Pooley Bridge

Draft Flood Investigation Report

Pooley Bridge, River Eamont Flood, 6th December (Peter Smith Photography)

Flood Event 5th- 6th 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	Undertaken by	Reviewed by	Approved by	Date
Working Draft for discussion with EA	David Scott			20/04/16
Version v 2.0	David Scott		Graham Fardell	29 June 2016

Contents

Executive Summary

The flooding experienced in Pooley Bridge on the 5th and 6th of December 2015 was unprecedented, and was the result of the effects 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 draft *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, 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 Pooley Bridge on the 5th and 6th of December, and has used a range of data collected from affected residents, site visits, surveys of the area, and data collected by observers and river & rainfall telemetry during the flood event. This data has been compiled by CH2M, specialist consultants in flood risk management who have provided advice in understanding the event and recommendations for future action.

Approximately 21 commercial and residential properties were directly affected by the flooding in Pooley Bridge. However we are conscious that other, individual properties and surrounding areas were adversely affected by the flooding or surface water runoff, impacting on the wider community out with Pooley Bridge.

This report details the flooding that occurred from Ullswater and the River Eamont at Pooley Bridge. It identifies the flow routes and the causes of the flooding.

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

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

In response to the flooding, a number of 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 in their area of the city.

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 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** and include the report number

Flooding History

Prior to this event, the most recent significant flooding incident in Pooley Bridge was November 2009 and, during that event, some 14 residential and 2 commercial properties were flooded. The 2009 flood event was analysed and assessed to have had an exceedance probabilithy of less than 0.05% (greater than a 200yr return period).

Event background

This section describes the location of the flood incident and identifies the properties that were flooded.

Flooding Incident

Pooley Bridge is a village that is situated in the Lake District National Park and is a popular tourist destination for outdoor activities in Cumbria. Pooley Bridge is located at the northern end of Ullswater and is on the B5320 to Eamont Bridge. There is one main watercourse running through Pooley Bridge, the River Eamont, which passes through the western edge of the village and is the outlet from Ullswater.

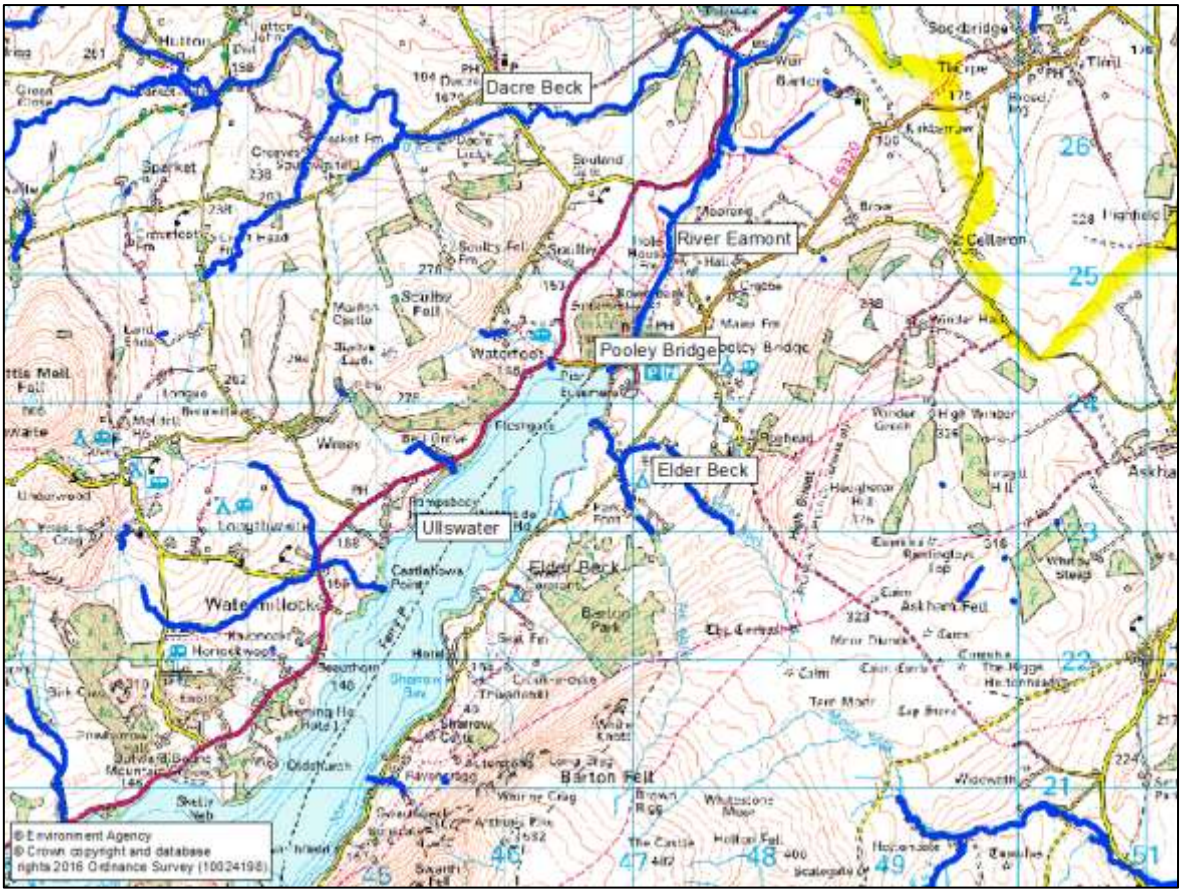


Figure 1 Location of Pooley Bridge

Approximately 21 residential and business properties were affected by flooding on 5th and 6th December 2015. This flooding can be attributed to extreme water levels in Ullswater and, subsequently, the River Eamont following extensive rainfall over the preceding 36 hour period.

