

High and Low Lorton

Flood Investigation Report



Low Lorton, 5th December 2015, Cumbria

Flood Event 5th December 2015

This flood investigation report has been produced by the Environment Agency as a key Risk Management Authority under Section 19 of the Flood and Water Management Act 2010 in partnership with Cumbria County Council as Lead Local Flood Authority.

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Executive Summary

The villages of Lorton and Southwaite experienced severe flooding on the 5th of December 2015 as a direct result of Storm Desmond. This storm caused a period of prolonged, intense rainfall across Northern England, falling on already saturated catchments, and led to high river levels and flooding throughout Cumbria and beyond.

In response to the flood event, this Section 19 Flood Investigation Report has been completed by the Environment Agency as a key Risk Management Authority (RMA) working in partnership with Cumbria County Council as the Lead Local Flood Authority (LLFA), under the duties as set out in Section 19 of the Flood and Water Management Act 2010. This report provides details on the flooding that occurred in High and Low Lorton on the 5th December. This flood investigation has used a range of data collected from affected residents, professional partners, site visits, surveys of the area, and data collected by observers and river & rainfall telemetry during the flood event.

This report details the flooding that occurred from the River Cocker, Whit Beck and from surface water. It identifies the flow routes, and the causes of flooding, including where river banks were overtopped in a number of locations around Lorton and Southwaite village.

The fluvial flooding from the River Cocker resulted in significant damage to 4 residential properties in Lorton with depths of up to 30cm above the ground floor and garden areas with 6 flooded in High Lorton. The properties in Low Lorton were also affected by the November 2009 flooding incident. Peak river flows occurred during the evening of 5th December. Lorton Bridge was overwhelmed, with significant outflanking of the structure and flow being routed down the public highway. Three properties were also impacted by the fluvial flooding from the River Cocker in Southwaite village.

Fifteen actions have been recommended in this report to manage future flood risk in High and Low Lorton, which will require the involvement of a number of organisations and local communities.

Any additional information that residents and others can provide to the Environment Agency and Cumbria County Council to help develop our understanding of the flooding is welcomed. A lot of information has already been provided, much of which has been used to inform this report. The scale of this report means that not every piece of information can be incorporated into the document. Any additional information should be provided to:

<http://www.cumbria.gov.uk/planning-environment/flooding/floodriskassessment.asp>

Introduction

Under Section 19 of the Flood and Water Management Act (2010) Cumbria County Council, as Lead Local Flood Authority (LLFA), has a statutory duty to produce Flood Investigation Reports for areas affected by flooding. Section 19 of the Flood and Water Management Act states:

- (1) *On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate:*
 - (a) *which risk management authorities have relevant flood risk management functions, and*
 - (b) *whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.*
- (2) *Where an authority carries out an investigation under subsection (1) it must —*
 - (a) *publish the results of its investigation, and*
 - (b) *notify any relevant risk management authorities.*

This section of the Act leaves the determination of the extent of flood investigation to the LLFA. It is not practical or realistic for Cumbria County Council to carry out a detailed investigation into every flood incident that occurs in the County, but every incident, together with basic details will be recorded by the LLFA.

Only those with 5 or more properties/businesses involved will have investigations published.

An investigation will be carried out, and a report prepared and published by the LLFA when the flooding impacts meet the following criteria:

- where there is ambiguity surrounding the source or responsibility of flood incident,
- internal flooding of one property that has been experienced on more than one occasion,
- internal flooding of five properties has been experienced during one single flood incident and
- there is a risk to life as a result of flooding.

As a flood Risk Management Authority (RMA), the Environment Agency have partnered with Cumbria County Council (CCC) to produce the 53 flood investigation reports across Cumbria.

Scope of this Report

This Flood Investigation Report **is**:

- an investigation on the what, when, why, and how the flooding took place resulting from the 5th-6th December 2015 flooding event and
- a means of identifying potential recommendations for actions to minimise the risk or impact of future flooding.

This Flood Investigation Report **does not**:

- interpret observations and measurements resulting from this flooding event. Interpretation will be undertaken as part of the subsequent reports,
- provide a complete description of what happens next.

The Flood Investigation Reports outline recommendations and actions that various organisations and authorities can do to minimise flood risk in affected areas. Once agreed, the reports can be used by communities and agencies as the basis for developing future plans to help make areas more resilient to flooding in the future.

For further information on the S19 process, including a timetable of Flood Forum events and associated documentation, please visit the County Council website at:

<http://www.cumbria.gov.uk/floods2015/floodforums.asp>

To provide feedback on the report please email LFRM@cumbria.gov.uk.

Flooding History: November 2009

Lorton is a village in the district of Allerdale, in the county of Cumbria. Lorton is made up of two small villages - Low Lorton and High Lorton, both of which are located at the northern end of the Vale of Lorton, overlooked by the mountains Grasmoor, Hopegill Head and Whiteside). The village is approximately 4 miles upstream of Cockermouth. Other nearby settlements include Southwaite which is located approximately 2 miles north-west of Low Lorton, Loweswater and Brigham. High Lorton is located at Ordnance Survey (OS) National Grid Reference (NGR) NY 16173 25530, Low Lorton at NY 15163 25654 and Southwaite is at NY 13080 28352.

The November 2009 event was estimated to be an event with a rarity greater than 0.2% Annual Exceedance Probability (AEP)¹. The AEP describes the likelihood of a specified flow rate (or volume of water with specified duration) being exceeded in a given year. There are several ways to express AEP as shown in Table 1. Throughout this report AEP is expressed as a percentage. As such an event having a 1 in 100 chance of occurring in any single year will be described as a 1% AEP event.

AEP (as percent)	AEP (as probability)
50%	0.5
20%	0.2
10%	0.1
4%	0.04
2%	0.02
1%	0.01
0.1%	0.001

Table 1-Probabilities of Exceedance

The Whit Beck is an Environment Agency main river that drains off the Lorton Fells. The Whit Beck flows in a south-westerly direction past High Lorton and joins the River Cocker approximately three quarters of a kilometre upstream of the village of Low Lorton.

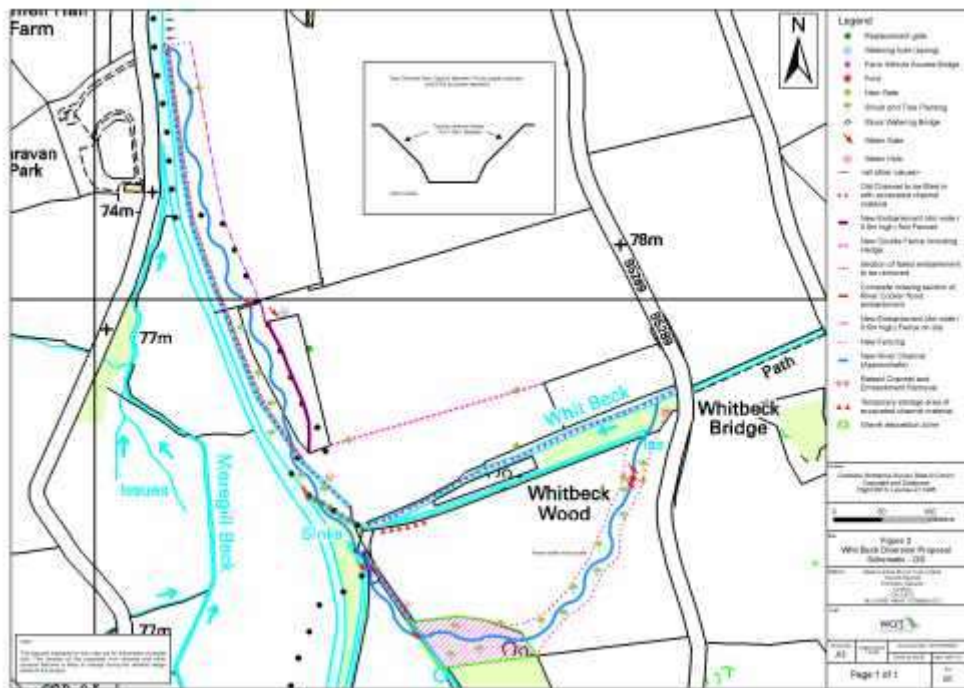
The River Cocker is another Environment Agency main river that originates at the head of the Buttermere valley, and flows south to north through High Lorton. The River Cocker is spanned by a road bridge near Lorton Low Mill. The bridge was completed in January 2010 following the destruction of the former structure during the November 2009 flooding event. Both High and Low Lorton were affected by major flooding on the 19th November 2009. Both the River Cocker and the Whit Beck flooded during this event as a result of prolonged rainfall falling over the northwest region from the 18th. An aerial photograph of the November 2009 flooding is shown in **Photograph 1**.

