

Workington including Barepot and Camerton

S.19 Flood Investigation Report



Barepot and Hall Park View, Workington 6/12/15

Photograph provided by Peter Smith Photography. Taken 06/12/2015 12:45

Flood Event 5-7th 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.

Version	Prepared by	Reviewed by	Date
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Executive Summary

Workington, Barepot and Camerton experienced severe flooding on the 5th, 6th and 7th of December 2015 during and after 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. The flow in the River Derwent on the 6th December was the highest flow ever recorded, with the previous record set in the November 2009 floods. Record levels were also observed in Derwentwater and Bassenthwaite Lake.

In response to the flood event, this 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, 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 Workington on the 5th, 6th and 7th of December 2015 and has used a range of data collected from affected residents, site visits, surveys of the area, and data collected by observers, along with river and rainfall telemetry during the flood event.

Within the Hall Park View area, 32 residential properties, the Cricket club, Bowling club, and the Cumbria Constabulary West Area Headquarters were reported as having suffered internal flooding. The flooding in Hall Park View was from the River Derwent and via Soapery Beck, a millrace from the River Derwent. Hall Park View does not benefit from any flood defences.

Some properties in Barepot benefit from Environment Agency constructed defences, and some from personal property level protection. Not all properties are protected. Ten properties were reported as being internally flooded in Barepot from Gale Brook, the River Derwent and/or via overland flow into Barepot Reservoir. Defences in Barepot leaked and were outflanked due to the high river levels. The rapid response and actions of the local residents blocked off a flow route which would have led to much greater volumes outflanking the defences. No defences were breached, and defences are seen to have reduced damage and delayed the onset of flooding, allowing residents additional time to prepare and reduce the impact of the flood.

One property in Camerton was reported to have suffered internal flooding from the River Derwent and via overland flow, with flooding exacerbated in this location by the backing up of water around Myers Bridge which was blocked up during its infilling following the November 2009 flood.

Please note that references to left and right bank are taken looking downstream with the flow of water.

Seventeen actions have been recommended in this report to manage future flood risk. These will require the involvement of a number of organisations and local communities. These include a review of the performance of the Barepot defended line in order to identify any areas that can be improved. This review will also include potential improvements to processes such as flood warnings and recovery. This review is being undertaken by the Environment Agency separately to this report.

In response to the flooding, community meetings have taken place, and these will continue in order to ensure that all those affected are given the opportunity to be involved in reducing the flood risk to the town.

Any additional information that can be provided 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. Any additional information should be provided to;

The Flood Investigation Report

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-7th 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:

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

Introduction

Geographical Setting

Workington is a port town, with a population of approximately 28,000, located at the mouth of the River Derwent on the West Coast of Cumbria. The River Derwent catchment extends to 617km² and includes the tributaries of the Rivers Marron, Cocker, Greta, and Glenderamackin. The catchment also includes the lakes, Thirlmere, Derwentwater, Bassenthwaite, Buttermere, Crummock Water and Loweswater. The towns of Keswick and Cockermouth are located on the Derwent, upstream of Workington, see **Figure 1**.

Workington and the surrounding area has a significant industrial history. Industrial working has had a significant impact on the topography and geomorphology of the landscape as a result of levelling, building, reinstatement and the construction of infrastructure including railway embankments. More recent changes to historic infrastructure, such as the infilling of Myers Bridge near Camerton, may impact on the flow regime of the watercourses during flood events.

The River Derwent passes to the north of Workington town centre which is on high ground. Historically water was diverted from the River Derwent into mill races using a number of weirs. The Yearl weir diverts water to Workington Mill, this mill stream becomes Soapery Beck. The Coops weir was designed to feed Salmon Hall Mill, Seaton Mill and Barepot reservoir via a series smaller weirs and sluices. These mill races, although now currently unused by industry, still provide waterways through residential areas.

Gale Brook drains the area north of Barepot, and flows through the fields on the River Derwent floodplain to the north-east of Barepot. The watercourse flows under the millrace supplying Barepot reservoir before flowing through Barepot itself. Gale Brook flows in an open channel in part with sections of culvert before discharging into the River Derwent near Crossings House.



Figure 1: Location plan of Workington and the wider catchment

Flooding History

Prior to the 2009 flood event, Hall Park View, Barepot or Camerton had no history of flooding from the River Derwent. The November 2009 flood 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 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

At the time, the November 2009 event produced the highest recorded flow in the River Derwent. It occurred following torrential rainfall with one month of average rainfall falling on the 19th November 2009. Prior to 2009, modelling was completed to produce a flood map to show the limit of the predicted 1% AEP flood extent. Both the 2009 and 2015 events have exceeded estimates and have changed the nature of the river corridor through erosion and deposition.

In November 2009, the flooding from the River Derwent resulted in significant damage to the A596 Workington (Calva) Bridge and the destruction of the A597 New Bridge and Navvies Bridge. The collapse of the A597 New Bridge resulted in the loss of life to a member of Cumbria Constabulary. Both bridges have been subsequently replaced. Myers Bridge was also destroyed in Camerton. 84 properties were flooded including 30 residential properties in the Seaton Mill and Barepot areas. In Workington, properties in Hall Park View and Forgehammer Court were flooded, with the Bowling and Cricket Club also inundated. Flooding was reported in Hall Park View, the Cumbria Constabulary Headquarters, Fusion Nightclub, Coopers Walk, Ladies Walk Brewery and Wilkinson's Opera/Bingo House building. Flooding was also reported at Workington Hall Mill and Seaton Mill. Flooding in the Hall Park View area was reported as having a maximum depth of approximately 1.5 metres in 2009 compared to approximately 0.5 metres in 2015.

During the 2009 flood event, the raised riverside track in Barepot that ran along the bank top of the River Derwent was destroyed. This ran from the United Utilities intake above the Yearl to Crossings House, offering protection from floodwater (see **Figure 3**). The destruction of this track, in conjunction with the passage of flows back into the river near Crossings House, reopened the floodplain East of Barepot. The protection offered by the raised track was replaced by a length of embankment in 2010, constructed opposite the Meadow Edge properties. This embankment was tied into a sandstone wall to the rear of Glenfield place and the wall was reinforced with a blockwork skin to the rear. The flow re-entry point, just upstream of Crossing House suffered a large amount of erosion during the 2009 flood event. To prevent further erosion of the river bank at the re-entry point, large logs were used to stabilise the river bank. However, undercutting resulting from the 5th December 2015 event is now evident.

¹ Estimate taken from CEH briefing note <http://nora.nerc.ac.uk/s510223/1/Nov09Floods-CEH-briefing-note.pdf>
Cumbria.gov.uk 7

Flood Event 5th-7th December 2015

Background

On 5-7th December 2015, 50 properties suffered internal flooding in the Workington and Barepot area, while others experienced flooding of gardens, footpaths and roadways. The area affected by the flooding in these areas is shown in **Figure 2**. During this period, Storm Desmond caused 36 hours of intense rainfall leading to high river levels on the River Derwent. Significant rainfall events throughout November led to out of bank river flooding prior to the event associated with Storm Desmond. The flood extent area is similar to that of the 2009 event.



Figure 2: Extent of River (Fluvial) Flooding* in Workington 5-7th December 2015

*The flood outline identifies the maximum extent of flooding. Not all properties within the extent area were flooded

For this report, the flooded area has been divided into five sub-areas for investigation. These are based on flood flow routes. These sub-areas are outlined below and are shown in **Figure 3**. The individual sub-areas will be investigated in greater detail in the following sections of this report.

- **Sub-area A: Camerton** – Upstream of the Coops Weirs.
- **Sub-area B: Seaton Mill** – Upstream of Barepot, downstream of the Coops Weirs.
- **Sub-area C: Barepot** – The right bank of the River Derwent upstream of Workington Bridge.
- **Sub-area D: Workington Hall Mill and adjacent properties** – The area on the left bank of the River Derwent downstream of the Yearl.
- **Sub-area E: Hall Park View including Cricket/Bowling clubs & Cumbria Constabulary** – The area on the left bank of the River Derwent and road to Workington Bridge including the area around Soapery Beck flow route.

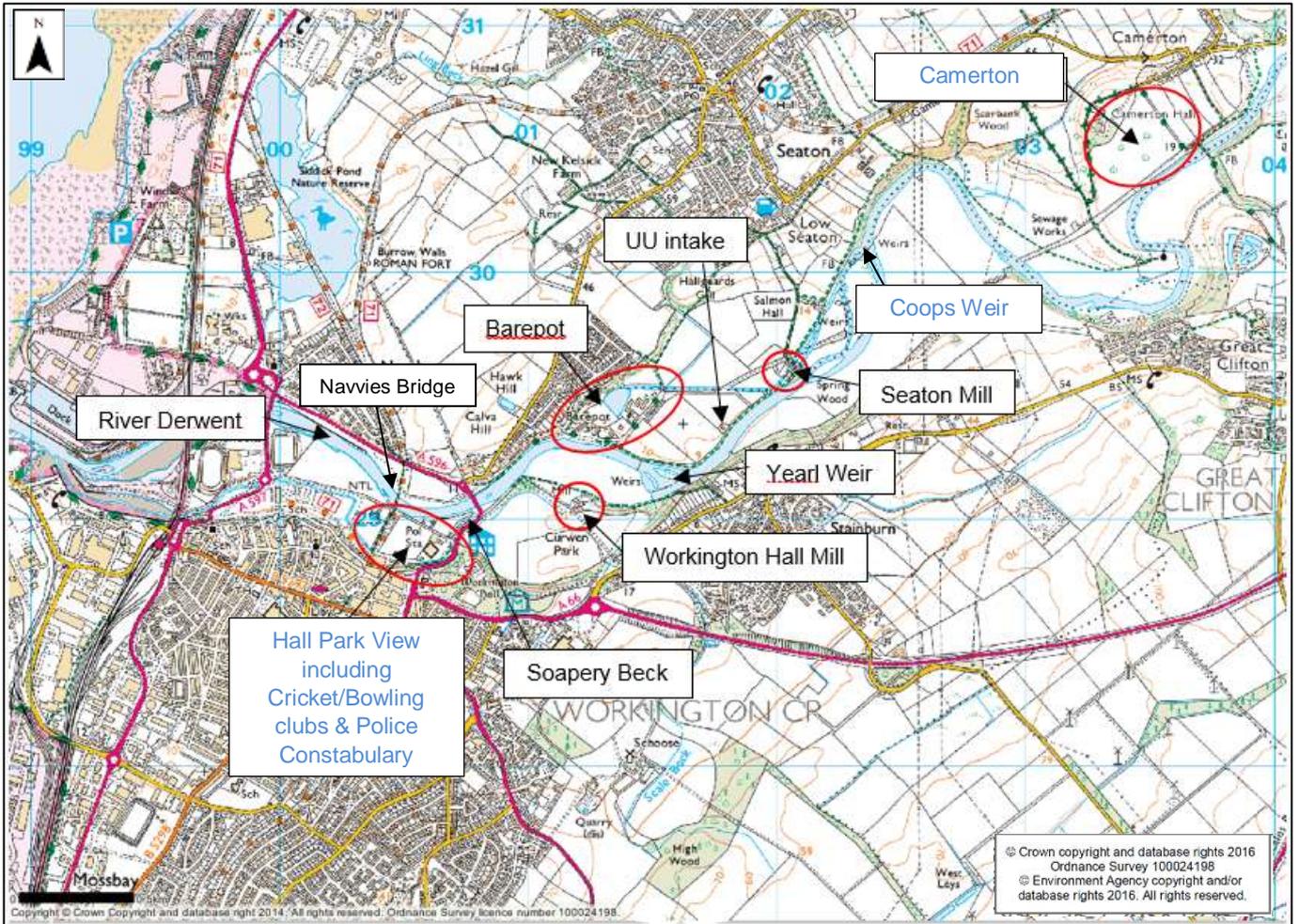


Figure 3: Identification of Areas Flooded (and key features)

Rainfall Event

Persistent wet weather throughout November 2015 resulted in much of the ground within the Cumbria catchments being saturated prior to the rainfall event associated with Storm Desmond. December 2015 was the wettest calendar month on record for the UK, with much of northern England receiving double the average December rainfall.

