

Holme

Flood Investigation Report



North Road, Holme

Flood Event 22nd November 2017

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

Version	Undertaken by	Reviewed by	Approved by	Date
Draft	Colin Parkes	Doug Coyle	Angela Jones	June 2018
Published				

DRAFT

Executive Summary

Cumbria County Council as Lead Local Flood Authority has prepared this report with the assistance of other Flood Risk Management Authorities as it considers necessary to do so under Section 19 of the Flood and Water Management Act 2010.

This report details the flooding that occurred primarily in two locations within the community, North Road where 10 residential properties flooded and Sheernest where 8 residential properties flooded. One further residential property flooded on Burton Road. In all 19 properties have reported internal flooding. Other areas have reported external flooding to buildings. The flooding experienced in Holme was a result of the following possible flooding mechanisms.

- Subsurface input of groundwater originating from eastern side of canal and motorway due to hydro-geological conditions. The catchment is limestone and so flows may be in part karstic and there is a geological boundary at both North Road and Sheernest which acts as a spring line.
- Historic legacy of inadequate drainage infrastructure unable to convey the water away effectively. This is in the form of an old stone culvert under North Road and lengths below properties between hillside and the North Road.
- Highway runoff where road drainage is inadequate to take overland flows surface water.

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

Any additional information that residents and others can provide to 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>

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Introduction

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

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

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

Only those with 5 or more properties/businesses involved will have investigations published. An investigation will be carried out, and a report prepared and published by the LLFA when the flooding impacts meet the following criteria:

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

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

Scope of this Report

This Flood Investigation Report **is**:

- an investigation on the what, when, why, and how the flooding took place resulting from the 22nd Nov 2017 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 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.

Event Background

The two main areas where flooding occurred are (1) North Road and (2) Sheernest. The fire brigade attended both locations. Flooding was also reported at (3) Brook Cottage. Nuisance from water has been reported at (4) Mayfield and (5) Holme Mills but it has not been reported that these locations suffered from internal property flooding.

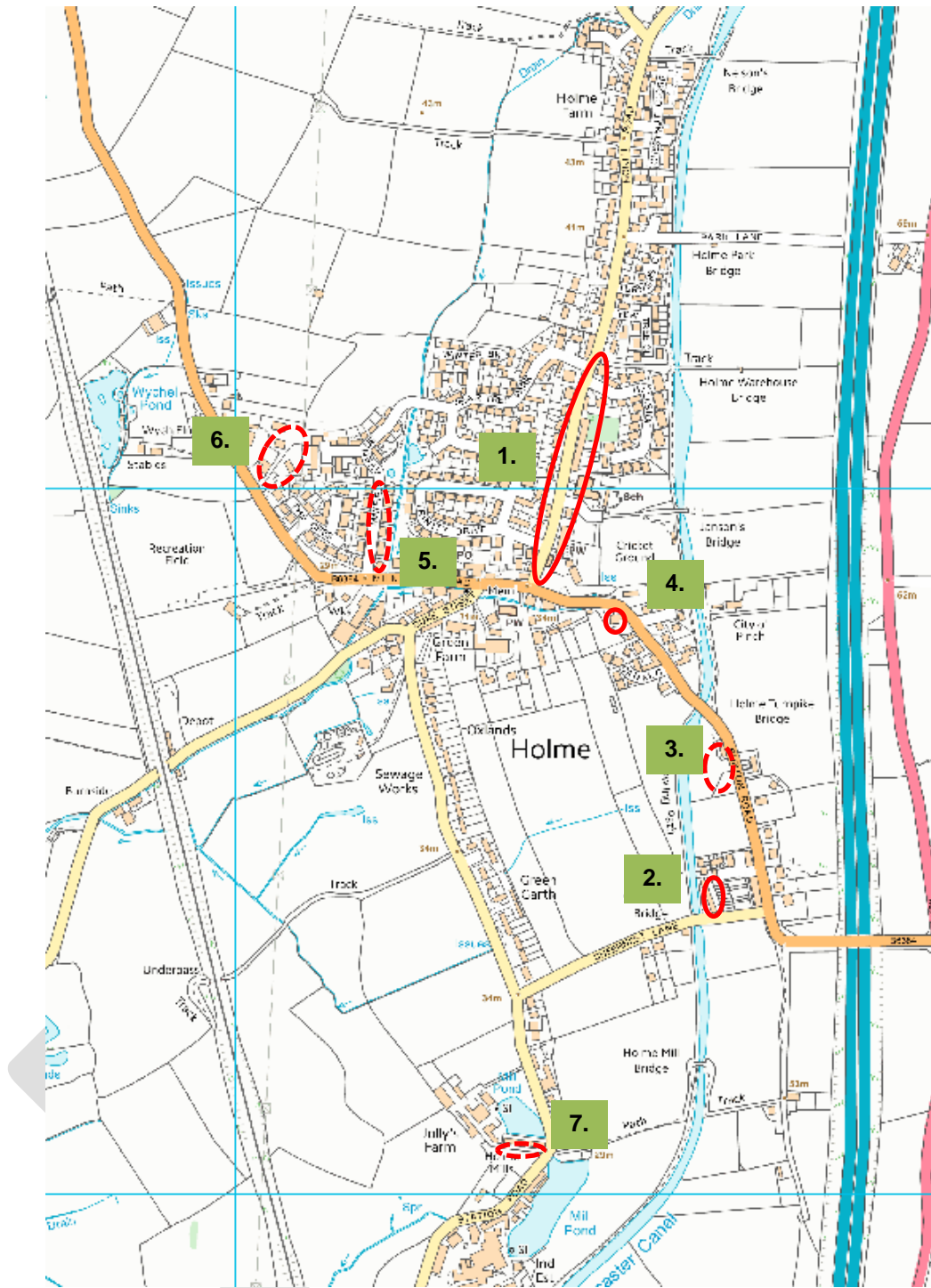
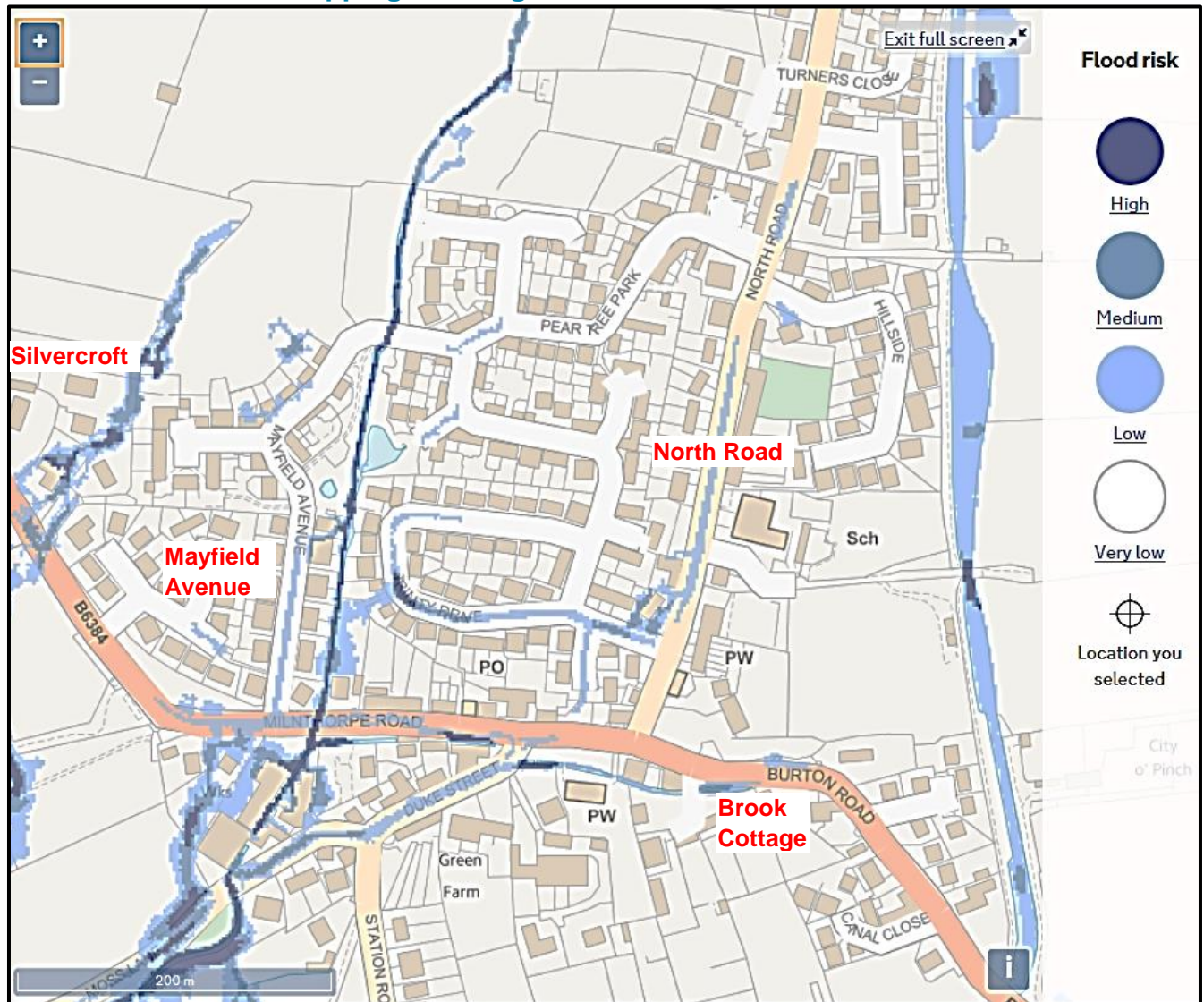
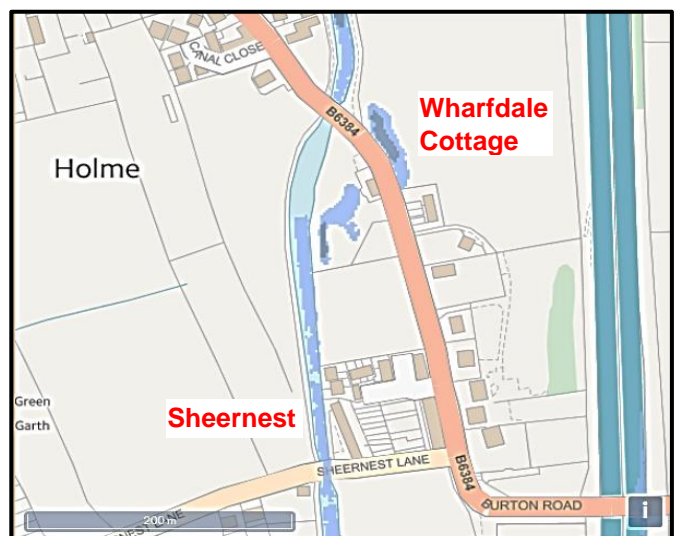


Figure 1: Location of Holme and the sub areas discussed within this report. 1. North Road. 2. Sheerness. 3. Wharfdale Cottage. 4. Brook Cottage. 5. Mayfield Avenue. 6. Silvercroft. 7. Holme Mills

Surface Water flood Mapping showing areas at risk



Figures 2, 3, and 4: Long term flood risk from surface water mapping from the Environment Agency. Identification of sub areas. It is notable that the observed flooded areas, as shown in the *Investigation* section of this report, were much more extensive than the areas identified as at risk of flooding by EA modelling.



Flood History

North Road

Previous to 22nd November 2017 we have records of flooding in the North Road area in December 2015 (Storm Desmond). South Lakeland District Council had previously investigated flooding in this area in 2011.

