

Appendix C

Flood Investigation Report

Brookhouse, Denbigh

9th February 2020



Document Control Sheet

Written by:	Name: Kenneth Bevan	Date: 04/03/2020
Checked by:	Name: Sue Moulton/ Denika Moes	Date: 15/04/2020
Checked by:	Name: James Williams	Date: 18/06/2020
Checked by:	Name: Eirain Gilford/ Richard Weston/ Gareth Evens	Date 7/09/2020
Checked by:	Keith Ivens	Date 22/10/2020
Approved by:		

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Distribution

Name	Organisation	Position	Date	Version
Keith Ivens	Natural Resources Wales	Flood Risk Manager		
Paula Harley	Natural Resources Wales	Operational Resource Manager		
Wayne Hope	Denbighshire County Council	Flood Risk Manager		
Nick Holt	Dwr Cymru Welsh Water	Data & Risk Manager		

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Executive summary

Under Section 19 of the Flood and Water Management Act, the Lead Local Flood Authority Conwy County Council on becoming aware of a flood in its area must to the extent that it considers 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.

Natural Resources Wales have agreed to investigate all main river flooding as part of this process.

Where a Lead Local Flood Authority carries out an investigation then the report must be published, and any relevant risk management authorities notified.

This investigation report is a best estimate of the flood incident that occurred at Brookhouse, Denbigh, on 9th Feb 2020. Written in a formal way for Natural Resources Wales to record the incident. It is based on evidence gathered by Natural Resources Wales' officers through several sources and is deemed fit for purpose at the approved date.

It was considered appropriate to carry out an investigation as it was reported 8 residential properties and 1 business outbuildings suffered internal flooding.

Following heavy rainfall from Storm Ciara, the Afon Ystrad overtopped its bank on the 9th February 2020 at Brookhouse.

This report provides details of the investigation with conclusions and recommendations.

1. Location

Brookhouse is a small community of Cottages situated on the outskirts of the town of Denbigh (Approx. population 8,500) Denbigh is a market town and community in Denbighshire, of which it was formerly the county town. Denbigh lies to the West of the Clwydian Hills. Brookhouse is on the South of Denbigh just off the A525 Denbigh to Ruthin road directly adjacent the Afon Ystrad.

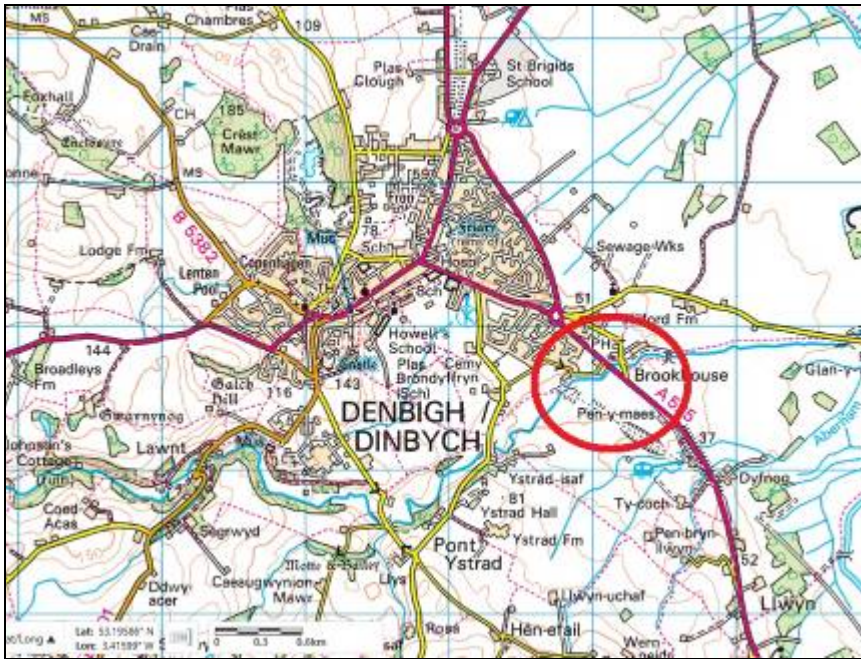


Figure 1: Location

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Figure 2 : General Overview

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Several residential and a commercial property are located on the banks of the River Ystrad, just upstream of the A525 Road Bridge. The properties sit between 0m (The Pottery) and 20m (Property No.10) from the riverbank. Properties 10 to 16 and the Pottery are at a higher level than Glan Llyn, Old Chapel and Nos. 4 to 9.

