

Blennerhasset & Baggrow

Flood Incident Investigation Report



Blennerhasset Bridge, Cumbria

Flood Event 3rd & 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 flooding experienced in Blennerhasset and Baggrow on the 5th December 2015 was severe and was the result of the effect of Storm Desmond. This storm caused a period of prolonged, intense rainfall across Northern England, falling on an already saturated catchment, 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 Blennerhasset and Baggrow on the 3rd and 5th December, and 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.

During the 5th December flood event fluvial floodwater exceeded the capacity of the River Ellen and overtopped the adjacent earth embankments into the adjacent floodplains. River floodwater was subsequently routed through a number of properties in Baggrow. Surface water and overland flow exacerbated the river flooding in Blennerhasset, resulting in 10 properties being affected by internal property flooding in Blennerhasset to include 5 within Baggrow. A total of 21 residents between the two villages submitted reports of being affected by flooding during the incident.

13 actions have been recommended in this report to manage future flood risk in Blennerhasset and Baggrow, which will require the involvement of a number of organisations and the local community.

The main source of the flooding in Blennerhasset and Baggrow is from the River Ellen, surface water runoff from the adjacent hillside and a combination of these sources. The Environment Agency currently manages flood risk by maintaining the river channels in this area and there are some informal flood defences in Blennerhasset and Baggrow. There are no flood warning areas in the area; however there may be some properties which have signed up to the River Ellen flood watch areas.

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

Blennerhasset and Baggrow have a known history of flooding, with the following incidents within recent records. The flooding impacts and mechanisms are summarised in Table 1.

Table 1: Historic Flooding Incidents

Flooding Incident	Flooding Impacts	Flooding Mechanisms
December 1991	Four properties and the Grey Goat Public House were flooded.	Fluvial flooding from the River Ellen.
January 2005	Six properties in Baggrow were flooded.	Fluvial flooding from the River Ellen.
November 2009	Two residential properties flooded. Sports field also inundated. Roads Closed	Fluvial flooding from the River Ellen (Photograph 1). The culverted ordinary watercourse in Blennerhasset exceeded the capacity of the culverted section and resulted in overland flow through the village (Photograph 2).
Nov 2012	Road closure. No properties reported flooding.	Fluvial flooding from the River Ellen.
May 2013	One property flooded	Fluvial flooding from the River Ellen.
Frequently	Blennerhasset bridge to Grey Coat Public House Floods	Surface water/Main river

The history of flooding in Blennerhasset and Baggrow spans a period over the last 60 years with community recollection of an incident as far back as 1951. Table 1 list incidents from more detailed records from 1991 through to May 2013, with 2005 recorded as the highest flood for 30 years up until December 2015. The last major incidents in January 2005 and November 2009 affected many locations within Cumbria and details of the November 2009 incident is documented for Blennerhasset and Baggrow.

The November 2009 caused extensive flooding throughout Cumbria and two properties in Blennerhasset were flooded. Downstream of Blennerhasset Bridge, floodwaters overtopped the right bank of the river Ellen leading to flooding of a residential property. To the east of the village a minor watercourse runs in open channel before discharging into a culvert. During the flood event, the capacity of the culvert was exceeded and excess flows spilled onto the highway leading to flooding of another residential property.

November 2009

The November 2009 event was estimated to be an event with a rarity greater than 0.2% Annual Exceedence 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

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

as shown in Table 2. 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.

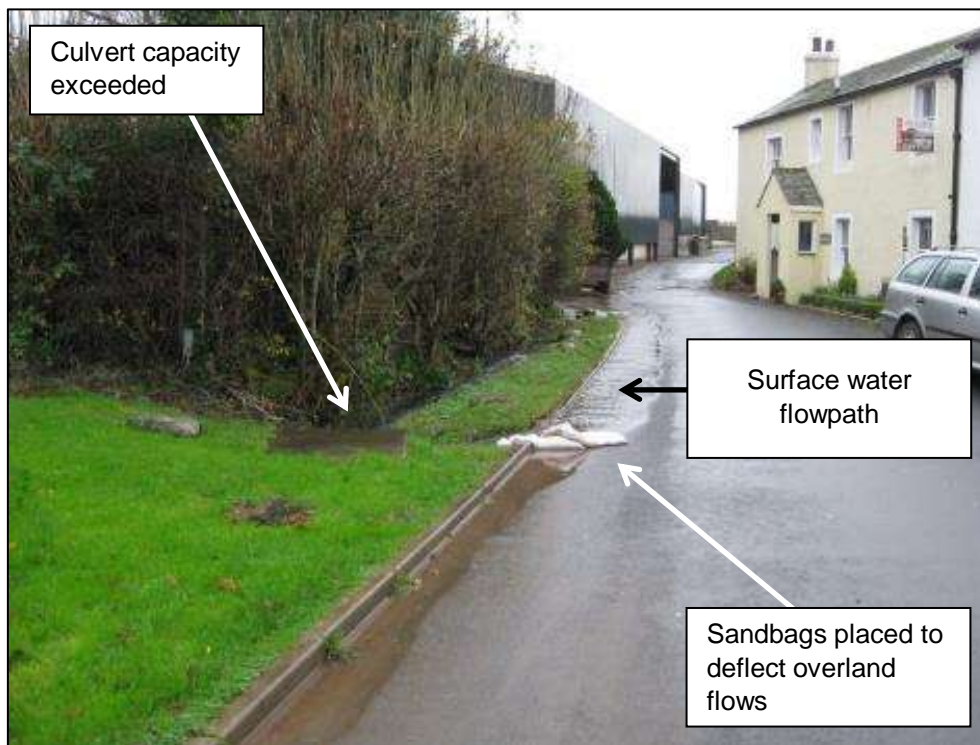
AEP (as percent)	AEP (as probability)
50%	0.5
20%	0.2
10%	0.1
4%	0.04
2%	0.02
1%	0.01
0.1%	0.001

Table 2-Probabilities of Exceedance



**Photograph 1: Flood debris on the embankment on the right bank of the River Ellen
(downstream of Blennerhasset Bridge)**

**November 2009, no timestamp,
NGR NY 17824 41682**



Photograph 2: Overland surface water flow adjacent to Ivy Cottage

**November 2009, no timestamp,
NGR NY 18001 41589**



Figure 1 Blennerhasset and Baggrow Location Map

Event Background: December 2015

This section describes what is known about the timing and extent of the flood incident in December 2015 and identifies the areas in Blennerhasset and Baggrow that are known to have flooded.

