cocker	+ 0.53m
		Wigton	Wampool	+ 0.07m
		Maryport	Coastal	+ 0.275m
		Workington	Coastal	+ 0.275m
Barrow in Furness	SW Lakes	Barrow & Walney Island	Coastal	+ 0.275m
Carlisle	Eden	Carlisle	Eden	+ 0.3m
		Carlisle	Caldew	+ 0.4m
		Carlisle	Petteril	+ 0.33m
Copeland	SW Lakes	Egremont	Ehen	+ 1.30m
			Coastal	+ 0.275m
Eden	Eden	Appleby	Eden	+ 0.35m
		Penrith	Eamont	+ 0.35m
South Lakeland	Kent and Leven	Kendal	Kent	+ 0.25m
		Grasmere	Rothay	+ 0.29m
		Ambleside	Rothay	+ 0.38m
		Coniston	Crake	+ 0.17m

Table 11 Predicted increase in fluvial and tidal flood levels on rivers and coastal areas in Cumbria

5.6.1.1 Table 11 gives an indication of the possible increase in water levels as a result of climate change. These levels tend to be applied to the coast and more major rivers in the county. These figures are valid in relation to local flood risk because flooding is often the result of the interaction between smaller watercourses discharging into larger rivers and the sea. An appreciation of how the receiving water bodies (i.e. the larger rivers and the sea) are likely to be affected by climate change will help local flood risk management. Knowing that a minor watercourse might experience tide locking in the future might help in the design of an outfall structure or highlight the need to provide adequate channel storage capacity in the lower reaches.

5.7 Long Term Developments

5.7.1 It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

5.7.2 In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

5.7.3 Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria), but should be recorded here so that they can be reviewed in the future.

6 Identification of Flood Risk Areas

6.1 No Flood Risk Areas have been identified in the study area. Based on information supplied by the Environment Agency (see also annex 3), the largest flood risk 'cluster' is Kendal with approximately 1973 people estimated to be at risk from surface water flooding during a 0.5% probability (1 in 200 chance) rainfall event. This falls some way below the 'Significant' threshold of 30,000 people at risk.

6.2 To ensure that a robust assessment has been applied, the possibility of merging clusters to form larger flood risk areas was examined. As all the clusters represented in the study area are discrete, separate areas this was not feasible. In any event, the numbers of people at risk in each cluster were such that no meaningful flood risk area could be created that would reach the threshold of 30,000.

6.3 The records of past floods, whilst showing a handful of previous floods in areas outside the flood risk clusters, did not identify any new areas or provide enough evidence to push an existing flood risk cluster over the ‘significant’ threshold.

7 Next steps

7.1 There is no significant flood risk related to flooding from local sources in Cumbria. Analysis at the nationwide scale has shown that there are no Significant Flood Risk Areas in Cumbria. Because of this there are no further requirements for work to be done as part of this PFRA.

7.2 The PFRA will be reviewed in line with the requirements of the Flood Risk Regulations in six years time. In particular, data which was optional for this first cycle of PFRA s will be mandatory in future. From 22 Dec 2011 the LLFA should record the following information: Start date, Days duration, Probability, Main source, Main mechanism, Main characteristics, and Significant consequences of flooding. The collection of this information will be incorporated into the process required of the LLFA in order to undertake Section 19 of the FWMA; Investigate Flood Incidents.

7.3 The outputs from the Cumbria Surface Water Management Plan and any other studies completed will be included at the review stage of the PFRA in 2017.

7.4 The data on flood risk collected as part of the Preliminary Flood Risk Assessment will be used to inform the Local Flood Risk Management Strategies required under the Flood & Water Management Act 2010. The outputs from any studies undertaken as part of the local strategy will be available for the next review of the PFRA.

References

[1] Environment Agency. Using Surface Water Flood Risk Information: Guidance for LRF, RRT, LPA and LLFA. V1 November 2010

[2] DEFRA Selecting and reviewing flood risk areas for local sources of flooding: guidance for LLFA s

[3] Environment Agency (2010) Preliminary Flood Risk Assessment - Final Guidance (Report – GEHO1210BTGH-E-E). Available from **http://publications.environment-agency.gov.uk/pdf/GEHO1210BTGHe-e.pdf**

[4] Environment Agency (2010) Preliminary Flood Risk Assessment – Annexes to the Final Guidance (Report –GEHO1210BTHF-E-E). Available from http://publications.environment-agency.gov.uk/pdf/GEHO1210BTHFe-e.pdf