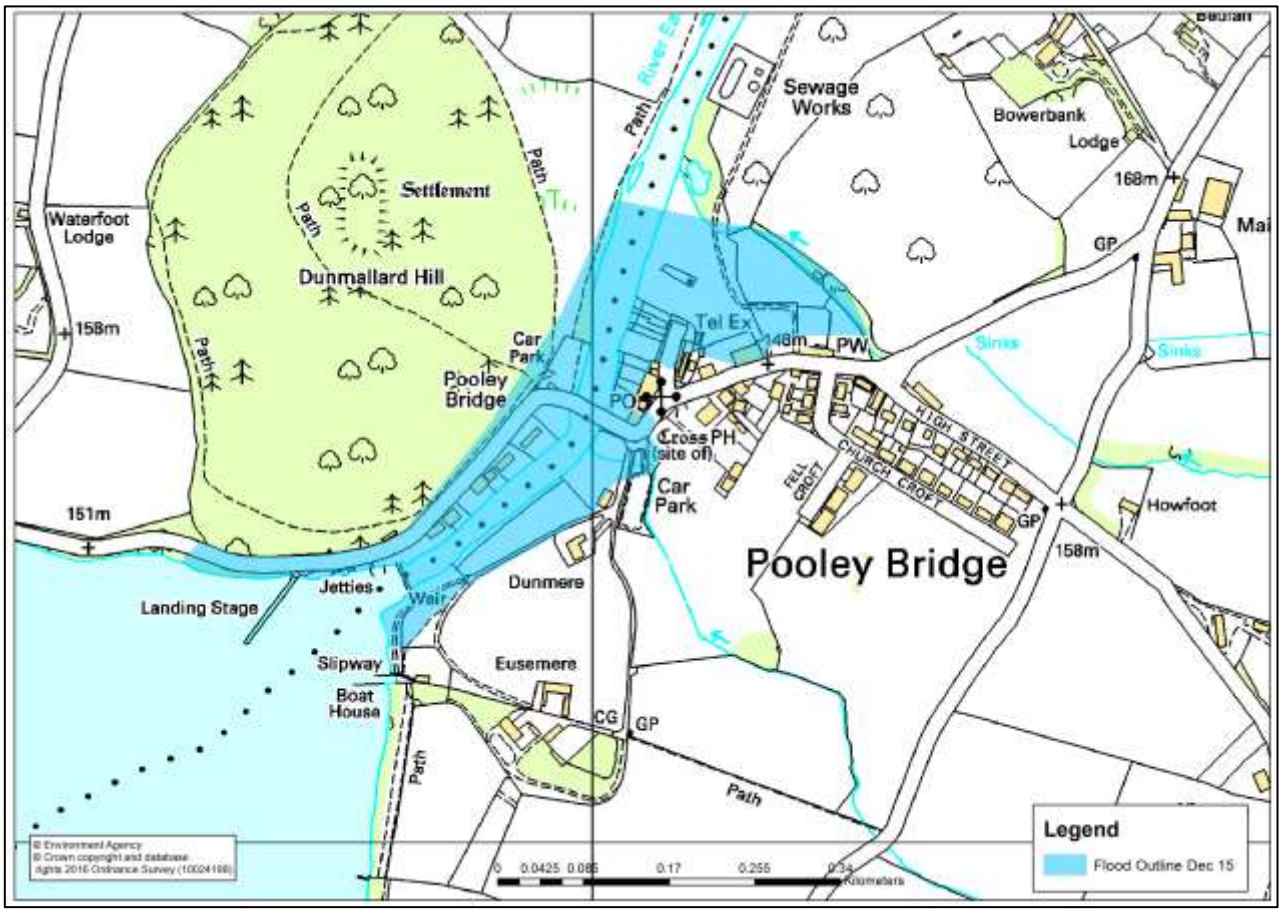


Figure 2 Extent of River Eamont Flooding in Pooley Bridge on 6th December 2015

Figure 3 Aerial Photograph Showing Extent of River Eamont Flooding in Pooley Bridge on 6th December 2015

Figure 2 shows the approximate extent of this flooding local to Pooley Bridge. The bridge in Pooley Bridge crosses the River Eamont at it uppermost extents at the outlet from Ullswater. This 16th Century road bridge was destroyed by the flood on the 6th Dec after the peak flow in the river. A temporary, single carriageway, bridge has recently been erected to reconnect the villages and properties on the eastern side of Ullswater with the wider Cumbrian community.

Current Flood Defences

Pooley Bridge has a limited flooding history, with properties on the B5320, between the steamer ticket office and the bridge, and some of those on Finkle Street downstream of the bridge, having a history of being flooded from the Lake or River. The last major event to affect these properties was in November 2009. No formal flood defences have however, been affordable and those properties at greatest risk of flooding have installed individual property barriers to the most vulnerable locations, such as door and window openings. The properties on the B5320 on the left bank upstream of the bridge and some on Finkle Street, on the right bank, are reported to be in Flood Zone 3, i.e. with a 1% probability or higher of flooding from the river in any one year. Many of the other properties that flooded on the 5th – 6th December are located within the medium to low risk (Flood Zone 2), 0.1% to 1.0% probability of flooding.

Figure 4 Photos of Flooding in Pooley Bridge (Peter Smith Photography)

Investigation

This section provides details of the rainfall event, the likely causes of flooding and the history of flooding in the area.

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 Ullswater and the River Eamont.

Rainfall Event

December 2015 was the wettest calendar month on record with much of northern UK receiving double the average December rainfall. This also followed a particularly wet November, it was the second wettest November since 1910, only exceeded by the 2009 November rainfall. Prior to November, the water levels in Ullswater were very low.

From the 4th to the 7th of December there was a period of prolonged, intense rainfall as Storm Desmond passed over the UK. Over this period new 24hr and 48hr rainfall records were set for UK, both within Cumbria, breaking the previous records, also both within Cumbria, set during the 2009 floods.

This unprecedented rainfall event led to exceptionally high river flows across the country and widespread flooding. Levels in the River Eamont at Pooley Bridge were the highest recorded, exceeding the records set during the 2009 floods.

	Previous record				December 2015 Event	
	Date	Location	mm	Date	Location	mm
24hr rainfall	19th Nov 09	Brotherswater	153.4	5th Dec 15	Brotherswater	245
		High Row	113.8		High Row	148
		Green Close Farm	41.8		Green Close Farm	68
48hr rainfall	18th-19th Nov 09	Brotherswater	245	4th-5th Dec 15	Brotherswater	372
		High Row	171.2		High Row	216
		Green Close Farm	62.6		Green Close Farm	121

Table 1 Rainfall recorded at gauges around Pooley Bridge *

Table 1 shows the rainfall recorded upstream of Pooley Bridge on the 4th and 5th December 2015 and compares this to the previously highest recorded rainfall in the area, the November 2009 event. Figure 5 shows the location of these rain gauges.

* Taken from met office – **Flooding in Cumbria December 2015 - Met Office**
www.metoffice.gov.uk/public/weather/climate-extremes
http://www.metoffice.gov.uk/climate/uk/interesting/nov2009