2. Flooding History

Properties on Brookhouse Road have previously flooded in October/November 2000, December 2007 and November 2012. This was due to overtopping of the left bank of the Afon Ystrad. In November 2012 this resulted in the flooding of 8 properties.

Nos. 3 – 8 all had Individual Property Protection (IPP) Flood guards in place therefore it is believed that water entered via the flooring or via non-sealed pipes at ground level. This assumption is supported by the lower levels of internal flooding being observed.

The Pottery backs directly onto the river. No flood defence door was in place during the 2012 event, so the backdoor is the assumed point of entry for flood water. The Resident stated that the premises did not flood during the event of 2000.

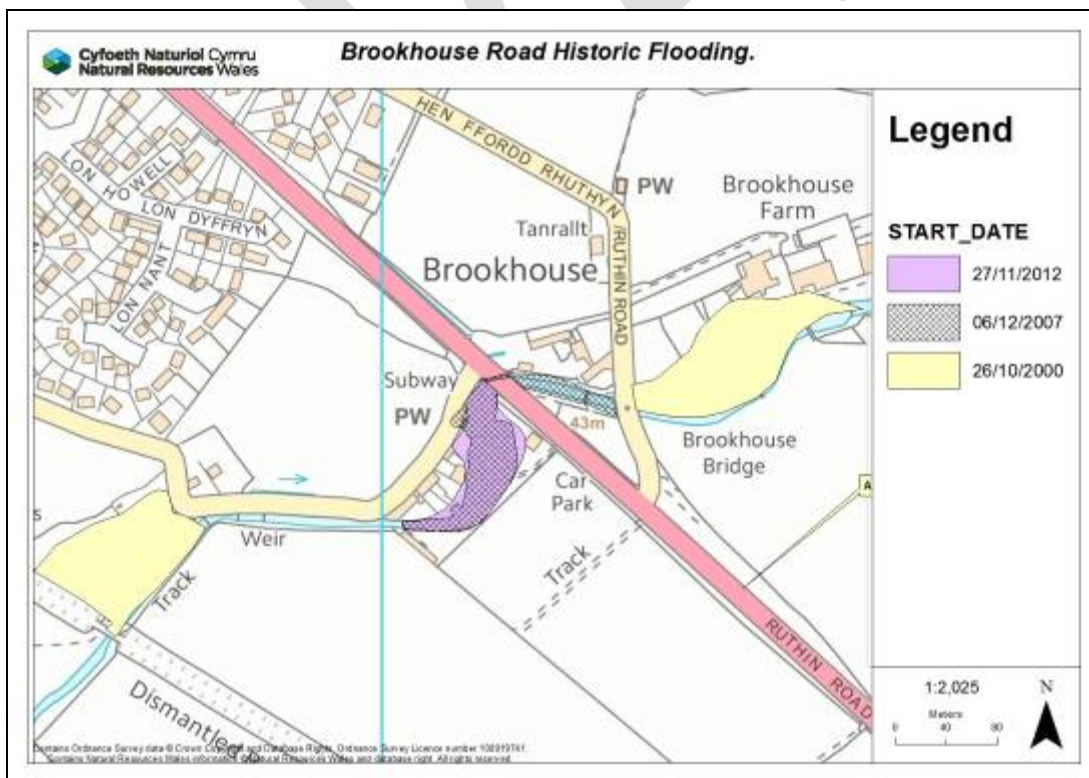


Figure 3: Historic Flood Outlines

3. Flood Risk Assets / Property Level Protection

NRW maintain a weir 100m upstream of the Brookhouse Cottages which includes a staircase type fish pass. The Weir is a Public Safety Risk Assessment (PSRA) site. NRW also maintain an embankment directly upstream of the Weir. Most outfalls on the left bank along this stretch are owned and maintained by Denbighshire County Council.

Six of the properties along Brookhouse Road have IPP. The properties identified as 'Glan Llyn, Nos. 6, 7, 8 and 9 all confirmed to have IPP installed during the event.

The Old Chapel (Hen Capel) and properties Nos.4 and 5 placed sandbags at the front of the properties to help protect against any flood waters coming from this direction, which has often been the case in past events.