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 UK rainfall records for 24 and 48 hour periods prior and post Storm Desmond. All locations are within the Derwent catchment. **Table 3** shows the rainfall more widely recorded over the catchment on the 4th and 5th December 2015. **Figure 4** shows the location of these rain gauges in the Derwent Catchment.

	Pre 2015 UK records		New UK records as of December 2015	
	Location	mm	Location	mm
24 hour rainfall record	Seathwaite	316.4	Honister Pass	341.4
48 hour rainfall record	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
	4-5 th December (09:00-08:59)	5-6 th December (09:00-08:59)	Maximum rainfall in a 24 hour period	
Cornhow	12.8	81.8	94.4	7.1%
High Snab Farm	39.6	159.2	193.0	0.7%
Honister Pass	58.6	294.4	341.4	<0.1%
Seathwaite	36.6	185.2	214	1.33%-1.67%
Thirlmere	35.0	317.6	324.8	<0.1%
Sunderland Waste Water Treatment Works (WWTW)	7.8	42.8	50.6	25%

Table 3: Rainfall recorded at gauges in the Derwent Catchment upstream of Workington

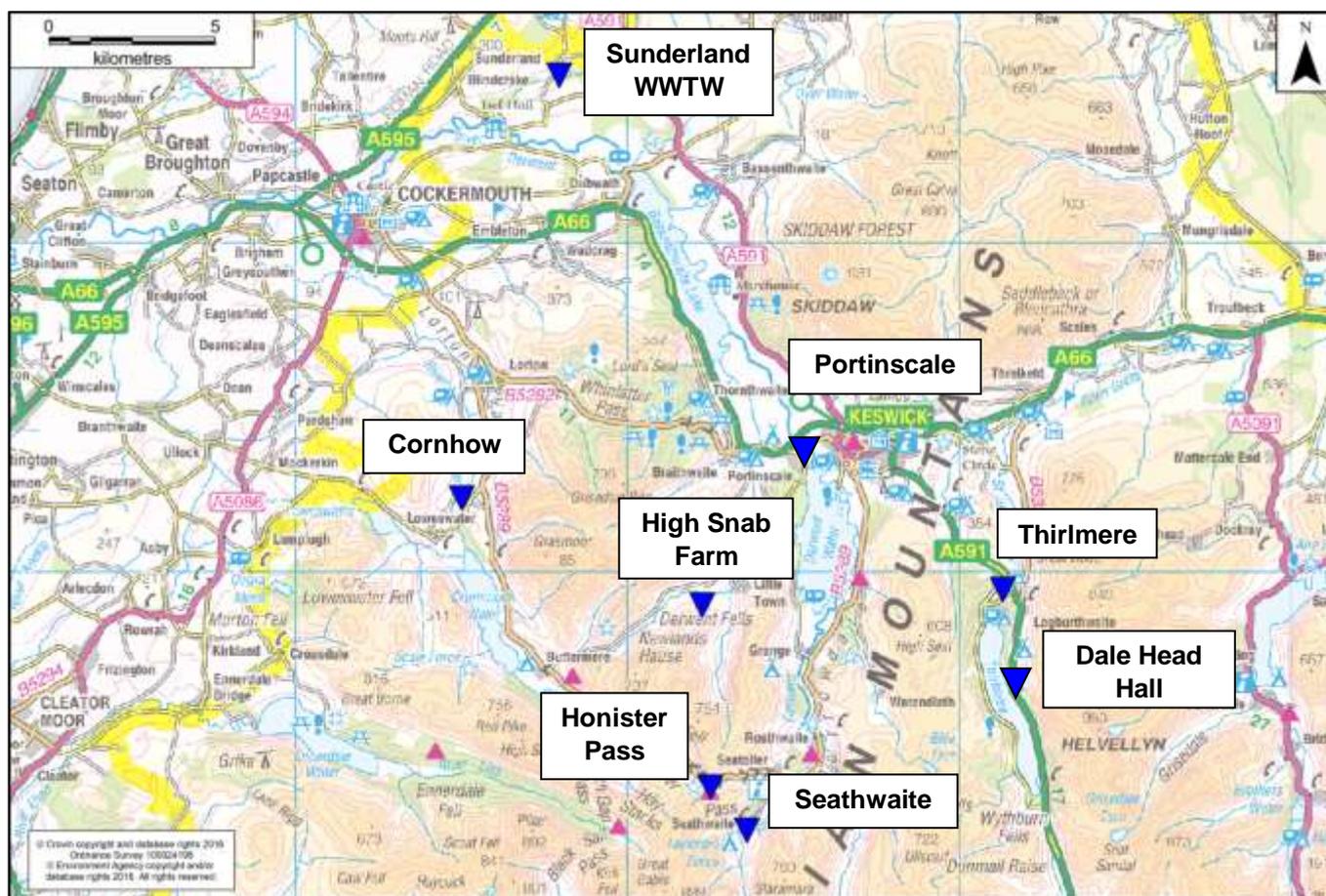


Figure 4: Location of Rain Gauges in the Derwent Catchment upstream of Workington

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

River Levels

There are a number of river monitoring gauges upstream and within Workington measuring flow and level on the River Derwent. The locations of these are shown in **Figure 5**.

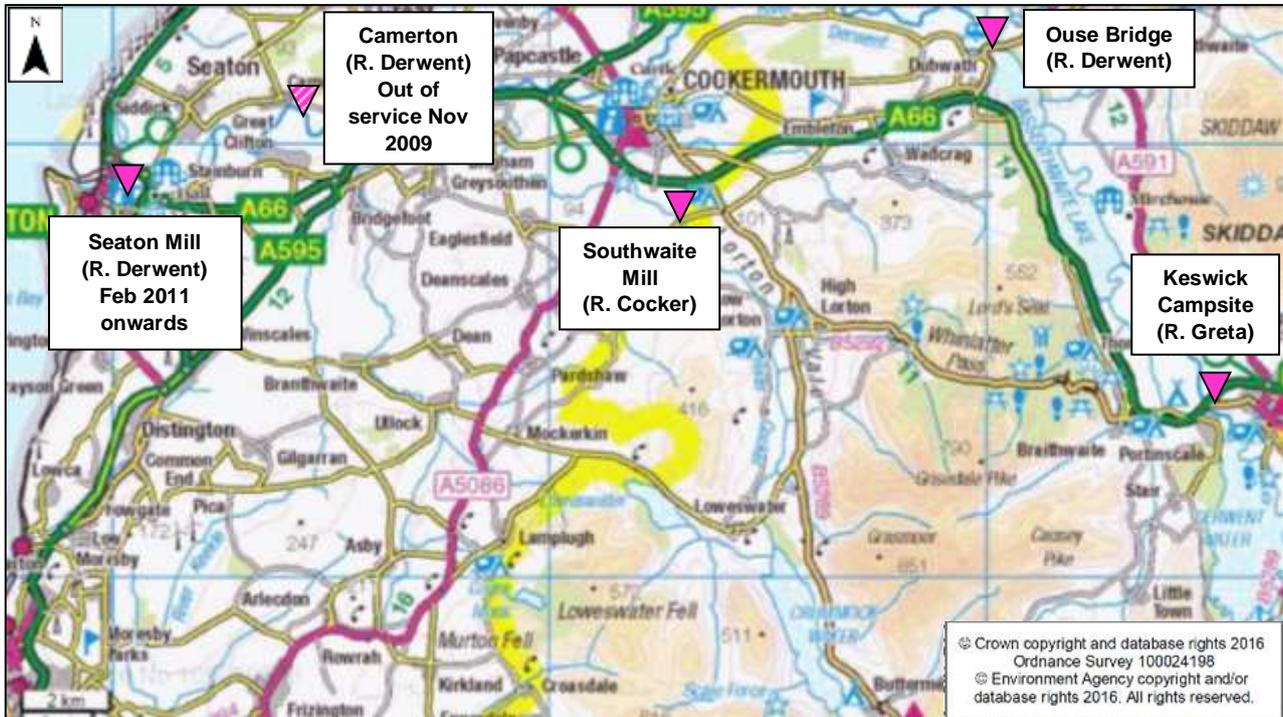


Figure 5: Location of River Gauging stations upstream of Workington

The gauging station at Camerton was destroyed during the 2009 floods. Estimation of peak flows during the 2009 event for the Workington area, taken from the Camerton gauge, range from 660-700m³/s, **Table 4**. The Seaton Mill gauge replaced the Camerton gauge, and is located approximately 3km downstream of the former Camerton gauge site. Although this gauge for the lower Derwent changed, it is evident that the 2009 flood event was of a higher magnitude than the 2015 event for the Workington and Lower Derwent area.

Gauging Station	River	Peak flow (m ³ /s)				
		Dec 2015	Past Events			
			June 2012	Nov 2009	October 2008	Jan 2005
Seaton Mill ^{*1}	Derwent	605 ^{*3}	215	-	-	-
Camerton ^{*2}	Derwent	-	-	660-700	301	293
Ouse Bridge	Derwent	466 ^{*3}	154	377	187	196

NB Camerton gauge was destroyed during the 2009 flooding, Seaton Mill is the replacement.

Table 4: Peak Flows recorded on the River Derwent

*1 Seaton Mill gauge has been used since February 2011

*2 Camerton gauge was damaged beyond repair during the November 2009 floods. A temporary gauge was established to record levels only between November 2009 and May 2011.

*3 Extensive modelling of the December 2015 flood event has been undertaken throughout 2016. The modelling has been verified using all available datasets including river level and rain gauges, surveyed wrack marks, photographs and video including a review of social media, aerial photography and first hand accounts. Following an iterative calibration process the model was able to replicate the flood mechanisms, levels and extents from all of the observed datasets to within agreed tolerances. The model has then been run to calculate flow at each of the gauge locations in the catchment by combining in-channel and out of bank flow. Our preferred estimates of peak flow in the Derwent have been produced using this modelling and are given below. These flows are to be adopted in Scheme Performance Reviews for Keswick and Cockermouth and will also be used in future scheme appraisals.