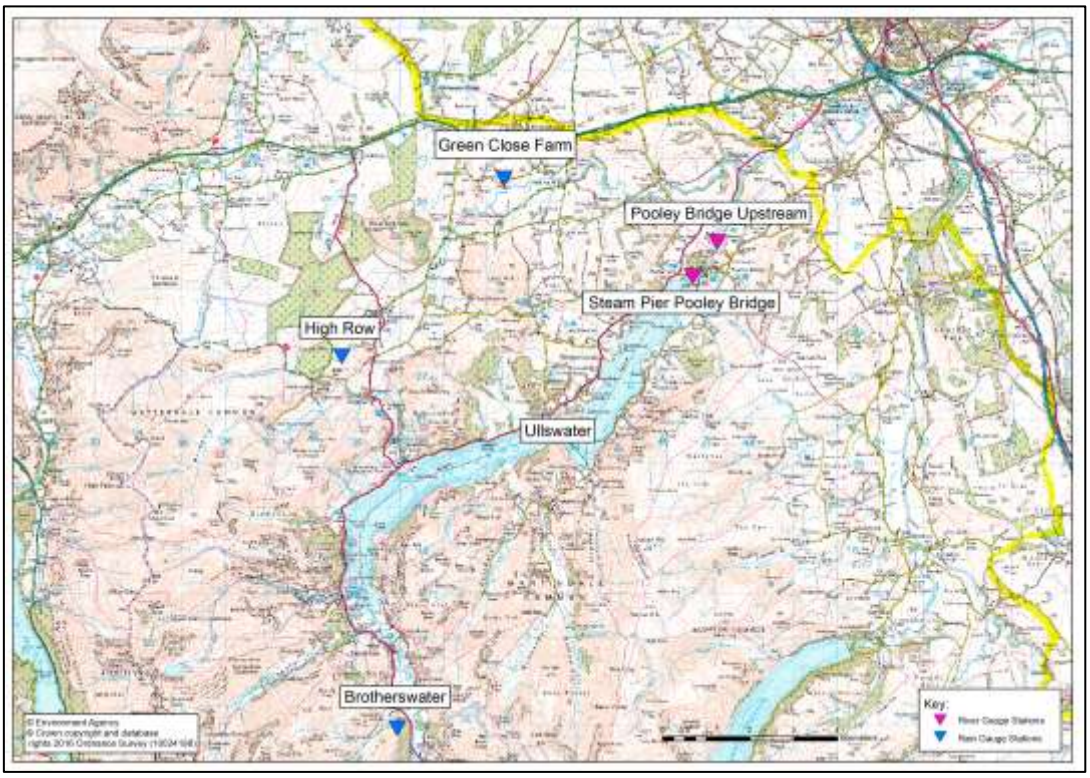


Figure 5 Location of River Level, Flow and Rain Gauges around Pooley Bridge

Table 2 shows the peak flows recorded at these gauging stations on the 5th December and for previous flooding events. Flows measured at both of these locations were greater than any flow that has been recorded previously.

Gauging Station	River	Peak Level (m)			Estimated return period of Dec 2015 event (AEP)
		December 2015	Past Events		
			November 2009	December 2013	
Steamer Pier Ullswater	Ullswater	**4.52 (Estimated)**	n/a	2.928	N/A
Pooley Bridge	River Eamont	**2.71 (Estimated)** *	2.226		0.23% AEP (1 in 435yrs)

Table 2 Flows recorded at the gauging stations

Note: * - The level recorded at the Pooley Bridge gauging station on the 6th Dec 2015 is 146.95mAOD, wrack was also recorded next to the station at 146.234mAOD, some 700mm lower. The previous highest recorded level was 146.466mAOD on Nov 2009. This would suggest this wrack level is not representative of the peak water level at this location.

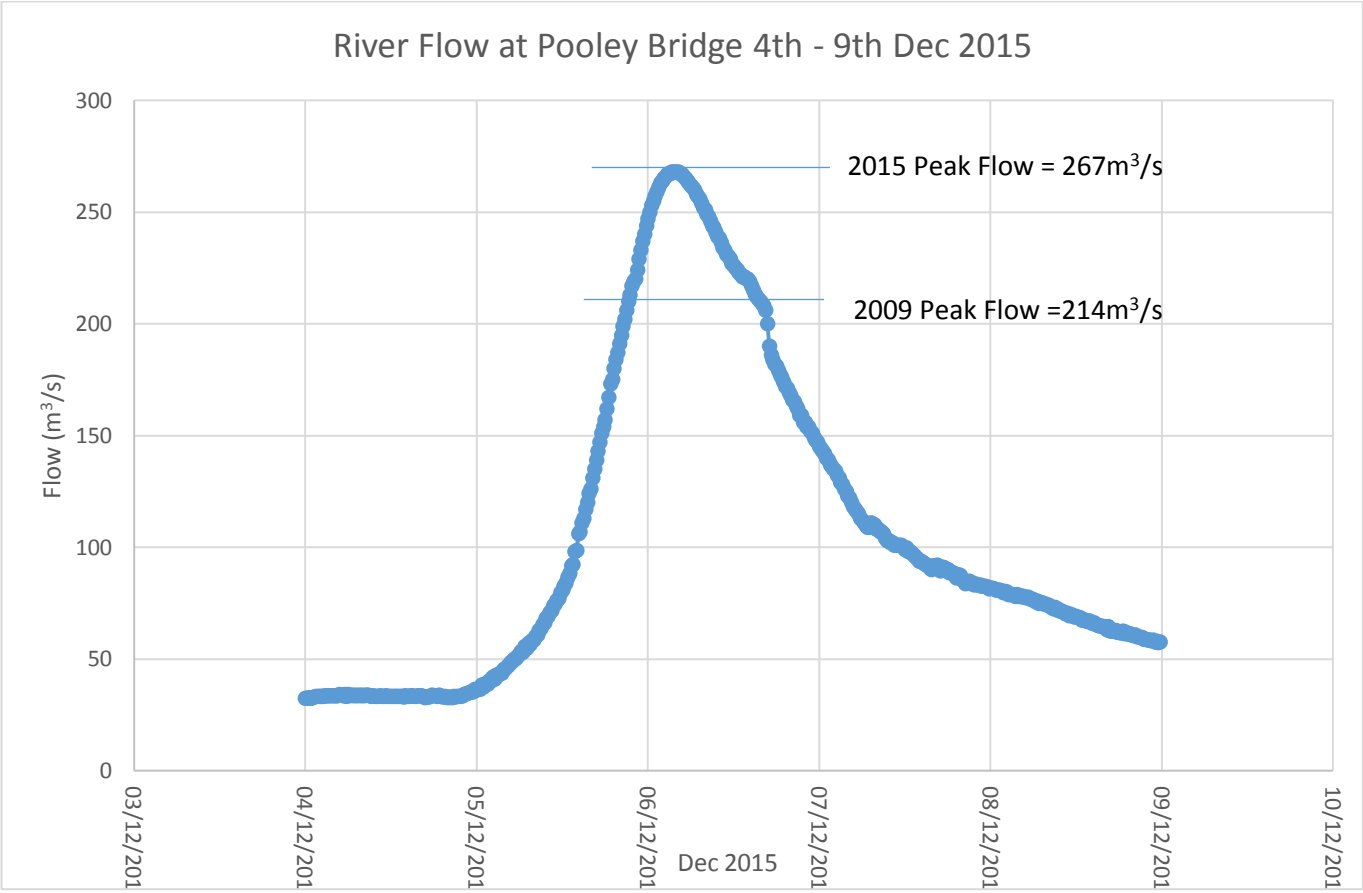


Figure 6 Peak Flow at River Gauge downstream of Pooley Bridge

Flooding Flow Routes

There are a number of potential flooding routes in Pooley Bridge. These include surface water runoff, inability of local surface water drainage to accommodate overland flows, and flooding from excess water in the River Eamont and Ullswater. Figure 7 shows an illustration of the most likely of these routes.

Route 1 is flooding from the high water levels in Ullswater where water overtops a low wall adjacent to the Steamer ticket office on the B5320. Wave action exacerbates this process and it has been reported, in the past, that water and debris collect on the road early on in a flood event. Once on the road flood water can be obstructed from returning to the river channel by roadside walls and the approaches to the bridge.