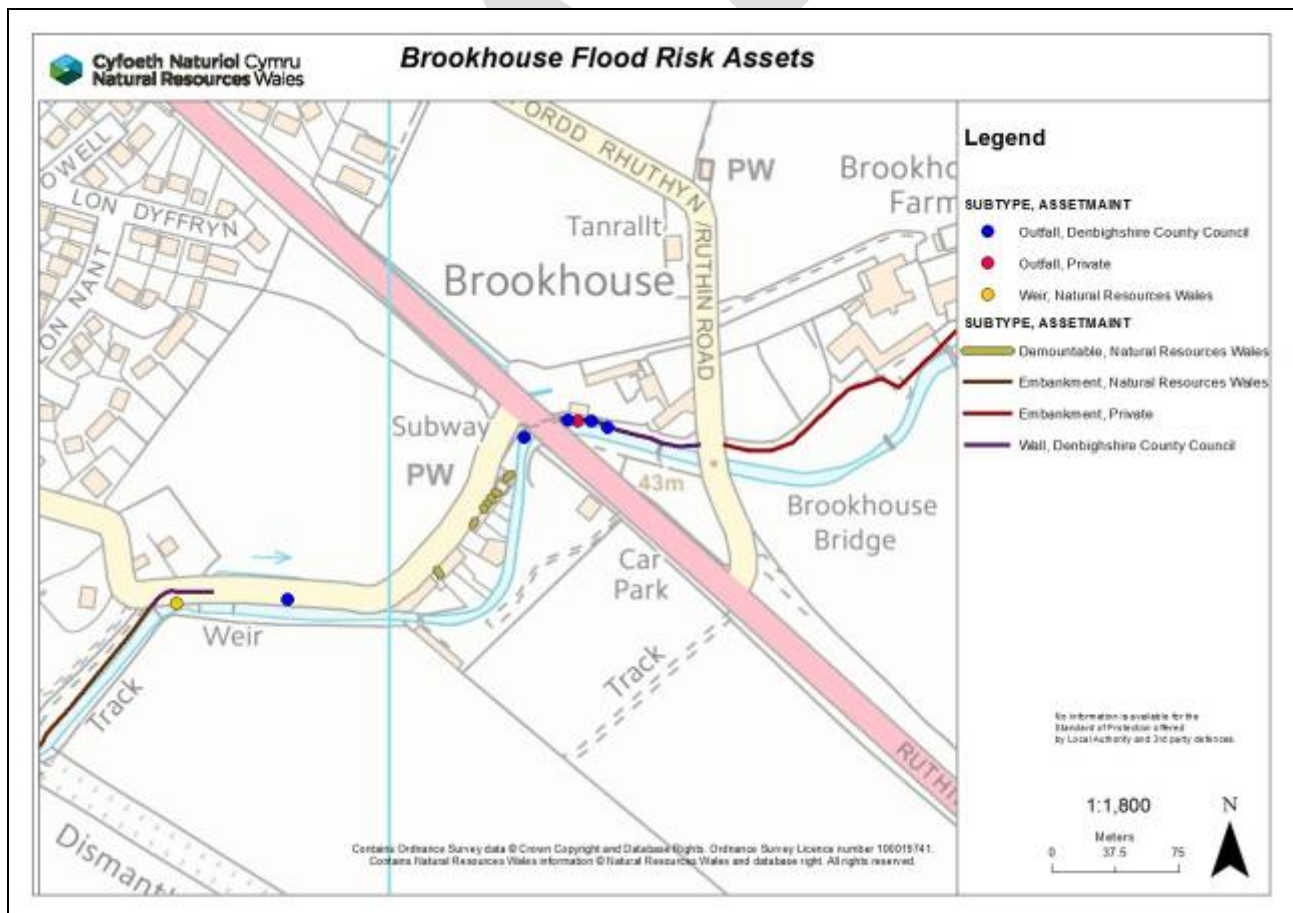


Figure 4: Asset map extracted from AMX database

4. Flood Event Information (9th February 2020)

On the evening of the 8th of February, Storm Ciara brought high winds and heavy widespread rainfall across Britain. Most areas in North Wales were affected by the rainfall on the morning of the 9th. River levels rose accordingly, most notably in the Elwy & Clwyd, Conwy and Dee catchments.

The rainfall caused the Afon Ystrad to overtop both its banks in the vicinity of and behind the properties at Brookhouse Road. Figure 5 shows the extent of the overtopping of the Afon Ystrad at the rear of Glan Llyn on the morning of the 9th February.