Flooding Incident

Blennerhasset is a small village in north-west Cumbria, in the Allerdale district of Cumbria northwest of the Lake District National Park. The village consists of residential properties, the Blennerhasset Primary School and East Farm. The village is surrounded by agricultural land and is located at Ordnance Survey (OS) National Grid Reference (NGR) NY178415. Blennerhasset is located on the south bank of the River Ellen which is classed as an Environment Agency Main River. The River Ellen rises out of the Uldale Fells and flows in a westerly direction towards Dearham, before flowing into the Solway Firth at Maryport.



Figure 2 Blennerhasset and Baggrow Villages on the River Ehen

The neighbouring village of Baggrow is located on the north bank of the River Ellen and consists of a small number of residential properties, farms and a public house. The village is located at OS NGR NY177419 where the River Ellen divides the two villages with the Blennerhasset Bridge linking Blennerhasset with Baggrow villages. The bridge is located at OS NGR NY 17850 41601 and situated at a sharp bend on the river and is adjacent to the Blennerhasset Primary School. A weir is located immediately downstream of Blennerhasset Bridge and a gravel shoal is located further downstream.

There are a series of privately maintained earth embankments on either side of the River Ellen at this location. The defences on the right bank of the River Ellen are approximately 550m in length and a short section is also located on the left bank adjacent to the Blennerhasset Primary School. These assets afford a low level of protection to the surrounding villages.

The Low Woodnook Beck is an Environment Agency Main River that originates from a land drainage network on the hillside south of Blennerhasset. This river system flows in a north-westerly direction towards the River Ellen where it forms a confluence at OS NGR NY 17545 41442. A site location map of Blennerhasset and Baggrow, the Main Rivers and the surrounding area is shown in Figure 2

On the 3rd and 5th December 2015 flooding occurred in Blennerhasset and Baggrow. A total of fifteen properties were reported to the Environment Agency as being affected by the 5th December 2015 flooding incident.

3rd December 2015

On the 3rd December 2015 the water level in the River Ellen began to rise in response to the initial period of severe rainfall that fell across the North-West region of Cumbria. The initial period of rainfall over the River Ellen catchment resulted in large volumes of floodwater laterally spilling into the adjacent floodplains between Blennerhasset and Baggrow villages as shown in **Photograph 3** and **Photograph 4**.



**Photograph 3: Photo from Blennerhasset Bridge looking towards Baggrow village
NGR NY 17853 41599**



**Photograph 4: Photo from Blennerhasset Bridge looking upstream
NGR NY 17853 41599**

There are no confirmed reports of property flooding on the 3rd December 2015; however floodwater came to within 2cm of a **property threshold near** the Grey Goat Public House in Baggrow village.

5th December 2015

On the 5th December 2015 severe flooding occurred in both Blennerhasset and Baggrow villages due to further severe and prolonged rainfall. This rainfall fell whilst water levels on the River Ellen were high and the catchment was still saturated from the preceding flood event on the 3rd December 2015.

Blennerhasset

During the 5th December 2015 flooding incident the River Ellen overtopped the raised embankments on this reach of the watercourse. This resulted in severe fluvial flooding around the meander at Blennerhasset Bridge. Floodwater flowed through the rear yard of the Blennerhasset Primary School which resulted in flood damage to the school's log cabin, though the water did not ingress into the main school building.

On the west side of the Blennerhasset Bridge fluvial floodwater inundated the sports field and Environment Agency post-event flood survey indicates that this may have also impacted upon the associated pavilion. During the peak of the flooding incident some fluvial floodwater routed past the Blennerhasset Bridge in a westerly direction along the main road (**Photograph 3**). This is anticipated to have combined with surface water contributions from the east side of the village.



Photograph 5: Floodwater flowing down the main road towards Cross Cottages, looking west from Blennerhasset Bridge

**5th December 2015, no timestamp,
NGR NY 17852 41592**

Floodwater flowed along the main road was subsequently routed towards the Low Woodnook Beck (as shown in **Photograph 6** and **Photograph 7**).



Photograph 6: Floodwater flowing down the main road, looking east

**5th December 2015, no timestamp,
NGR NY 17807 41519**



Photograph 7: Floodwater flowing down the main road, looking west

**5th December 2015, no timestamp,
NGR NY 17807 41519**

To the east of Blennerhasset a small ordinary watercourse runs in open channel before entering a culvert. The culvert capacity was exceeded and the excess flows were routed down the main road towards the centre of the village. This overland flow impacted on residential property and combined with the fluvial floodwater from the River Ellen.

Additional resident reports indicated that additional flooding occurred on the southern side of Blennerhasset village.

Baggrow Village

On the right bank of the River Ellen floodwater overtopped the embankments upstream of Blennerhasset Bridge, impacting on five residential properties. This floodwater flowed across the floodplain and onto the main road, flooding the lowest point in front of the residential properties located between Blennerhasset Bridge and The Grey Goat Inn. Consequently, two empty buildings including the Grey Goat Inn were flooded.