Sheernest

Reported flooding in December 2015.

Brook Cottage / Wharfdale Cottage

We hold no record of flooding prior to our investigation for this flood report.

Mayfield

We became aware of the groundwater issues on Mayfield at the flood forum in 2017.

Holme Mills

It had been recorded that groundwater had been a problem at Holme Mills prior to 22nd November 2017. No date known.

Since our investigation began people have reported further incidents of flooding which are recorded in the annex.

Investigation

This section provides details of the authorities who have contributed to this investigation, an analysis of flow routes and details of likely causes of flooding.

Rainfall Event

On 21st November the Met Office had issued a yellow warning of heavy and persistent rain with many places expected to see 25-50mm of rainfall during 22-23 November. The forecast proved to be correct and heavy rain persisted all day over the north where 77mm was recorded at Silverdale rain gauge station between 4am on 22nd and 4am on 23rd.

Just after 5pm on the 22nd there was very heavy rain period lasting from 5pm to 11pm which caused flooding.

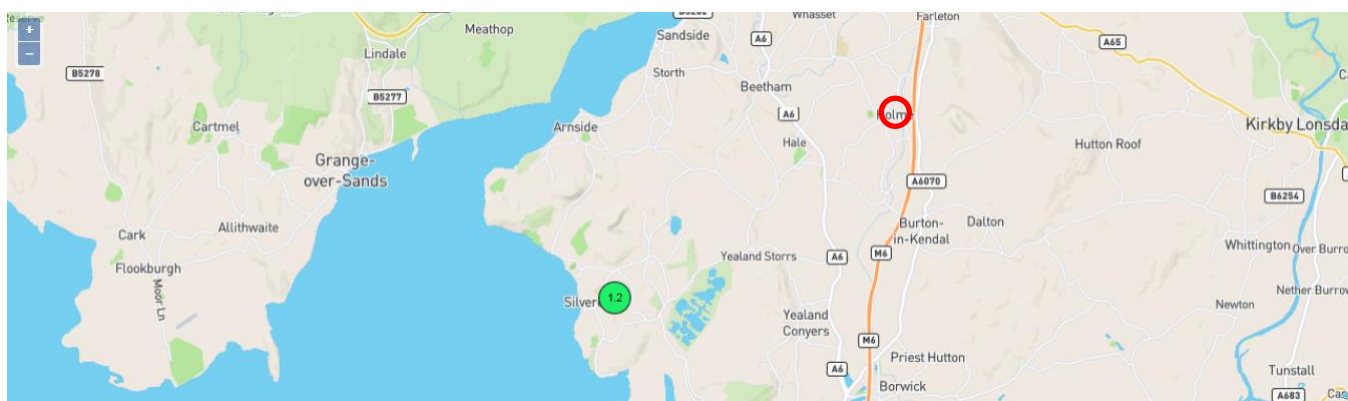


Figure 5: Location of rainfall gauge compared with Holme.

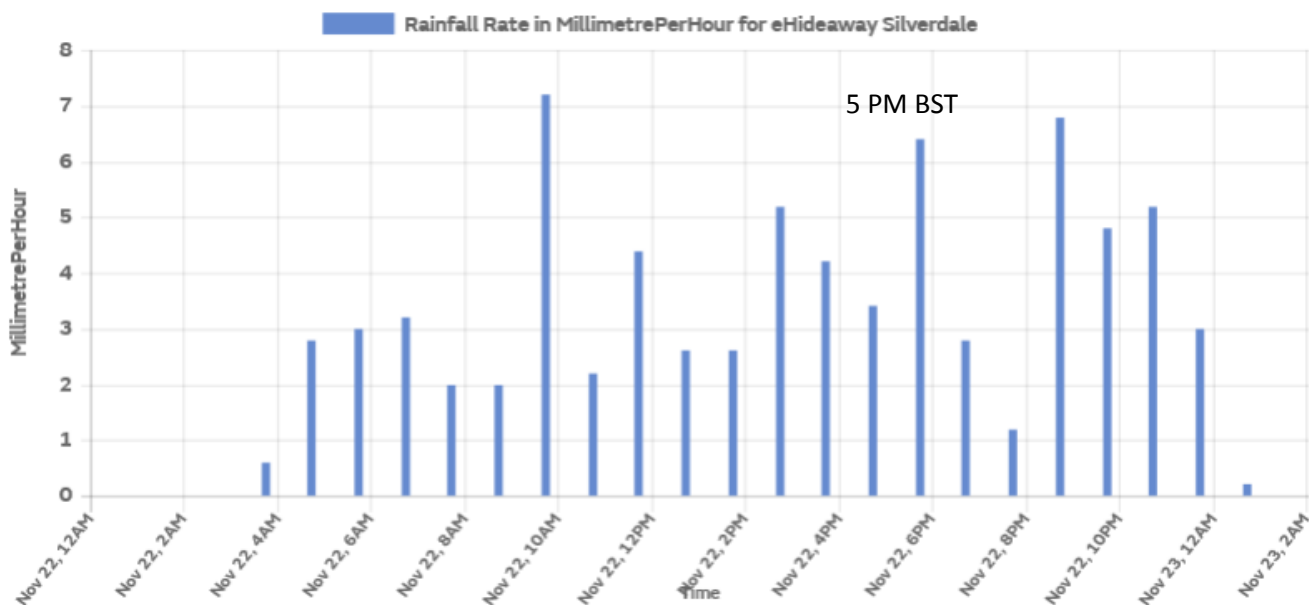


Figure 6: 77mm rainfall in 24 hours was recorded at the nearest gauging station in Silverdale.

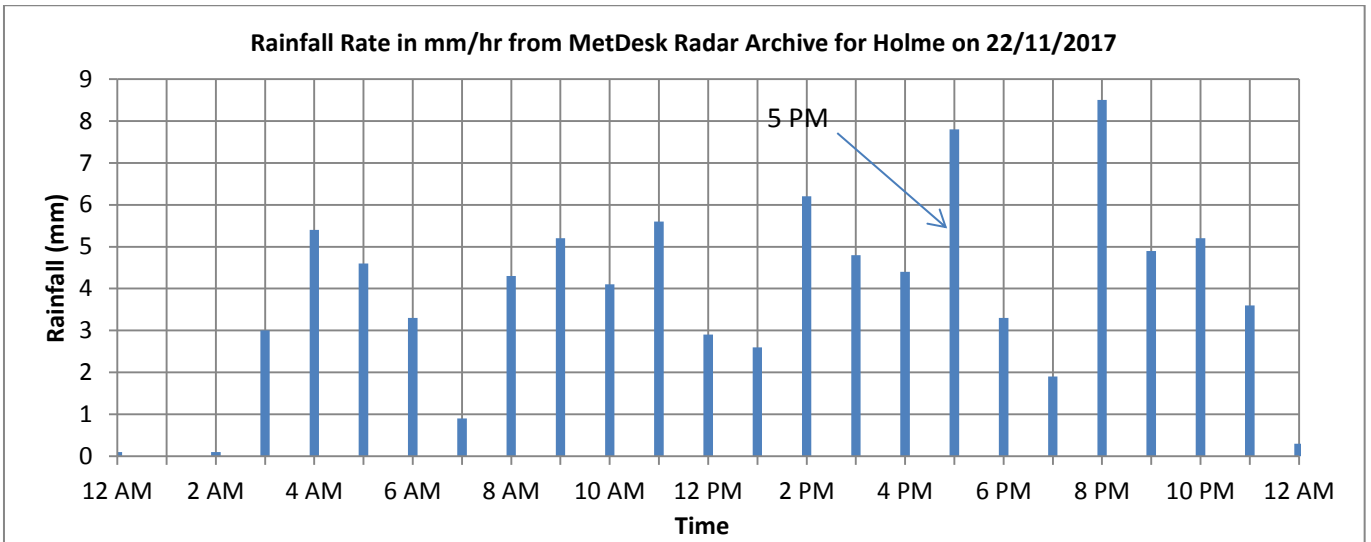


Figure 7: Analysis of radar information suggests 93mm rainfall in 24 hours at Holme.

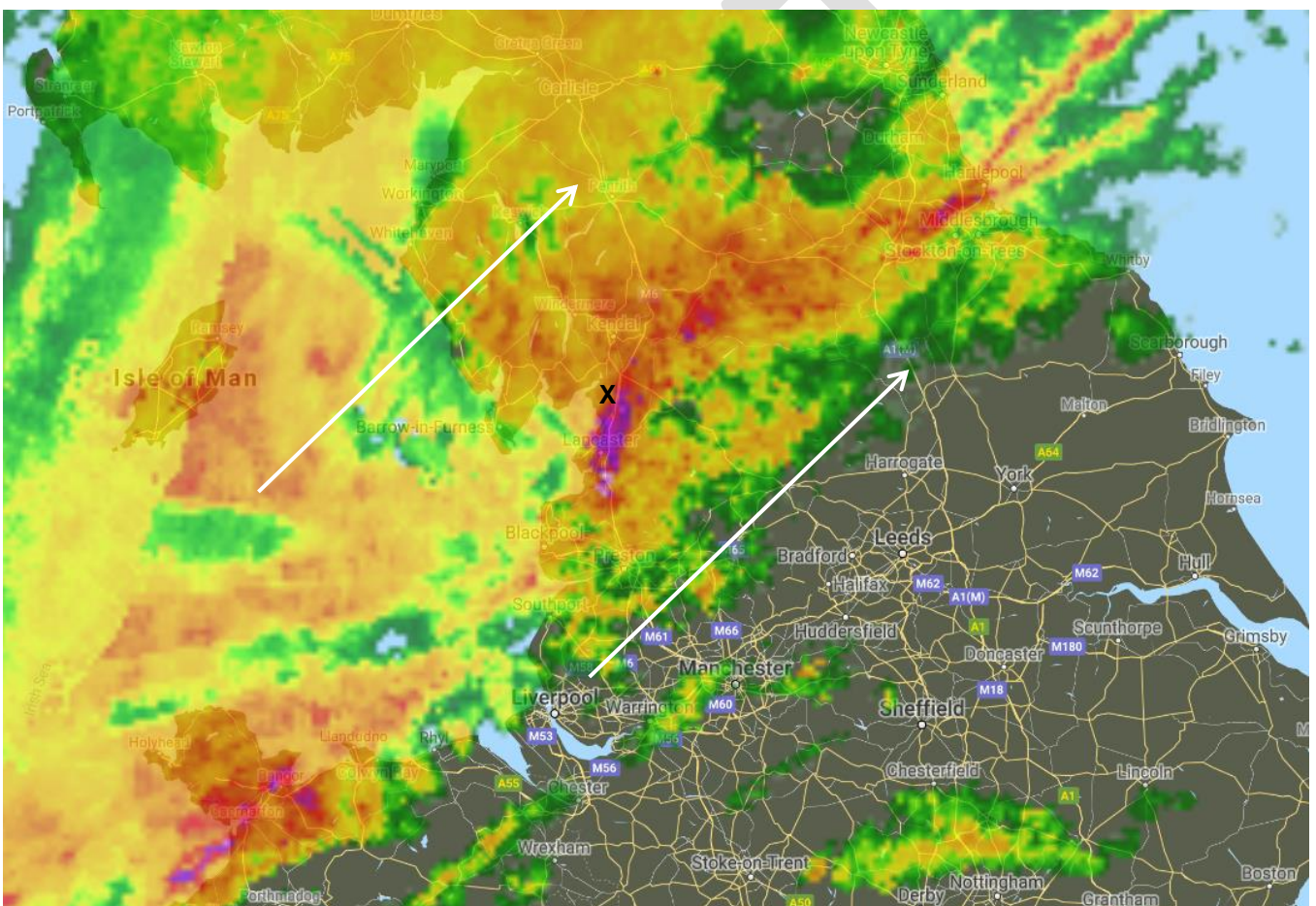


Figure 8: Radar imagery at 19:45 on 22nd November 2017. General track of weather indicated by arrows. The cloudburst over Middlesbrough had been over Holme at 17:00 and the cloudburst then over North Wales reached Holme at 21:30.