Route 2 is flooding from out of bank flows from the River Eamont upstream of the bridge.

Route 3 is from surface runoff and flooding from drainage systems. At the time of this photograph it is unlikely that any local surface runoff made any significant difference to the level of flooding experienced. The most likely cause of flooding was the excessive level of water in Ullswater leading to high river levels in the River Eamont (Routes 1 and 2). However it is possible that route 3, surface water runoff, initiated property flooding earlier than the excessive river levels on Finkle Street for example. Records indicate that flooding local to the drainage ditch on the right hand bank of the River Eamont, upstream of the road bridge, commenced some 1 to 2 days prior to the peak flows in the river.

Route 4 is due to excessive water levels in the River Eamont downstream of the bridge.

It is very likely that surface water and foul drainage were unable to function due to both the high river levels and the fact that the treatment works, located approximately 200m downstream was flooded. However this is not likely to have had any impact on the recorded water levels at Pooley Bridge. However, drainage systems could have had an impact on the timing of flooding, causing flooding to areas prior to the high water levels in the river and lake.

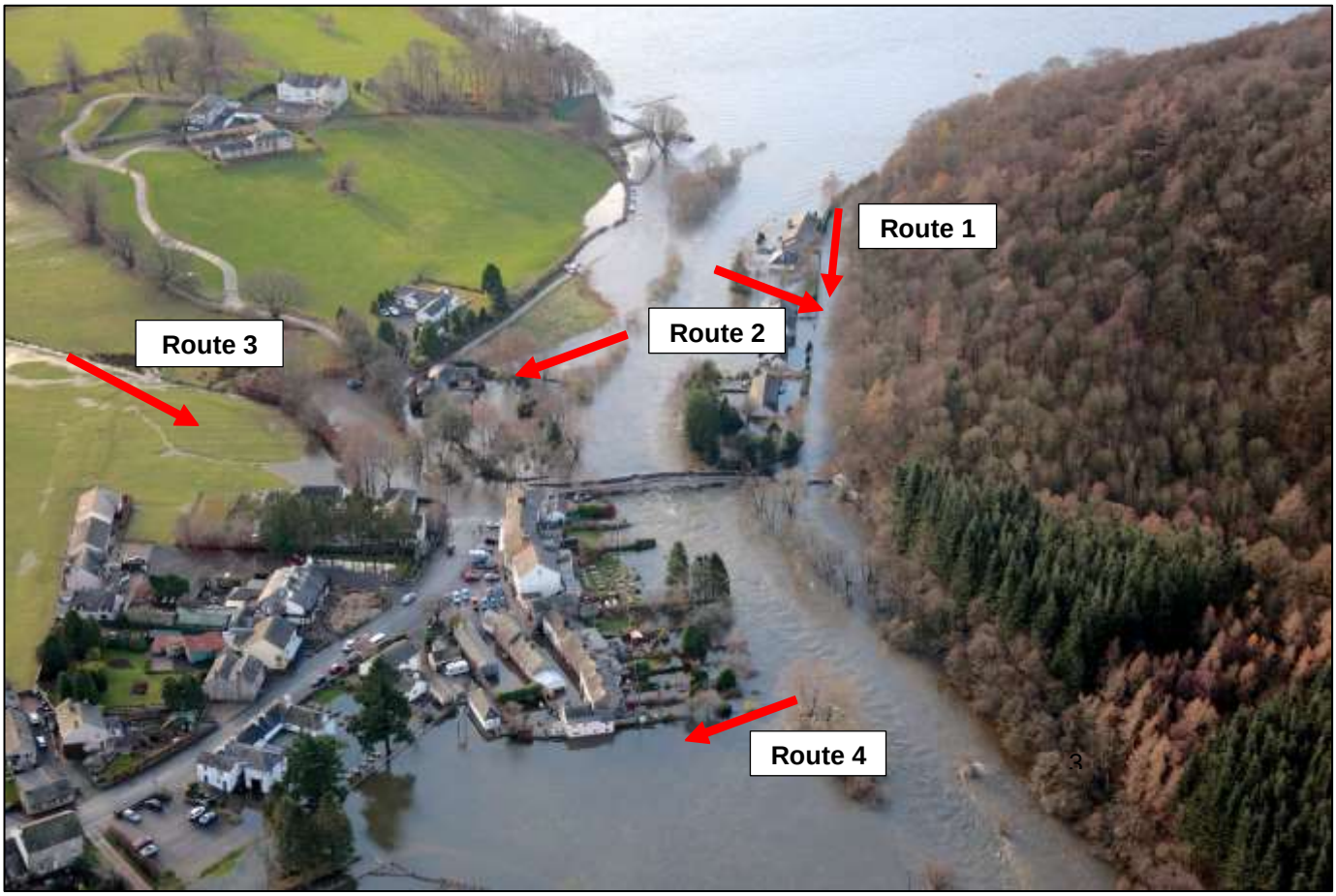


Figure 7 Flood Flow Routes (Peter Smith Photography)

Impacts and Likely Causes of Flooding

Timeline

Table 3 below shows the times of key events during the Pooley Bridge flooding.

4th December Time	Flood Warning Area	Type and Location
15:14		Flood Alert:- Rivers Lowther and Eamont
5th December		
07:50	NC27A	Flood Warnings Issued, Dunmallard Hill, B5320, Steamer Pier.
15:11	NC27B	Flood Warnings Issued, Finkle St, Heughscar Cl, B5320.
6th December		
02:17	NC27A&B	Severe Flood Warning Issued, All areas in Pooley Bridge.
03:45		Peak flow in R. Eamont at 268m3/s, from estimated data
16:00		Bridge Collapses
7th December		
16:47	NC27A&B	Severe Flood Warning reduced to Flood Warning
8th December		
17:34	NC27A&B	Flood Warning Lifted
22nd December		
10:05	NC27A	Flood Warning Issued, Dunmallard Hill, B5320, Steamer Pier.
23rd December		
09:59	NC27A	Flood Warning Lifted

Table 3 Timeline of Actions at Pooley Bridge

Cumbria experienced record levels of rainfall between the 5th and 6th December 2015. This rainfall fell on already wet ground following three previous storms in November, which generated more than twice the monthly average rainfall for November. The wet conditions exacerbated the runoff from Storm Desmond and combined to produce a flood event that exceeded the previous highest Lake and River levels of November 2009.

The Environment Agency installed a gauging station on the steamer pier at the mouth of the River Eamont in August 2012 and it recorded an estimated water level, at 07:00 on the 6th December 2015, of 148.20mAOD. This level ties in reasonably well with surrounding wrack levels taken following the flood event, which ranged from 148.15mAOD adjacent to the Boat House Jetty upstream to 147.85mAOD on the B5320, upstream of the bridge.