¹ Estimate taken from CEH briefing note <http://nora.nerc.ac.uk/s510223/1/Nov09Floods-CEH-briefing-note.pdf>



**Photograph 1: River Cocker during the November 2009 flooding
November 2009, no timestamp, NGR NY 15162 25622**

Image below reproduced from: <http://westcumbriariverstrust.org/projects/river-restoration-strategy/whitbeck>



**Whit Beck Diversion
(Main River maps to be updated in due course)**



Figure 1 Location Map

The November 2009 flood event resulted in the collapse of Lorton Bridge. The former structure was an old stone arch design with a central pier and limited capacity (**Photograph 2**). The majority of the structure and several cars were swept away during the peak of flood (**Photograph 3** and **Photograph 4**). No people were harmed by the collapse of the structure.



Photograph 2: Lorton Bridge (pre-destruction)

November 2009, NGR NY 15162 25645



Photograph 3: Looking downstream from the destroyed Lorton Bridge

November 2009, NGR NY 15162 25645



Photograph 4: Looking south towards the destroyed Lorton Bridge

November 2009, NGR NY 15162 25622

Images reproduced from: http://www.loweswatercam.co.uk/101119_Lorton_Bridge.htm

Event Background: December 2015

This section describes the location of the flood incident and identifies the areas that are known to have flooded as a result of the December 2015 Storm Desmond event.

Flooding Incident

Both High and Low Lorton were affected by significant flooding on the 5th December 2015. Southwaite Village was also affected by the flooding, with 3 reports of internal property flooding.

High Lorton

High Lorton was affected by localised fluvial flooding from Whit Beck (**Photograph 5** and **Photograph 6**) as high river flows resulted in scour and structural damage around residential properties at NGR NY 16182 25538. There were 10 residential properties reported to have flooded with 3 of these confirmed as having been flooded internally flooded up through the floors and in basement rooms. Other sources of flooding were the public highway surface water that flowed down the access roads connecting High Lorton with the B5292 and surface water running off fields into the rear of properties. This resulted in localised damage to walls and the public highway. The Whit Beck overtopped its banks approximately 200m downstream of High Lorton, resulting in fluvial floodwater routing across agricultural fields towards the River Cocker.



Photograph 5: Whit Beck in High Lorton, looking upstream

December 2015, NGR NY 16141 25512



Photograph 6: Whit Beck in High Lorton, looking downstream

December 2015, NGR NY 16141 25512

Low Lorton

On the 5th December 2015 water levels within the River Cocker catchment rose in response to the prolonged and severe rainfall across the northwest region. This resulted in significant volumes of floodwater spilling into the adjacent floodplains within the Lorton Valley as shown in **Photograph 7** and **Photograph 8**.



Photograph 7: Looking north towards the River Cocker from the left bank near Lorton Bridge

5th December 2015, NGR NY 15153 25679



Photograph 8: Looking south from Lorton Low Bridge (Bridge End Cottage)

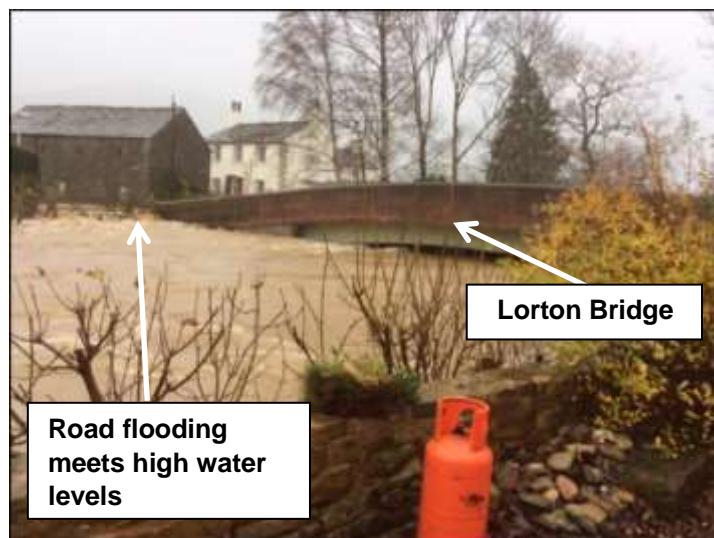
5th December 2015, NGR NY 15153 25679

The fluvial flooding resulted in significant damage to 6 residential properties with depths of up to 30cm above the ground floor and garden areas (**Photograph 9**). All of these properties were affected by the November 2009 flooding event. Peak river flows occurred during the evening of 5th December. Lorton Bridge was overwhelmed, with significant volumes of water rising up and spilling out onto the road approaching Lorton Bridge from the east. The flooding at his location was exacerbated by surface water flooding flowing from the B5289 cross roads (**Photograph 10**). A culverted section of an ordinary watercourse collapsed approximately 30 meters north of Bridge End Cottage on the left bank of the River Cocker.



Photograph 9: Flood damage at Low Lorton

5th December 2015, NGR NY 15153 25679



Photograph 10: Looking upstream towards Lorton Bridge on the River Cocker

5th December 2015, NGR NY 15153 25679

Southwaite Village

Three properties were reported as flooding in Southwaite village. No further information has been provided about the December 2015 flooding at this location.

Existing Flood Defences

There are no formal Environment Agency flood defences in this area.

Flood Investigation

This section provides details of the rainfall event and any previous flood history in the area.

Rainfall Event

December 2015 was the wettest calendar month on record with much of the northern UK receiving double the average December rainfall. This also followed a particularly wet November and as such much of the soil within the Cumbria catchments was already saturated.

From the 4th to the 7th of December there was a period of prolonged, intense rainfall caused by Storm Desmond. Over this period, new 24 hour and 48 hour rainfall records were set for the UK. Both of these were within Cumbria and broke the previous records, also within Cumbria, set during the November 2009 floods.

Table 2 shows the record levels of rainfall that fell prior to the flooding event. **Table 3** shows the rainfall more widely recorded over the catchment on the 4th and 5th December 2015. **Figure 2** shows the location of these rain gauges within the catchment.

	Previous record November 2009		Current Record December 2015	
	Location	mm	Location	mm
24 hour rainfall	Seathwaite	316.4	Honister Pass	341.4
48 hour rainfall	Seathwaite	395.6	Thirlmere	405

Table 2-UK Rainfall Records

Return periods (calculated using historical rainfall event data) have been calculated for this event. Two of these locations have recorded rainfall that is estimated to be rarer than 0.1% AEP.