The long term average monthly amount of precipitation for November at Holme is 164mm, by comparison

- 93mm fell at Holme in 24 hours on the 22nd November 2017 (50% monthly rain)
- 113mm fell at Holme in 24 hours on 5th December 2015 (Storm Desmond). 70% monthly rain.

Sources of Flooding, Flood Flow Routes

Surface water and groundwater contributions

There is a large amount of uncertainty about where the volume of water that has caused flooding all across Holme came from. Comparing flood outlines (provided in figures 2, 3, and 4 - details taken from <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>) with the actual flooded areas, the flooding appears to be greater in all locations than would be expected from surface water alone.

Holme Beck begins in the village with no evidence of any continuation on the other side of the canal or motorway. Holme Beck is the main carrier for village drainage, it runs beneath the West Coast Main Line and then through the large marsh area of Holme Moss before joining the River Bela.

The accounts of flooding through the floors, water spouting up from the ground and through the road surface, the prevalence of names such as Springfield, old well locations, the infiltration manholes (soakaways in working in reverse), all point to groundwater being a significant factor in the flooding at many locations. Indeed the leaky nature of the North Road culvert itself may point to its main function being as a conduit to receive groundwater. Appendix 3 gives more detail on possible groundwater mechanism in Holme.

In the centre of the village near Brooklands, Holme Beck emerges from the ground as a fully formed watercourse, flow can be seen welling up out of the stone – it is not delivered there by a culvert. This process is easily visible here and there are indications that this is occurring out of sight at a number of locations across the village.

North Road

North Road is the main north-south running road in the village running from the A6070 to the village centre and generally falling in the southerly direction. Above North Road to the east is the Lancaster Canal and then the M6 motorway. The flooding that occurred on 22nd November 2017 resulted in 10 residential properties flooding.

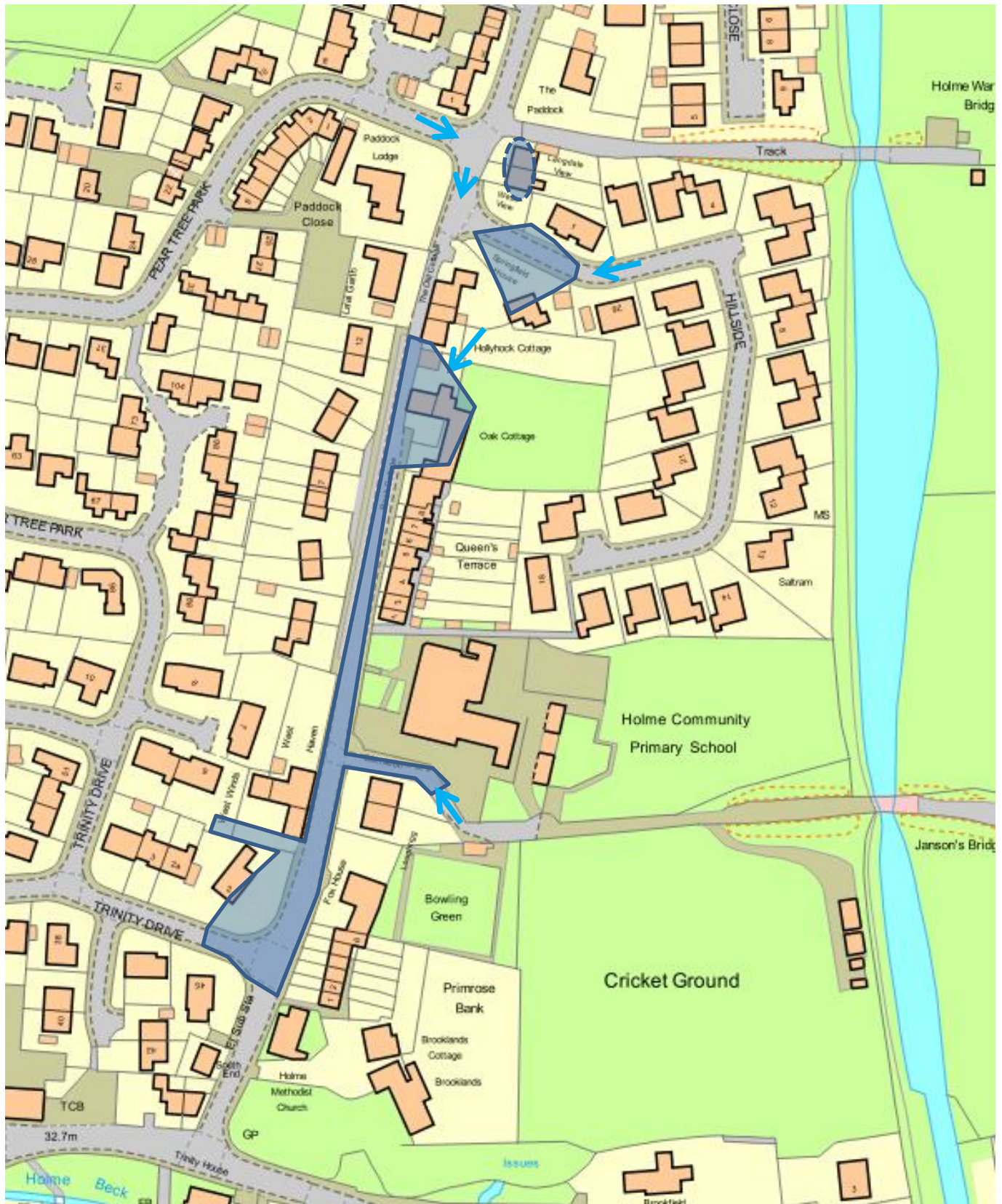


Figure 9: Extent of flooding on North Road, 22nd November 2017.

The highest location reporting flooding is Langdale View where water rose up through the cellar floor flooding to a depth of approximately 0.6m (2ft) over a period of two hours. A spring is reported behind the properties.

The rest of the North Road area is served by a culvert system which begins in Hillside. The only known drainage in Hillside is the drainage serving Hillside itself. The culvert at Springfield begins in Hillside. There is no continuation of the culvert in the upstream direction on the opposite side of the canal from Hillside.

Extensive searches for a source of water, such as a siphon under the canal, were undertaken. There is a spur on the drainage system pointing towards number 5 Hillside but it is capped off, there is no possibility of flow entering the system via this route and no other connection other than roof drainage was found.

Springfield House is at a localised low point which was filled with water spouting up from below out of a manhole and out of the ground at other locations nearby. The manhole is only fed by drainage serving Hillside itself and is dry in normal conditions. There was some contribution from surface flows of flood water that had exceeded the capacity of the local drainage system (see figures 10 and 11). There was severe flooding at Springfield causing the fire brigade to spend five hours at the scene.



Figure 10: Flow routes around Springfield. Approximate line of culvert shown by dashed line.

The drainage system from Hillside continues from Springfield towards Oak Cottage in a culvert beneath the gardens and passes under the buildings of Oak Cottage and Oaklands. The culvert passes through a manhole in the public footway at the front of Oak Cottage (as shown in figure 11) and there is still no flow here in normal weather conditions. From this manhole the culvert continues southwards.

Because of the flooding it had been assumed that there was a collapse somewhere but we have found no sign of a collapse. The culvert is stone built and the shape is irregular and, although functional, there are places where capacity is reduced. This occurs all along the length of the stone culvert towards Trinity Drive open beck, more so in the section between Springfield house and Oak Cottage. The line of the culvert is indicated in figure 11 (below) and detail of the culvert is in appendix 1.

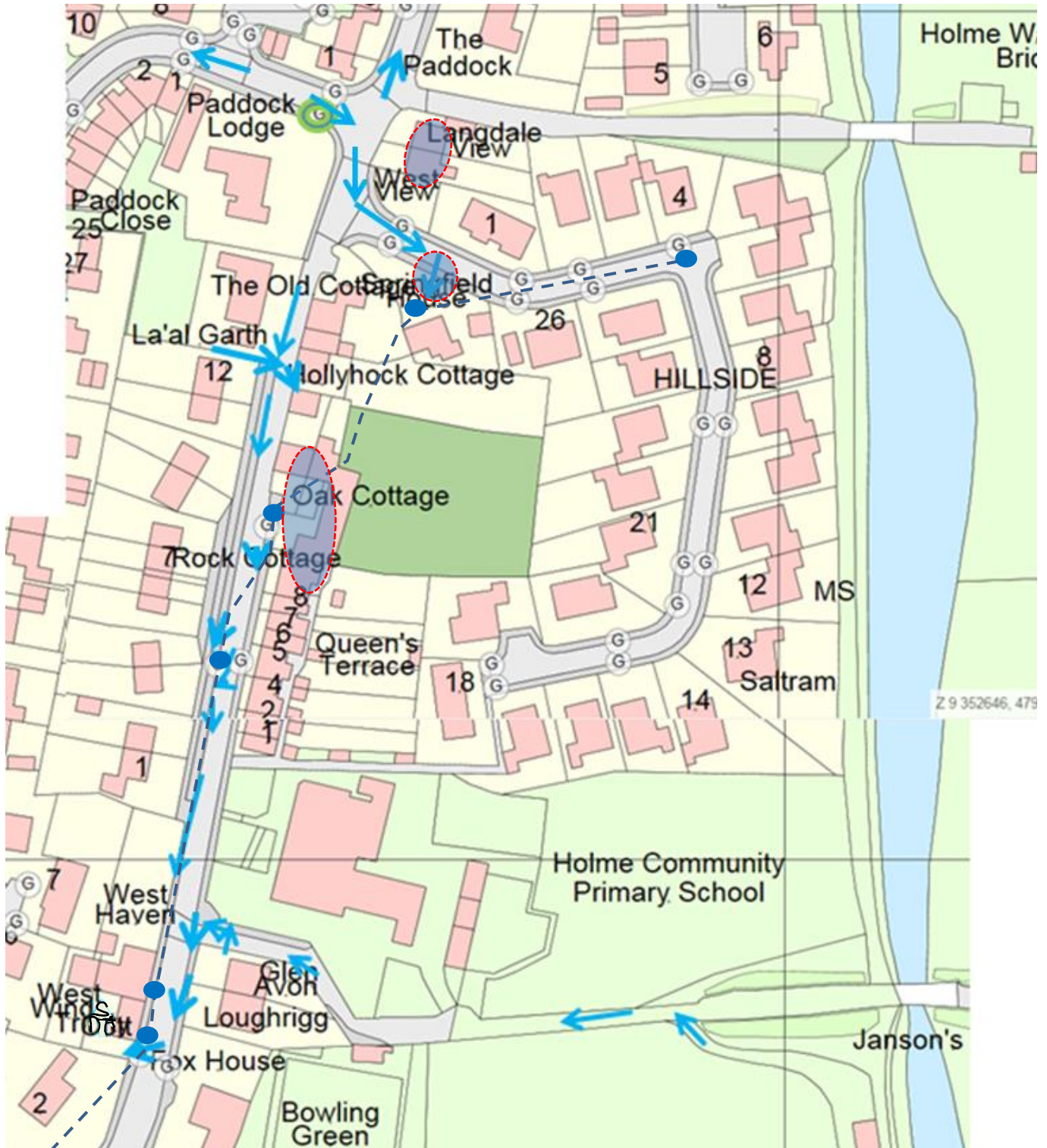


Figure 11: Observed and reported surface flows indicated by blue arrows around North Road. Main line of culvert indicated by dashed line with manholes on it indicated by blue circles. Reports of groundwater flooding indicated with red circular outline.

