

Denbighshire County Council

Investigation into the November 2012 Floods

Flood Investigation Report - Part 1



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Executive Summary

On the 26th and 27th of November 2012, Denbighshire experienced heavy and prolonged rainfall, which led to the flooding of more than 500 properties and, tragically, the death of a St Asaph resident.

According to Natural Resources Wales, the rainfall event had a 1 in 13 chance of happening. However, because the rain fell on ground that was already saturated many of the rivers in the county rose to record levels. The flood event has been calculated to have had a chance of occurring of between 1 in 100 and 1 in 200.

The overall investigation has been led by Denbighshire County Council, with support from Natural Resources Wales. The Council has appointed independent experts to examine the complex issues surrounding the flooding of the Glasdir housing development in Ruthin and to review the investigation of the other flood locations. The investigation has been coordinated by a Flood Investigation Officers' Working Group, with representation from all of the relevant risk management authorities.

The investigation into the flooding at Glasdir has raised numerous questions concerning the hydrology of the River Clwyd catchment. Work to answer these questions is progressing well and it is expected that the independent investigators will be able report on their findings by September 2013.

There is now a clear understanding of the flood events other than Glasdir and both Natural Resources Wales and Denbighshire County Council are considering a range of options to reduce the risk of flooding in future. The recommendations range from straightforward maintenance and improvement work to multi-million pound flood risk management schemes. It will be essential to seek the support of the Welsh Government with respect to the funding of these schemes.

In the case of St Asaph, flood modelling work carried out as part of the investigation has shown that the level of protection provided by the raised defences is considerably less than what had previously been understood. Instead of being defended against a 1 in 100 chance flood event, parts of the city are now believed to be at risk from an event with an annual likelihood of 1 in 30.

Throughout the investigation there has been good cooperation between the relevant authorities. There is now an opportunity to build on the working relationships that have been forged, by engaging with all the affected stakeholders and managing flood risk through a partnership approach.

1 Introduction

1.1 Background to the Flood Event

According to the Met Office, 2012 was the third wettest year on record in Wales. Following a dry start to Spring, wetter conditions prevailed resulting in saturated ground conditions in the run up to the November rainfall event. The rainfall event, although prolonged, could probably be described as moderate rather than severe and had a 1 in 13 chance of happening in any one year. However, because the rain fell on ground that was already saturated many of the rivers in the county rose to record levels. As a consequence, the flood defences of the River Elwy and River Clwyd were overtopped at numerous locations leading to widespread flooding of property and agricultural land. There was also flooding from the River Ystrad and River Alyn, as well as several ordinary watercourses. The flood event has been calculated to have had a chance of occurring of between 1 in 100 and 1 in 200. Based on the evidence gathered during the investigation, there were no major incidents of surface water or groundwater flooding.

1.2 Purpose of the Investigation

The purpose of the investigation was to address the following key questions:

- Why did the flooding happen?
- How likely it is for that scale of flooding to happen again?
- What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

1.3 Legislative Context

Denbighshire County Council, as a Lead Local Flood Authority, has a duty under Section 19 of the Flood and Water Management Act to investigate flooding in its area.

The 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.

The main sources of flooding during the November event were the River Elwy, River Clwyd and River Ystrad. These are classified as main rivers and the responsibility for the detailed investigation of each flood location rests with Natural Resources Wales. There were nine separate locations affected by main river flooding. These ranged from large communities, such as St Asaph and Ruthin, to individual isolated properties.

Significant, but less extensive flooding was experienced from ordinary watercourses at three separate locations. The responsibility for the investigation of these events rests with Denbighshire County Council as the Lead Local Flood Authority.

1.3 Flood Investigation Officers' Working Group

Because of the extensive, and likely complex nature of the flood investigation, potentially involving a number of flood risk management authorities, Denbighshire County Council decided as Lead Local Flood Authority to undertake a full investigation of the relevant flooding incidents and to establish a Flood Investigation Officers' Working Group to oversee and support the process. The working group, which met frequently, proved essential in ensuring strong communication between the relevant parties and helped to forge a partnership approach to the investigation by building on strong existing relationships between the respective organisations.

1.4 Independent Investigation

Recognising that the circumstances surrounding the flooding of the Glasdir housing development were far from straightforward, Denbighshire County Council decided to commission two independent experts, Dr Jean Venables and Clive Onions, recommended by the Institution of Civil Engineers, to carry out a full and independent investigation of the Glasdir event. In addition, the experts have been requested to review the findings of the other investigations and validate the conclusions and recommendations.

1.5 Public Consultation

The investigation involved a considerable amount of public engagement and consultation, aimed at gathering information about the flood and keeping people aware of progress with the investigation. Public drop in sessions took place at St Asaph, Rhuddlan and Glasdir, with visits to individual properties elsewhere. For St Asaph and Glasdir, these were followed by meetings with residents groups representing the affected residents.

2 The Flooding Locations

There were 12 distinct flooding locations, from Rhuddlan in the north of the county to Glyndyfrdwy in the south. St Asaph, Rhuddlan (including Sarn Lane) and Lower Denbigh Road were flooded from the River Elwy under similar circumstances, so have been grouped together. The other flooding locations are considered separately.