Photograph 8: Looking towards Baggrow village from Blennerhasset Bridge

**5th December 2015, no timestamp,
NGR NY 17851 41596**



Photograph 9: Looking towards Baggrow village from Blennerhasset

**5th December 2015, no timestamp,
NGR NY 17838 41573**

To the north of Blennerhasset Bridge, one property was completely surrounded by floodwater but not initially flooded from the river but by ground water when the drains nearby by were overwhelmed. This was reported as being approximately 5cm over the ground floor and receded by 07:30 on the 6th December 2015. A Baggrow resident advised that floodwater entered their property at approximately 16:00 and receded by 22:30 on the 5th December 2015. The resident reported that floodwater flowed from the fields east of Baggrow which then subsequently flowed around the property and discharged underneath the rear fence before returning to the River Ellen.

An approximate timeline for the flooding incident at Blennerhasset and Baggrow is shown in **Table 3**.

Table 3: Flood Incident Timeline

Time	Impact
5 th December 00:00	Water levels begin to rise in the River Ellen
5 th December 07:00	Water level peaks and begins to temporarily subside
5 th December 10:00	Water level begins rising again, exceeding the previous peak level
5 th December 16:00	Confirmed property flooding in Baggrow
5 th December 17:15	Water level reaches peak on the River Ellen
5 th December 22:30	Final report of flooding receding at Baggrow

Flood Investigation

This section of the report provides details of the rainfall event that caused the flooding 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 3rd to the 5th 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.

The 24 hour rainfall totals for various points across Cumbria are shown in **Table 3**.

Table 4: Cumbria 24 Hour Rainfall Records in December 2015

Location	December 2015 Event
	mm
Seathwaite	214.0
Honister Pass	341.4
Scalebeck	147.6
Skelton	137.8
Thirlmere	324.8
Brotherswater	293.4
Aisgil	105.7
Quarry Hill	35.6
Abbeytown	39.8

The Environment Agency operates a river gauge on the River Ellen at Bull Gill village. This gauging station is located approximately 6 miles downstream from Blennerhasset and Bagrow. The station was opened in January 1975.

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 during the 5th December 2015 flooding incident.

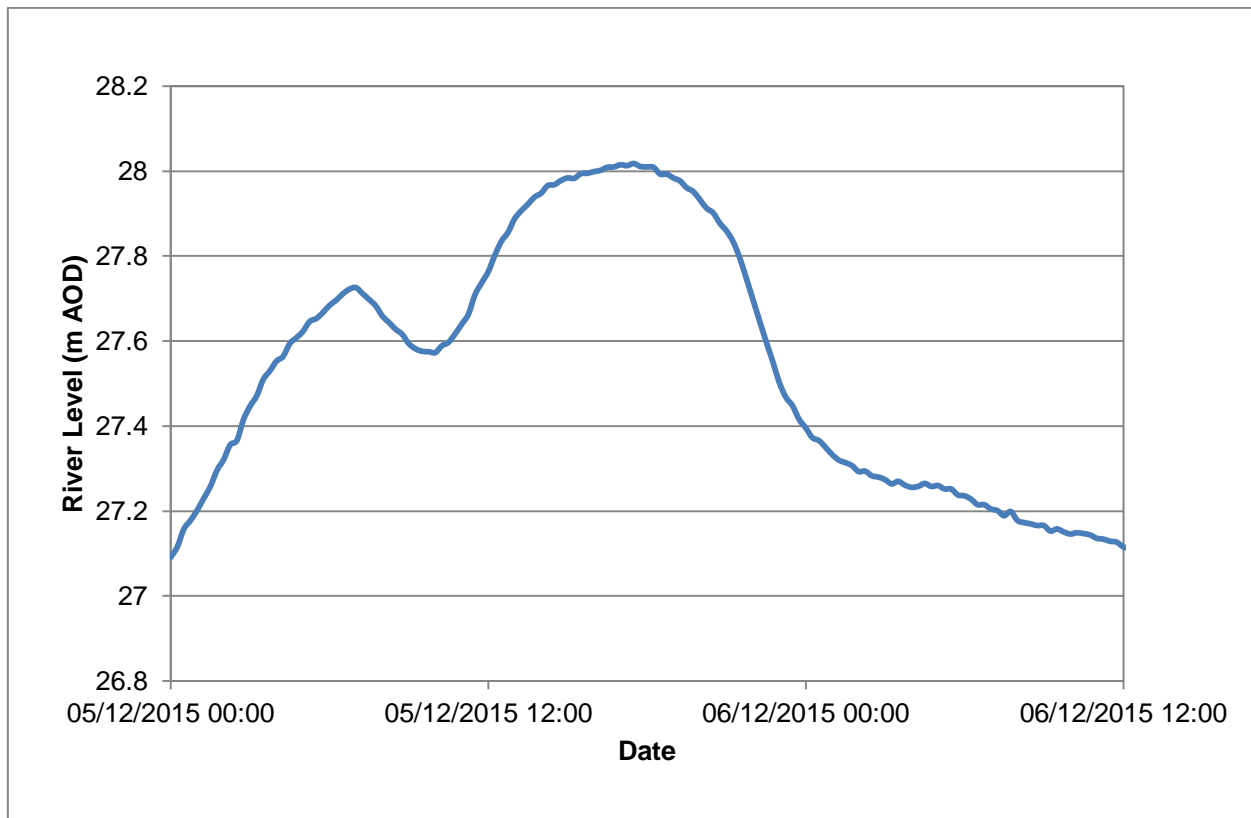


Figure 3 Recorded Water Levels on the River Ellen at the Bull Gill Gauging Station

Figure 3 shows that the water levels on the River Ellen progressively rose over a 17 hour period on the 5th December 2015. River levels initially peaked at 27.7m at 07:00 and began to temporarily subside before the secondary peak which occurred at 17:15m to a level of 28m. This is the highest recorded level at this Gauge Station since the last high level recorded in 2005.