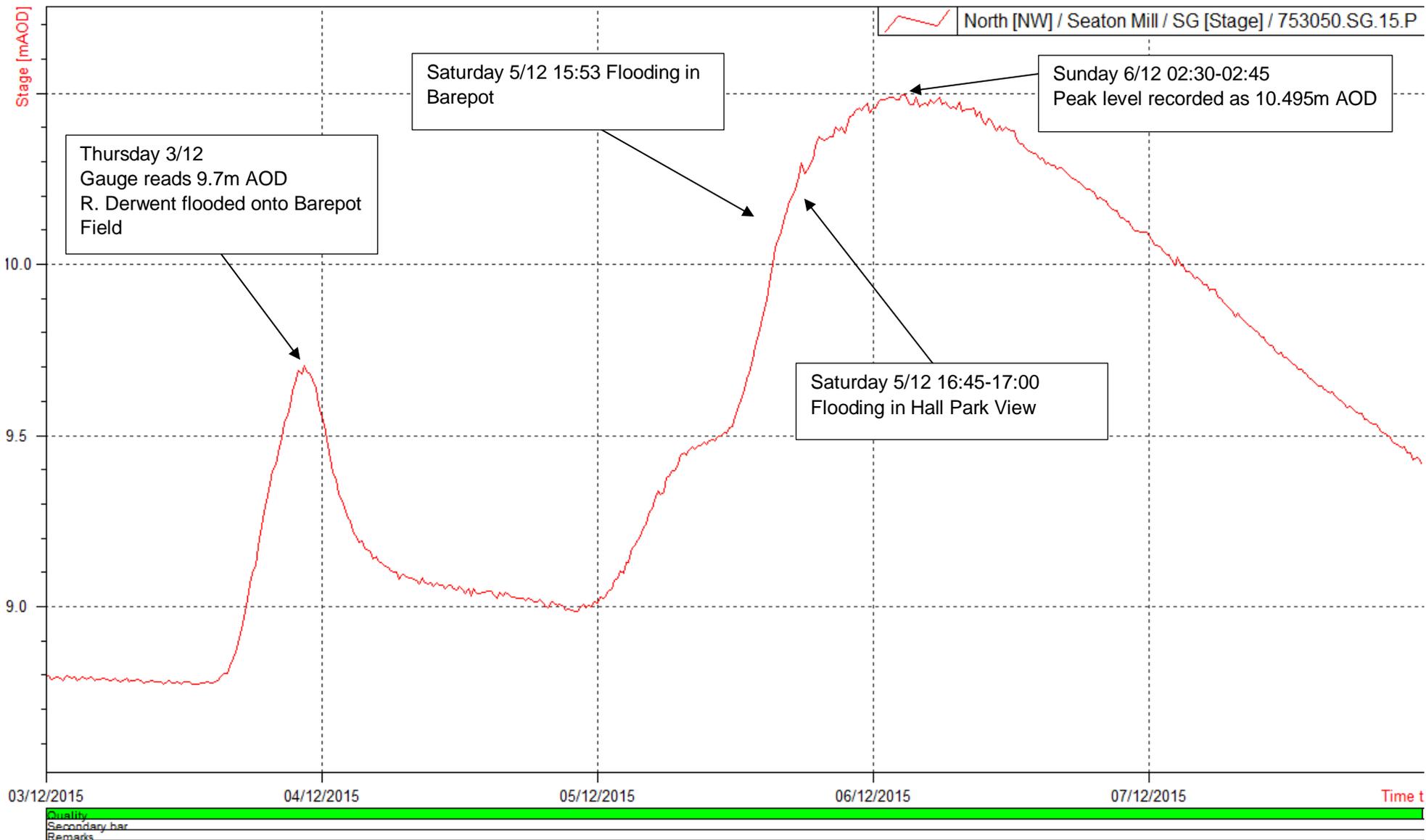


Figure 6: Seaton Mill River gauge 3-7th December 2015

Impact of tides

The National Tide Limit for Workington is shown extending to Navvies Bridge on the River Derwent. The record spring high tide for Workington is recorded as 9.27m above chart datum (5.07m AOD), see **Figure 7**). This maximum spring tide limit extends beyond Barepot, nearly reaching the Yearl weir. High tides were recored at 19:15 on Saturday 5th December and 07:30 on Sunday 6th December 2015. The peak discharge from the River Derwent was recorded between 02:30 and 02:45 on Sunday 6th December 2015. Under high spring tide conditions, Gale Brook may also be subject to tidal influence.

Existing Flood Defences

Parts of Barepot benefit from Environment Agency flood defences, constructed after the 2009 floods following the destruction of a raised track running parallel with the right bank of the River Derwent. This includes an embankment constructed opposite the Meadow Edge properties tying into the old railway embankment behind Crossings house. This embankment was tied into a sandstone wall to the rear of Glenfield place and the wall was reinforced with a blockwork skin. In 2014 work was carried out to reduce the risk of flooding from Barepot reservoir by opening up a culvert to a larger capacity open channel. See **Figure 7**.

A small bund was also constructed by Allerdale Borough Council at Workington Hall Mill. Hall Park View however does not benefit from flood defences. Many residents also use property level protection.

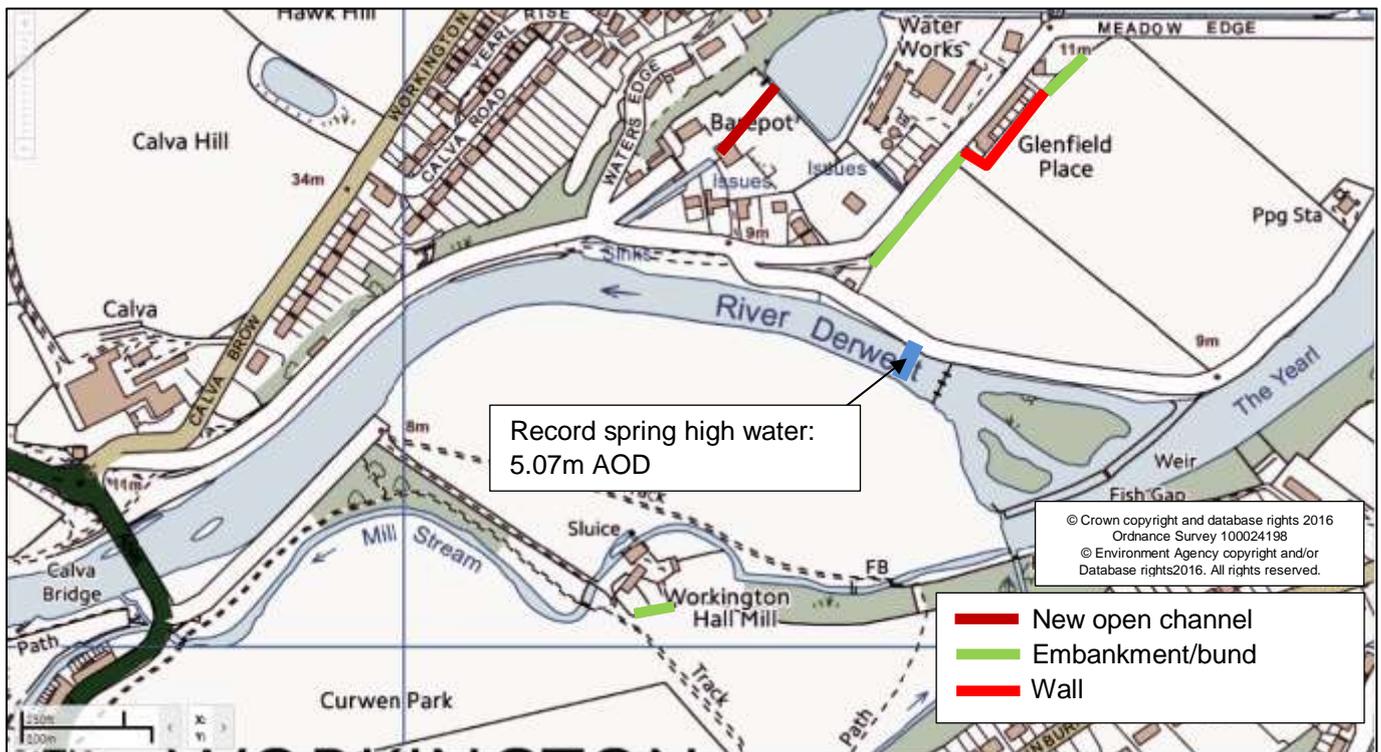


Figure 7: Flood Defences and spring tidal limit in Workington

Investigation

This investigation was carried out by the Environment Agency through surveys of the area, and data collected from the community affected. This report has compiled this data to provide details of flooding from the River Derwent which is a Main River.

For the purposes of this report, the flooded area within Workington, Barepot and Camerton have been divided into five sub-areas for investigation, see **Table 5**. These are shown in **Figure 8** and are examined in detail in the following sections of this report.

Sub-area	Sub-area Name	Description
A	Camerton	An area approx. 4km upstream of Workington on the right bank of the River Derwent upstream of Coops Weirs
B	Seaton Mill	Upstream of Barepot, downstream of the Coops Weirs
C	Barepot	The right bank of the River Derwent upstream of Workington Bridge
D	Workington Hall Mill	The area on the left bank of the River Derwent downstream of the Yearl
E	Hall Park View including Cricket/Bowling clubs, Cumbria Constabulary and other properties	The area on the left bank of the River Derwent and road to Workington Bridge including the area around Soapery Beck flow route

Table 5: Identified sub-areas for investigation

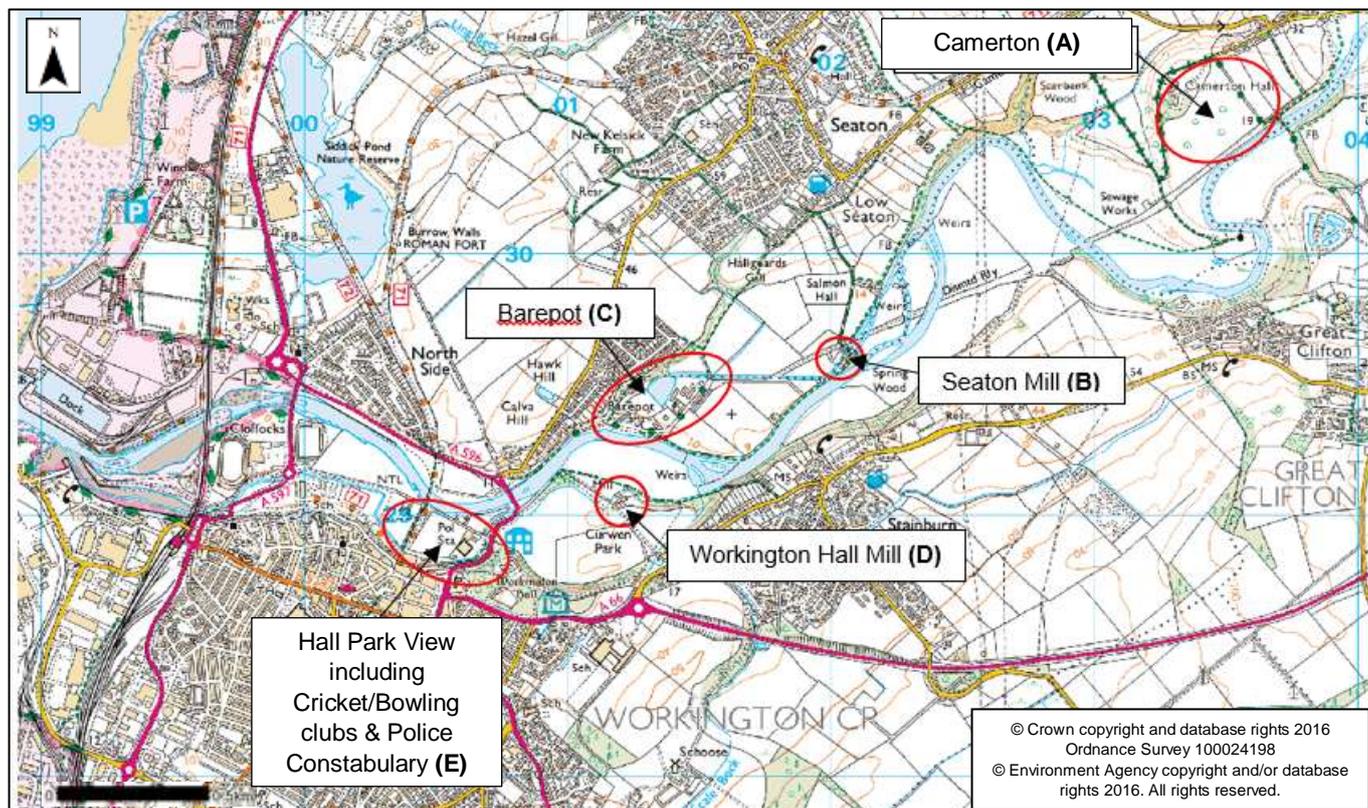


Figure 8: Identification of Areas Flooded

Impacts and Likely Causes of Flooding

Timeline

Friday 4th December	Event
15:30	Flood Alert issued
Saturday 5th December	Event
~13:00	Barepot field starts to flood
14:00	Seaton Mill Gauge reads 9.8m AOD
15:30	Seaton Mill Gauge reads 10m AOD
15:53	Crossings House and Gale Brook, Barepot begin to flood. Water coming up through the property floor
~ 16:00	The grounds at Camerton Hall began to flood
~ 16:00	Workington Hall Mill evacuated. Mill Field flooding
16:45 – 17:00	Hall Park View begins to flood – no access to Workington Bridge
17:00	Seaton Mill Gauge reads 10.2m AOD
~ 17:00	Continued rising water levels in Barepot due to high levels in the River Derwent and water from the River Derwent flowing up the Gale Brook culvert
21.01	Flood Warning Issued for the River Derwent at Workington, Seaton Mill and Barepot area
21:15	Seaton Mill Gauge reads 10.4m AOD
Sunday 6th December	Event
02:30 – 02:45	Peak flows recorded at Seaton Mill Gauge – 10.495m AOD
~11:00	Barepot residents dam Tractor crossing to prevent outflanking flows
11:30	Seaton Mill Gauge reads 10.4m AOD
17:56	Flood Warning update
19:30	Seaton Mill Gauge reads 10.2m AOD
20:12	Flood Alert updated
19:50	Flood Warning update
Monday 7th December	Event
15:30	Flood waters receding – no longer flowing through Crossings House. Water still ponding around the property and flowing over the adjacent field back into the river
Tuesday 8th December	Event
17:32	Flood Warning removed

Table 6: Timeline of events and actions in the Workington and Barepot area.