At Rock Cottage and Mayland Cottage some of the flow was coming by a surface route via North Road (see figures 11 and 12). The cottages are lower than the road and dropped kerbs let the water come to the front door. A skip didn't help as the flow had to build behind the skip before it could spill around. At Rock Cottage they managed to prevent damage from this route by improvised flood defences and sweeping flow away until 7:15am. There was no surface runoff from the back. However groundwater rose through the concrete floor here.



Figure 12: Water pooling upstream of the same skip on North Road during heavy rain on 14th December 2017. No flooding occurred on 14th December 2017 so it can be assumed that surface flows were much greater during the flood event of 22nd November 2017.

Flood water at Oak Cottage, Oaklands, and Mayland Cottage also rose up from the ground through concrete floors (see figure 11).

At West Winds the flooding was mainly water which came through or under the garden wall affecting the garage only. There was also an element of surface water which had flowed down the track from the cricket club and primary school and across North Road.

Until this point the culvert is dry in normal weather conditions but dry weather flow joins the culvert under North Road just to the south of Trinity Cottage. The watercourse is open through 2 Trinity Drive and can be seen to be flowing every day unless there is a long dry spell. Further south it is widely understood that a natural spring which used to be tapped into by a pump is under the Trinity Drive/North Road junction (as shown in figure 13) and this also provides a source of dry weather flow.



Figure 13: The pump in the bottom right of the picture is now purely ornamental. It is believed to have been moved from approximately the location as indicated by a red X.

The open watercourse at 2 Trinity Drive drops back into a culvert so that it can cross under the road and remains in culvert from then on. There is a physical drop over a waterfall into the highway culvert here and this arrangement takes out energy from the flow and causes deposits of gravel to build up at the culvert inlet. In December 2017 this culvert was up to 80% full of stone severely restricting flows. This caused the flow to back up and spill out of the open channel causing erosion at 2 Trinity Drive.

The flooding at 2 Trinity Drive came up through the floor and was likely to be from the beck close by due to hydraulic pressure on the beck walls.

Across Trinity Drive the 450mm diameter concrete pipe changes into a stone culvert of the same construction as under North Road then changes into a smaller pipe and then back to a stone culvert which was severely restricted by tree roots (especially beneath the Parish Council car park) which have been cleared. In this area there was external flooding of gardens.

It took 36 hours for the water level in the Trinity Drive area to drop.

The culvert comes to a manhole in the Parish Council car park where it is joined by a significant flow coming down Milnthorpe Road from the east. From this manhole the flow splits into two with both outfalls going to Holme Beck opposite the village hall.

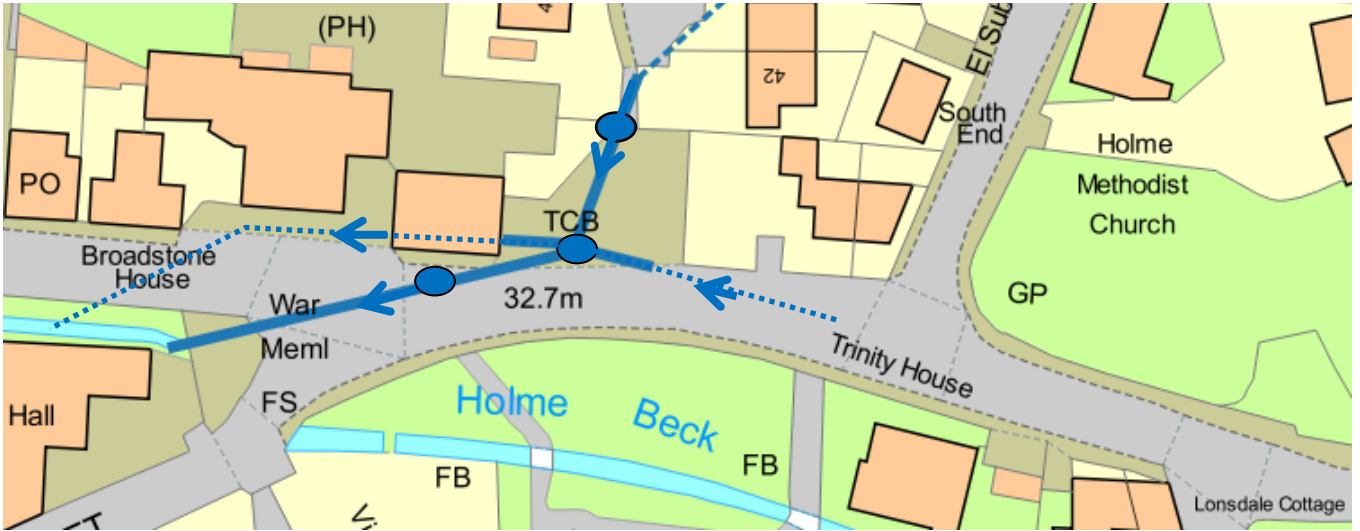


Figure 14: Final part of culvert system near outfall.

The North Road culvert is functional throughout, there is no total collapse. Appendix 1 shows what was encountered in all of the places where our CCTV survey was undertaken.

Sheernest

Sheernest Cottages are a row of houses off Sheernest Lane to the south of the main part of the village. The houses are alongside the Lancaster Canal which is below the cottages to the west. Above the cottages to the east is Farleton View estate and then the M6 motorway. The flooding that occurred on 22nd November 2017 resulted in 8 residential properties flooding.



Figure 15: Extent of flooding and reported flows leading to Sheernest Cottages indicated by blue arrows.

Water ran from the motorway bridge and down Sheernest Lane and Holmefield into the back alley of Sheernest Cottages. The gullies on the B6384 Burton Road, Holmefield, and on Sheernest Lane were full of soil and did not intercept the flow. It appears that the most significant flow route was the Sheernest Lane route. The water flowed to the far end of the alley close to no.11 and the flood water built up back towards no.2 which is slightly higher. Once there was a significant depth of flood water, properties were flooded internally through the floors (the floors are below ground level by around 150mm). The flood water was mainly shallow and confined within kitchen areas and lasted for six hours then took several days to dry out.

There is just one road gully for Sheernest Lane which was not able to take the flows reaching it from the motorway bridge, flows from the canal bridge cannot reach this gully. The gully discharges into the field to the south of Sheernest Cottages via a 100mm pipe under the road to a soakaway and it may be that either the pipe was not able to convey flow effectively enough or that a soakaway has become blinded by silt and is not working effectively. It seems that the drainage system around here is particularly susceptible to blockage by sediment as the highway gully system and Sheernest back alley system were both cleaned around Christmas 2017 but had to be cleaned again after inspection in May 2018.

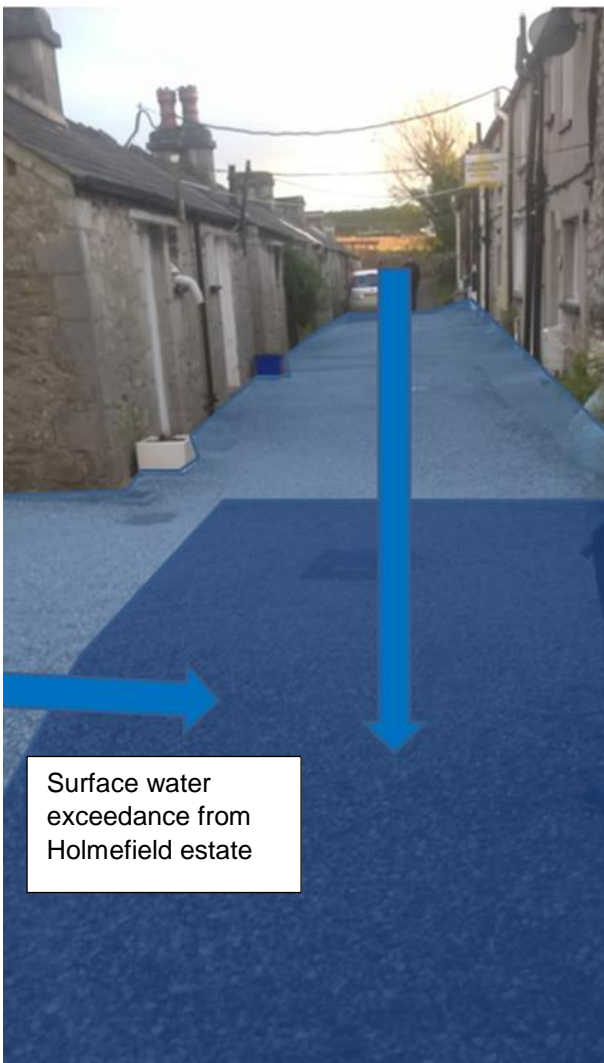
There is a private 150mm diameter drain running underneath the Sheernest Cottages back alley which flows into the canal, it appears blocked partly half way along the alley. It flows well past No 11 and there was no backflow from this during the event. There is a complex

arrangement of drainage at the end of the alley with three outfalls into the canal (see figures 16 and 18).

There was also water pouring from the road surface of the canal bridge and into the drive way in front of Sheernest Cottages where it entered No 2 the lowest house on this side.



Figure 16: Images from CCTV survey along Sheernest Cottages back alley to northernmost outfall drainage run.



Surface water exceedance from Holmeffield estate

Figure 17: Surface flows from Sheernest Lane (top) and Holmeffield (left) start to flood in the darker shaded area and built up to fill the whole alley way.



Figure 18: Complex drainage system at Sheernest (red lines are the foul system).

Wharfdale Cottage

External flooding occurred at Wharfdale Cottage from water flooding out of a manhole on the foul system. This indicates a significant misconnection of surface water which is thought to have been the flood water at Sheernest getting into the foul system. United Utilities have surveyed this sewer and found no defect which means that the issue is hydraulic, the full discharge of the Wharfdale Cottage sewer is unable to connect with a downstream sewer that is running already at close to capacity. Repairs and improvements at Sheernest will reduce surface water getting into this system.



Figure 19. Wharfdale Cottage. Near miss of internal flooding out of foul sewer system.

Brook Cottage

Water entered through the garden gate from the road where it becomes trapped in the yard by the building walls. Water came into kitchen, hall, and toilet, through the walls to a depth of 25mm throughout. It also backed up through the surface water and foul drainage systems.



Figure 20: Reported flood route at Brook Cottage on 22nd November 2017.

Mayfield Avenue

Frequent garden flooding has been reported on the older part of Mayfield Avenue. The gardens fill with ground and surface water which drains away very slowly. This occurs after every medium to heavy rainfall event.



Figure 21: Mayfield Avenue. The groundwater issues reported occur within the area circled in red.

Silvercroft

External flooding is reported to have occurred affecting three properties around Silvercroft. There are three reported sources of this flood water. These are surface water from the field to the north, runoff from overflowing soakaways from the Mayfield Avenue development to the east, and water backing up from where the culvert reduces in size under the highway to the south.