Existing Flood Defences

The existing defences within Blennerhasset consist of earth embankments. The defences on the right bank of the River Ellen are approximately 550m in length and a short section is also located on the left bank adjacent to the Blennerhasset Primary School.

The Standard of Protection (SoP) that these embankments provide to the area is not established.

Impacts and Likely Causes of Flooding

An initial site visit was undertaken by Environment Agency staff on 16th December 2015 following the flooding incident. A further site visit was undertaken on Tuesday 26/4/16 by the Capita AECOM survey team. The weather was clear and sunny. The survey team initiated the site visit with a visual inspection of Blennerhasset Bridge, the adjacent floodplain and neighbouring residential properties.

Key features, observations and photographs from the site visit are presented in Figure 4 (overleaf).

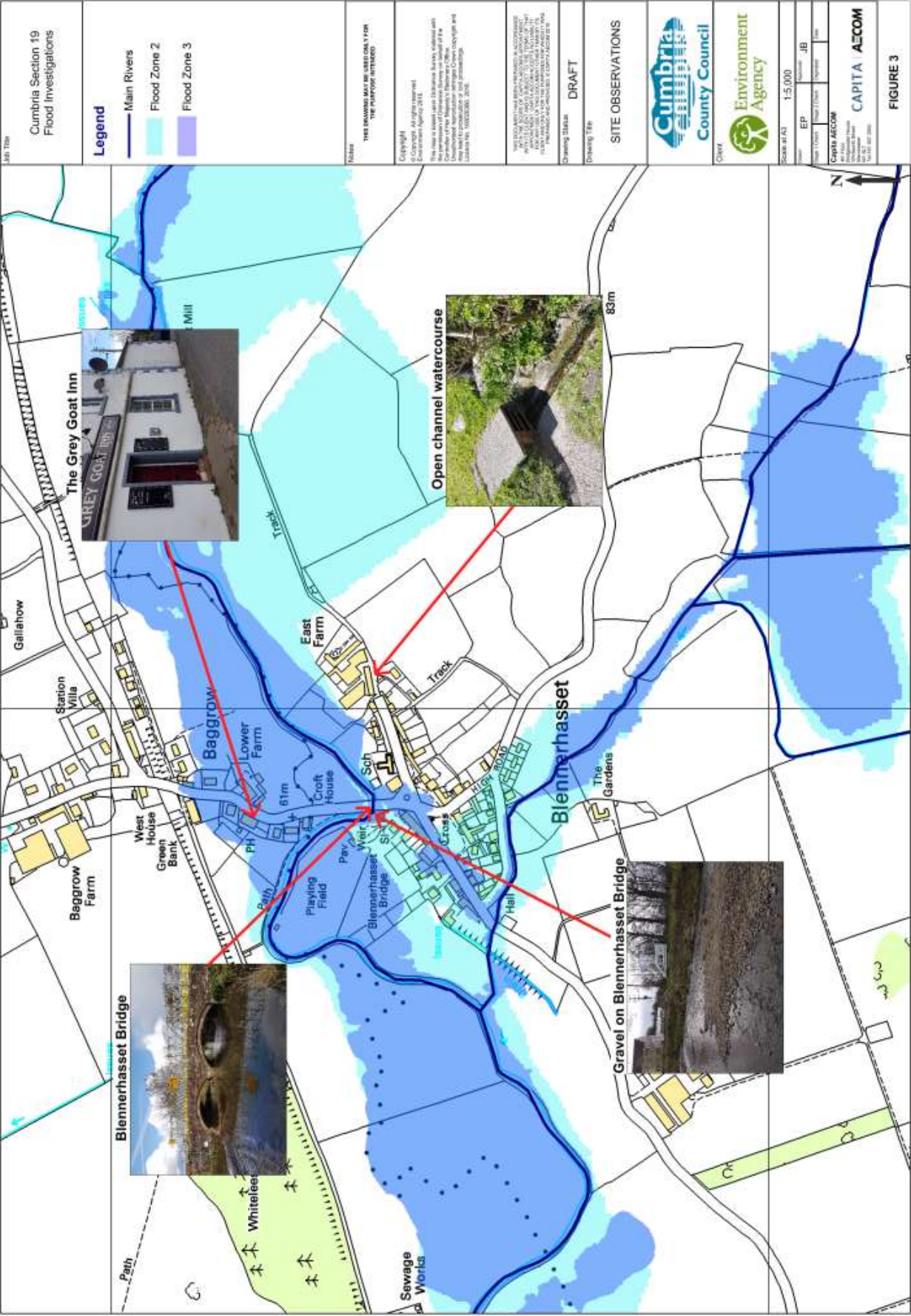


Figure 4 Key Observations

Blennerhasset Village

The survey team initiated the site visit with a visual inspection of Blennerhasset Bridge. Major remedial works on the structure were being undertaken on behalf of Cumbria County Council and the main road was closed to vehicular traffic (**Photograph 10**). Remedial work that had started in August 2015 was being extended as a result of damage that occurred during the 5th December 2015 flooding incident to address the presence of a large void (**Photograph 11**) beneath the structure and localised scour around the pier.

A moderate gravel shoal was observed in the river bed downstream of Blennerhasset Bridge (**Photograph 12**). This feature has been established within the watercourse for over a decade and has varied in size with seasonal variations in river flow and sediment load. The gravel shoal was previously assessed by the Environment Agency to determine if it increases flood risk locally. Our assessment from the 2010 study revealed that the gravel shoal did not increase flood risk. The assessment also recommended that we should continue to manage vegetation growth which is in the current maintenance programme. (River maintenance records from Ellen)



Photograph 10: Remedial works on Blennerhasset Bridge

26th April 2016, no timestamp,
NGR NY 17852 41587



Photograph 11: Temporary works around the void beneath Blennerhasset Bridge

26th April 2016, no timestamp,
NGR NY 17834 41617



Photograph 12: Gravel shoal (Erosion evident)

**26th April 2016, no timestamp,
NGR NY 17831 41624**

Wrack marks were observed at a number of locations around the bridge, adjacent floodplain and area around the residential properties.