Table 7 below shows the number of flooded properties in the previous flood events in comparison to the December 2015 flood event.

Years	2015	2009	2005
Total Number of flooded properties	50	84	0
Hall Park View area	32	38	0
Barepot area	10	31	0
Camerton	1	6	0
Seaton Mill	6	6	0
Workington Mill	1	3	0

Table 7: Number of flooded properties

Overview of Flow Routes

There were a number of flooding flow routes during the event, shown in **Figure 9**. The details of these flow routes, and the flooding within each of the identified areas including the upstream areas of Seaton Mill and Camerton, is discussed in the following sections.



Figure 9: Overview of flow routes over Barepot, Workington Hall Park and Hall Park View

Sub-area A: Camerton

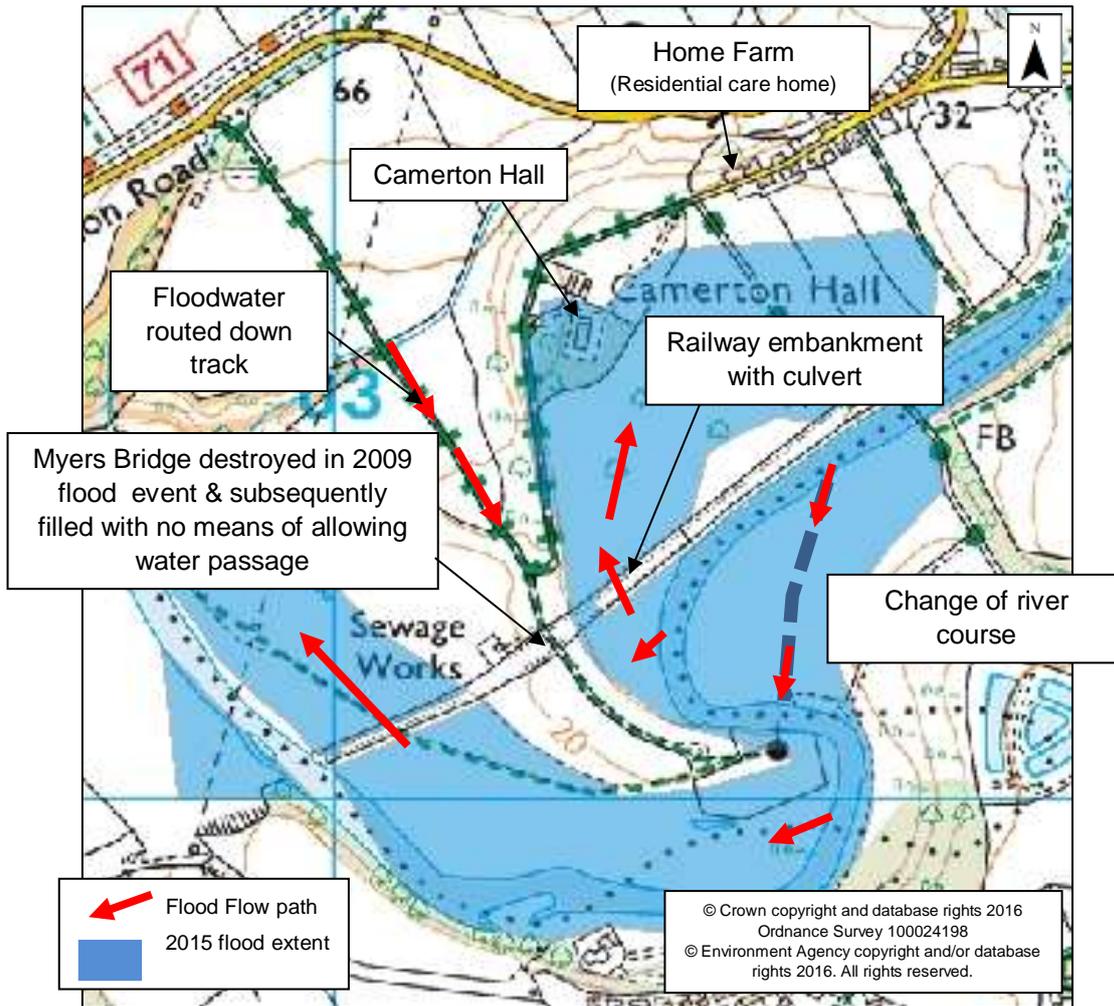


Figure 10: Camerton Hall Flooding Mechanisms

Camerton Hall, a Grade II listed property/business venue located approximately 4km upstream of Workington was flooded as a result of Storm Desmond, **Figure 10**. Camerton Cottage courtyard flooded up to door thresholds but water did not enter the property. During the 2009 event, six properties flooded in this location including Home Farm Care Home.

During the 2015 event, the River Derwent breached its banks immediately upstream of St Peters Church, Camerton and flowed towards the railway embankment, through an open culvert in the embankment and onto already saturated ground adjoining Camerton Hall. As the level of the River Derwent continued to rise, the railway embankment was overtopped by 0.75m and the water level in the adjoining field backed up substantially, entering Camerton Hall grounds at approximately 16:00. It was reported that the river continued to rise and by 18:00 river levels had reached 0.1m above floor level inside the property. Flood water was reported to have receded at around 15:00 on 6th December 2015.

There were several mechanisms causing flooding in this location:

- Flood water passing through an open culvert through the railway embankment and converging with water flowing from the road coming down from Ivy Lodge onto already saturated ground
- The River Derwent overtopping its banks and rising some 0.75 metres above the lowest point of the railway embankment in the vicinity of Myers Bridge

- Surface water run off down the unnamed road from Ivy Lodge which failed to flow into the road drainage ditch and subsequently flowed to the lowest section being the field between the railway embankment and Camerton Hall
- Following the collapse of Myers Bridge in the November 2009 flood event, no means of allowing water passage e.g. pipework/culvert was fitted during the reconstruction of the road. As a result, flood water had no means of escape from the field adjoining Camerton Hall causing flood water to levels to be higher 100mm back up considerably. **Figure 10** and **Photograph 1**.



Photograph 1: Aerial photo Camerton Hall
Photograph provided by Peter Smith Photography. Taken 06/12/2015

Sub-area B: Seaton Mill

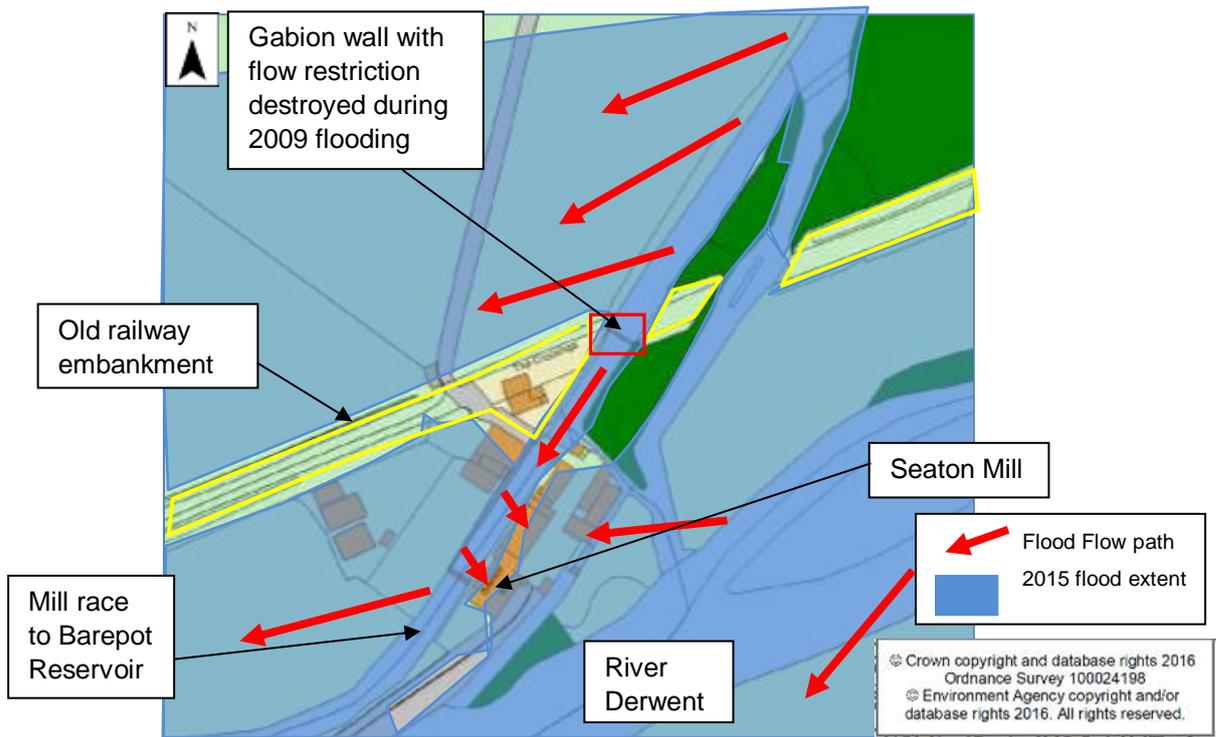


Figure 11: Seaton Mill Flooding Mechanisms

Seaton Mill has flowing water on both sides of the property, see **Figure 11**. The River Derwent flows to the front of the buildings, with the mill race to Barepot Reservoir flowing to the rear. The mill race is approximately 2-3m higher than the river. During the 2009 flood event, a wall on the mill race was washed away, leaving the flow to Barepot reservoir uncontrolled and governed wholly by the water levels on the River Derwent upstream. During 2015, a structure was constructed in the channel, designed to replace what was destroyed during the 2009 flood event. During very high river levels, the structure can be outflanked and floodwater can cross the fields to re-enter the mill race and reservoir downstream.

The 2015 flood event resulted in water overtopping from the mill race to join floodwaters from the River Derwent in the front yard of Seaton Mill, **Photograph 2**. Personal property protection measures were used to keep the majority of the water out of the buildings.