Monitoring Station	Rainfall (mm)			Estimated Annual Exceedance Probability ²
	4 th December	5 th December	Rolling 24 hour Rainfall	
Cornhow	12.8	81.8	94.4	7.1%
Honister Pass	58.6	294.4	341.4	<0.1%

Table 3-Rainfall recorded at gauges within the Derwent catchment

² Calculated using FEH DDF methodology, this estimation is not calibrated for values with an AEP less than 0.1%

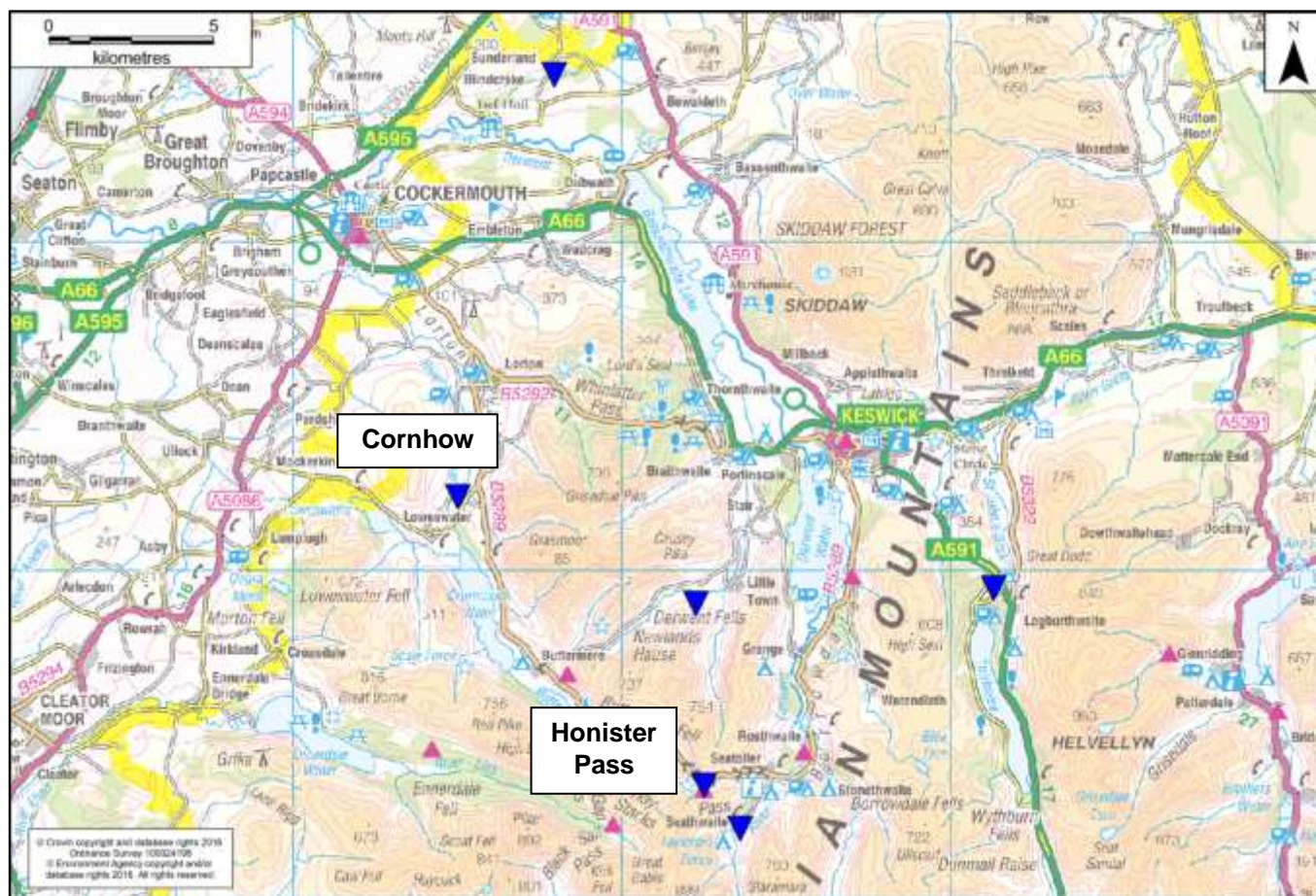


Figure 2-River Derwent catchment and locations of rain gauges

This rainfall event led to exceptionally high river flows across the country and widespread flooding.

River Flows

The Environment Agency operates a river gauge on the River Cocker approximately 3.5km downstream of Low Lorton. This is location at NGR NY 13071 28089, and was opened in October 1967. River gauges are used to provide an assessment of river flow and are often used by the Environment Agency to determine when Flood Warnings and Flood Alerts should be issued to communities at risk of flooding. **Figure 3** shows the river flows and levels recorded at Southwaite Bridge during the 5th December 2015 flooding event.

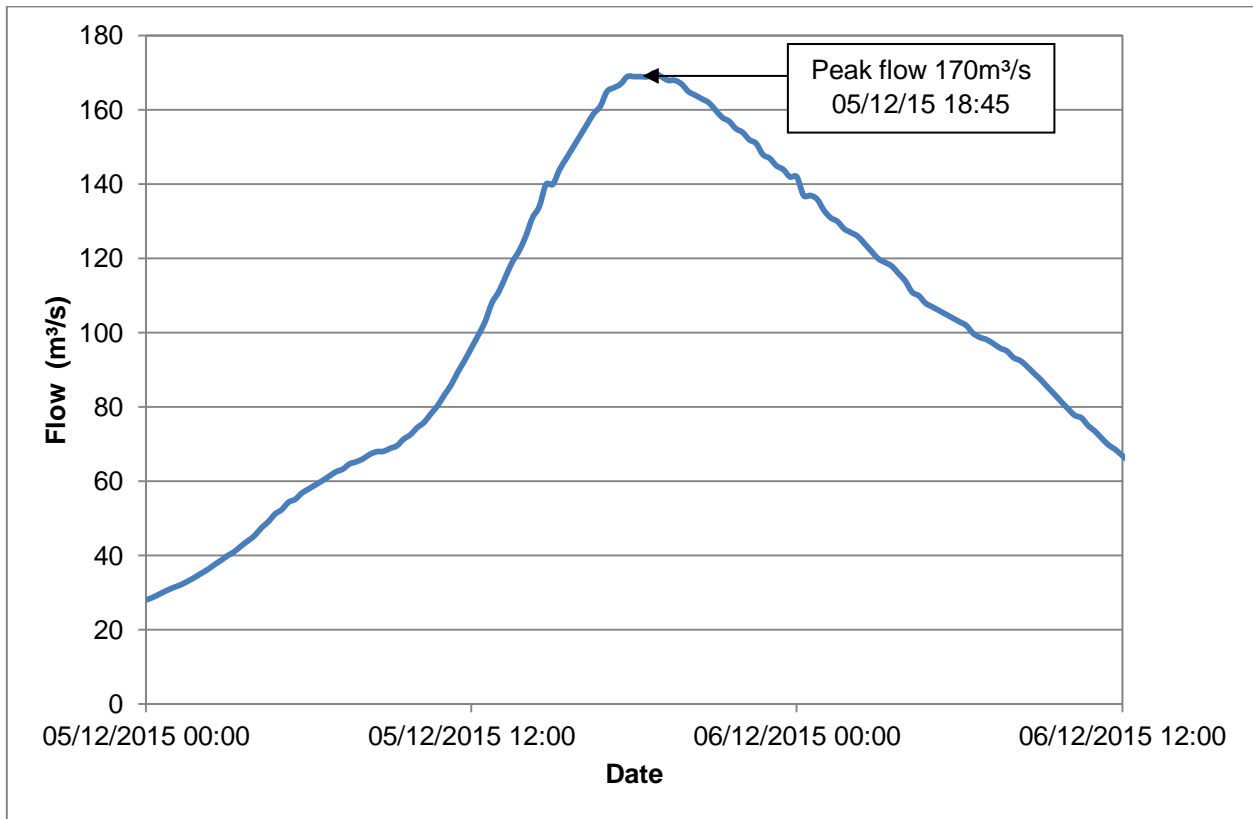


Figure 3 River Flows on the River Cocker at Southwaite Bridge, 5th December 2015

Figure 3 shows that the river flow at Southwaite Bridge peaked at 170m³/s at 18:30 on the 5th December 2015. By comparison, the 19th November 2009 flood event peaked at 201 m³/s at the same gauging station (**Table 4**).

Table 4: Flood Flows recorded at Southwaite Bridge

Gauging Station	River	Peak flow (m ³ /s)					Estimated AEP of Dec 2015 event
		Dec 2015	Past events				
			June 2012	Nov 2009	October 2008	Jan 2005	
Southwaite	Cocker	170	110	201	117	107	1%

Southwaite village, High Lorton and Low Lorton are not located within an Environment Agency Flood Warning Area. However, all three settlements are located within the Lower Derwent Flood Alert area.