4.1. Brookhouse Cottages

During a site visit by NRW staff on 12 February, several properties were confirmed to have flooded internally during this event, on the right bank, Nos. 7 & 8 Brookhouse Road, Glan Llyn and on the left bank, the Pottery's outbuildings suffered internal flooding, including the shed adjacent to the A525. NRW were also informed of internal flooding to the Old Church (Hen Capel) and to No.9 by phone from the residents during and after the event. Properties Nos. 4,5 & 6, that sit between No. 7 and the Old Chapel, could not be confirmed as having internal flooding at this visit. An assumption has been made from external observation and anecdotal evidence that they had suffered some ingress from the Afon Ystrad.

The following information was provided by residents during the site visit or via phone call:

- Nos. 7 and 8 reported water entered their properties through the floor and the internal floor drains, not through the doors or over the IPP. The water entered and receded very quickly.
- At about 09:20 am, water began to enter the Old Church through the doors. There was no IPP installed, only sandbags to prevent ingress. The resident contacted both NRW and the local authority. The depth of internal flooding was about 4 inches.
- At about 10:20 am, the resident at Glyn Llyn identified that water had begun to overtop the wall at the side of the house from the Ystrad. This floodwater then entered the property through both the front and back doors and entered all rooms on the ground floor (Figure 6). The depth of flooding was 1inch. IPP was implemented after water had begun to ingress. The resident stated that they have laid new concrete flooring since 2012.

- Shallow water entered the outbuilding of the Brookhouse Pottery directly from the Ystrad. The depth of internal flooding in the shed adjacent the A525 was about 2 inches (Figure 8).
- Caller reporting flooding to No.9's kitchen during the event. Caller stated this cottage is higher than those downstream and believes that the properties lower down (i.e. *downstream*) on the terrace are also flooded
- The Residents in the properties in the middle of Brookhouse have always expected flooding to enter their houses via the front door, off the road. However, on the 9th February, the field in front of the houses was dry and there was hardly any water from the Ystrad flowing down the tarmac road towards the houses.



Figure 5 Video still of floodwater overtopping from Afon Ystrad at back of Glan Llyn/ Old Church during high flows (the trees in the middle of the photo are standing on the submerged far river bank). Source: Resident



Figure 6: Photo of property ingress of floodwater from Afon Ystrad during Incident at Glan Llyn. Source: Resident



Figure 7: Photo of wrack mark left by Afon Ystrad at the back of the Pottery. Source: NRW



Figure 8: Wrack Mark in Pottery Outbuildings Source: NRW

4.2. Afon Ystrad weir

The NRW Asset Inspector for this area noted that maintenance works above the weir in the last few years has resulted in better water conveyance through the constricted section of channel at Brookhouse. In 2018, NRW undertook Tree management on the banks of the Ystrad from the disused railway to the road bridge at Brookhouse Mill.

This has decreased the risk of the Ystrad overtopping upstream of the weir and flowing along Brookhouse Road towards the properties. Further site investigation from the NRW Asset Inspector determined that there was no evidence that the Ystrad had overtopped the embankments immediately upstream of the weir. The Afon Ystrad over topped its banks immediately downstream of the weir both sides (Figure 9, Figure 10 arrowed). However, it was localised, and the overtopping re-entered the river upstream of any properties on the left bank and consequently, the overspill did not run down the road).

It may be that significant exceedance of channel capacity during this event resulted in overtopping the bank and no amount of maintenance would have prevented this flood.



Figure 9: Photo of wrack mark left by Afon Ystrad on Right Bank just downstream of the weir 12 February 2020. Source: NRW



Figure 10: Photo of wrack mark left by Afon Ystrad on Brookhouse Road adjacent to right bank by weir at small layby. Source: NRW

4.3. Mill Race/ Drain

Historically, Brookhouse Mill, situated on the left bank upstream of the A525, was supplied by a man-made channel across the field, that was fed by the Ystrad through an old Mill inlet. It connected to the other side of the road via a culvert (306892, 365673).