Photograph 2: Seaton Mill

Photograph provided by Peter Smith Photography. Taken 06/12/2015 12:45

Sub-area C: Barepot

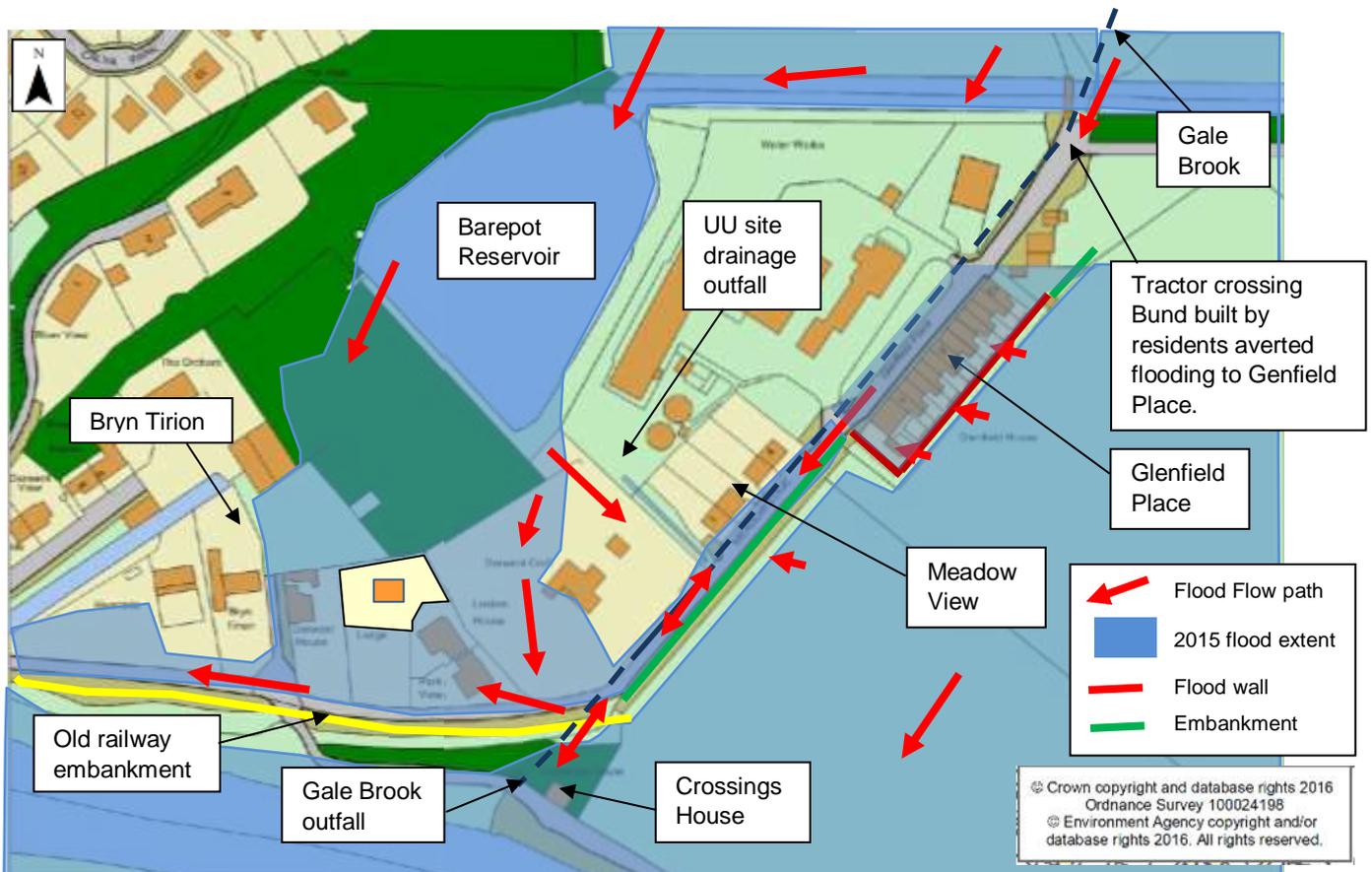


Figure 12: Barepot Flooding Mechanisms

*The flood outline identifies the maximum extent of flooding. Not all properties within the extent area were flooded

Ten properties are recorded as having been flooded as a result of Storm Desmond. The flooding came from a number of directions, see **Figure 12** and **Photograph 3**.

- The embankment and wall constructed in 2010, following the loss of the raised riverside track in 2009, provided some protection to properties. However, seepage occurred through the wall, see **Photograph 9**. Floodwater from the River Derwent remained against the wall and embankment for over 48 hours. The seepage through the wall ran down the road and into Gale Brook.
- River levels rose to approximately 10.2m AOD (Seaton Gauge), submerging the Gale Brook outlet into the River Derwent. Flood water from the River Derwent returned up the outlet of Gale Brook through the culvert under the old railway embankment, adding to the impact of flooding.
- Gale Brook is fed from the fields north east of Barepot. These fields became flooded from the River Derwent which flowed into Gale Brook. The outfall to Gale Brook was impeded by the rising River Derwent. A post event CCTV survey was conducted in 2015 identifying defects within sections of the culvert. Reports have been submitted identifying that the defects contribute directly to the flooding of at least 3 properties.
- The flow across the fields to the North of Barepot entered the reservoir and mill race. The work to deculvert, carried out below Barepot Reservoir in 2014, contained the majority of this flow although some flow overtopped, again adding to the flooding impact in Barepot, see **Photographs 5 and 6**. Flood waters also leaked through the reservoir wall. See **Photograph 7**. Flood water also overtopped the reservoir earth embankment at the southern extent of the reservoir. This embankment is approximately 500mm below the level of the reservoir wall at the tie in point. The only drain for this floodwater was the already inundated Gale Brook.

- The overland flows from the fields also crossed over the mill race at the tractor crossing, see **Photograph 8**, and flowed down the road past Glenfield Place. The quick actions of residents constructing a bund across the tractor crossing prevented more serious flooding.
- Personal property protection measures were used by residents, and this helped to keep floodwater out of some properties.

The wrack mark surveyed following the event on the river side of the embankment was 9.3m AOD.



Photograph 3: Barepot
 Photograph provided by Peter Smith Photography. Taken 06/12/2015 12:45



Photograph 4: Flooding at Crossings House



Photograph 5: Flooding outside Bryn Tiron



Photograph 6: Overland flow from Barepot Reservoir



Photograph 7: Barepot Reservoir wall leaking



Photograph 8: Meadow Edge and Flood Bank



Photograph 9: Wall to rear of Glenfield Place

Sub-area D: Workington Hall Mill and adjacent properties

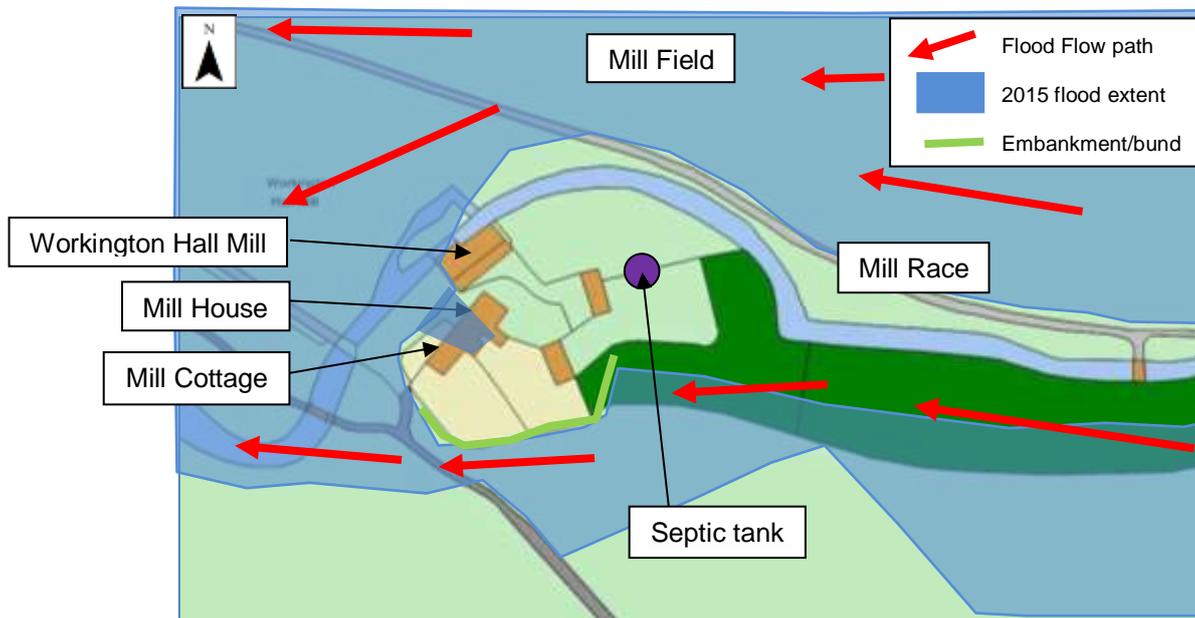


Figure 13: Workington Hall Mill flooding mechanisms

Workington Hall Mill consists of three residential properties built on raised ground in the middle of Workington Hall Park, see **Figure 13**. Mill Field lies to the north, making up the flood plain of the River Derwent which is just beyond, **Photograph 10**. The mill race is fed from the Yearl Weir on the River Derwent. The Workington Hall Mill buildings flooded in 2009. Following this 2009 event, a small bund was constructed to protect the properties. In addition to this, residents also installed personal property protection measures. Some water was seen to flow through the yard of the Mill which is suspected to be back flow, overflowing from the septic tank.



Photograph 10: Workington Hall Mill and Mill Field
Photograph provided by Peter Smith Photography. Taken 06/12/2015 12:45

Sub-area E: Hall Park View including Workington Cricket/Bowling clubs and Cumbria Constabulary Headquarters

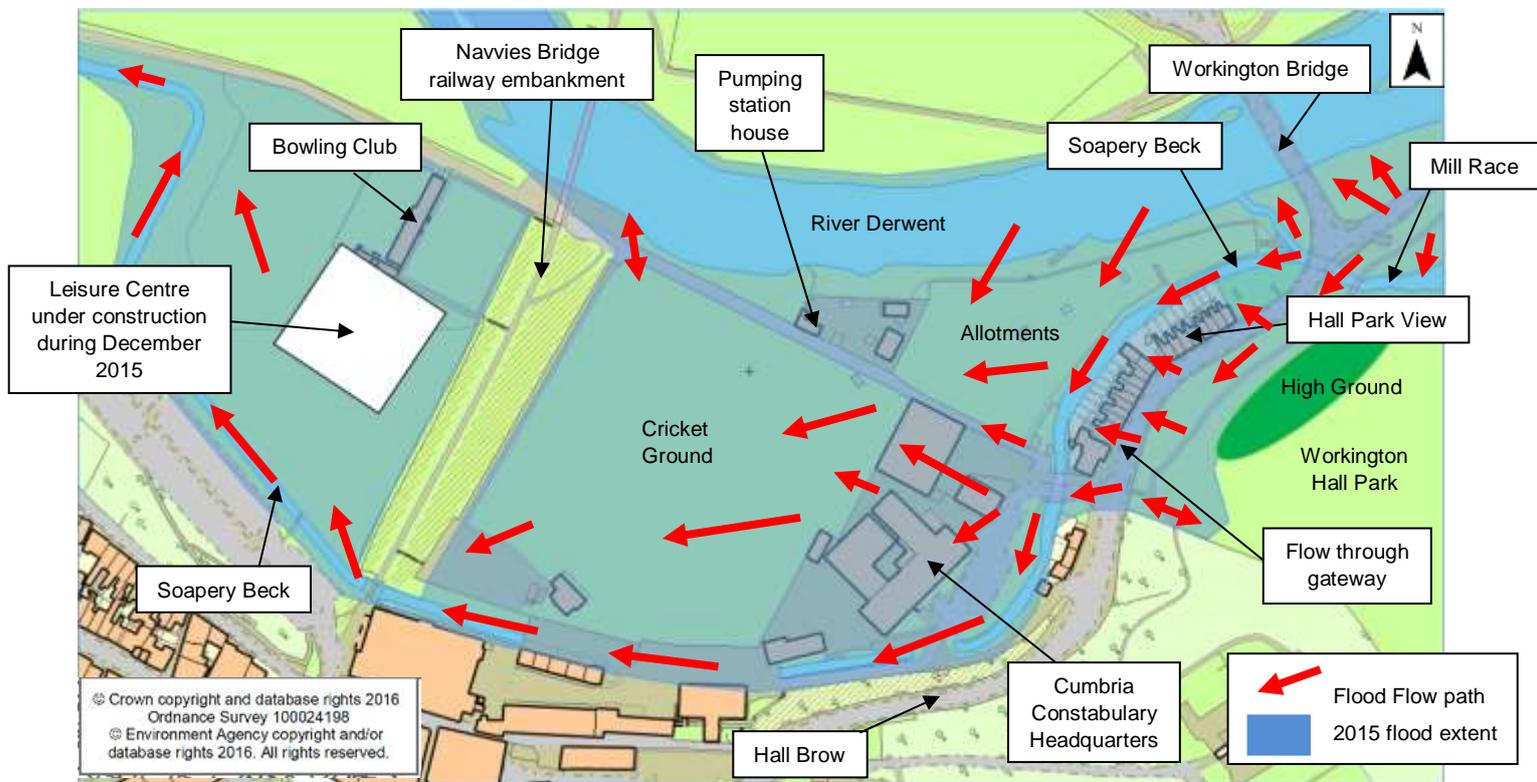


Figure 14: Hall Park View including Workington Cricket ground and Cumbria Constabulary flooding mechanisms

The area of flooding at Hall Park View is similar to that of the 2009 event. In the Hall Park View area 32 properties, 28 residential, the Cumbria Constabulary West Area Headquarters, the Cricket Club and Bowling club all experienced internal flooding. Floodwaters from the River Derwent filled Mill Field and then flowed overland to surround Workington Hall Mill, finally overwhelming the mill race downstream of the Mill to Hall Park View, see **Figure 14**.