Map of Flow Routes

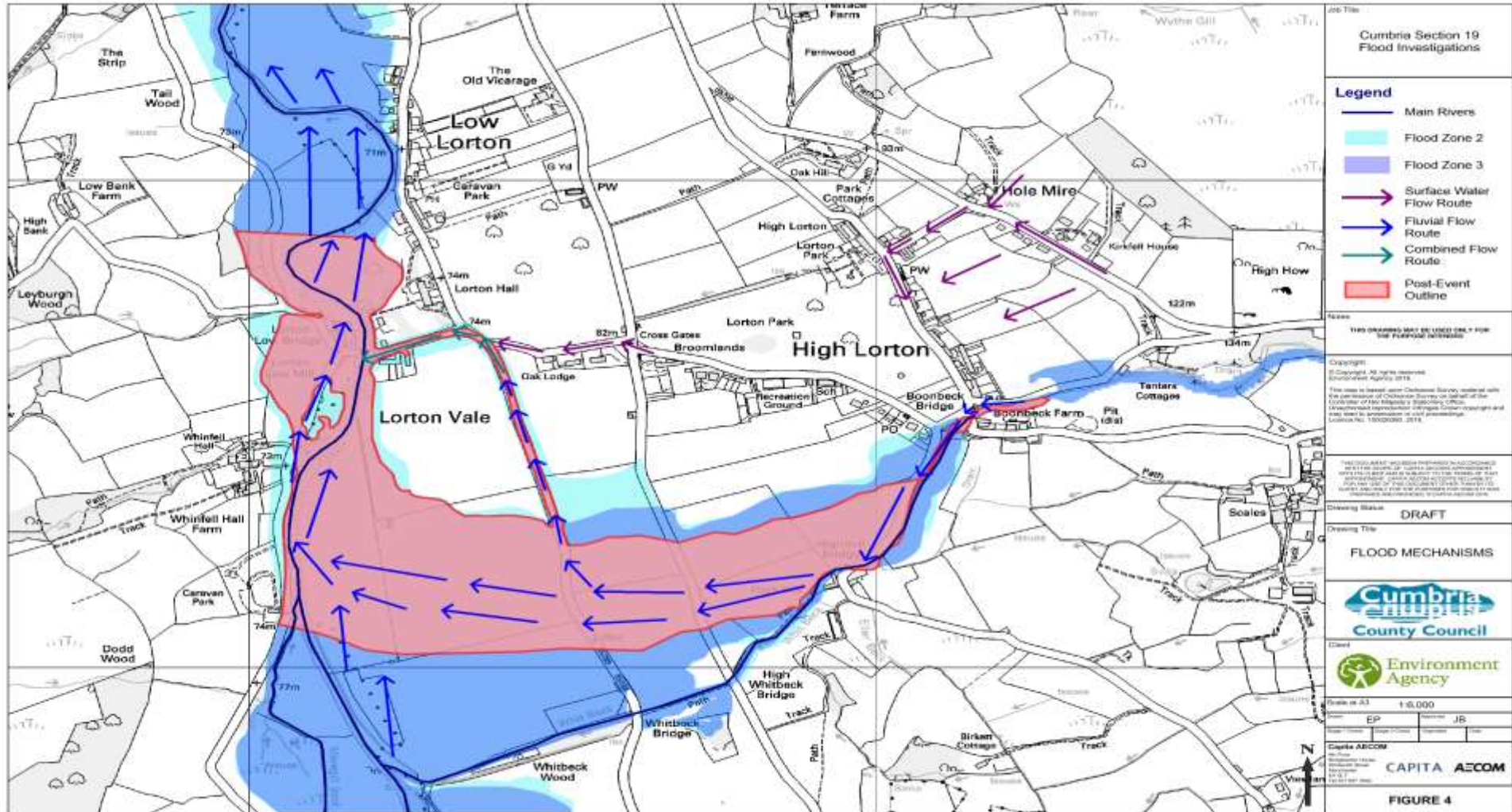


Figure 5: Map of flood flow routes *The flood outline identifies the maximum extent of flooding. Not all properties within the extent area were flooded.

Impacts and Likely Causes of Flooding

An initial post-event site visit was undertaken on the 9th December 2015 by Environment Agency staff. A secondary site visit was undertaken on the 28th April 2016 by the Capita AECOM survey team. Key features, observations and photographs from the site visit are presented in **Figure 6**.



Figure 6 Key Observations

High Lorton

The survey team initiated the site visit of High Lorton with a visual inspection for signs of property damage and other evidence of flooding. The majority of the village showed no visible signs of damage from fluvial flooding, although a number of sandbags were present outside residential properties on the main road through the village. The bridge over the Whit Beck was observed as being in good condition (**Photograph 11**), with no visible signs of flood damage. Channel scour and some structural damage was observed outside the properties upstream of the bridge over the Whit Beck (**Photograph 12**). It is anticipated that this was the result of the high velocities within the river channel during the flooding on the 5th December 2015.



Photograph 11: Bridge over the Whit Beck in High Lorton

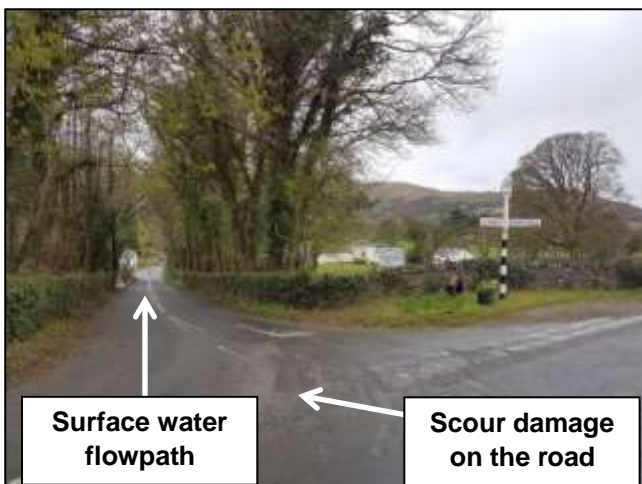
April 28th 2016, NGR NY 1614 25516



Photograph 12: Scour around properties on the westerly access road to the B5292

April 28th 2016, NGR NY 1614 25516

The surface of the second access road into High Lorton (located NGR NY 16083 25902) showed visible signs of flood damage and scour which was likely as a result of surface water from the steep valley sides (**Photograph 13**). The adjacent wall on the southern side of the road also showed signs of damage (**Photograph 14**) and improvised flow barriers to route surface water into the adjacent gullies were observed.



Photograph 13: Scoured tarmac leading into High Lorton from Hole Mire

April 28th 2016, NGR NY 1614 25516



Photograph 14: Flood damaged wall and improvised surface water flow barriers

April 28th 2016, NGR NY 1614 25516

Additional sandbags and other improvised resilience measures were observed around High Lorton and appear to have been employed to route surface water from the steep valley hillsides into the highways drainage system (**Photograph 15** and **Photograph 16**).



Photograph 15: Sandbags in High Lorton

April 28th 2016, NGR NY 15970 25922



Photograph 16: Improvised surface water flow barrier

April 28th 2016, Near to Telephone Box, Low Lorton

Low Lorton

The survey team initiated the site visit at Low Lorton with a visual inspection of Lorton Bridge. Work on this structure was completed in January 2010 following the destruction of the original stone arch in the November 2009 flooding event (**Photograph 17**). The structure was in good condition, with no visible signs of flood damage. A minor amount of gravel deposition was present beneath the span of the bridge. The channel immediately downstream of the structure was free-flowing with lightly-vegetated river banks (**Photograph 18**).



Photograph 17: Looking upstream towards Lorton Bridge from the right bank of the River Cocker

April 28th 2016, NGR NY 15179 25642

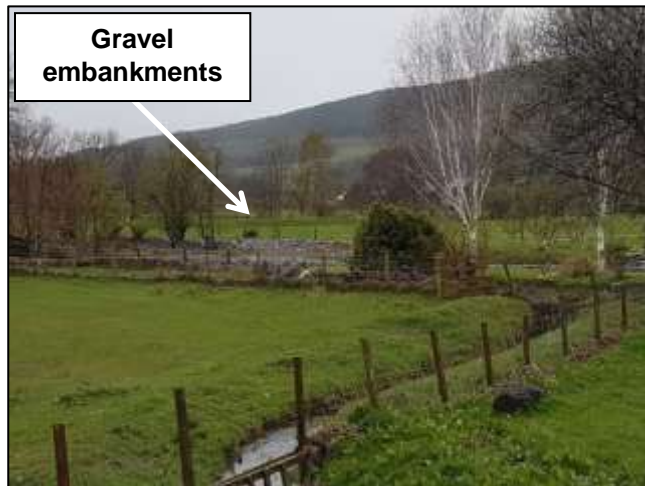


Photograph 18: Looking downstream on the River Cocker from Lorton Bridge

April 28th 2016, NGR NY 15179 25642

A series of stone embankments and bunds were observed further downstream of Lorton Bridge on the River Cocker (**Photograph 19**). These features are a result of historic gravel deposition and the excavation of dredged material from the River Cocker.