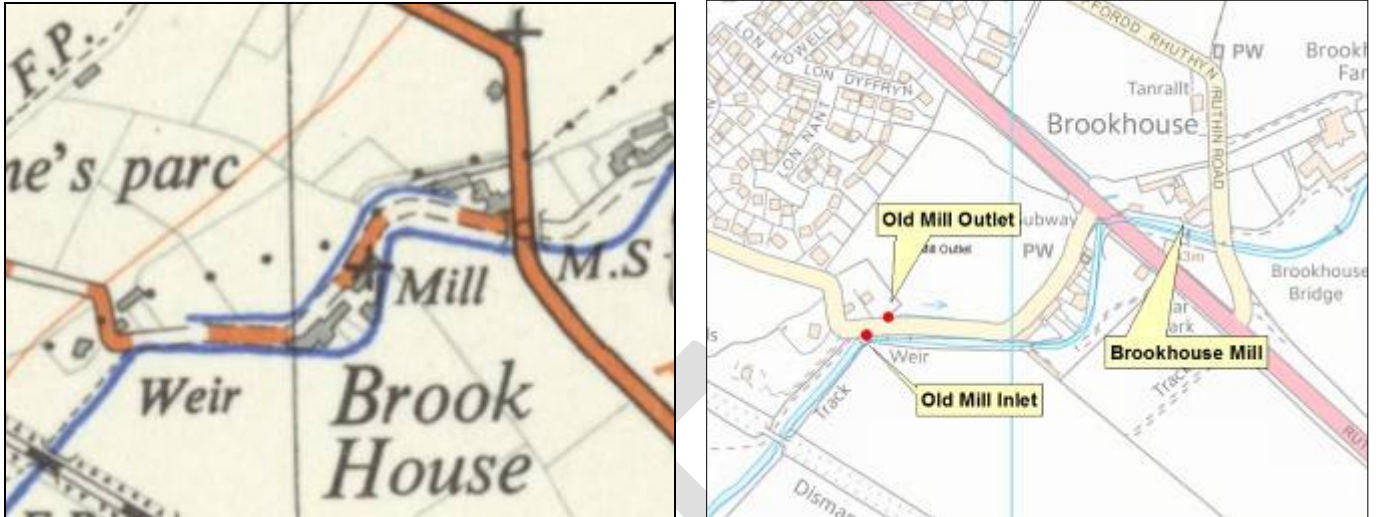


Figure 11: 1937 Map showing route of man-made channel on Brookhouse Road to Brookhouse Mill adjacent to present day map Source: <https://maps.nls.uk/> Contains OS data © Crown copyright [2020]

Several decades ago when the new road was built, the Mill leat appears to have been blocked off, however the archway still exists (See Photo below Figure 12) and a small flow into but not through is present.



Figure 12: Photo of Old Mill Inlet. Source: Denbighshire County Council.

The Old Mill outlet to the field (Figure 13) was inspected after the event and was observed to be dry as expected as it is understood to have been blocked off.



Figure 13 : Photo of Old Mill Outlet. Source NRW

The Mill race/drain running along the wall in the field was clear, there is a 400mm diameter Outfall to allow surface water drainage from the field back into the river (Figure 15). This was clear and no debris was seen within the river itself.

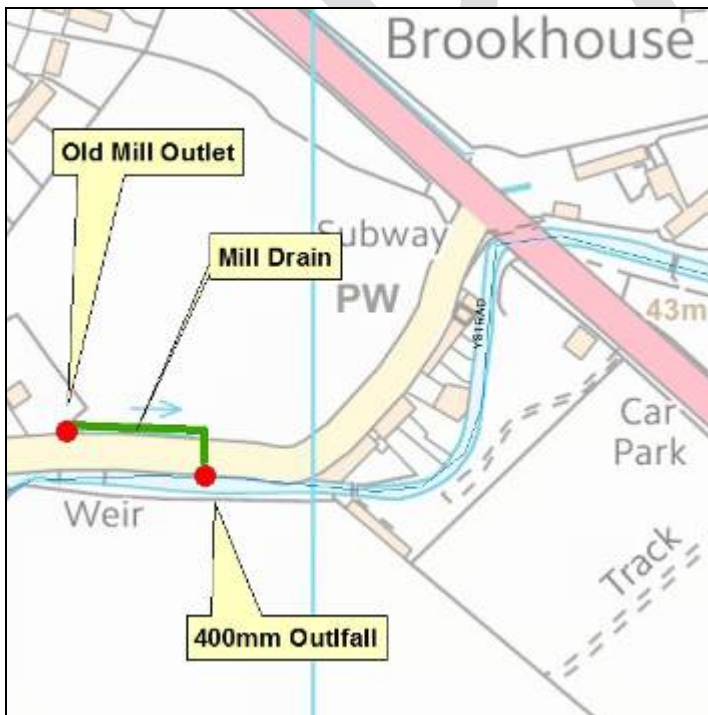


Figure 14: Map showing outlet and 400m Outfall associated with Mill Race Drain. Source: NRW



Figure 15 - 400mm Outfall associated with Mill Race Drain

From the evidence gathered in the investigation of this event, it is concluded that the main source of flooding was channel exceedance from the river Ystrad, behind the resident's properties.