At Hall Park View, the mill race flows under the road and becomes Soapery Beck. The bridge over this section had insufficient capacity during the 2015 event. Flood waters passing across Hall Park View overwhelmed Soapery Beck, and flowed overland through the allotments and through the Police Station into the Cricket Ground, **Photograph 11**. Soapery Beck assists in draining the area but has limited capacity and bridge obstructions, which cause the water to flow out of the channel when the capacity is exceeded.

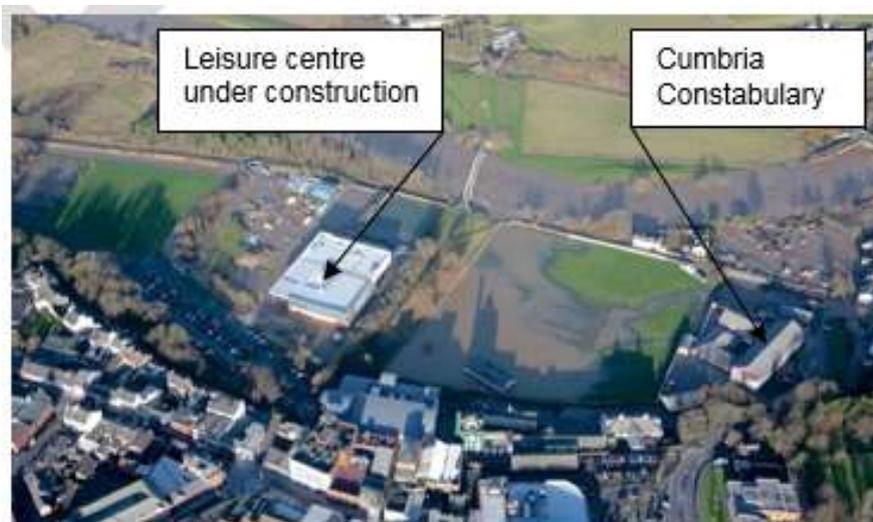
The River Derwent flooded through Hall Park View for over 48 hours before the water level started to recede. Property numbers 1-5 Hall Brow, are built into the hillside with their basements at ground level at the rear, and first floor at ground level at the front. In these properties the basements flooded from Soapery Beck at the rear. Additionally, property numbers 1 & 2 were reported to have flooded prior to the main flooding event, on the night of the 3rd/4th December due to the intense rainfall impacting surface water drains.



Photograph 11: Aerial Photo Hall Park View
Photograph provided by Peter Smith Photography. Taken 06/12/2015 12:45

The Leisure Centre, under construction during December 2015, is divided from the cricket ground by the old railway embankment leading to Navvies Bridge, **Photograph 12**. Contractors thoroughly inspected the Leisure Centre site, and established that it did not receive any overflow of water from the River Derwent. Floodwater from the Soapery Beck flowed towards the main entrance of the leisure centre, but did not enter the building.

The only areas of the Leisure Centre that were flooded were near places where the blockwork was incomplete to allow contractors access to different parts of the building. There was some water in the incomplete swimming pool area, which was still exposed to the elements as its windows had not yet been installed. In addition, part of the bund wall had not yet been built to its correct height. This meant that the water could enter that area.



Photograph 12: Cricket Ground / Cumbria Constabulary
Photograph provided by Peter Smith Photography. Taken 06/12/2015 12:45

During the 2009 flood event, erosion under Workington Bridge (Calva Bridge) almost caused the bridge to collapse. Extensive works were carried out to rebuild the bridge pier rather than demolish the historic bridge. Without modelling, the influence of the bridge on flood levels is difficult to determine as Hall Park View threshold levels are below the level of the bridge arches. At the time of writing, no assessment has been completed as to the upstream impact of the bridge on the upstream settlement of Barepot.

Flood flows returning to the river have caused substantial erosion to the river bank both upstream and downstream of Workington Bridge. Downstream of the bridge, on the left bank between the allotments and the river, a strip of land is owned by Iggesund for access to their pumping station intake. Upstream of the bridge, the land is owned by Allerdale Borough Council with the road access to Mill Field and Workington Hall Mill on the edge of the riverbank.

Environment Agency Flood Incident Response

The first flood alert was issued for the rivers Cocker, Marron and Derwent on Thursday 3rd December 2015. The Flood warning for Barepot and Hall Park View was issued at 21.01 on Saturday the 5th December, by which time properties had already been flooded. Barepot flooded at 15:53 and Hall Park View flooded at approximately 16:45.

Maintenance Activities

During May 2015, Cumbria County Council and the Environment Agency have carried out CCTV inspections of culverts and highways drains.

The Environment Agency maintains flood risk management structures and sections of river channel where maintenance actively reduces the risk of flooding to people and property. Activities we undertake are summarised below:

- We conduct visual inspections of flood defence embankments and walls and deliver a variety of maintenance tasks which include, as necessary:
 - grass cutting,
 - tree and bush management,
 - invasive species control,
 - vermin control and
 - expansion joint repairs.
- We deliver targeted maintenance on River Channels where the activity is beneficial to the reduction in flood risk. This could include:
 - Weed Control,
 - Grass Control,
 - Tree and Bush Management,
 - Invasive Non Native Species Control,
 - Gravel Removal, when justified through investigation and survey.

In Workington we undertake grass cutting of the embankment opposite Meadow Edge and weed control at Barepot reservoir open channel.

United Utilities: Thirlmere Reservoir

Background

Thirlmere reservoir was built in 1894 to supply drinking water for Manchester. The reservoir can store up to 40,000 megalitres (million litres) of water and approximately 700,000 people – about 10% of the region's water users - receive drinking water supplies from Thirlmere. Most are in Manchester but other communities include Blackpool and the Fylde coast, Lancaster and local communities such as Keswick and Borrowdale.

At the southern end of Thirlmere is the Thirlmere aqueduct. This is a 134 mile long gravity tunnel which links Thirlmere to Manchester. The aqueduct extracts up to 220 megalitres (million litres) of water from Thirlmere per day.

Thirlmere discharges into St John's Beck, which is a tributary of the River Greta. The River Greta flows through Keswick and joins the River Derwent just after it leaves Derwent Water as it flows towards Bassenthwaite Lake. St John's Beck accounts for about one fifth of the water in the River Greta.

How Thirlmere is operated

Thirlmere reservoir is maintained and managed according to legislation and the local arrangements agreed with Keswick Flood Action Group (K FAG). United Utilities operate to a set of flood level drawdown rules agreed with K FAG.

These rules specify reservoir levels for each month at which United Utilities will release more water into St John's Beck. Releases continue until the month target level is achieved, and further to maintain it if necessary. This is a best endeavours effort as incoming water from rainfall and the catchment may be greater than the maximum possible releases.

In November 2015 this level was 3.0m below top water level – equivalent to 76% full. The idea being that this spare capacity can absorb some of the heavy rain which falls during these months. United Utilities operated the reservoir to these agreed levels prior to the December 2015 flood event.

However, the catchment is in a delicate environmental balance and there is a natural limit to the amount of water United Utilities can release without causing damage to St John's Beck which is a Special Area of Conservation. The normal compensation flow in St John's Beck is 13.64 megalitres a day. This can be increased to 140 megalitres per day.

Even at this level, it causes some flooding to farmland. Any more than 140 megalitres per day will cause farmland will flood on a more frequent basis. United Utilities also have to consider the impact increased flows have on those who use the Beck for fishing. All releases, except the 13.64 megalitres litres compensation, are ceased if the reservoir starts to spill.

Nov 2015- Levels in Thirlmere Reservoir

United Utilities can increase the rate at which water is removed from the reservoir up to a certain limit. When the Thirlmere Aqueduct is open, the safe and environmental limit is 320 megalitres a day. If the rain falls faster than this then the reservoir will start to fill until it eventually overflows.

In November 2015, whilst Thirlmere reservoir releases were managed in exact accordance with the agreed K FAG protocol, the catchment experienced more than twice the normal level of rainfall expected for the month, and Thirlmere reservoir continued filling and started to spill on Monday 30 November. On 5th December alone, around 14,000 million litres of water entered the reservoir, which is more than a third of its capacity. The average rainfall for Cumbria for the month of December is 146.1mm, and more than this fell during one day. Over the course of the weekend, flows down St John's Beck were higher than ever recorded before. Given the amount of rainfall, increasing the 320 megalitres daily removal would have made little material difference.

Future investment

United Utilities have been considering options for further flood drawdown releases and possible modifications to the infrastructure at Thirlmere as part of the new pipeline scheme to West Cumbria.

Limitations to the speed of reservoir drawdown, caused by constraints at the dam outlet to St John's Beck, are well understood, and following studies potential solutions have been identified. These solutions will be considered as part of the detailed design of the modifications to abstraction infrastructure, new water treatment works and pipelines for the Thirlmere to West Cumbria transfer.

Current flood drawdown releases are approximately 140 MI/d. The limitation is not the outflow from the low level scour valves on the dam, which can release up to 900 MI/d in emergency draw down for reservoir safety. The issue at present is infrastructure downstream of the valves, including an operational foot bridge that provides essential access to Bridge End Water Treatment Works (WTW), which could be damaged and access be lost if flows higher than the currently agreed releases are made.

Work has progressed to develop the long term provision of water to West Cumbria which will include a solution that could allow a higher rate of release. In essence this is to engineer a channel to accommodate the higher flows, and make modifications to the valves to enable better control. This would allow approximately 500 MI/d of flood drawdown release to be made whilst still maintaining flows to the WTW to supply customers.

United Utilities are committed to ongoing engagement with K FAG, the Environment Agency, and Natural England regarding the volumes of water that can be released in to St. John's Beck in the future.

- United Utilities have committed to undertaking a study to investigate the hydrology, geomorphology and ecology of river function at different flow rates and locations.
- We have prepared a scope for the study, which has been agreed with Natural England and the Environment Agency.
- The first stage of the study will propose the maximum drawdown release rate to provide ecological benefits, to inform design of new release infrastructure. This stage will commence in winter 2016, and is scheduled to report in summer 2017.
- The second stage of the study will include monitoring and assessments from 2017 to 2022, including during the periods when higher flood drawdown releases will be made in order to monitor the influence of these releases and determine the best high flow management regime to provide the range of flows necessary to provide ecological benefits in St John's Beck.

St John's Beck is part of a Special Area of Conservation and therefore any solution needs to be compliant with the Habitats Directive.