An ordinary watercourse is culverted beneath the Thackthwaite Road approximately 100m north of Lorton Bridge (**Photograph 20**). This was free-flowing and in good condition at the time of the site visit, though is understood to have become blocked and collapsed during the 5th December 2015 flood event.



Photograph 19: Gravel embankments on either side of the River Cocker

April 28th 2016, NGR NY 15179 25642



Photograph 20: Culverted ordinary watercourse

April 28th 2016, NGR NY 15109 25713

Summary of observations

An initial Based upon the information reviewed above, it is concluded that on the 5th December 2015 the flooding mechanisms in Lorton were as follows:

High Lorton

A significant volume of floodwater was routed along the Whit Beck from the upper river catchment in the Lorton Fells flooding Brewery House. This is not known to have caused any internal flooding within the centre of High Lorton. However, the river flows subsequently overtopped the right bank of the watercourse leading to flooding of the fields between High and Low Lorton. This flooding mechanism also occurred in November 2009 and is evident in **Photograph 1**.

The fluvial floodwater from the Whit Beck combined with floodwater from the River Cocker. This was partially routed in a northerly direction along the B5289. This subsequently combined with surface water flows from High Lorton and drained towards Low Lorton via the access road next to Lorton Hall.

Low Lorton

Flood flows on the River Cocker overtopped the left bank of the watercourse approximately 400m upstream of Lorton Bridge. Floodwater was consequently routed along Thackthwaite Road towards and through the residential properties adjacent to Lorton Bridge. Floodwater also outflanked the right side of Lorton Bridge, impacted on residential property, and returned to the channel on the downstream face of the structure.

In 2009 the Environment Agency undertook a hydraulic modelling study which sought to quantify the potential flood risk impacts associated with the growth of the stone bunds on either side of the River Cocker. This study concluded that the removal of the embankments may provide potential flood risk benefits around Low Lorton as these features may result in increased water levels upstream in area of Low Lorton Bridge. Whilst this was the overarching conclusion, the technical approach was strategic in scope, stated a number of modelling limitations and made a number of broad assumptions about the representation of the bunds along the River Cocker.

Given the limitations outlined above and changing morphology of the stone bunds since 2009 it is therefore recommended that additional detailed appraisal is undertaken with new topography survey of the bunds and hydraulic modelling for a range of different river flow scenarios. This study would provide a quantifiable evidence base which, if proven to increase flood risk upstream, could be used in the development of a strategic outline business case to remove the stone bunds in this area.

Recommended Actions

The following table details recommended actions for various organisations and members of the public to consider using the Cumbria Floods Partnerships 5 Themes: Community Resilience, Upstream Management, Strengthening Defences, Maintenance, and Internal Drainage Boards (IDB's). Some of these recommendations may have already been carried out and or are ongoing.

Table 2: Recommended Actions for High and Low Lorton

Cumbria Flood Partnership Theme	Action by	Recommended Action	Timescale
Community Resilience	Cumbria Local Resilience Forum *	Review and update the Community Action Plan to enable homes & business to be better prepared for flooding & reduce the impacts of flooding.	2017
	Community Resilience Network (subgroup of Cumbria Local Resilience Forum)	Support the existing the network of across the four parishes of Lorton, Buttermere, Blindboethel and Loweswater so they can better help communities prepare, respond and recover.	2017
	Environment Agency, Cumbria County Council Highways, Electricity North West and British Telecommunication	To review the flood risk and resilience of critical transport, communication, and power supply infrastructure.	2017
	Allerdale District Council, Environment Agency and Lead Local Flood Authority	Review Local Development Plans and Strategic Flood Risk Assessment to reflect current understanding of flooding.	2017
	Environment Agency	Ensure all properties at risk can register to receive flood alerts and details are up-to-date.	Complete

	Environment Agency	All Risk Management Authorities to work proactively with the local communities to improve awareness of flood risk and resilience.	Ongoing
Upstream Management	Environment Agency, Cumbria County Council, Natural England, farmers, landowners and land managers	Identify opportunities for further land management and natural flood management options to reduce flood risk across the catchment. This may also include land use changes and or flood storage	Ongoing
	Environment Agency	As part of the initial assessment (See Strengthening Defences) options for natural flood across the catchment management to reduce flood risk to people will be investigated. This may also include land use changes and or flood storage.	Ongoing
Maintenance	Cumbria County Council	Undertake a CCTV survey of the section of the collapsed culvert near Bridge End Cottage in order to determine its condition and capacity to accept future flood flows.	Completed in April 2016 by Cumbria County Council. The collapsed culvert has been repaired and blockages cleared.
	Environment Agency	Complete on-going inspections and repairs to assets, which may have been damaged during the flood event.	Inspections complete. There are no risk management assets at this location

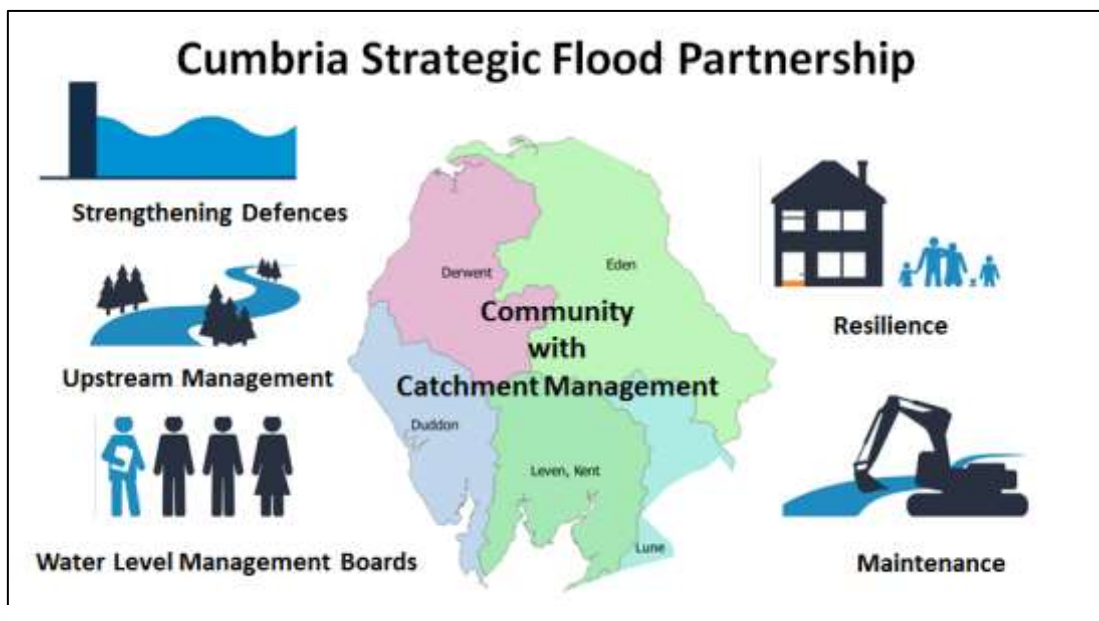
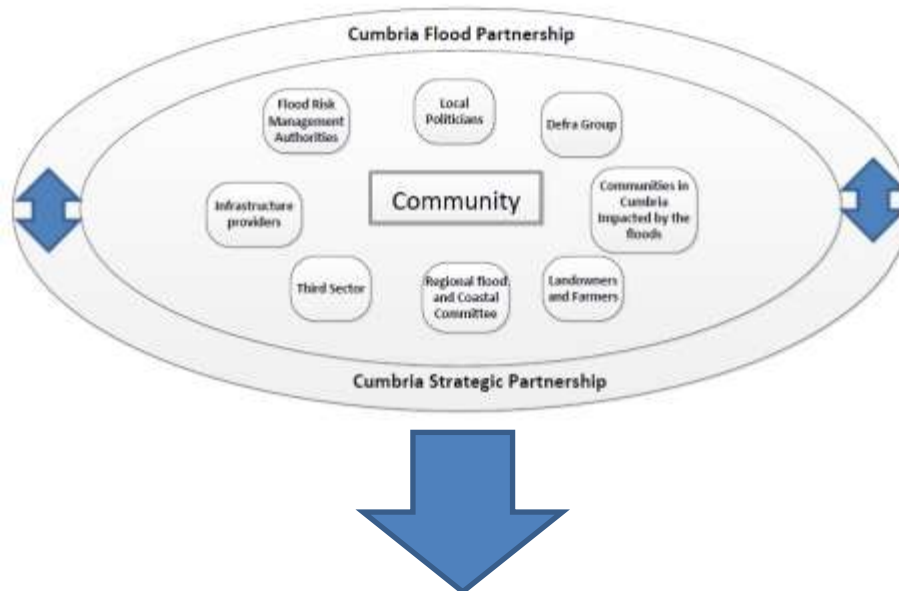
	Environment Agency	Review maintenance programme in response to the flooding events of 2015. This will include gravel/debris removal from the river channel.	Complete
	Environment Agency	Improve the published maintenance programme on the "Gov.uk website to make it easier for communities to find out what and where maintenance is planned.	2017
Strengthening Defences	Environment Agency	Review modelling data to ensure that models for the Derwent catchment reflect real conditions as accurately as possible, and use this information to make any improvements to the flood warnings service. This will also be used to inform future investment plans.	Spring 2017
	Environment Agency	Carry out an initial assessment to determine whether a flood mitigation scheme would be technically or economically feasible against Flood Defence Grant-in-Aid funding criteria.	2017
	Environment Agency	Review impact of the stone bunds either side of the River Cocker on flood risk of properties in the area of Low Lorton Bridge.	2017