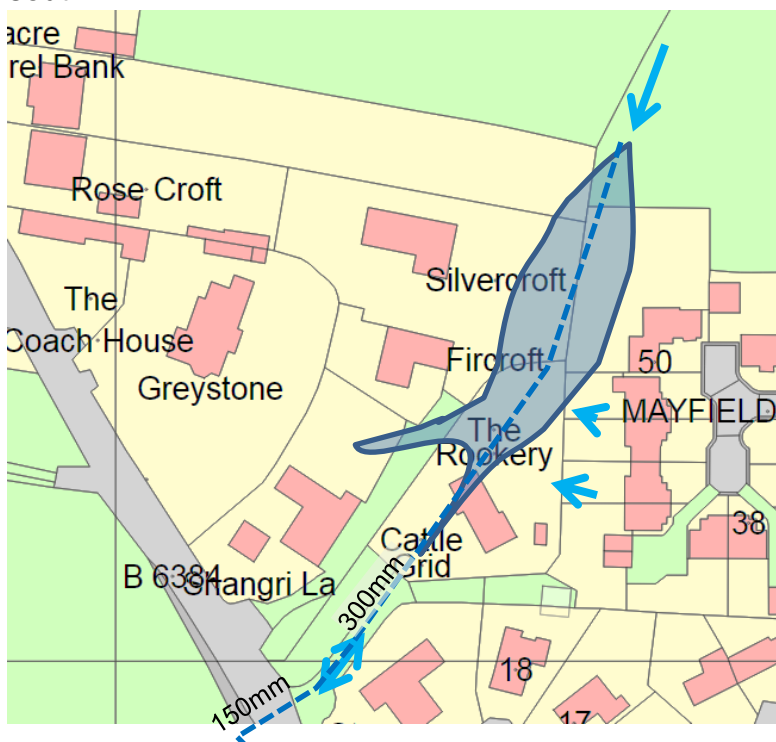


Figure 22: Silvercroft area: Extent of flooding. Line of culvert indicated by dotted line.

Holme Mills

External flooding is reported to have occurred on the road serving the terrace leading up to Jolly's Farm. Heavy rain and snow melt are said to cause run off from the fields and to cause springs to emerge from underground. There have been blocked drains and the flow into the reservoir has been blocked in the past. There is a hole in the reservoir wall which is an overflow to let water out of the reservoir.



Figure 23: Flooding and flow routes at Holme Mills.

Recommended Actions

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

Cumbria Flood Partnership Theme	Action by	Recommended Action	Timescale
Maintenance	Landowners	Investigate the drainage and culverts and remedial action where necessary.	Ongoing
	CCC Highways	Exploratory dig to find the natural spring which appears to be under the Trinity Drive North Road junction and provide a formal drainage route for this water.	2018
	CCC Highways	Increased frequency of gully emptying to be agreed with Highways in key locations	2018
	CCC Highways	Review Holmeffield estate drainage system.	2018
	SLDC	Regular sweeping of Sheernest Lane	Ongoing
	UU	There may be a surface water cross connection into the foul sewer in the Brook Cottage area which should be investigated and removed if necessary.	
Strengthening Defences	CCC Highways/LLFA	Provision of replacement culvert for Hillside into North road. (flood relief for top most flooded properties	Bids 2018/19
	CCC Highways	Provision of new culvert down remaining section of North road.	Bids 2019/20
	Highways/Landowner	Look to reconfigure the culvert entrance in 2 Trinity Drive garden	2018
	CCC Highways	Further investigation as to outfall of gully system on Sheernest Lane.	Ongoing
	CCC Highways	Review runoff routes on highway (kerbing alterations, etc) around Sheernest Lane and Holmeffield at Sheernest, and North Road.	On going

Strengthening Defences	CCC Highways	Investigate removal of verges on Sheernest Lane need to be removed as these are a source of mud causing blockage	2018
	Residents / LLFA	Investigate whether a formal exceedance route such as a swale could be installed at No 2 (for the route from the canal bridge) and No 11 (for the main pooling of surface water) Sheernest Cottages to route any excess water into the canal.	2018
	SLDC / LLFA / CCC Highways	Look for opportunities to bring Silvercroft culvert to an appropriate standard.	Potential Development opportunity
Community Resilience	Residents	Investigate property level protection for affected homes (flood doors, concrete floors, tanking to prevent groundwater ingress, etc).	2018

* 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.

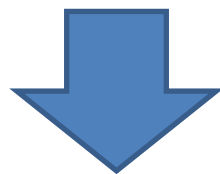
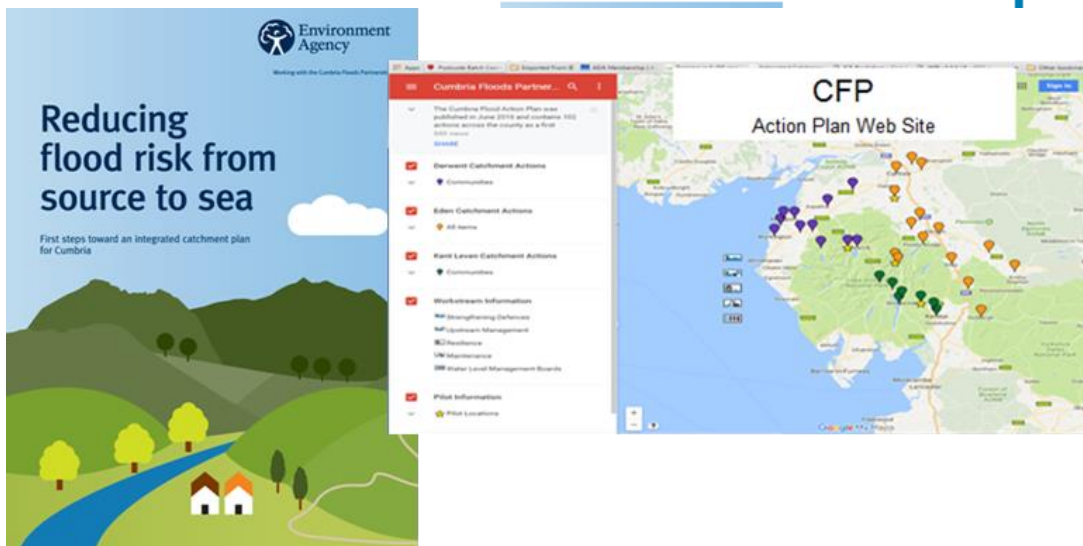
Residents and property owners who are aware that they are at risk of flooding should take action to ensure that they and their properties are protected. Community resilience is important in providing information and support to each other if flooding is anticipated. Actions taken can include laying sandbags and moving valuable items to higher ground, to more permanent measures such as installing floodgates, raising electrical sockets and fitting non-return valves on pipes. Anyone affected by flooding should try to document as much information about the incident as possible.

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 Flood Partnership



NEW Cumbria Strategic Flood Partnership



Defra 25 Year Environment Plan Cumbria Flood Action Plan Local Flood Risk Management Strategy

2016 – Cumbria Pioneer	January 2016 - Cumbria Flood Partnership	2013 – LLFA Cumbria Strategic Partnership
<p>DEFRA 25 Year Environment Plan and vision</p> <p>New and innovative ways of working</p> <p>Making best use of resources</p> <p>Working at Catchment scale through engagement and commitment</p> <p>Place based decision making within DEFRA vision</p> <p>Lead – Jez Westgarth, Environment Agency</p>	<p>Created following December 2015 floods</p> <p>Local knowledge and expertise</p> <p>Integrated catchment management</p> <p>Community focus</p> <p>25 year Cumbria Flood Action Plan</p> <p>Lead – Rory Stewart MP, Environment Agency and 3 Catchment Directors</p>	<p>Flood and Water Management Act (2010)</p> <p>Professional partnership providing strategic leadership for flood risk management</p> <p>Reporting to RFCC</p> <p>Coordination and cooperation between Risk Management Authorities (RMA's)</p> <p>Lead – CCC as LLFA</p>