There is also a gauging station located on the Steamer Pier at Glenridding which was installed in November 1961. This Glenridding gauge recorded a water level in Ullswater of 148.23mAOD on 7 December 2015. The highest level previously recorded was 147.70mAOD on 20 November 2009. From the available level data, it can be concluded that the level in the lake was around 0.5m higher than previously recorded.

A further gauging station installed in March 1976, located some 500m downstream of Pooley Bridge, recorded an estimated water level of 146.95mAOD at 03:45 on the 6th December 2015. This recorded level is 0.7m higher than a wrack mark record (146.234mAOD) taken of the estimated flood extents opposite the station. The previously highest recorded water level at this station was 146.47mAOD, also on the 20 November2009 and, as such, would suggest this wrack level is not a good indication of the maximum water levels reached around the station.

Flow estimates for the River Eamont have been given as ranging from 220 – 268m^3/s, with an exceedance probability of around 0.23% (or 1 in 435 years) which would take the event well into the low risk (0.1% to 1% probability range) of occurrence zone. The 2009 event, the previously highest recorded flood at Pooley Bridge, was assigned an exceedance probability of <0.5% (>1 in 200years).

An estimate of some 43.1 million cubic metres of water (9,500 million gallons) flowed past Pooley Bridge between the 5th and 9th of December.

There is a record of flooding to a single property on the right bank of the River Eamont on the 3rd of December 2015. This could not have come from Ullswater or the River Eamont. The source of flooding was surface run off from Heughscar Hill and the extent of flooding at this property is unknown.

Environment Agency Flood Incident Response

A flood alert was issued for the Rivers Eamont and Lowther on the 4th December 2015 at 15:14, however a more local flood warning for the River Eamont covering area A, Dunmallard Hill, B5320 and the Steamer Pier, was issued on the 5th of December at 07:50, this was raised to a severe warning (Danger to Life) at 02:17 on the 6th December. This was subsequently returned to a flood warning on the 7 December at 16:47 and finally lifted at 17:34 on the 8th December. A further warning was raised for this area on the 22nd December 2015 at 10:05 and then removed at 09.59 on the 23rd December.

A Flood warning for area B, Finkle Street, Heughscar Close and the B5320 was issued at 15:11 on the 5th December, this was raised to a severe warning (Danger to Life) at 02:17 on the 6th December and was subsequently returned to a flood warning on the 7th December at 16:47 and finally lifted at 17:34 on the 8th December.

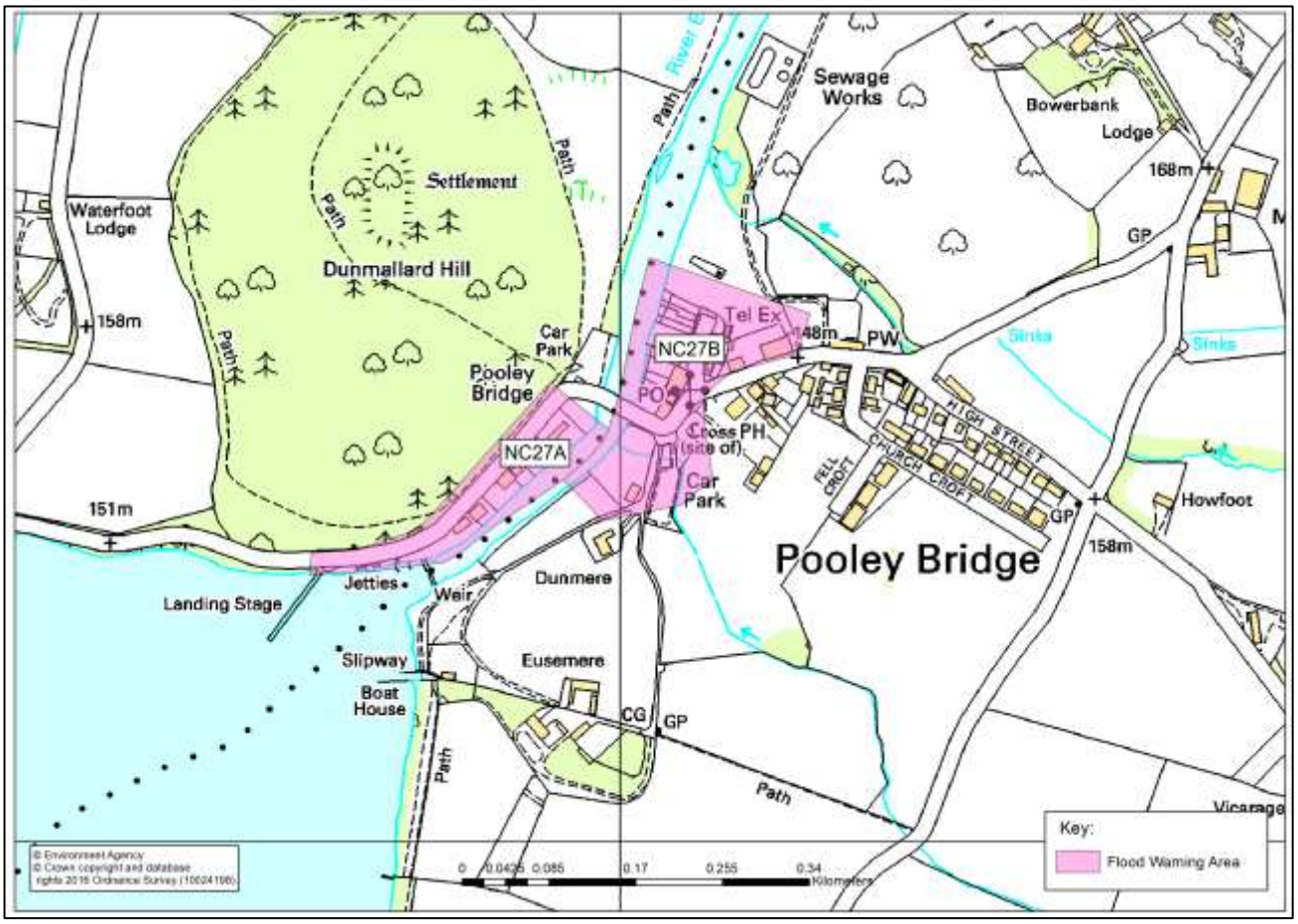


Figure 8 Flood Warning Areas within Pooley Bridge

Residents that provided information to the Agency regarding flooding, confirmed that a warning was given and received in time, however 20% of those that provided information to the Agency were not registered on Floodline.

There are no flood defences at Pooley Bridge but some individual properties have their own flood gates. It is understood that these gates were overtopped during the event, exacerbating property flooding.

The Environment Agency carry out local river maintenance works to clear sand and gravel accumulation levels when they are above pre-determined trigger levels. The gravel levels are monitored annually with the last survey prior to the December event taking place in January 2015. At this time the trigger to remove the gravel was not reached, however the Parish Council removed a gravel shoal, located in front of the National Park car park on the left bank of the river, downstream of the bridge. Following the collapse of the 16th century bridge across the River Eamont, at 4pm on the 6th December, the Environment Agency worked with Cumbria County Council to reinstate access and remove the debris from the watercourse. The bridge carried sewerage, drinking water, telecommunication and internet broadband services across the river.