* The Cumbria Local Resilience Forum includes emergency services, local authorities, Cumbria County Council, Environment Agency, Maritime Coastguard Agency and health agencies along with voluntary and private agencies. Under the Civil Contingencies Act (2004) every part of the United Kingdom is required to establish a resilience forum.

Next Steps – Community & Catchment Action Plan

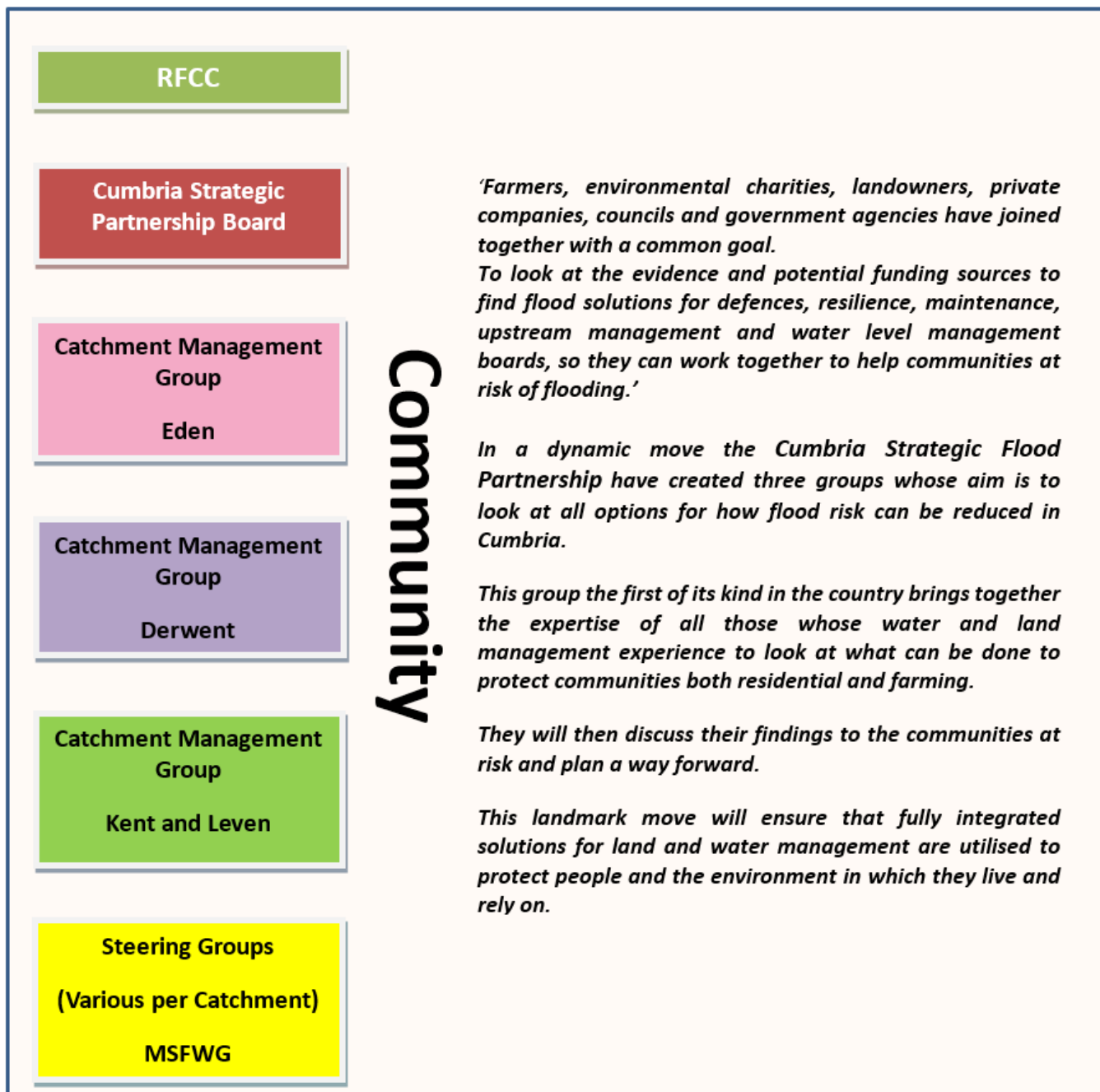
The Cumbria Floods Partnership has brought together a wide range of community representatives and stakeholders from a variety of sectors to plan and take action to reduce flood risk. The Cumbria Floods Partnership, led by the Environment Agency, is producing a 25 year flood action plan for the Cumbrian catchments worst affected by the December 2015 flooding, including Carlisle. The plan will consider options to reduce flood risk across the whole length of a river catchment including upstream land management, strengthening flood defences, reviewing maintenance of banks and channels, considering water level management boards and increasing property resilience. The Cumbria Floods Partnership structure below details how these 5 themes are being delivered in the Flood Action plans which will be completed in July.

The diagrams below helps demonstrate how the two partnerships have now come together:



Cumbria Strategic Flood Partnership





Appendices

Appendix 1: Acronyms and Glossary

Acronym Definition

EA	Environment Agency
CCC	Cumbria County Council
UU	United Utilities
LLFA	Lead Local Flood Authority
LFRMT	Local Flood Risk Management Team
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act 1991
WRA	Water Resources Act 1991

Term Definition

Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level planning strategy through which the EA works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert	A channel or pipe that carries water below the level of the ground.
De Facto Flood Defence	A feature or structure that may provide an informal flood defence benefit but is not otherwise designed or maintained by the Environment Agency
Flood Defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption)
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework

Term	Definition
	for managing surface water flood risk in England.
Flood Storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Flood Zone	Flood Zones are defined in the NPPF Technical Guidance based on the probability of river and sea flooding, ignoring the presence of existing defences.
Flood Zone 1	Low probability of fluvial flooding. Probability of fluvial flooding is < 0.1%
Flood Zone 2	Medium probability of fluvial flooding. Probability of fluvial flooding is 0.1 – 1%. Probability of tidal flooding is 0.1 – 0.5 %
Flood Zone 3a	High probability of fluvial flooding. Probability of fluvial flooding is 1% (1 in 100 years) or greater. Probability of tidal flooding is 0.5%(1 in 200 years)
Flood Zone 3b	Functional floodplain. High probability of fluvial flooding. Probability of fluvial flooding is >5%
Fluvial	Relating to the actions, processes and behaviour of a water course (river or stream)
Fluvial flooding	Flooding by a river or a watercourse.
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Inundation	Flooding.
Lead Local Flood Authority	As defined by the FWMA, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case Lancashire County Council.
Main River	Watercourse defined on a 'Main River Map' designated by DEFRA. The EA has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
River Catchment	The areas drained by a river.