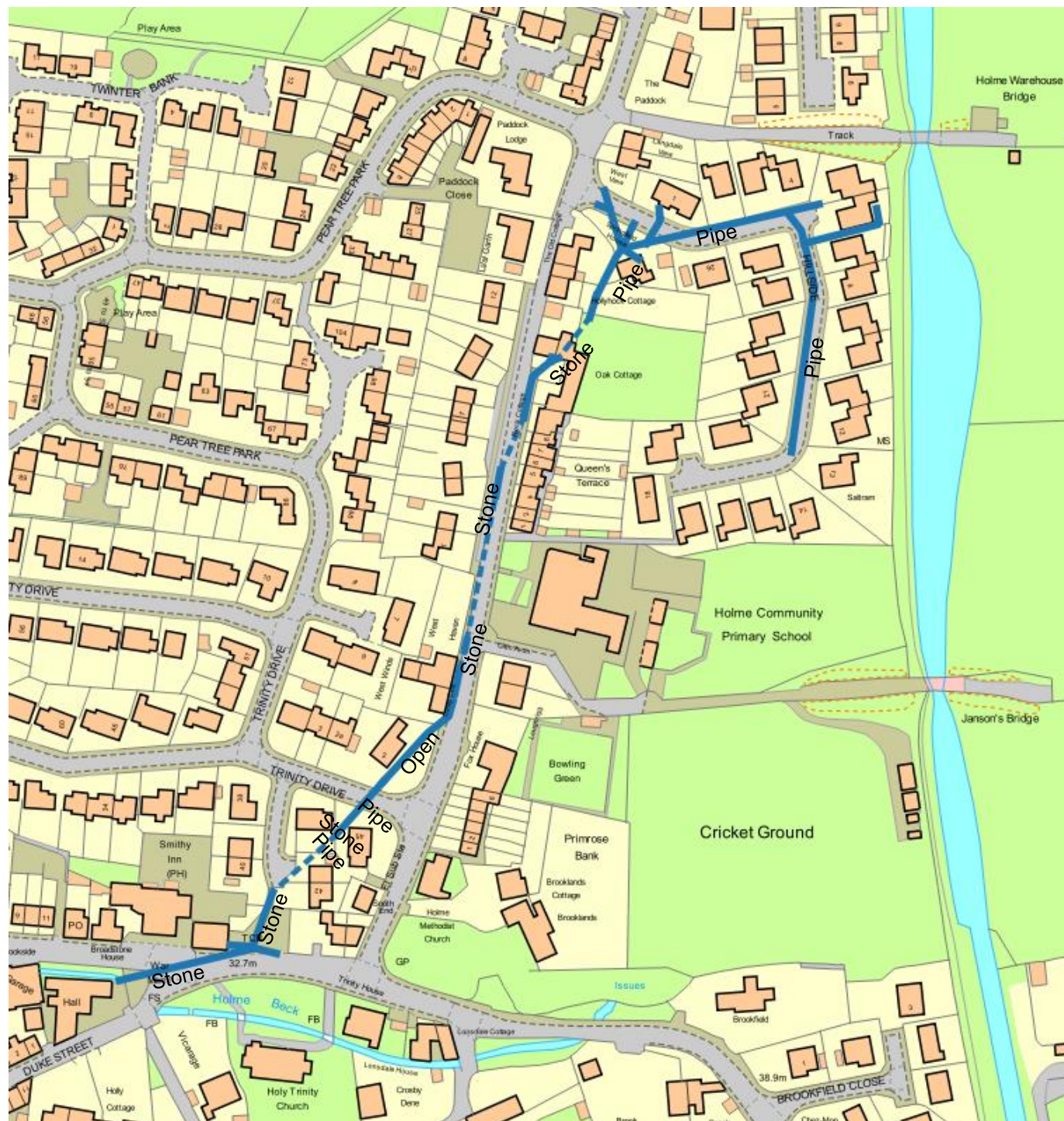
Communities



Communities working together across Cumbria

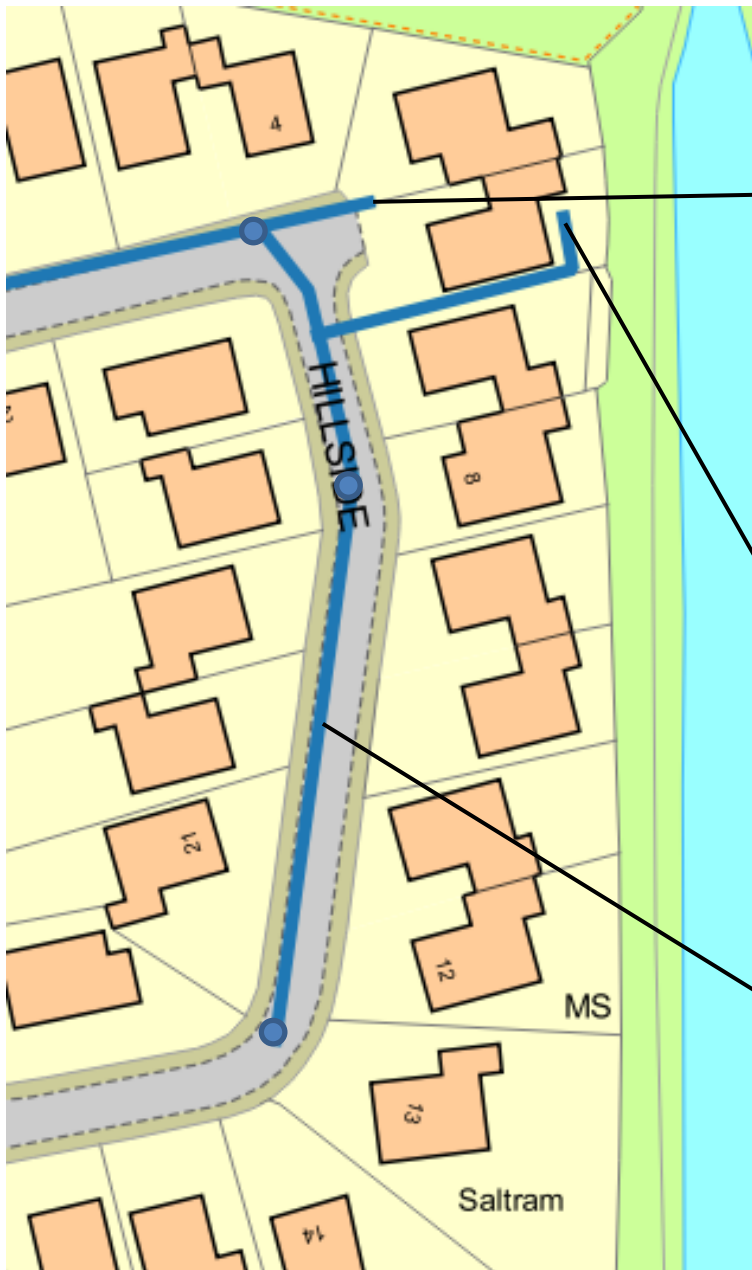
Appendices

Appendix 1: North Road Culvert System and survey images



Overview. We were unable to get CCTV footage of the dashed sections. There are no connections coming in from the upstream ends of the system other than roof drainage.

Cumbria County Council are responsible for the maintenance of sections under the highway. Individual property owners are responsible for the maintenance of their sections.



Top of run. Line is capped off with concrete finish. Continues as 225mm dia. clay pipe.

Top of run capped off. Roof drainage of no.6. No other connections.



150mm dia. clay pipe. Silt but no defect. Didn't get footage to top of run but starts at no.18 and receives roof, driveway, and highway drainage for Hillside.

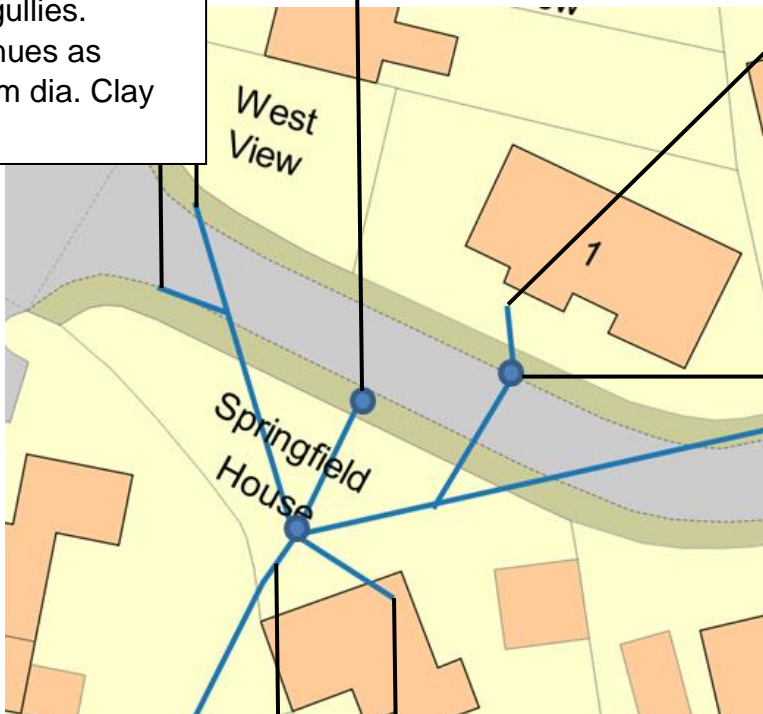


This picture is beneath one of the locations where water spouted up from the ground. The soil had collapsed in from the top next to the garden wall. This has been repaired and the pipe leads to the manhole in the pavement which is the top of the run. Continues as 150mm dia. Clay pipe.



This ends at a failed land drain from the days when this land was undeveloped fields. A small quantity of water could be added to the system by this route. Continues as 150mm dia. clay pipe.

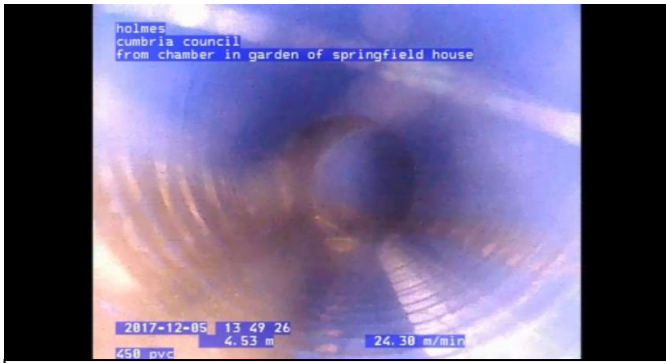
Top of run. From road gullies. Continues as 150mm dia. Clay pipe.



This manhole has gaps in the brickwork which are to allow water in the ground into the system to be drained away. Continues as 150mm dia. clay pipe.

Outlet is 450mm dia. Plastic pipe.

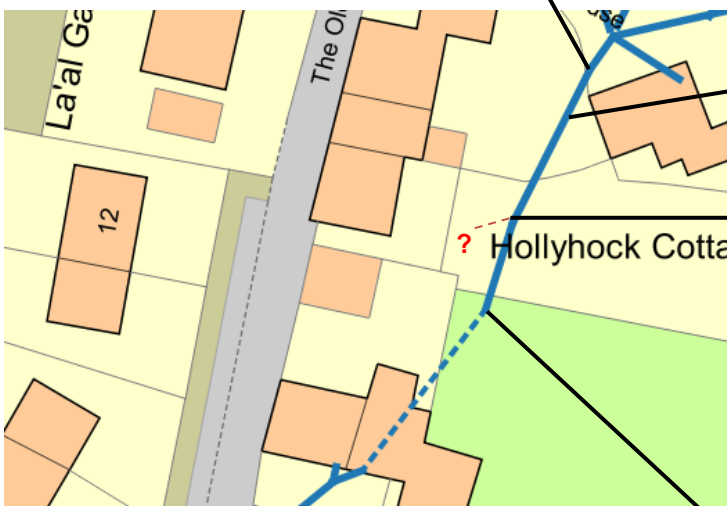
Roof drainage for Springfield House.



450mm dia. plastic pipe



Culvert reduces from 450mm dia. plastic to 300mm x 300mm brick.



Cannot be sure if there is a split to the right (looking downstream) here.



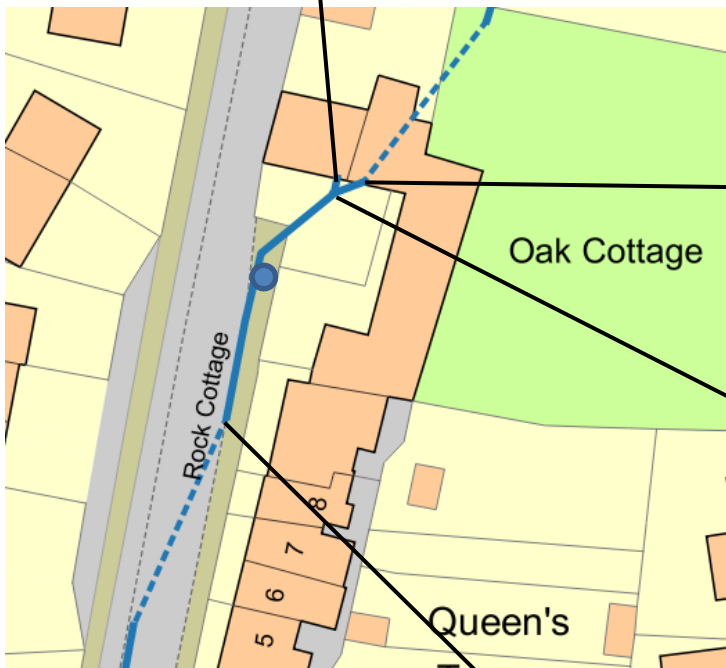
Survey ends here, just beyond the fence line, where collapse is near total and there is an unidentified pipe within the culvert barrel. No further progress with camera in downstream direction. Significant flow does come through as proven by dye testing.



The left branch looking upstream is either capped off or has collapsed directly beneath the wall of the building. The dimensions are 300mm x 300mm stone.



No further progress in upstream direction, low roof and debris shoal directly beneath wall of building restricts clearance and camera can't get through. Significant flow does come through this branch though as seen with dye testing.



Junction (looking in upstream direction). The flow from Hillside comes through the right branch which is 300mm x 300mm stone.



Debris shoal restricts clearance and camera can't get through. Walls crumbling in. Where good the shape is approx. 450mm w x 300mm d stone.



Debris, stones on base from culvert wall.



Large brick in the line from side. Where good the dimensions are recorded as 250mm x 250mm, stone.



Stone debris shoal restricts clearance and camera can't get through. Loose material deflects camera into sides. Where good recorded as 450mm x 450mm, stone.



Stone debris restricts clearance deflects camera into sides. Camera can't get through.



Large stone debris deflects camera into sides. Camera can't pass. This section is recorded as 450mm x 450mm, brick.





Camera caught in roots. Daylight visible downstream. 450mm x 450mm, brick.



Lots of gravel collects at step down as open channel changes to pipe. CCTV image is looking upstream to waterfall. 450mm dia. concrete pipe.