Recommended Actions

The following table details recommended actions for various organisations and members of the public to consider. These recommendations may have already been carried out.

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	2016
	Environment Agency and Cumbria County Council Highways, Network Rail and Electricity North West.	To review the flood risk and resilience of critical transport and power supply infrastructure.	Autumn 2016
	Environment Agency and Cumbria County Council Highways	Update understanding of impact new, clear span, bridge will have on flooding.	Summer 2016
	Cumbria Planning Group, Cumbria County Council and Environment Agency	Review Local Development Plans and Strategic Flood Risk Assessment to reflect current understanding of flooding	2016
	Environment Agency	Ensure all properties at risk can register to receive flood warnings and details are up-to-date.	Summer 2016
	Residents	Flooded properties to implement flood resilience measures to reduce impacts of future flooding	Winter 2016
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.	July 2016
Maintenance	County Council and United Utilities	Review and investigate drainage and sewage systems to better understand where improvements are required.	2016
	United Utilities	Review surface water drainage and sewerage in areas that flooded to assess if improvements could be made to minimise pollution	Summer 2016

		to flooded properties.	
	Environment Agency, United Utilities and Cumbria County Council	Complete on-going inspections and repairs to assets which may have been damaged during the flood event.	2016
Strengthening Defences	Environment Agency	Review modelling data to ensure that models for Pooley Bridge reflect real conditions and flood risk zones 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 and also future gravel management	July 2016
	Environment Agency	Promote a flood defence scheme at Pooley Bridge.	Summer 2016

Next Steps

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, has produced a 25 year flood action plan for the Cumbrian catchments worst affected by the December 2015 flooding. The Cumbria Flood Action Plan, as well as a series of community action plans, are available online at:

https://www.gov.uk/government/publications/cumbria-flood-action-plan

The plan considers 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 were published on 30th June 2016.

The Cumbria Floods Partnership was set up by Flood Minister Rory Stewart MP following December's floods, and includes all of Cumbria's RMAs. They are working alongside the existing 'Cumbria Strategic Partnership', which was formed as part of the Flood and Water Management Act 2010 and comprises of the County's RMAs, including the Environment Agency, Cumbria County Council, Local Authorities and United Utilities. Both partnerships are working with communities, businesses, and relevant stakeholders to understand and reduce flood risk across Cumbria.

Figure 9 helps to demonstrate how the two partnerships are working together.

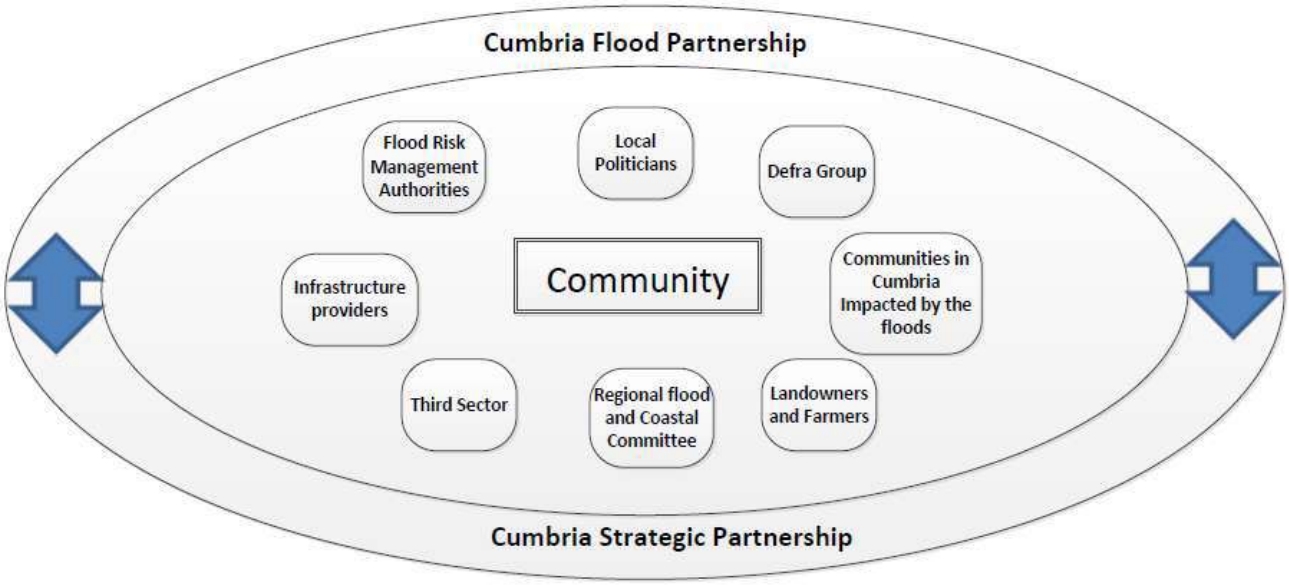


Figure 9: Cumbria Flood Partnership and Cumbria Strategic Partnership

Appendices

Appendix 1: Glossary

AEP	Annual Exceedance Probability
ARI	Annual Recurrance Interval
AOD	Above Ordnance Datum
CCC	Cumbria County Council
EA	Environment Agency
FAG	Flood Action Group
FWD	Flood Warnings Direct
LLFA	Local Lead Flood Authority
LRF	Local Resilience Forum
MsfWG	Making space for Water Group
RMA	Risk Management Authority
UU	United Utilities

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 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 3: 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