We currently estimate that construction of new infrastructure will begin in 2017, and take an estimated 12 months to deliver the work to accommodate the releases in to St John's Beck.

In addition, recommendations arising out of a report on Thirlmere by Aecom, commissioned by the Environment Agency following the floods in December 2015, considers the role of the Mill Gill open aqueduct in supporting flood attenuation at Thirlmere. A proportion of Mill Gill flows can be directed to bypass Thirlmere or to flow into Thirlmere depending on conditions but more detailed modelling work is required to fully understand this and to develop a protocol for management by United Utilities staff. This is being actively pursued by the Environment Agency and United Utilities following site visits in October and November 2016. In the interim United Utilities are using the initial recommendations of the Aecom report to operate Mill Gill to best advantage.

In the interim we are reviewing the potential to use the two top level scour valves in the dam at Thirlmere to increase releases and a test is planned for early 2017. This test will have to coincide with the hydrology study referred to above as the results of this will ultimately determine release rates.

Source: United Utilities

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 or are ongoing.

Table 8 Recommended Actions

Cumbria Flood Partnership Theme	Action by	Recommended Action	Timescale
Community Resilience	Cumbria Local Resilience Forum *	Review and update plans to enable homes & business to be better prepared for flooding & reduce the impacts of flooding. For example, review of evacuation procedures / emergency response.	Complete
	Environment Agency, Cumbria County Council Highways, and Electricity North West.	Review the flood risk and resilience of infrastructure.	2016/17
	Cumbria Planning Group, Allerdale Borough Council, Cumbria County Council, and Environment Agency	Review Local Development Plans and Strategic Flood Risk Assessment to reflect current understanding of flooding.	2016/17
	Environment Agency	Ensure all properties at risk can register to receive flood warnings and details are up-to-date.	Complete
	Environment Agency	Raise awareness/engagement with community on gravel management activities and the influence of the Yearl weir and tides on flood flows.	2016/17
	Residents	Review effectiveness and improve flood resilience/ resistance measures for properties to reduce impacts of future flooding.	
Upstream Management	Cumbria Floods Partnership (CFP)	The CFP action plan will consider natural flood management options to reduce flood risk across the catchment. This may also include land use changes and or flood storage.	Complete

Cumbria Flood Partnership Theme	Action by	Recommended Action	Timescale
	Environment Agency	Investigate if catchment lake levels can be managed differently to reduce flood risk.	March/April 2017
Maintenance	Cumbria County Council, United Utilities, and Allerdale Borough Council	Review and investigate drainage and sewage systems to better understand where improvements are required to help reduce surface water flooding.	2016/17
	Environment Agency, United Utilities, and Cumbria County Council	Complete on-going inspections and repairs to assets that may have been damaged during the flood event.	Complete
	Environment Agency	Review maintenance programme within the catchment in response to the flooding event of 2015.	2016/17
	Environment Agency	Remove gravel in the River Derwent to modelled threshold.	Complete
	Community	Obtain permit and remove additional gravel.	Complete
Strengthening Defences	Environment Agency	Review modelling and forecasting 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 be used to inform future investment plans.	March/April 2017
	Environment Agency	Complete repairs to flood defence assets that were damaged during the floods as part of the c.£10m Asset Recovery Programme which covers Cumbria and Lancashire.	Complete
	Environment Agency / Allerdale Borough Council/ Iggesund	Investigate low flow and flood flow mechanisms/problems of mill race/ Soapery Beck at old Intake, under Hall Brow and through allotments.	2016/17
	Environment Agency	Carry out a Flood Risk Assessment /Review Study for Hall Park View area and Barepot including partnership funding scoring and AEP.	March/April 2017
	United Utilities	Carry out work to prevent flows from eroding around the Yearl – consider permanent access track from Pumping station.	TBC

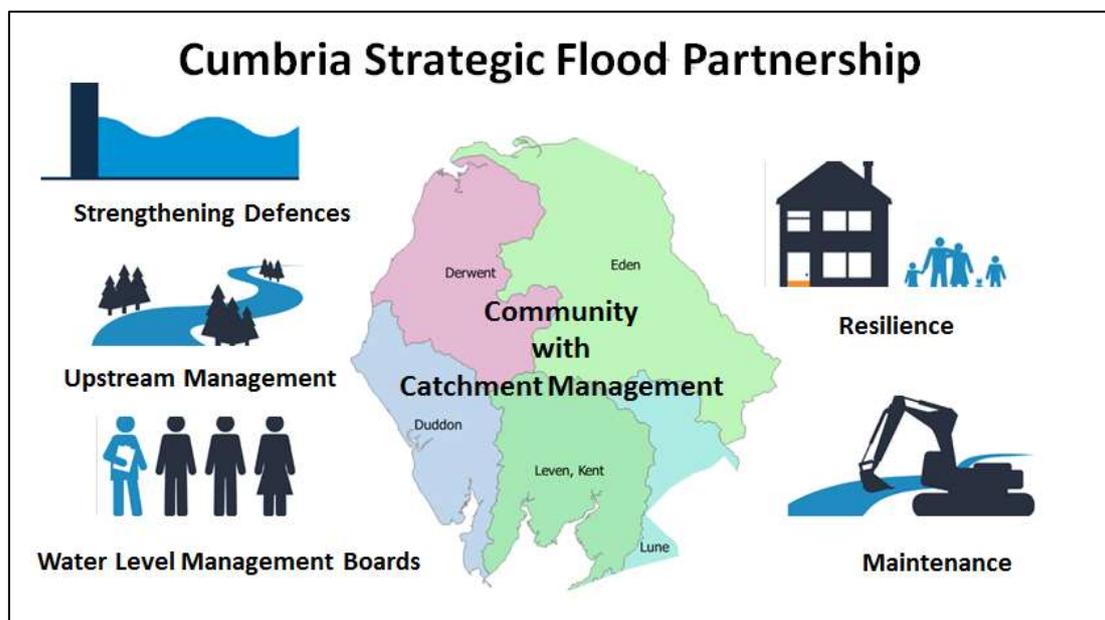
Cumbria Flood Partnership Theme	Action by	Recommended Action	Timescale
	Landowners	Review issues caused by river bank erosion up and downstream of Workington Bridge	2016/17
	Environment Agency	Complete an Strategic Outline Case in order to obtain options for Flood Risk Management in Workington.	March/April 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

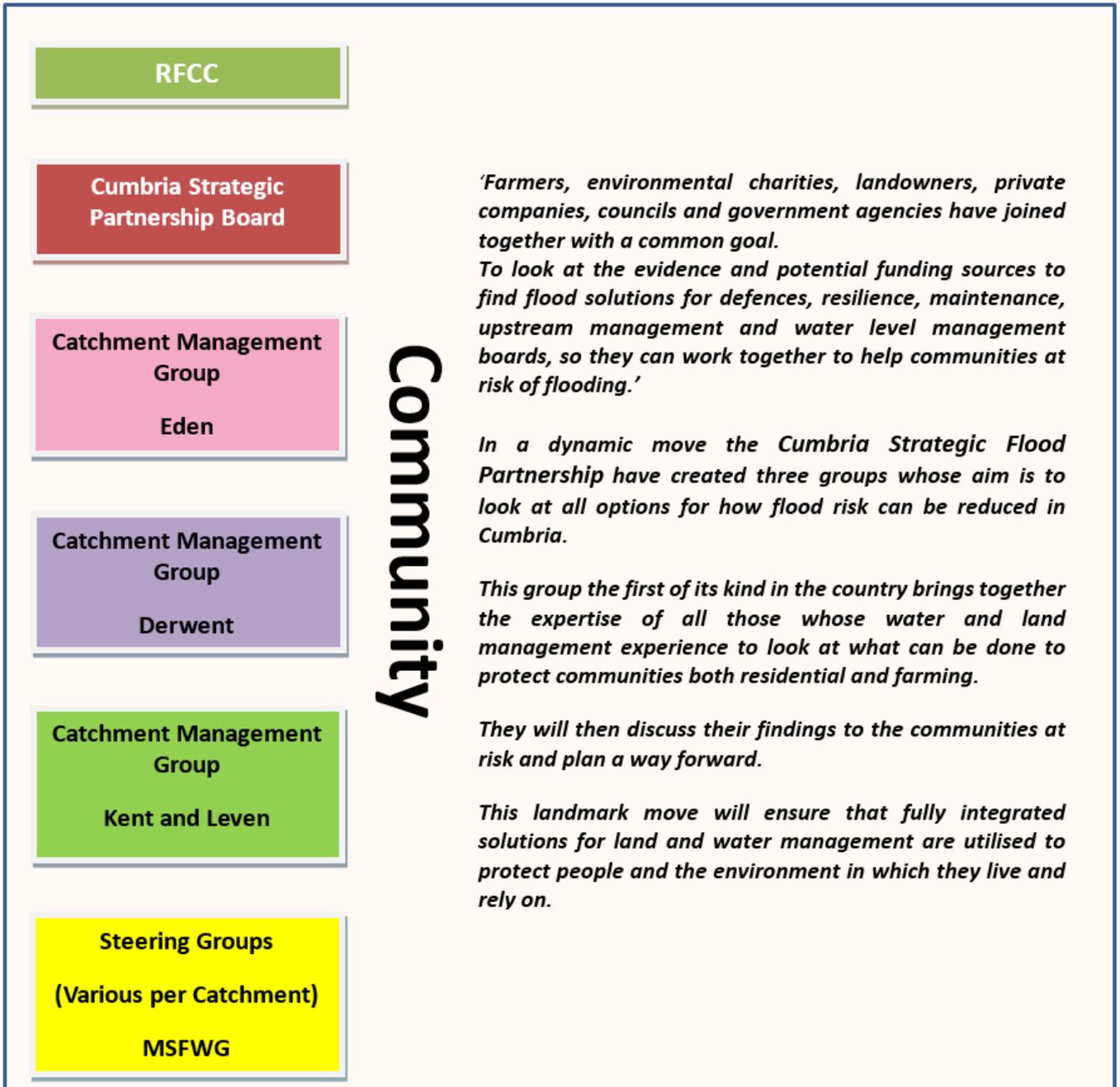
The Cumbria Floods Partnership has brought together a wide range of community representatives and stakeholders from a variety of sectors to plan and take action to reduce flood risk. The Cumbria Floods Partnership, led by the Environment Agency, is producing a 25 year flood action plan for the Cumbrian 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 help demonstrate how the two partnerships have now come together:





Cumbria Strategic Flood Partnership



Appendices

Appendix 1: Glossary

EA	Environment Agency
CCC	Cumbria County Council
UU	United Utilities
ABC	Allerdale Borough Council
LLFA	Lead Local Flood Authority
MSfWG	Making Space for Water Group
FAG	Flood Action Group
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

Term	Definition
	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 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.