4.4. Pedestrian subway and footpath

Water and wrack debris were seen on the landward side of the wall that runs along the Ystrad from the subway to the A525 (Figure 16). However water did not flow into the pedestrian subway as has been the case in previous events, as there was no reported problems by residents and during the site visit, the subway was seen to be dry with no wrack and no silt present (Figure 17).



Figure 16: Wall on Left bank from A525 to Brookhouse Mill. Crack in wall potential seepage routes Source: NRW



Figure 17: Pedestrian Subway. Source: NRW

It is likely that the floodwater seepage was through the wall to the footpath as there is no evidence to suggest the Ystrad overtopped the wall in this area. This is further supported by observations made by residents at the Brookhouse Mill, which identified that the peak water level in the Ystrad was at the at the soffit of the footbridge (see figure 18 below).

The footbridge soffit is at 41.02mOAD, which is lower than the top of the wall, as shown in Figure 19.



Figure 18: Footbridge over River Ystrad at Brookhouse Mill. Source: NRW



Figure 19: Surveyed levels of Wall on Left bank from A525 to Brookhouse Mill and footbridge deck levels

4.5. Brookhouse Farm

The Afon Ystrad also overtopped its bank further downstream of the A525 near Brookhouse Farm (Figure 20), however there was no internal flooding reported. The farm owner reported several locations along the Ystrad, downstream of the A525, where trees had fallen into the river during the event causing partial blockage of flow.



Figure 20: Wrack mark on right bank of Ystrad, downstream of A525, opposite Brookhouse Farm. Source: NRW

5. Flood Outlines and Flood Flow Routes

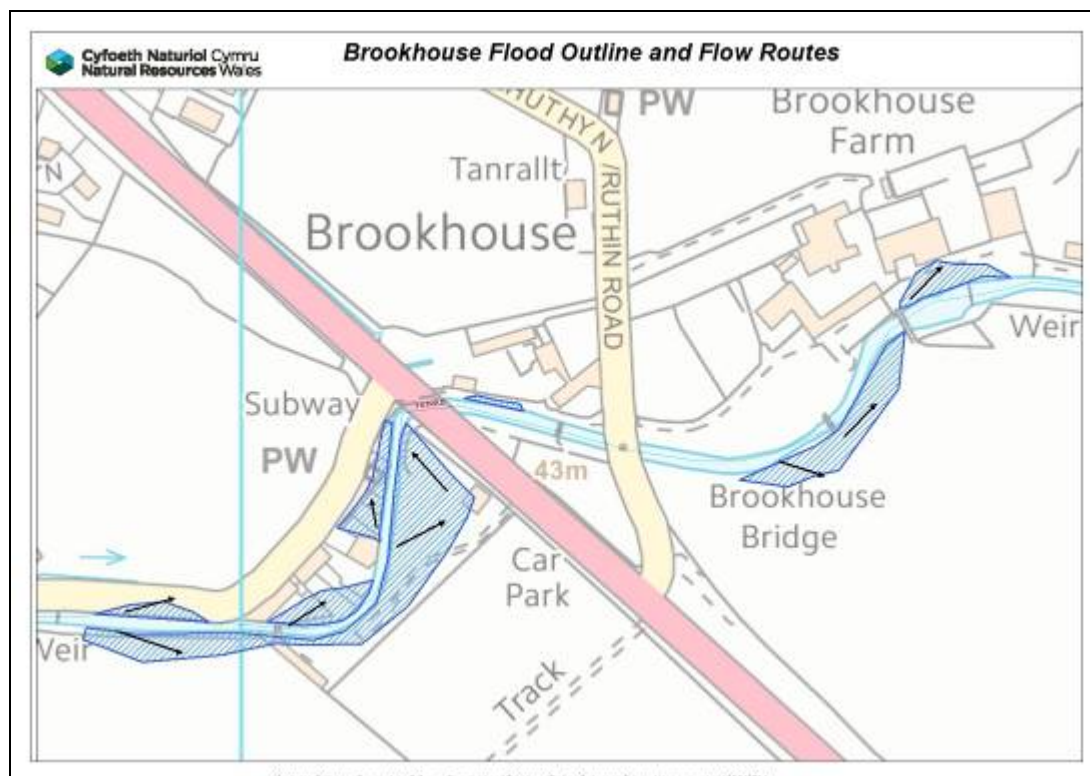


Figure 21: Outline and Route

6. Details of Warnings and Alerts issued

The Afon Ystrad does not currently have any level monitoring equipment in the vicinity, hence Brookhouse Community has no specific Flood Warning Service. There is also no current community flood plan in place.