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

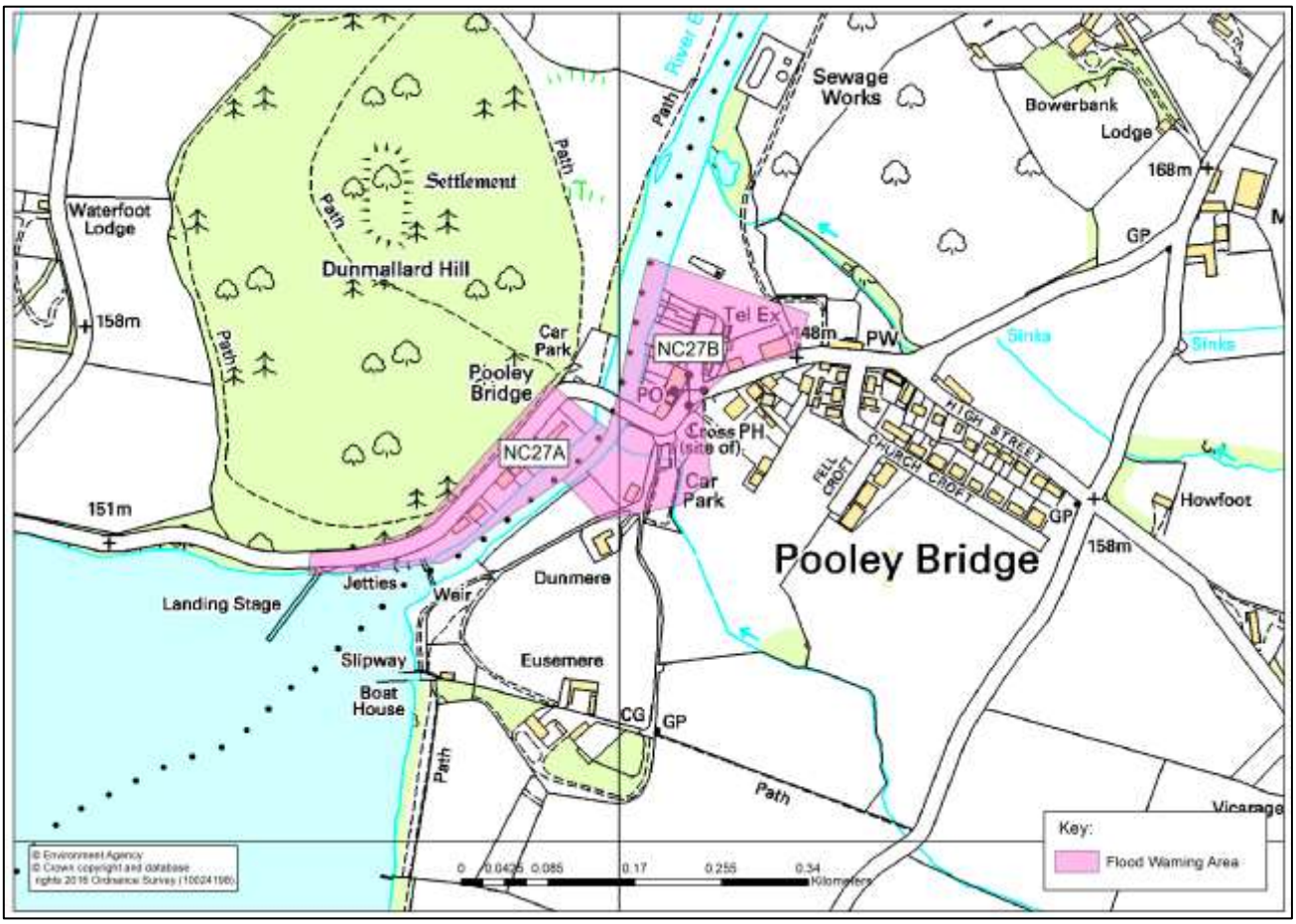
Cumbria County Council Community Services
Alison.Meadows@cumbria.gov.uk, www.cumbria.gov.uk, tel: 1229 407576

United Utilities: tel: 0845 746 2200

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

Land Drainage Act:
http://www.legislation.gov.uk/all?title=land%20drainage%20act

Appendix 4: Flood Warnings and Alerts



Identification of Flood Warning Areas

The table below summarises the times of the flood warning issued during this flood event:

4th December Time	Flood Warning Area	Type and Location
15:14		Flood Alert:- Rivers Lowther and Eamont
5th December		
07:50	NC27A	Flood Warnings Issued, Dunmallard Hill, B5320, Steamer Pier.
15:11	NC27B	Flood Warnings Issued, Finkle St, Heughscar Cl, B5320.
6th December		
02:17	NC27A&B	Severe Flood Warning Issued, All areas in Pooley Bridge.
03:45		Peak flow in R. Eamont at 268m3/s, from estimated data
16:00		Bridge Collapses
7th December		
16:47	NC27A&B	Severe Flood Warning reduced to Flood Warning
8th December		
17:34	NC27A&B	Flood Warning Lifted

4th December Time	Flood Warning Area	Type and Location
22nd December		
10:05	NC27A	Flood Warning Issued, Dunmallard Hill, B5320, Steamer Pier.
23rd December		
09:59	NC27A	Flood Warning Lifted

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.

আপনি যদি এই তথ্য আপনার নিজের ভাষায় পেতে চান তাহলে অনুগ্রহ করে **01228 606060** নম্বরে টেলিফোন করুন।

如果您希望通过母语了解此信息，
请致电 **01228 606060**

Jeigu norėtumėte gauti šią informaciją savo kalba, skambinkite telefonu 01228 606060

W celu uzyskania informacji w Państwa języku proszę zatelefonować pod numer 01228 606060

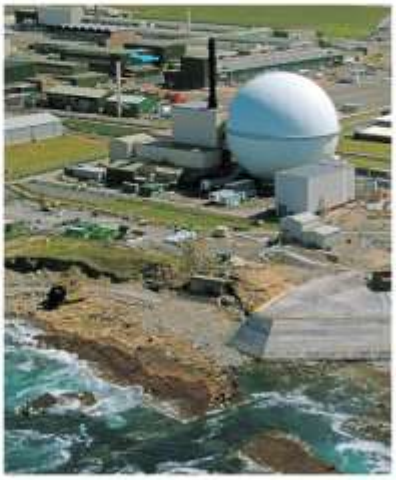
Se quiser aceder a esta informação na sua língua, telefone para o 01228 606060

Bu bilgiyi kendi dilinizde görmek istiyorsanız lütfen 01228 606060 numaralı telefonu arayınız

Appendix 5: CH2M Hill UK Projects and Flood Risk Management brochure

CH2MHILL.

Key Projects in the UK



We partner with your industry

- Municipal Water, Wastewater, and Water Supply
- Aviation, Ports, Transit, and Rail
- Nuclear Decontamination and Decommissioning
- Chemical Manufacturing
- Environmental Remediation and Compliance Management
- Environmental Industrial Systems
- Commercial Nuclear
- Oil and Gas
- Electronics and Advanced Technologies
- Manufacturing
- Life Sciences
- Communications Infrastructure
- Security Systems

Employee-owned CH2M HILL is one of the world's leading consulting, design, design-build, operations, and programme management companies serving government, civil, industrial and energy clients, employing over 28,000 people worldwide. Our work is concentrated in the areas of water, transportation, environmental, energy, facilities and resources.

Having operated in the UK for over 20 years, we acquired Halcrow in 2011 and continue to base our European headquarters in London, now employing over 3,300 people in the UK. CH2M HILL is working on some of the most iconic infrastructure programmes including High Speed 2, Thames Tideway Tunnels, the decommissioning of Dounreay and was one of the leading partners in CLM, Delivery Partner to the ODA for the London 2012 Olympic & Paralympic Games.

We serve as a single point of contact and responsibility, managing your project through planning, financing, permitting, design, construction, and operations. We use technology transfer and leverage established relationships with local firms to deliver industrial and enterprise management solutions throughout the United Kingdom.

CH2M HILL is an active member of Business in the Community and the Employee Ownership Association.