A visual inspection of the unnamed ordinary watercourse on the main road next to East Farm was undertaken. The watercourse was observed to have a small amount of flow, though the preceding weather had been dry. The watercourse is culverted from OS NGR NY 18001 41589 and the culvert inlet has restricted capacity (**Photograph 13**). The capacity structure has been exceeded historically (**Photograph 2**) and resulted in overland flow routing down the road towards the centre of Blennerhasset (**Photograph 14**). There is limited highways drainage at this location.



Photograph 13: Culvert inlet on the unnamed ordinary watercourse

**26th April 2016, no timestamp,
NGR NY 18001 41589**



Photograph 134: Looking east on the main road towards East Farm

**26th April 2016, no timestamp,
NGR NY 17884 41557**

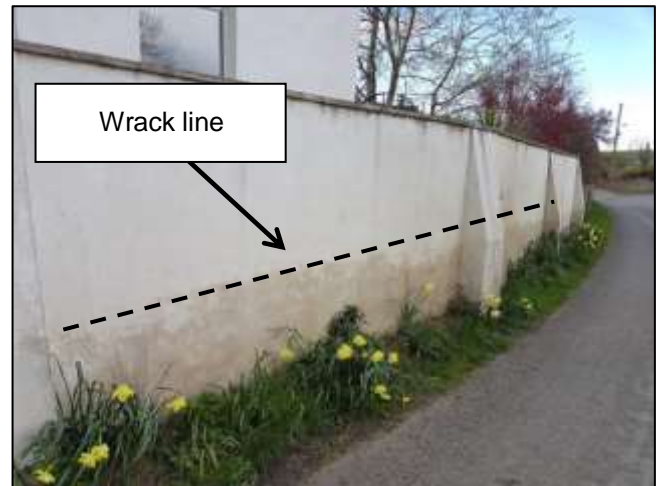
Baggrow Village

The team undertook a visual inspection of the main road and the adjacent residential properties north of Blennerhasset Bridge. The topography is relatively flat, with a slight uphill gradient towards the Grey Goat Public House. The properties nearest the River Ellen are well above the road level (**Photograph 15**) and still flooded despite local resilience measures being taken at one of the houses. A wrack line was observed on the easterly boundary wall that is adjacent to the properties (**Photograph 136**). Some of these properties were flooded internally while others were protected by floodgates and other measures of property level protection by the 5th December 2015 flooding event.



Photograph 145: Looking north towards residential properties in Baggrow

26th April 2016, no timestamp,
NGR NY 17842 41680



Photograph 156: Wrack line from fluvial flooding on the main road through Baggrow

26th April 2016, no timestamp,
NGR NY 17840 41707

The Grey Goat Public House showed signs of flood damage (with sandbags still installed), as did a number of other residential properties at this location (**Photograph 17**).



Photograph 17: Sandbags at the entrance of the Grey Goat Inn

26th April 2016, no timestamp,
NGR NY 17840 41785

Based upon a review of the site observations, local resident photographs and the Environment Agency flood event data it is concluded that the flooding mechanisms at this location are primarily a result of Main River fluvial flooding and surface water from agricultural land.

During 5th December 2015 flood event floodwater within the River Ellen exceeded the capacity of the river channel and overtopped the earth embankments, filling the adjacent floodplains. This combined with surface water resulted in internal flooding of 15 residential properties between the two villages.

Blennerhasset Village

High water levels in the River Ellen overtopped the short reach of flood embankments near the Blennerhasset Primary School. These flows were subsequently routed towards the central roundabout and combined with floodwater from the unnamed ordinary watercourse near East Farm. This feature resulted in the generation of a large amount of overland flow as the culvert capacity was exceeded and excess flows routed down along the road towards the centre of the village.

Run off from agricultural land to the south of East End Cottages flowed down the road, contributing to the build-up of surface water flow along the main road. This overland flow continued to flow along roads before finding its way back into the River Ellen. Overland flow also continued to flow along roads in a westerly direction, past Village Green, before discharging into the watercourse Low Woodnook Beck.

Additional resident reports indicated that the flooding occurred on the southern side of Blennerhasset which resulted in the flooding of two cottages, was an issue of agricultural land runoff upstream of High Road, routing towards the centre of Blennerhasset from south to north.

Baggrow Village

High water levels in the River Ellen overtopped a significant length of the flood embankments on the right bank of the River Ellen upstream of Blennerhasset Bridge. Floodwater inundated this area of agricultural floodplain, before being routed by the topography towards the Lower Farm and residential properties on the main road. Flow was then routed around the properties, flooding several of them before ultimately re-joining the River Ellen downstream of Blennerhasset Bridge. Ground water flooding also occurred in this location

The various flooding mechanisms across Blennerhasset and Baggrow are illustrated in Figure 5 overleaf