Residents of Brookhouse can register for the Clwyd Catchment Flood Alert but this covers a much broader area (Fig.22) and the main rivers covered by this alert are much slower to react than the Afon Ystrad. This is a free service that provides flood warnings by telephone, mobile, email and SMS text message. This would provide residents prior warning of a fluvial flood event. However, it should be noted that this would only give warning of fluvial flooding in this area and would not cover pluvial or groundwater flooding. A Flood Alert was issued by NRW at 09.48hrs for the Clwyd catchment on the 9th February.

The following addresses are registered to receive warnings for the Clwyd catchment: Old Chapel, Nos. 7, 9, and 16.

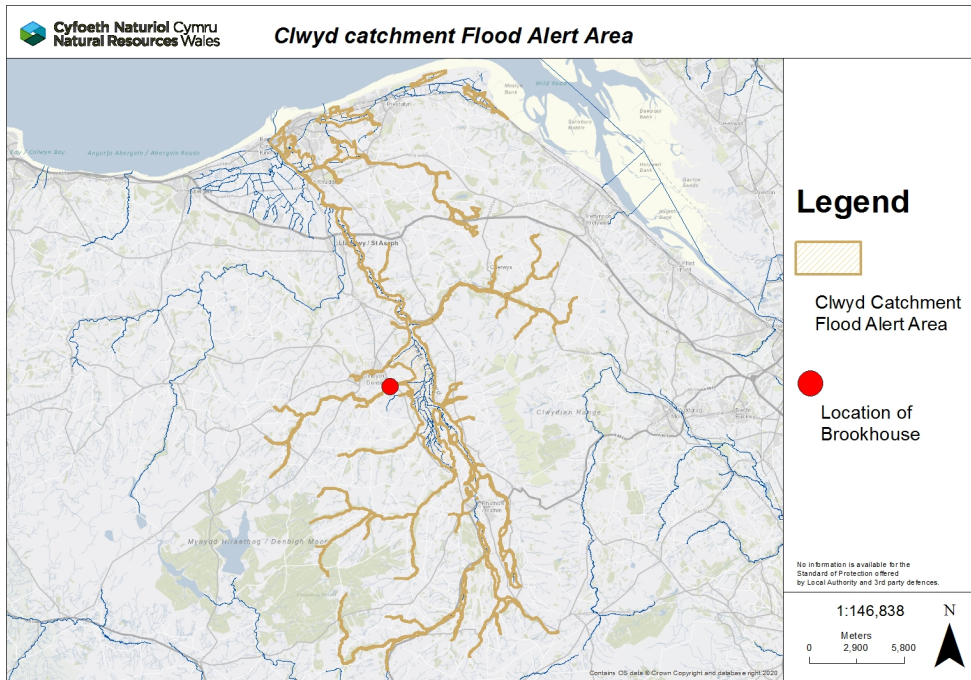


Figure 22: Flood Alert Area – Clwyd Catchment Total Extent.