Term	Definition
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 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: Additional information from the community

Flood Risk Assessment / Review Study – Specific actions

No	Action
1	Carryout topographic survey at Hall Park View including Workington Bridge to determine viability of landscaped defences in Hall Park and use of Workington Bridge pedestrian underpass for flood flows.
2	Investigate possibility of flood wall with flow limiter at Soapery Beck inlet by Hall Park View to protect rear of Hall Park View from flooding and prevent flood flows entering Soapery Beck.
3	Investigate possibility of landscaping park to remove River Derwent flood flow route across Hall Brow.
4	Carryout topographic survey of Barepot defended line including threshold level of properties, areas of outflanking and raised features acting as flood defence/ barriers to flows escaping.
5	Investigate possible solutions to improve/ extend Barepot defences and reduce infiltration through defences.
6	Investigate landscaping and flow limiting measures to prevent high flows entering Barepot Reservoir including overland flow routes to rear of reservoir, and across mill stream in conjunction with barrier to limit flow along millstream into Barepot reservoir.
7	CCTV Gale Brook and investigate possibility of flapped outfall to prevent back flow from River Derwent.
8	Revisit the influence of Yearl weir and Yearl gravel Islands on flood risk.
9	Assess the impact of the Coops Weir on flood risk in Barepot.
10	Assess reinstatement of the barrier on millstream to limit flows behind Seaton Mill.
11	Look at flood flow routes across the floodplain from Salmon Hall downstream with a view to increasing active floodplain and diverting flows away from property.
12	Carry out work to prevent flows from eroding around the Yearl – consider permanent access track from pumping station.
13	Investigate practicality of community pumps for Barepot.
14	Investigate the possibility of diverting Gale Brook outside of the defended area in Barepot.
15	Produce Partnership Funding scores for Barepot and Hall Brow.
16	Engineered scheme required for Barepot and Hall Park View.
17	Repairs on displaced joints and general condition of Gale Brook Culvert.
18	Workington Bridge: Any works to the structure needs to consider afflux impact to both Hall Park View and Barepot.
19	Assess the safety and reduce risk posed by Barepot reservoir wall and embankments.
20	Assess the impact of the River Marron and the risk of flooding posed to Workington. Investigate attenuation possibilities.
21	Assess the flood risk posed by the old railway embankments downstream of Coops weir.
22	Investigate the potential for floodwater attenuation in the Lorton Valley at Corn How Farm and the incised valley behind the water treatment works.
23	Investigate the impact of highways drains on flooding from Gale Brook and surface water flooding issues at the low point at Hall Park View and Barepot.
24	The football pitches in Cerwen Park did not flood. Lower these levels and use for flood storage.
25	Assess the potential for upstream storage / flow control on the floodplain between Cockemouth and Workington.

Appendix 3: Summary of Relevant Legislation and Flood Risk Management Authorities

The Flood Regulations 1999 and the Flood and Water Management Act 2010 (the Act) have established Cumbria County Council (CCC) as the Lead Local Flood Authority (LLFA) for Cumbria. This has placed various responsibilities on the EA including section 18 of the Act which states:

The Environment Agency must report to the Minister about flood and coastal erosion risk management.

(2) In particular, the report must include information about the application of the national flood and coastal erosion risk management strategies under sections 7 and 8.

(3) The Minister may make regulations about—

- (a) the times or intervals at which a report must be made, and
- (b) the content of a report.

(4) In this section “the Minister” means—

- (a) the Secretary of State in relation to flood and coastal erosion risk management in England, and
- (b) the Welsh Ministers in relation to flood and coastal erosion risk management in Wales.

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 Cumbria County Council’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. 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 risk management authority 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 risk management authorities 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.

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.

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.

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 4: Links to other information on Flooding

Cumbria County Council (Local Flood Risk Management):
lfrm@cumbria.gov.uk, www.cumbria.gov.uk, tel: 01228 211300

Cumbria County Council (Highways):
highways@cumbria.gov.uk, www.cumbria.gov.uk, tel: 0845 609 6609

United Utilities: tel: 0845 746 2200

Flood and Water Management Act 2010:
<http://www.legislation.gov.uk/ukpga/2010/29/contents>

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>

Highways Act 1980:
<http://www.legislation.gov.uk/all?title=highways%20act>

Translation services

If you require this document in another format (e.g. CD, audio cassette, Braille or large type) or in another language, please telephone 01228 606060.

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Appendix 5: Flood Warnings and Alerts

The following section show additional details on the flood alerts and warnings issued during this event.

Flood Alert

011WAFCD- Rivers Cocker, Marron and Derwent.

Alert issued on Thursday 03/12/2015 at 14:46

Alert removed on Friday 04/12/2015 at 06:47

Alert issued on Friday 04/12/2015 at 15:30

Customers in Flood Alert area registered on FWD: 233

Contacts (landline, mobile, email etc) in Flood Alert area registered on FWD: 823

Successful contacts: 714

Unsuccessful contacts: 109

Alert Message:

A Flood Alert has been issued by the Environment Agency for the Rivers Cocker, Marron and Derwent. Flooding is possible for Lower Derwent from Bassenthwaite Lake to the coast at Workington. The Cocker from Crummock Water to Cockermouth. The River Marron from Ullock to its confluence with the Derwent near Bridgefoot. Low lying land and roads will be affected first.

Heavy and persistent rainfall is forecast to continue throughout today until this evening. With the ground already saturated the river levels are expected to rise and we may see some localised flooding to low lying land and roads. An outlook for the weekend shows although Friday is looking a relatively dry day, the rain will again become heavy and persistent in the early hours of Saturday continuing right through until Sunday. As River levels are already high, we may see some localised flooding throughout Cumbria.

Flood Warning

011FWFNC22- River Derwent at Workington, Seaton Mill and Barepot

Area covered: The River Derwent at Workington, Seaton Mill and Barepot

Flood Warning issued on Saturday 05/12/2015 at 21:01

Flood Warning updated on Sunday 06/12/2015 at 17:56

Flood Warning updated on Monday 07/12/2015 at 19:50

Flood Warning removed on Tuesday 08/12/2015 at 17:32

Customers in Flood Warning area registered on FWD: 113

Contacts (landline, mobile, email etc) in Flood Warning area registered on FWD: 304

Successful contacts: 235

Unsuccessful contacts: 69

Flood Warning Message (05/12/2015 21:01) :

A Flood Warning has been issued by the Environment Agency for the River Derwent at Workington, Seaton Mill and Barepot.

Flooding is expected for Low lying roads, agricultural land, commercial and residential properties adjacent to the River Derwent including Glenfield Place, Meadow Edge, Workington Hall Mill, Hall Brow and Curwen Park. Immediate action required.

Heavy and persistent rainfall is expected throughout Saturday and into Sunday morning. River levels will continue to rise and further Flood Warnings are likely. Please check for updates throughout the weekend. Operational Teams have closed flood defences and are checking watercourses for blockages.

Appendix 6: Barepot recovery programme update

Background

The flood defence embankment and wall reduce the risk of flooding to properties in the Barepot area. During the December 2015 floods there was some leakage observed through these two structures. As part of the Environment Agency's recovery programme, measures have been taken to prevent leakage along with further work to reduce flood risk for the community (shown in the plan overleaf). This work is scheduled to be completed in March 2017, with ground reinstatement being carried out in the spring growing season.

The works fall into the following sections:

Embankment works

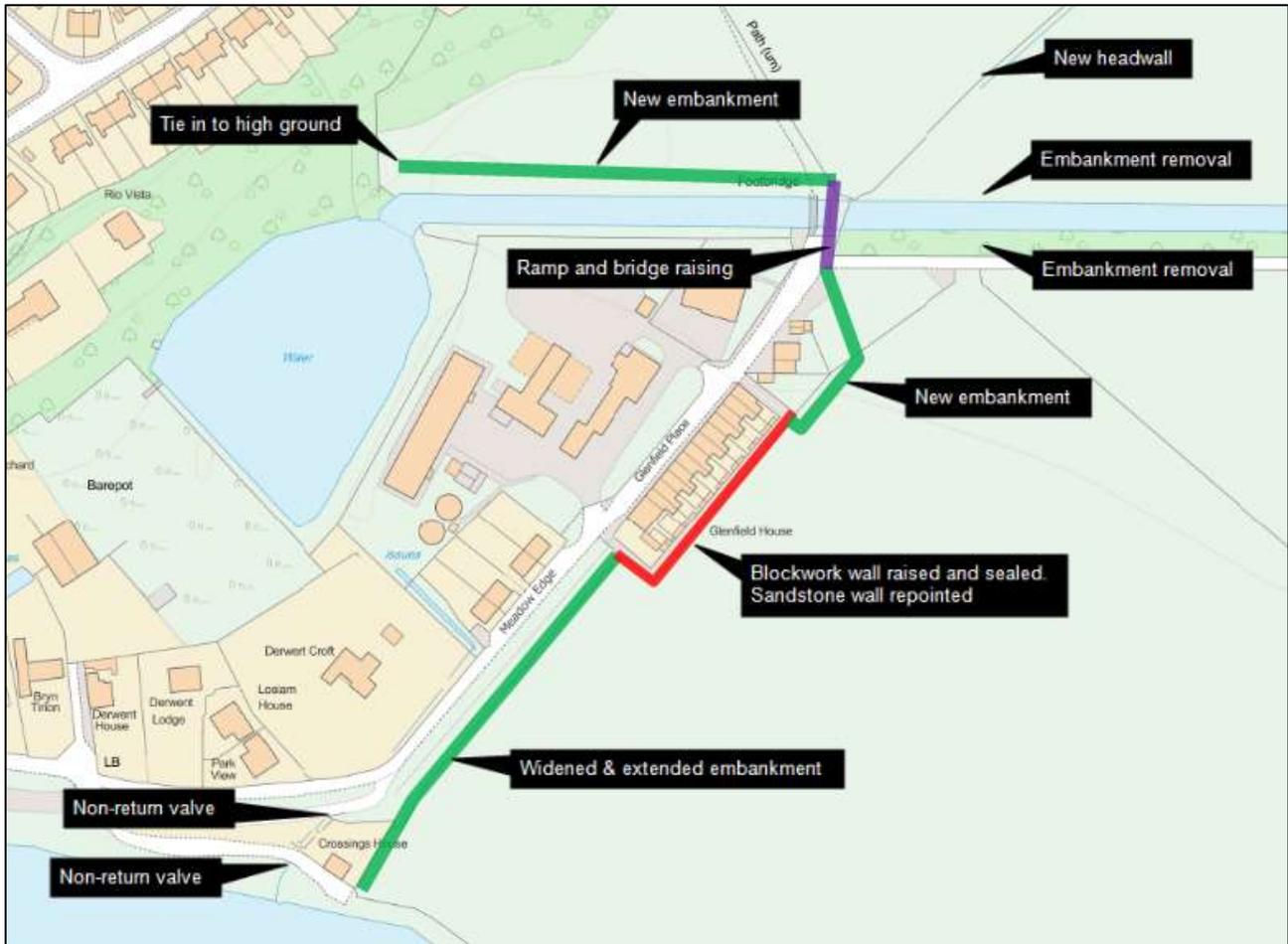
- Increased the width of the existing embankment using clay - complete.
- Extension to the south west extent of the embankment, tying into the wall of Crossings House - complete.
- Extension of the north east extent of the embankment, tying into the wall protecting Glenfield Place, and joining the new concrete road and bridge deck raising over the mill stream - ongoing.
- Construction of a new clay cored flood defence embankment north of the mill stream from the raised bridge deck to the high ground at the western end – expected to start in February.
- Removal of sections of the existing mill stream embankments to the east of the bridge, reconnecting the flood plain and allowing water to pass over this low point rather than the flood defence embankment surrounding properties in Barepot and the reservoir – ongoing work.

Repairs to the wall

- Raising the blockwork wall behind Glenfield Place - complete
- Sealing of expansion joints in blockwork wall – expected to complete in February
- Repointing of the sandstone wall in front of the blockwork wall – ongoing.

Gale Brook

- Installation of a new headwall at the upstream end of the culverted section of Gale Brook – expected to start in February.
- Install two non-return valves on the downstream end of Gale Brook in the vicinity of Crossings House - ongoing.



Future improvements

Teams of engineers, economists and environmental professionals are using local and historic flood information to evaluate options to reduce flood risk – this is known as appraisal work. The Environment Agency has commissioned £3 million of appraisal work on projects across Cumbria, including Workington and Barepot following the December 2015 flooding. We are expecting to have a list of potential options, based on evidence, in April 2017. At present there is no additional funding for flood defence improvement works in Workington and Barepot however it is hoped the appraisal work will lead to funding being made available to reduce the flood risk.

The hard work and contributions made by the Workington Flood Action Group and community is highly valued, and we are keen to continue to work closely with communities through the Flood Action Groups to reduce flood risk throughout the catchment.

customer service line
03708 506 506
www.environment-agency.gov.uk

incident hotline
0800 80 70 60

floodline
0845 988 1188