Urban Programmes

Key endorsements:

"From the outset of the project, the Olympic Park has set new standards in sustainability, including delivery of lightweight venues, recycling or reuse of waste materials, using concrete with a high recycled content and delivering materials by rail or water. We have achieved new standards for a project of this size and scale and have raised the bar for the industry."
– John Armitt, ODA Chairman

"The ODA did a fantastic job in delivering the Olympic venues and infrastructure on time and within budget. They did our nation proud."
– Margaret Hodge MP, Chair of the Public Accounts Select Committee

London 2012 Olympic and Paralympic Games

CH2M HILL was one of the three first constituting the international consortium CLM, the Delivery Partner to the Olympic Delivery Authority (ODA). CLM oversaw the design and construction of the nine venues across the 500-acre Olympic Park for the London 2012 Olympic and Paralympic Games. CH2M HILL provided the consortium and ODA with global engineering, construction and programme management expertise.

Completed one year ahead of the games, the programme was delivered at an impressive £1Bn under the baseline budget of £7.2Bn with notably zero construction fatalities, the first of such records of any modern Olympics.

Water

Thames Tideway Tunnel and Lee Tunnel

CH2M HILL is the programme manager for the London Tideway Tunnels Programme, one of the biggest and most historic public works initiatives in London's history. With the Rivers Lee and Thames currently overflowing approximately 50-60 times annually, the London Tideway Tunnels Programme looks to reduce overflows to three or less per year.

The programme will see the construction of the Lee Tunnel and the Thames Tideway Tunnel and aims to greatly improve the river quality and reduce the environmental impact of sewerage overflows. Both tunnels will be more than seven metres wide, running beneath a vast network of existing tunnels, including six Underground lines and utilities. The programme includes constructing numerous collection and diversion facilities, a large high-head underground pumping station, and a major upgrade at Beckton sewage treatment works. Ultimately, CH2M HILL will manage over 300 work packages. So far, CH2M HILL have delivered £700M of savings on a £4.1Bn budget and carried out exemplary stakeholder relations across 14 London Boroughs.

Transport

Crossrail

As Europe's largest engineering project, Crossrail will connect 37 stations, including Heathrow airport and Maidenhead in the west with Canary Wharf, Abbey Wood and Shenfield in the east—reducing journey times across London while delivering extensive economic benefits.

The Transcend team, which includes CH2M HILL, AECOM and The Nichols Group, was appointed as the programme partner to work alongside Crossrail to oversee the construction of a 21 kilometre-long tunnel beneath central London, build eight new stations and integrate Crossrail with London's existing transport systems. Additionally, the team is responsible for programme controls, encompassing the functions of scope, cost and schedule control, as well as risk and value management.

When Crossrail opens in 2018, the £14.8Bn rail link will boost London's rail-based network capacity by ten percent—transporting 200 million passengers annually, bolster the capital's position as a world-leading financial center, and significantly reduce journey times across the city.

High Speed 2 (HS2)

HS2 will be the UK's new high speed rail network and is being designed and built to resolve impending capacity issues for both passengers and freight on existing routes, particularly the West Coast Main Line.

The network will provide enhanced infrastructure links between London and the West Midlands (Phase One), as well as the Channel Tunnel, expanding in future to connect Manchester, Leeds and the North with Birmingham, the south of England and Heathrow Airport (Phase Two).

CH2M HILL is development partner with HS2 Ltd and is leading the development of the next phase of engineering, design and environmental work on the London to the West Midlands line. The 80 strong team, working alongside HS2 Ltd, largely consists of project management and engineering specialists from the UK. The team project manage the professional services companies who are carrying out the design, environmental and land referencing work for the London to West Midlands line. CH2M HILL's expertise ensures that the work is fully integrated and delivered to the required quality.

On appointing CH2M HILL, HS2 Ltd's Chief Executive Alison Munro said: "The appointment means that we will have world class project managers and technical experts working alongside us to deliver the design, engineering and environmental work necessary for the hybrid bill. They will bring, in particular, their highly regarded experience of working on HS1 and Crossrail, two major UK infrastructure projects that have direct relevance to our work."

We provide services for your success

- Programme and Project Management
- Site Selection
- Infrastructure Planning
- Economic Development
- Energy Management and Planning
- Information Systems
- Master Planning
- Licensing and Permitting
- Management Consulting
- Project Financing
- Project Development
- Architecture and Programming
- LEED and BREEAM Facility Certification
- Civil, Structural, Mechanical, and Electrical Engineering

Water Resources-Ecosystem Management Services

Flood Risk Management

CH2M is a world leader in flood risk management, providing integrated and sustainable solutions for both the built and natural environment. Our large team of specialists and scientists, who are primarily based in the UK and USA, deliver projects around the world. They are supported by environmental scientists, surveyors, geotechnical engineers, and business planning, finance and contract, and other specialists. Our work includes the full cycle of flood risk mapping and strategic planning; capital works delivery; and operation, maintenance and asset management.

The solutions we develop recognize the effect climate change is increasingly having on the built and natural environment within river catchments and estuaries, and thus our focus is on developing long-term solutions that work with nature and continue to leave a sustainable legacy to protect future generations from the effects of climate change.

A core focus is delivering fully integrated solutions that maximize both direct and indirect benefits for the clients that we serve in WBG, TBG and Strategic Consulting. This means we are linked with several technologies including IWRM, Dams and Levees (Conveyance), Water Resilience, H&H modeling (Software Applications and Integration), Urban Watershed Management; and Coastal Planning and Engineering.

Sub-technologies

The FRM technology group has three key sub-technology areas that we steward, offering several capabilities in each:

Flood mapping and appraisal

- Watershed-scale flood risk management planning
- Flood hazard modeling/mapping and hydraulic analysis
- Flood risk management alternatives development and testing
- Risk vulnerability and damage analysis
- Flood forecasting/warning
- Flood incident management and exercise

Capital works delivery

- Program/project management
- Conceptual, preliminary and final design
- Contract preparation and administration
- Construction supervision
- Due diligence and other pre-bid assistance

O&M and asset management (AM)

- Asset management
- Strategic and tactical investment advice
- Disaster recovery

Challenges, Trends, Opportunities

Floods are increasing in frequency around the world and it is forecast that these will only get worse as a result of climate change. As the frequency of floods increases, the tolerance of the public, governments, the private sector, and insurance companies is reducing, prompting action.

A key market differentiator is being able to deliver multiple outcomes to clients through a river basin management approach which links together flood risk management needs with regeneration, recreational, and environmental enhancement opportunities and combines the associated available funding to generate both efficiencies and the financial support necessary for scheme delivery.

To achieve this we need to combine our flood risk management capabilities and technology with our knowledge of what the issues are within the river basins.

Did You Know?

- A review by the Organization for Economic Cooperation and Development on 136 coastal cities found that the estimated damage from sea level rise, storm surge and subsidence for 1 in 100 year flood event in 2070 was estimated at $35,000 billion.
- In 2070 it is estimated that over 150 million people will live in these 136 coastal cities at risk.
- River flooding is the most common type of flood event.
- Floods are the number one natural disaster in the US, and just a few inches of water from a flood can cause tens of thousands of dollars in damage.
- The flooding in Alberta, Canada in 2013 flooding displaced 100,000 people and is estimated to cost $6 billion.
- According to the House of Commons library, £2.34 billion has been spent on new flood defenses in England alone since 2011.