Term	Definition
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Sustainability	To preserve /maintain a state or process for future generations
Sustainable drainage system	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs.
Sustainable Flood Risk Management	Sustainable Flood Risk Management promotes a catchment wide approach to flooding that uses natural processes and systems (such as floodplains and wetlands) to slow down and store water.
Topographic survey	A survey of ground levels.
Tributary	A body of water, flowing into a larger body of water, such as a smaller stream joining a larger stream.
Watercourse	All rivers, streams, drainage ditches (i.e. ditches with outfalls and capacity to convey flow), drains, cuts, culverts and dykes that carry water.
Wrack Marks	An accumulation of debris usually marking the high water line.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

Appendix 2: Summary of Relevant Legislation and Flood Risk Management Authorities

The table below summarises the relevant Risk Management Authority and details the various local source of flooding that they will take a lead on.

Flood Source	Environment Agency	Lead Local Flood Authority	District Council	Water Company	Highway Authority
RIVERS					
Main river					
Ordinary watercourse					
SURFACE RUNOFF					
Surface water					
Surface water on the highway					
OTHER					
Sewer flooding					
The sea					
Groundwater					
Reservoirs					

The following information provides a summary of each Risk Management Authority's roles and responsibilities in relation to flood reporting and investigation.

Government – DEFRA develop national policies to form the basis of the Environment Agency's and the LLFA's work relating to flood risk.

Environment Agency has a strategic overview of all sources of flooding and coastal erosion as defined in the Act. As part of its role concerning flood investigations this requires providing evidence and advice to support other Risk Management Authorities (RMA's). The EA also collates and reviews assessments, maps, and plans for local flood risk management (normally undertaken by LLFA).

Lead Local Flood Authorities (LLFAs) – Cumbria County Council are the LLFA for Cumbria. Part of their role requires them to investigate significant local flooding incidents and publish the results of such investigations. LLFAs have a duty to determine which RMA has relevant powers to investigate flood incidents to help understand how they happened, and whether those authorities have, or intend to, exercise their powers. LLFAs work in partnership with communities and flood RMA's to maximise knowledge of flood risk to all involved. This function is carried out at CCC by the Local Flood Risk Management Team.

District and Borough Councils – These organisations perform a significant amount of work relating to flood risk management including providing advice to communities and gathering information on flooding. These organisations are classed as RMA's.

Water and Sewerage Companies manage the risk of flooding to water supply and sewerage facilities and the risk to others from the failure of their infrastructure. They make sure their systems have the appropriate level of resilience to flooding and where frequent and severe flooding occurs they are required to address this through their capital investment plans. It should also be noted that following the Transfer of Private Sewers Regulations 2011 water and sewerage companies are responsible for a larger number of sewers than prior to the regulation. These organisations are classed as RMA's

Highway Authorities have the lead responsibility for providing and managing highway drainage and certain roadside ditches that they have created under the Highways Act 1980. The owners of land adjoining a highway also have a common-law duty to maintain ditches to prevent them causing a nuisance to road users. These organisations are classed as RMA's

Flood risk in Cumbria is managed through the Making Space for Water process, which involves the cooperation and regular meeting of the Environment Agency, United Utilities, District/Borough Councils and CCC's Highway and LFRM Teams to develop processes and schemes to minimise flood risk. The MSfWGs meet approximately 4 times per year to cooperate and work together to improve the flood risk in the vulnerable areas identified in this report by completing the recommended actions. CCC as LLFA has a responsibility to oversee the delivery of these actions.

Where minor works or quick win schemes can be identified, these will be prioritised and subject to available funding and resources will be carried out as soon as possible. Any major works requiring capital investment will be considered through the Environment Agency's Medium Term Plan process or a partners own capital investment process.

Flood Action Groups are usually formed by local residents who wish to work together to resolve flooding in their area. The FAGs are often supported by either CCC or the EA and provide a useful mechanism for residents to forward information to the MSfWG.

Appendix 3: Questions and Answers from Draft Report

1. **Comment:** BT should be included

Ans: The Cumbria Floods Partnership is working with utility companies to bolster the resilience of their infrastructure assets. BT is one of the group of utilities that the Cumbria Floods Partnership is working with to review the resilience of telecommunication infrastructure.

2. **Question:** The High and Low Lorton report and the 25yr plan do not show costs. How are the schemes prioritised so that the money is spent fairly and in the right place?

Ans: With regards a scheme for High and Low Lorton our recommendations are based on the 25 year Cumbria Flood Action Plan. The details of cost for specific locations, however will be subject to assessments based on estimates of cost and benefit. The benefits will be initially based on the estimated damages avoided with mitigation measures installed and the cost on solutions and most probable options. At this stage the proposal attain a partnership funding score which is used to promote the potential for a scheme in Lorton Valley and a bid is submitted for funding to develop a scheme. The steps we are taking following the flood incident investigation and the 25 year plan in High and Low Lorton involves using the DERFA guidelines for the allocation of Flood Defence Grant in Aid funding (FDGiA). Since 2012 the Environment Agency and other Risk Management Authorities have been applying the Partnership Funding policy to fund projects in England that reduce flood and coastal erosion risks. This relatively new policy, **Flood and coastal erosion resilience partnership funding** aims to achieve main objectives of offering communities the opportunity to invest in (and benefit from) local flood and coastal erosion risk management (FCERM) measures, that were not usually affordable with funding from central government alone prior to May 2011 when the government first made the announcement.

For schemes where the costs outweigh the benefits Partnership Funding offers the community the opportunity to use additional funding from external sources to make up the shortfall and have the scheme partly funded by Grant in Aid. We will submit a bid for FDGiA before the Winter 2016 and then in order to prioritise a scheme for your community we will undertake a review of the business case (Initial Assessment / Strategic Outline Case) to fund a scheme in Lorton Valley.

3. **Question** Page 2 of the report mentions flood storage – what, when & how?

Ans: Floodplains in the river valley would normally provide flood storage when there is natural connectivity between the watercourse and the floodplain. In many areas across the country and here in Cumbria features like embankments formed from spoil or built up to reduce flooding along the river banks have disconnected the floodplains from the watercourses. In order reinstate flood storage watercourse can be re-connected with floodplains so that they “operate” in the significantly large incidents like the big floods in November 2009 and December 2015 and reduce the damage and levels of flooding experienced by providing flood storage. The more natural condition of the river allows the water to come out of bank into the floodplain along the reach of the river reducing the energy of the flood water. The result is less deposition, erosion and flooding downstream to community on the riverside.

We are working with Natural England and the West Cumbria Rivers Trust to develop schemes to naturalise the river where possible. We will want to discuss these plans with riparian landowners and farmers to explain how the schemes will work and that by naturalising the rivers there will very likely to be far less flooding to people, damages to property and gravel deposition of gravel on the flood plain.

4. **Question:** How did the Whit Beck scheme affect the flooding event?

Ans: It is very likely that the re-meandered watercourse provided greater storage as a meandering river is longer than a straightened water course. We have not yet, however determined through river modelling analysis how the river restoration work has benefited the area in terms of flood risk.

5. **Question:** To what extent will the river be dredged?

Ans: Based on levels surveys of the River Cocker carried out annually over the last decade we can determine to the extent to which we need to remove gravel should the level gravel exceed established safe thresholds. The EA have carried out level surveys almost every year since 2005 as tabled below

Deliverable	Organisation	Location	Dates
Gravel survey	Environment Agency	River Cocker	2005
"	"	"	2006
"	"	"	2008
"	"	"	2009
"	"	"	2010
"	"	"	2011
"	"	"	2012
"	"	"	2013
"	"	"	2014
			2015
Gravel survey	Environment Agency	River Cocker	April 2016

The level data enables us to determine whether the cross section area of the river has reduced significantly enough to constrict flow and increase flooding. If and when the levels exceed the established safe threshold we would remove gravel. The extent to which the river will be dredged is therefore very little if any at all as we will be taking out loose material to the extent required to keep the risk of flooding to a minimum.