Walls tilting inwards preventing passage of camera. 450mm x 450mm, brick.



Dig revealed a step down, and size reduces downstream to a ribbed pipe. No image.



Culvert outfall into Holme Beck at village Hall. 450mm x 450mm brick. Flows well.

A lot of roots were removed from this section. No image.



Walls tilting inwards preventing passage of camera. 450mm x 450mm, brick.

Appendix 2: Summary of feedback from Flood Forums

Source of flooding – general

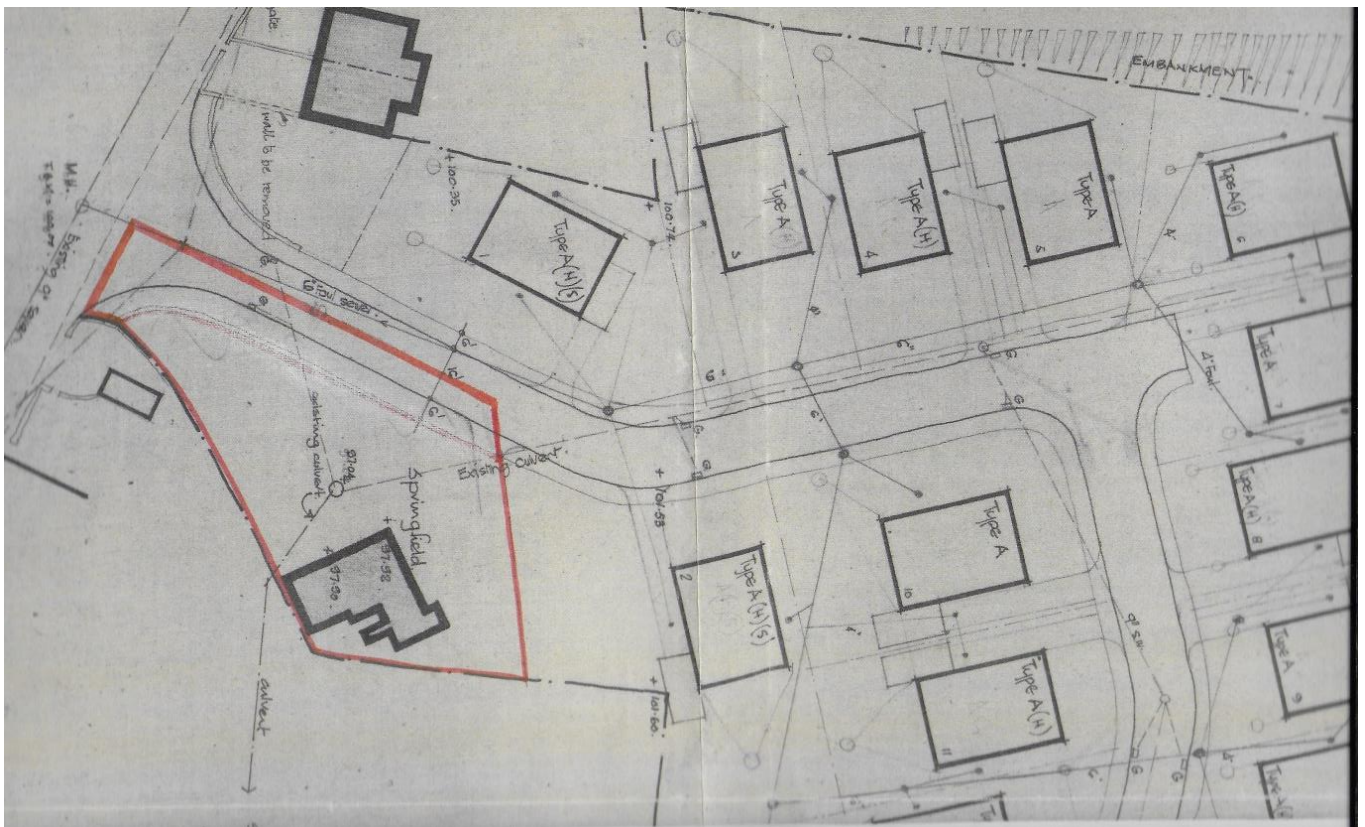
Across the village people reported surface water as the primary mechanism of flooding and groundwater flooding as secondary mechanism. Inadequate road drains were also reported.

New developments on fields that would have previously absorbed heavy rain but now nowhere for the runoff to go other than the road was raised as a concern.

Source of flooding – North Road

Insufficient capacity and/or blockage in North Road culvert was widely understood to be the problem.

Numerous accounts that shortly after 6 Hillside was built, it was washed away and had to be re-built and there is a manhole at the side of this house which it was thought may be on top of a culvert with its source on the far side of the canal. Old plans from the time when the Hillfield estate was built were provided and would seem to point towards this being the case.



Old plan of Hillfield drainage. Similar but did not correspond to what we surveyed.

NB: Extensive searches were made for this route in our investigation but no such route was ever found.

The well on the road next to Trinity Drive/North Road was frequently brought up as a line of investigation.

Holme Mills

It has been reported that several flooding incidents, including 22nd November 2017, have occurred affecting Holme Mills Cottages, the terrace which leads to Jollys Farm. It is our understanding that this is highway flooding, we have no report that any of these properties have been flooded internally.

Mayfield Avenue/Silvercroft

Garden flooding from ground and surface water on Mayfield Avenue linked to Pear Tree Park development was reported. Non functioning of detention ponds which were installed as part of Pear Tree Park development was frequently raised as a concern. The flood history goes back to 2007. Future development was also a concern of people in this area, any such development is likely to rely on the Silvercroft culvert which backs up in current conditions. Residents suggested that this culvert should be upgraded from the point where it reduces under the highway and asked whether a grated manhole could be installed.

Wharfdale Cottage

A land drain took some of the water away, it can be seen on the map as an 'issues' on the other side of the canal.

Brook Cottage

Groundwater can't be absolutely discounted but it might be important that the house is built on a number of levels and the lowest rooms in the house don't get flooded. Sandbags across the gate don't help because water bubbles up through yard drain.

Flood History

In North Road area December 2015 (Storm Desmond) and 22nd November 2017 are the most notable events. There seems to have been a long history without any flooding until Storm Desmond in 2015 then about 5 times in the 2 years since.

Sheernest had also flooded in January 2014 and there have been numerous occasions where flooding has been recorded in 2015, 2016, and 2017. It is not clear how many of these occasions internal flooding occurred.

On 23rd December 2016 the front porch of no.2 was flooded as water poured from the canal bridge and over the retaining wall to the lowest point.

Brook Cottage and Wharfdale Cottage were also flooded in December 2015 (Storm Desmond).

Mayfield Avenue has been reporting nuisance linked to rainfall since 2007 and Silvercroft also report a flood history beginning in 2007.

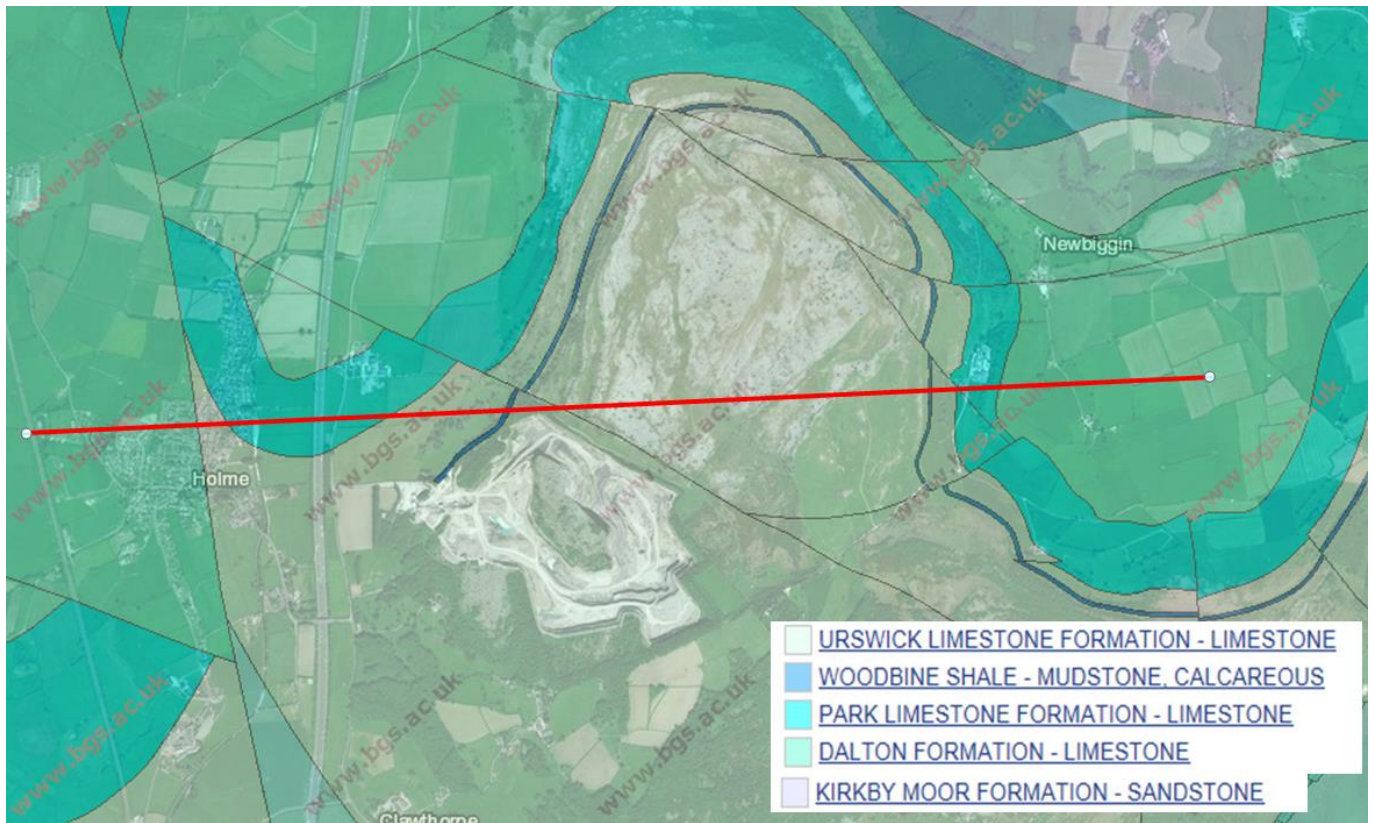
Other

Flooding that was reported at the flood forum from locations outside of the parish have not been recorded within this report although we will still investigate and make recommendations for them.