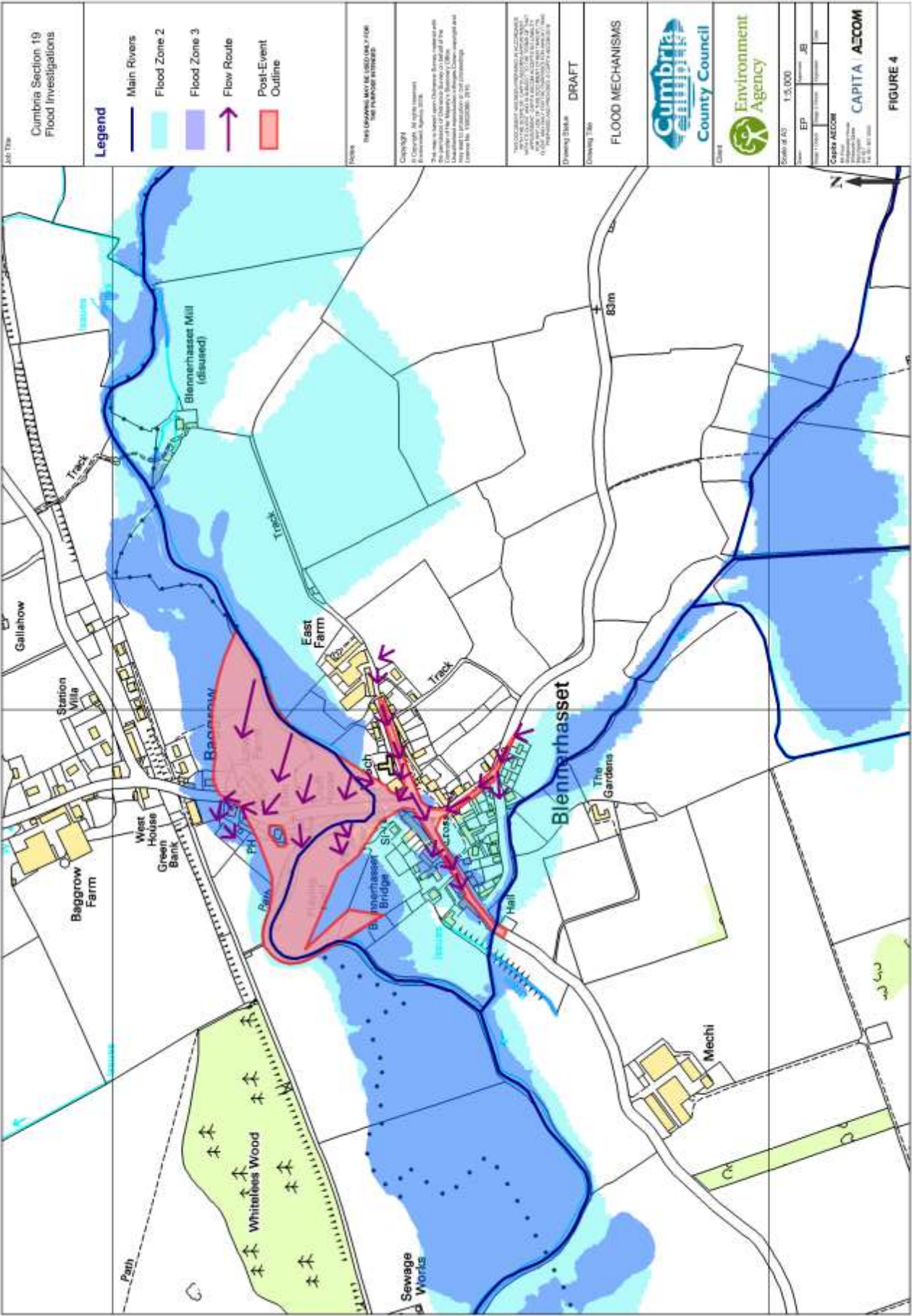


Figure 5 Flooding Mechanisms

Recommendations

Table 2 details recommended actions for various organisations and members of the public to consider.

Cumbria Flood Partnership Theme	Action by	Recommended Action	Timescale
Strengthening Defences	Cumbria County Council Highways and United Utilities	Work with United Utilities and Cumbria County Highways to minimise the impact of sewer and highway flood risk in the area.	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
	Cumbria County Council Environment Agency	Review the role that bridges play in flood risk and their vulnerability during a flood	2017
Maintenance	Environment Agency	The Environment Agency will continue to carry out weed control on the River Ellen through the village.	Ongoing
	Cumbria County Council/Riparian Landowner	Cumbria County Council and County Highways to work with riparian landowners to CCTV survey culverts on a section of the unnamed ordinary watercourse adjacent to East Farm. Where necessary the respective landowners should undertake maintenance.	2017
	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

Community Resilience	Cumbria Planning Group, Allerdale District Council	Review Local Development Plans and Strategic Flood Risk Assessment to reflect current understanding of flooding.	2016
	Environment Agency, Cumbria County Council Highways, and Electricity North West	To review the flood risk and resilience of critical transport, communication, and power supply infrastructure.	Autumn 2016
	Cumbria County Council, Environment Agency	Community flood groups: Cumbria County Council and the Environment Agency to work with residents to form a flood action group comprising of members of the community. The community will be represented by volunteers from the community to act as key persons on matters of flood risk.	2017
	Community Resilience Network (subgroup of Cumbria Local Resilience Forum)	Establish a network for community flood action groups and community action groups across the county so they can better help communities prepare, respond and recover.	2017
	Community Resilience Network (subgroup of Cumbria Local Resilience Forum)	Support the community and flood action group to develop a Community Action Plan. Arrange to assess how effectively and efficiently the emergency response agencies and communities are working together with this plan.	2017
Upstream Management	Environment Agency	As part of the initial assessment (See Strengthening Defences) options for natural flood management across the catchment to reduce flood risk to people will be investigated. This may also include land use changes and or flood storage.	2017/18
	Environment Agency and Natural England	Investigate the feasibility of weir removal, re-meandering channels and reconnecting rivers to the natural flood plain as part of the Cumbrian River Restoration Strategy.	By 2021