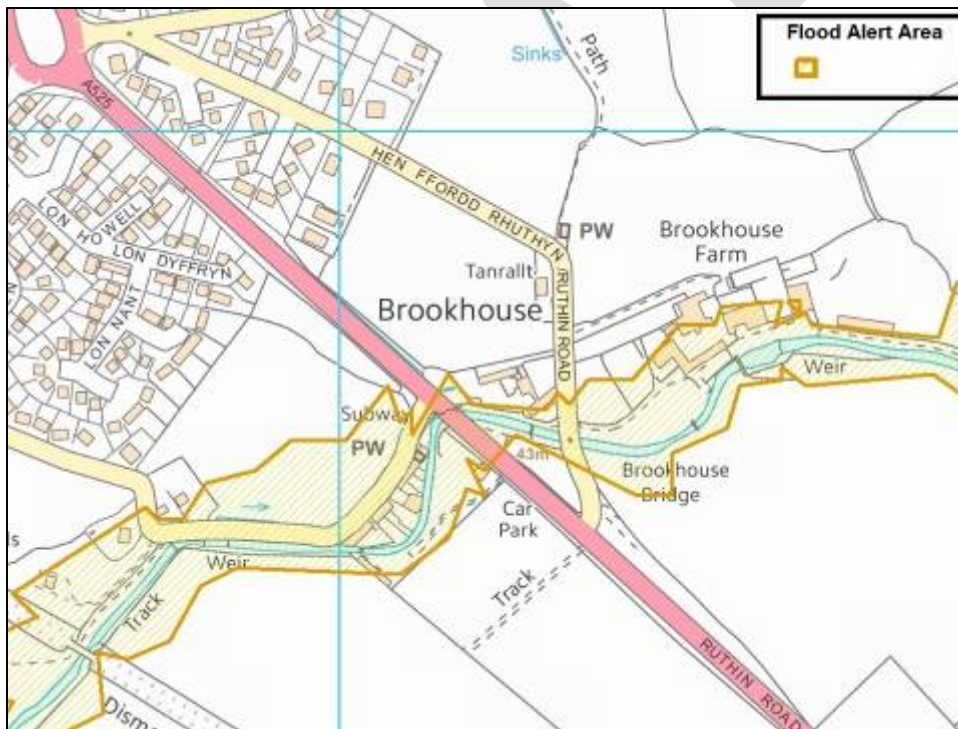


Figure 23: Flood Alert Area – Clwyd Catchment in locality of Brookhouse.

7. Response

NRW has no formal operational response procedure for Brookhouse. Attendance by NRW did not take place during the event, but post event data gathering did occur both by NRW and Denbighshire County Council.

Property Nos. 4 and 5 and the Old Chapel were seen to have sandbags at the front doors of the properties to defend against any flood waters coming from the front. DCC could provide Sandbags and / or flood sacks to provide temporary defences.

Individual Property Protection measures (floodgates) were used during this event. They were effective to the extent that they reduced the flood depth but failed to keep the properties dry as water evidently entered through floors, service entries and drains.

8. Conclusion

On 9 February 2020, river water from Afon Ystrad exceeded its channel capacity both upstream and downstream of the weir, although the wall on the left bank by the weir was not overtopped. Overtopping at Brookhouse Road caused confirmed internal flooding to 5 residential properties - The Old Church, Glan Llyn, Nos.7 & 8 and 1 commercial property - the pottery outbuildings. Internal flooding to Nos. 4, 5, 6 & 9 Brookhouse Road was implied by residents during the visit and via phone, even though this was unable to be confirmed on site.

Glan Llyn did have concrete flooring that prohibited access through the floor but did not install IPP until water ingress had begun.

Residents expectation was flooding from the front of the properties as had been the case on previous occasions.

On this occasion, flooding was caused by the overtopping of the Afon Ystrad at the back of the properties. Recent tree clearance above the weir may have decreased the risk of blockage of the Ystrad and subsequent overtopping upstream of the weir, thus impeding this flow route along Brookhouse Road towards the properties. The tree work may have resulted in a greater river conveyance made the Afon Ystrad react more quickly to heavy rainfall.

It is more likely there was significant exceedance of channel capacity as a consequence of the rainfall associated with Storm Ciara and hence arguably no amount of maintenance would totally prevent this flood.

9. Recommendations

- NRW should inform residents of Brookhouse Road that are not currently registered, of the process to sign up for Flood Alerts for the Clwyd Catchment. DCC should approach residents for assistance with obtaining Individual Property Protection if not already owned.
- NRW will continue to work closely with the community of Brookhouse to further understand flooding mechanisms and where appropriate, liaise with Denbighshire County Council to identify options for flood defence for the village.
- NRW to consider the viability of the implementation of a river level monitoring site on the Afon Ystrad to assist in earlier warning issued to residents.
- NRW will undertake a topographic survey of both banks of the Afon Ystrad from the weir to below Brookhouse Farm.
- NRW will update the hydraulic modelling to take into account the findings of this 2020 flood investigation report.
- DCC should investigate the possibility for Non-Return Valve to be add to Mill Race Drain Outfall to reduce risk of water from Afon Ystrad entering field. Home owners are advised to assess whether further flood resilience measures can be installed at their properties.
- DCC should investigate the potential of seepage through wall on Left bank of the Ystrad from A525 to Brookhouse Mill Wall where wrack debris and evidence of pooling water were observed the day after.
- NRW will continue to complete reactive routine maintenance on the Ystrad, review schedules and takes where appropriate and make improvements if it is determined to be viable and proportionate to the risk.

LL57 2DW

0300 065 3000 (Llun – Gwener 8yb – 6yr.Mon-Fri, 8am - 6pm)

lifogyddgogleddcymru@cyfoethnaturiolcymru.gov.uk
floodingnorthwales@naturalresourceswales.gov.uk

www.cyfoethnaturiol.cymru
www.naturalresources.wales

DRAFT