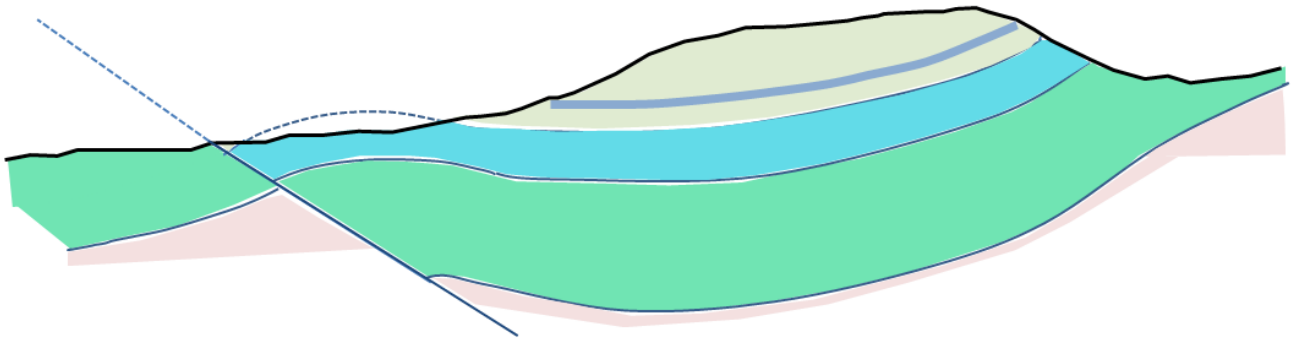
Appendix 3: Groundwater in Holme

Water was spouting up out of the ground at a number of locations near to Springfield House. Some of these locations were on top of pipes that connect to the manhole at Springfield but some were not i.e. there was water spouting up through cracks in the tarmac of Hillside, investigations have revealed no drainage infrastructure which brings water to this location. Brook Cottage has also been flooded from water which reports suggest may have risen out of further springs under the road surface.

It can be seen from the geological map that there is a geological boundary between two rock types which runs very close to all of the flood locations throughout the village. The cross section reveals the nature of this boundary and it is believed that the Park Limestone Formation is karstic limestone which dissolves forming fissures allowing rapid conveyance of heavy rainfall in underground caverns, because of the slope of the layers of rock it can gather water from the far side of Farleton Fell and bring under the motorway and canal to Holme where it meets the fault line and is forced up to the surface against the less karstic Dalton Formation bedrock.



Geology of Holme map. Red line is the line of cross section.



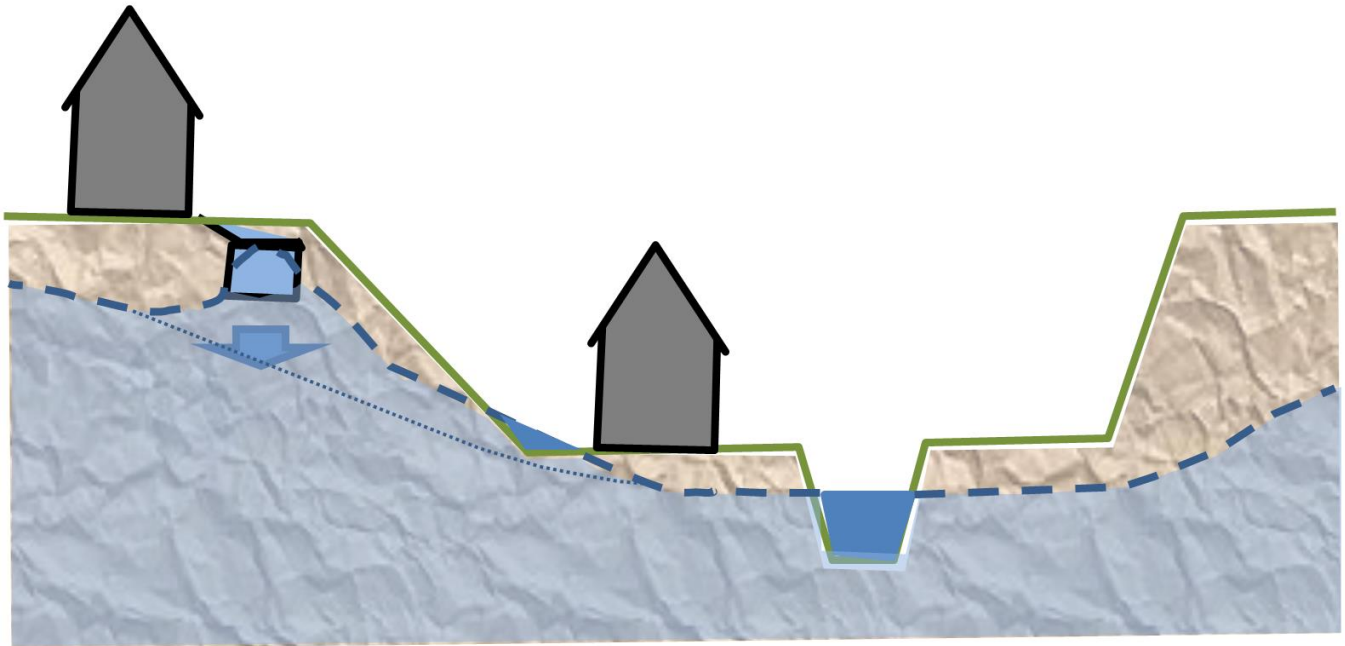
Geology of Holme cross section.

In the centre of the village near Brooklands, Holme Beck emerges from the ground as a fully formed watercourse, flow can be seen welling up out of the stone – it is not delivered there by a culvert. This process is easily visible here and there are indications that this is occurring out of sight at a number of locations across the village.



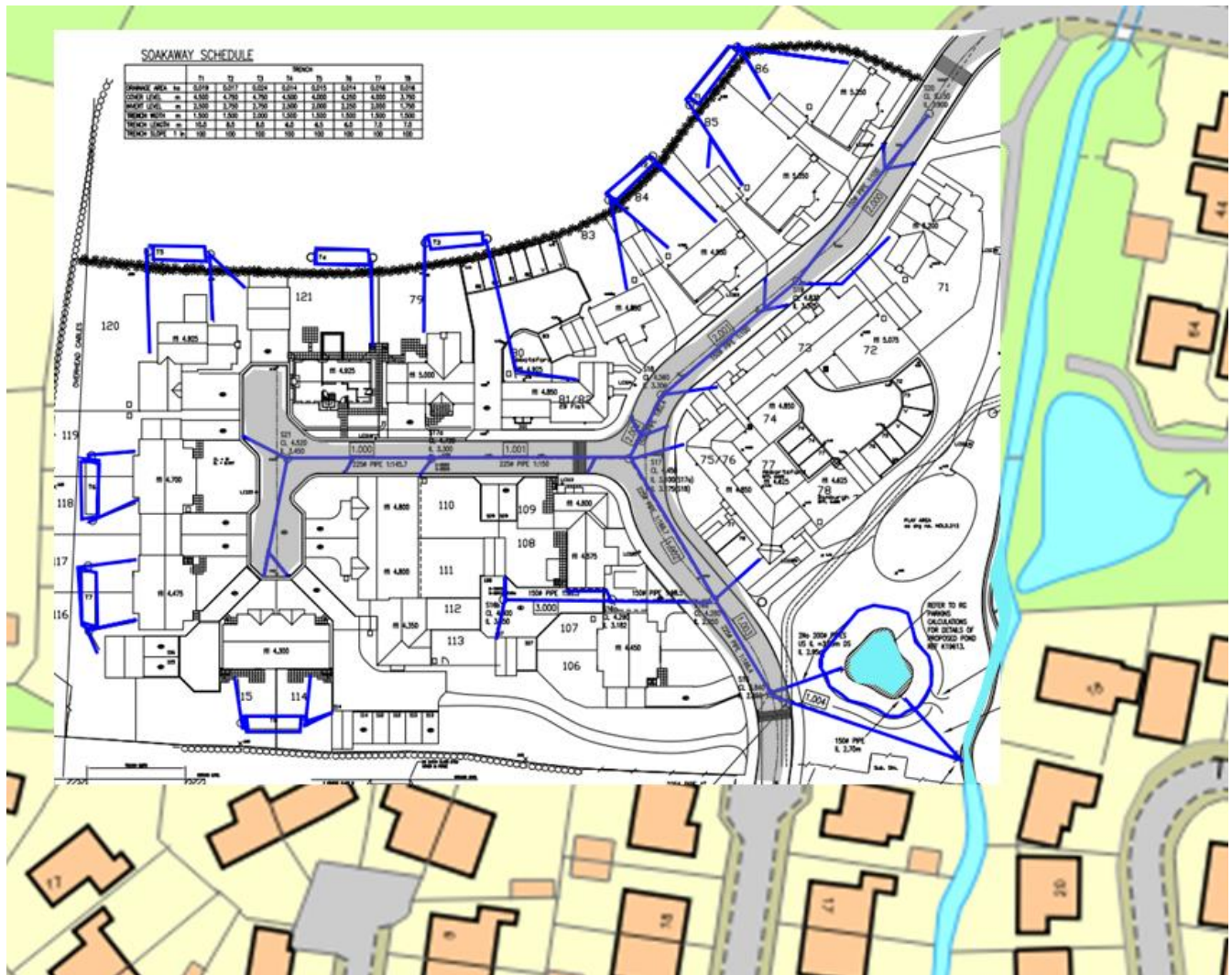
Water can be seen welling up from the stone from the road near Brooklands. This process is visible here and there are indications that this is occurring out of sight at a number of locations across the village.

Mayfield lies on the other side of the geological divide so the groundwater issues here are by a different mechanism. Mayfield is located close to a watercourse so there may be a high water table associated with that which soakaway drainage in the area would be adding to.



Groundwater flooding at Mayfield/Silvercroft. Water table intersects with the level of the watercourse and rises with the topography. It can also rise locally under an input of water as from a soakaway and where this intersects with the surface flooding can occur. This is a particular risk at the base of a slope.

Appendix 4. Mayfield Drainage Plan



Drainage plan for the 2007 development (with colour added to pick out details) set in its context. The blue boxes are soakaways and the rest of the drainage is shown to go to the beck via a pond which can be bypassed.

There has been frequent garden flooding on the older part of Mayfield Avenue which is said to have started to occur only since the development of the new part of Mayfield Avenue and Pear Tree Park. The gardens fill with ground and surface water which drains away very slowly. This occurs after every medium to heavy rainfall event including on 22nd November 2017. The new part of Mayfield Avenue is drained by use of soakaways. There are two drainage basins serving the development which are meant to hold water to prevent flooding elsewhere in times of flood but they have never held any water in them despite the numerous flood events which have occurred nearby. It can be seen in the drainage drawing that there is a bypass past the drainage basin which could be the reason that the basins never fill with water.

Appendix 5: Glossary

Acronyms

EA	Environment Agency
CCC	Cumbria County Council
UU	United Utilities
LLFA	Lead Local Flood Authority
LFRM	Local Flood Risk Management
MSfWG	Making Space for Water Group
FAG	Flood Action Group
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act 1991
WRA	Water Resources Act 1991

Appendix 6: Summary of Relevant Legislation and Flood Risk Management Authorities

The Flood Risk 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 CCC including Section 19 of the Act which states:

Section 19

- (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.

A 'Risk Management Authority' (RMA) means:

- (a) the Environment Agency,
- (b) a lead local flood authority,
- (c) a district council for an area for which there is no unitary authority,
- (d) an internal drainage board,
- (e) a water company, and
- (f) a highway authority.

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 is 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 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 7: Useful contacts and links

Cumbria County Council (Local Flood Risk Management):
lfrm@cumbria.gov.uk, www.cumbria.gov.uk, tel: 01228 221330

Cumbria County Council (Highways):
highways@cumbria.gov.uk, www.cumbria.gov.uk, tel: 0845 609 6609
Out of hours emergencies should be reported via the Police on 101

Insert Neighbourhood forum contact details

United Utilities: www.unitedutilities.com, tel: 0845 746 2200

South Lakeland District Council: customer.services@southlakeland.gov.uk, tel: 01539 733 333

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>

EA – ‘Living on the Edge’ a guide to the rights and responsibilities of riverside occupation:
<http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx>

EA – ‘Prepare your property for flooding’ how to reduce flood damage including flood protection products and services:
<http://www.environment-agency.gov.uk/homeandleisure/floods/31644.aspx>

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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