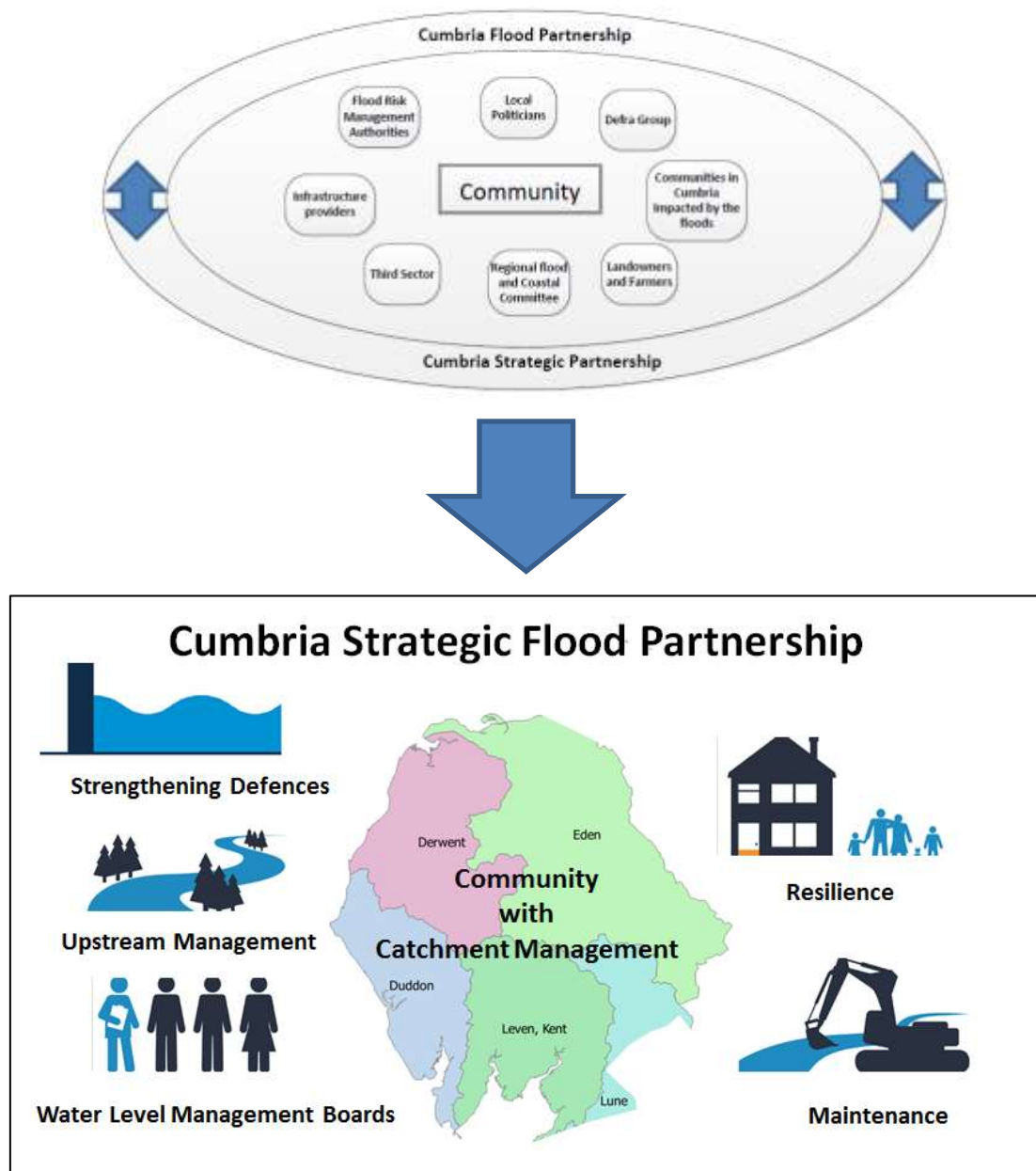
Table 2: Recommended Actions for Blennerhasset and Baggrow

*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

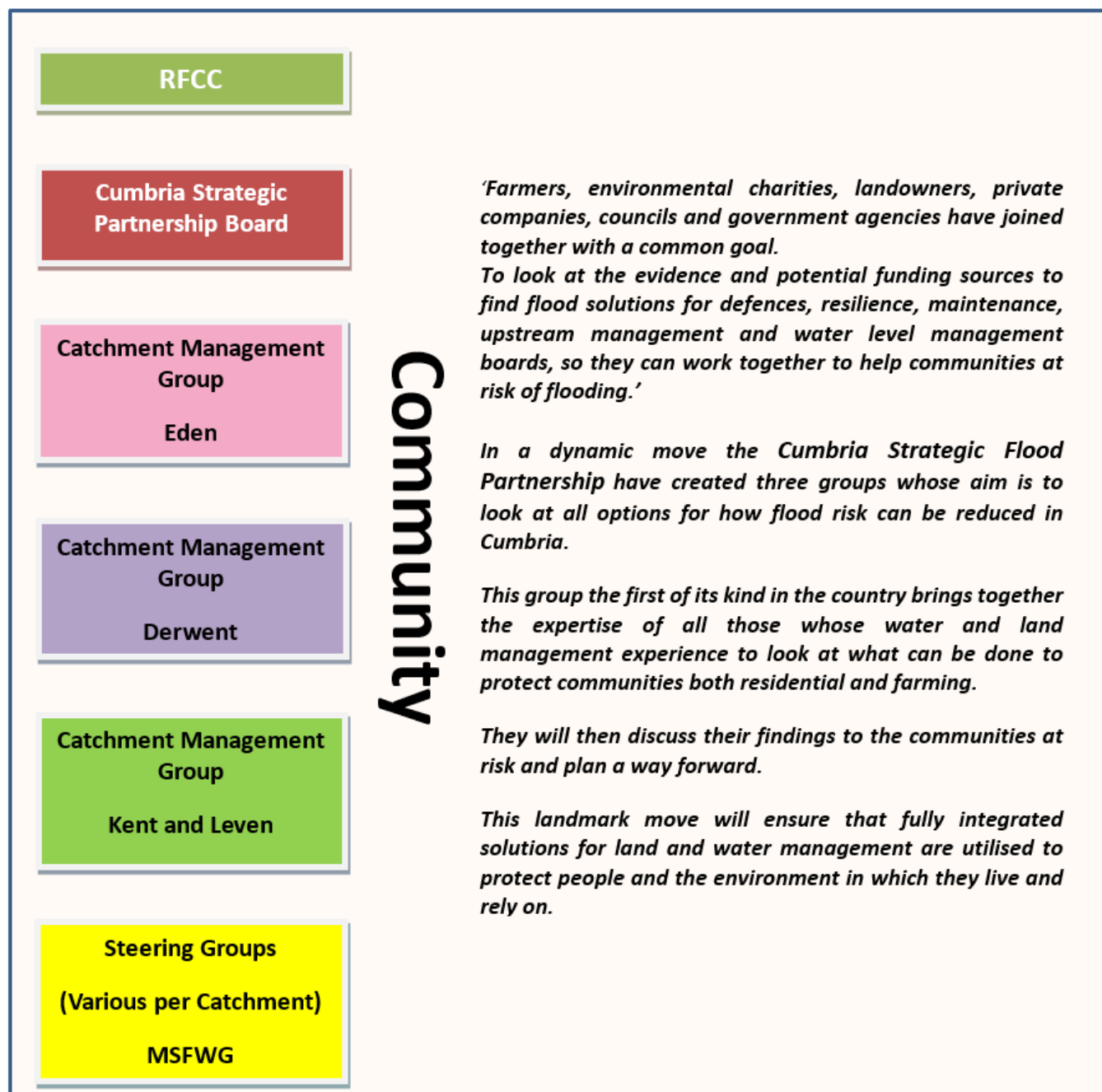
The Cumbria Floods Partnership has brought together a wide range of community representatives and stakeholders from a variety of sectors to plan and take action to reduce flood risk. The Cumbria Floods Partnership, led by the Environment Agency, is producing a 25 year flood action plan for the Cumbrian 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 help 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
LLFA	Lead Local Flood Authority
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 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