6. **Question:** Diverting the River Cocker?

Ans: As far as we are aware there are no plans to divert the River Cocker. We are, however, working with Natural England and the West Cumbria Rivers Trust and where there are benefits to communities in Lorton Valley in terms of reducing flood risk and enhancing the river environment proposals will be shared with the community, riparian landowners, farmers and all stakeholders likely to benefit or be affected.

7. **Question:** The report mentions that a series of repairs will be carried out before this winter. Are there any in High Lorton?

Ans: There are no flood defence assets on any of the Main Rivers through High and Low Lorton and therefore it will not be necessary to undertake any repairs.

8. **Comment:** Reference 'slow the river by 2017'

Ans: Slowing the river involves encouraging more natural processes and natural obstacles like trees and vegetation to develop in the river basin upstream of areas of risks so that the flow of water is held up and the energy and velocity of the flow dissipated. The flow downstream is reduced so that it is less destructive through more built up areas where it can have an impact on people and property.

9. **Comment:** Report needs to reflect the change to Whit Beck

Ans: We are working with the West Cumbria Rivers Trust with regards to the benefits of the restorative work on Whit Beck. With regards to the mapping of the new water course nationally variations to Main River and the changes in Whit Beck have been on hold for the last two years. DEFRA is reviewing the policy to resume the mapping of significant changes on Main River.

10. **Comment:** There is an Island building by Southwaite Bridge, can someone look at this.

Ans: Southwaite Mill Bridge is one of our sites monitored for gravel and the last survey was carried out on 3 March 2016 and the gravel levels were found to be below trigger level.

11. **Question:** In an emergency event which emergency services would come to Southwaite as in between Keswick and Cockermouth?

Ans: The emergency services operate in a network as responders and depending on circumstances the Fire and Police may also have to travel from Workington depending on availability. Cockermouth Mountain Rescue are also another possible resource as they have swift water technicians. Mountain Rescue are normally tasked by Cumbria Police and may be dispatched from either Keswick or Cockermouth. In order for the community in Southwaite to understand and plan better for emergencies the Environment Agency and Cumbria County Council can assist the community with developing a Community Emergency Plan. This plan will help the community and the emergency services to understand and be aware of the unique circumstances of the village preparing the villagers of Southwaite and the emergency services to respond accordingly.

12. **Comment:** There is a difference in the monitoring stations at Southwaite & ?

Ans: We could look at the gauge data from Southwaite Bridge and provide any explanations of what the data represents.

13. **Comment:** Upstream management – High Lorton at risk of water coming from the fells.

Ans: Upstream management is one of the methods of managing flood risk. By applying natural flood management techniques at a catchment scale the aim is to slow the flow of surface water runoff and overland flow from the area of land above the areas where the communities live. This will require the cooperation of landowners to look at ways to management uplands differently if at all possible to reduce the runoff where applicable and practicable.

14. **Comment:** Statement in the report that no properties were flooded in High Lorton was incorrect. 6 properties flooded.

Ans: This was noted and is now correct in the report. The purpose of consulting with the draft report with the community now is to gather any missing accounts and facts on the flood incident.

15. **Comment:** There is still tree debris by the bridge. This contributes to the properties that flooded.

Ans: The Environment Agency carry out post incident inspections to ensure that there are no significant obstructions that would increase flooding. The Operation team will check on locations in High and Low Lorton for obstructions on the upper reaches of Whit Beck and the River Cocker respectively.

16. **Question:** Who owns the verges and banks beside the roads?

Ans: We can look at the areas of concern to the community and to be able to answer the question and identify which area of land belong to County Highways and which belong to other landowners.

17. **Comment:** Downstream management and bunding – some farmers built up the bund which contributed to the flooding.

Ans: Across Cumbria of the years going back decades and even centuries watercourses have been modified by straightening and in some places embankments built up on the river banks. Some of this work was done before there was regulation in place requiring consent or permits to undertake river works. Unconsented work deemed to increase flood risk is something we take very seriously and riparian land owners will be first asked to remove structures deemed to increase flood risk to people. With regards watercourses that have been modified historically we are in discussions with Natural England and the West Cumbria Rivers Trust to manage land in way that does not increase flooding to people. Through schemes like the River Cocker Crag End Farm Floodplain Re-connection Project the plan is to remove embankments to improve connection of the river to the floodplain.

18. **Question** The EA doesn't have the legal powers to make land owners use land as flood plains but can the EA ask if anyone has a flood risk asset that they the EA could use?

Ans: Third Party Assets, to which you are referring, are often relied on as part of flood risk management systems. The Environment Agency are working with Natural England and riparian landowners to make the reconnection of floodplains and watercourses more attractive to riparian land owners. There are numerous environmental benefits to riparian landowners from floodplain re-connectivity. Floodplains can occasionally provide storage and have great potential for reducing flood risk in other places where people live. The Countryside Stewardship Scheme, which not all farmers are signed up for yet, can facilitate payments for "wetting up" floodplains which can be achieved by reconnecting the river with the floodplain by naturalising watercourses, removing or re-profiling raised banks.

19. **Comment:** The 2013 report created for the EA reported that if bunds were removed it would reduce the water level at Lorton Bridge by 1/2mtr

Ans: See answer above

20. **Comment:** There have been no forums to discuss incentives for land management

Ans: Under the theme of Upstream Management the Cumbria County Council as Lead Local Flood Authority aims to lead further land management opportunities with the support of Forestry Commission, Natural England, Lake District National Park, National Farmers Union, Farmers Network, Countryside Landowners Association, National Trust, Rivers Trusts and environmental non-governmental organisations. With the support of farmers, landowners and land managers increase the uptake of natural flood management measures through schemes such as Countryside Stewardship and Catchment Sensitive Farming as part of an integrated approach to managing catchment.

21. **Question:** Financial incentives – was EU funded, now what?

Ans: See comment below regarding the commitment of the Cumbria Floods Partnership to the catchment based approach of upstream management working with Natural England, the Environment Agency, farmers, landowners and all other stakeholders.

22. **Comment:** ½ the pot of money for planting trees last year wasn't used as the incentive were not good enough.

Ans: The Upstream management plan will be for the Environment Agency to work with Natural England, Iggesund and landowners in the Lorton Valley to continue to manage the landscape in a way that reduces the impact to people downstream. Upstream management is part of the Cumbria Flood Action Plan where organisations involved will continue to strive towards seeking the flood management benefits of tree planting.

23. **Comment:** Dredging needs to be carried out upstream where they are looking at the bund

Ans: In order to justify carrying out dredging we need to ensure that this type of work is technically feasible, i.e. that it will reduce the risk of flooding, environmentally sustainable, i.e. will not endanger habitat and is value for money, i.e. applying HM treasury guidelines the benefit of the work is greater than the cost

24. **Comment:** There is a manhole cover in a field, never any water in it. Appears to be blocked somewhere.

Ans: Further investigation into any associated flood risk to people and the how and whether this manhole contributes/reduces flood risk will be necessary before the authorities can justify further activity.

Appendix 4: Useful contacts and links

Sign up for Flood Warnings

<https://www.gov.uk/sign-up-for-flood-warnings>

Environment Agency – Prepare your property for flooding; a guide for householders and small businesses to prepare for floods

<https://www.gov.uk/government/publications/prepare-your-property-for-flooding>

Environment Agency – What to do before, during and after a flood: Practical advice on what to do to protect you and your property

<https://www.gov.uk/government/publications/flooding-what-to-do-before-during-and-after-a-flood>

Environment Agency – Living on the Edge: A guide to the rights and responsibilities of riverside occupiers

<https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>

Flood and Water Management Act 2010:

<http://www.legislation.gov.uk/ukpga/2010/29/contents>

Water Resources Act 1991:

<http://www.legislation.gov.uk/all?title=water%20resources%20act>

Land Drainage Act:

<http://www.legislation.gov.uk/all?title=land%20drainage%20act>

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