Term	Definition
	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 Cumbria 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.
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 way as to pipe and manhole.

Term	Definition
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 meeting

- Gravel Removal :
 - Where EA have evidence there is a flood risk they will dredge. If community disagree they can dredge themselves. Currently EA does not believe levels pose a flood risk.
- Wasted resources: lack of coordination results in necessary measures not done.
 - We understand the frustration but the highways team and divers who are reconstructing the bridge are not responsible for gravel removal and cannot respond to random requests by members of the public. As previously discussed the EA does not believe the levels pose a risk
- School (5x flooded) wall and footway: CCC to discuss with property dept. to ensure assessment done and ensure it is safe.
 - Divers comments are as follows,

We inspected the school wall on 11th January 2016 and found the wall to be in a satisfactory state with active scouring against the wall which had scoured the natural bank away exposing the wall but the foundations to the wall had not been undermined. The only recommendation we would make to protect the wall footings would be to place scour nets or rock armour against the wall.
- The effects of rocks under the arch of the bridge : Doug to come back and investigate
 - Additional diver repairs carried out (after one failed attempt) and majority of rip rap removed from invert and rock rolls placed under arch in dished configuration resulting in bed depth under arch being lower than both u/s and d/s river bed level.
- Highway flooding and the impact on Emergency services access to village: Discussions with landowners (culverts/drains blocked), CCC will inspect & survey, AH meeting with PC, Planned maintenance Feb in this area.
 - Highways are to carry out works at Gowrie cross roads and cctv has found a blocked culvert in this vicinity. There are also works planned between Gowrie and the old railway line. The culvert at East farm has been checked and tonnes of gravel removed from the pipework. The issues at Low wood nook are being worked on and there is already a smoot hole in the hedgerow so the water cannot build up to previous depths, this can hopefully become formalised.
- Property next to Public House is the low point :
 - AH flooded from river not drains, this part of the highway is flood plain and will always be at risk during flood conditions.
- Vegetation Management not done
 - The EA have suggested that they are happy to share the vegetation management plan with residents or parish councils.
- How will the outcomes of discussions with stakeholders be fed back:
 - Final report & presentation. Community Action Plan to be developed and constant liaising with parish councils.
- What happens if floods again in Jan 2017?
 - Thankfully this has not happened but it is important to make properties more resilient to further flooding (grant money must be applied for by the end of March).
- Baggrow floods 3-4 times a year on Highway
 - The road on the Baggrow side of the bridge is in flood zone 3 and will always be susceptible to fluvial flooding. However new measures being explored by the catchment management group regarding upstream slow the flow and attenuation measures could see the current situation being improved.

- School: was inspected in January but no report seen (lost a classroom)
 - See above comments from divers e mail.
- Grey Goat 2x flooded.
 - Again the pub is in flood plain, hopefully upstream measures will improve the situation here. Is it possible to provide a flow route through the garden of the pub ?
- Driver safety: Danger as Highway floods up to vehicle rooves
 - See above, liaise with parish as to possibility of depth markers at this location.
- Check Culvert capacity on Main Road
 - Culvert has been cleaned at East farm. Highway drains and sewers are not designed to withstand a storm of such magnitude hence a large amount of surface water. There has been no reports of blocked or surcharging drains since the Storm Desmond event. The village has recently had its programmed clean.
- Upstream Management on River Ellen what is being done?
 - As previously suggested a Catchment management partnership group has been set up with 25 year plans looking at upstream management and natural realignment.
- 2 Garth Cottages drain blocked.

Drain has been checked and was not blocked, there is very little threshold between the kerbed highway and the property threshold, this is being looked at with a possibility of heightening the kerbs.
- Weir removal: in recommendations to investigate
 - LLFA, rivers trust and EA will explore suggestion this year.
- Low farm Multiple flooding
 - AH to check and advise.

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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