2.1 St Asaph, Rhuddlan (including Sarn Lane) and Lower Denbigh Road

According to Natural Resources Wales, the River Elwy recorded its highest ever level on the 26th and 27th November 2012. This was due to prolonged heavy rain falling on saturated ground. As a consequence, the river overtopped its banks and the flood defence bunds, leading to widespread and significant flooding. Computer modelling work carried out by Natural Resources Wales indicates that the flood event had between a 1 in 100 and 1 in 200 probability of occurring (referred to as an Annual Exceedance Probability, or AEP).

St Asaph

Overtopping of the flood defences took place between approximately 4:45 am and 3:15 pm on the 27th November. Flooding began downstream of the A55 with water spilling into the Spring Gardens area. This was followed quickly by flooding at Roe Park, and soon after by flooding upstream of the A55 as the majority of the flood defences became overwhelmed and large areas of the centre of St Asaph became inundated. Parts of the city were flooded for several days, despite the deployment of high capacity pumps.

Approximately 320 properties and 70 caravans were flooded during the event. St Asaph is protected from the River Elwy by flood defences consisting of raised earth embankments which were overtopped due to high river levels. There is no evidence of any breach of the defences.

Flood modelling carried out for the investigation has concluded that, contrary to previous understanding, the defences downstream of the A55 only offer protection against a 1 in 30 AEP event, whilst those upstream of the A55 will protect against a 1 in 75 AEP event. The level of protection is, therefore, significantly less than what was understood to be the case prior to the November 2012 event. The improved understanding has come about through refinement of the methods used by Natural Resources Wales to create the flood model, combined with records of the actual flood which have enabled the model to be precisely calibrated.

During the course of the investigation, a number of questions have been raised by the affected residents concerning factors which might have had an influence on the levels in the River Elwy.

Firstly, did the high tide make the situation worse? Natural Resources Wales has confirmed that the River Elwy at St Asaph is high enough above sea level for the tide not to have had any impact. The limit of tidal influence is near the confluence of the River Elwy and River Clwyd, around 1.5km downstream.

Secondly, was water being released from Llyn Aled and Aled Isaf during the flood? Welsh Water has confirmed that there were no releases from Llyn Aled and only a small quantity of water was released from Aled Isaf between 25th November and 29th

November, but that this was within agreed operating procedures. It is believed unlikely that either reservoir had a significant influence on the St Asaph flood.

Thirdly, did Spring Gardens Bridge contribute to the flooding? Computer modelling work carried out by Natural Resources Wales shows that while the bridge does create a 'constriction' on the flow of water, in this instance it did not contribute significantly to the flooding. Data shows that the height of the water was so significantly above the level of the flood defence bunds that they would have been overtopped even if the bridge had not been in place, although Roe Park would have been flooded to a lesser depth and Spring Gardens Holiday Park probably wouldn't have flooded at all.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which resulted in water levels in the River Elwy that were higher than the flood defences were able to cope with.

How likely it is for that scale of flooding to happen again?

The event is believed to have had between a 1 in 100 and 1 in 200 chance of occurring in any one year. Although this could be described as an extreme event, with a relatively low risk of recurring, the investigation has shown that the flood defences at St Asaph could be overtopped leading to widespread flooding in a far less severe event.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

The current defences in St Asaph provide protection against a 1 in 30 chance event north of the A55 and 1 in 75 chance event south of the A55. This is below the standard of protection considered appropriate. Natural Resources Wales is currently considering options to reduce the risk of flooding to a more acceptable level. Early indications are that a range of solutions may be possible, but that the costs could be significant (in excess of £5 million). Natural Resources Wales is also investigating whether any short term interim measures could be carried out to reduce the risk until a scheme is put in place. These could include the removal of trees and vegetation from the river banks, which would reduce the risk of blockage and potentially increase the capacity of the river during a flood, and the localised raising of defences north of the A55, providing this doesn't increase the risk of flooding elsewhere in the short term. It is likely that the costs of these short term measures and any longer term solutions would have to be borne by Natural Resources Wales from within its capital funding budget.

Rhuddlan, including Sarn Lane

The investigation into the flooding that affected the Marsh Road & Station Road areas of Rhuddlan has established that this was caused by the River Elwy overtopping its banks north of St Asaph and flowing along the flood plain behind the flood defences. Sarn Lane, which is an access route to Glan Clwyd hospital, was flooded from the same source. Isolated sections of the River Clwyd flood defences were also overtopped upstream of Rhuddlan. A total of 10 properties (residential and commercial) were flooded.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which resulted in the River Elwy overtopping its defences downstream of St Asaph and flowing along the floodplain towards Rhuddlan. The River Clwyd also overtopped its banks. The River Clwyd at Rhuddlan is tidal. Although the full effect of the high tide is unknown, evidence suggests that the flood was still occurring even at low tide, which would indicate that the tide had minimal impact as a cause of flooding.

How likely it is for that scale of flooding to happen again?

The event is believed to have had between a 1 in 100 and 1 in 200 chance of occurring in any one year. As noted previously in relation to St Asaph, the flood defences at the source of the floodwater, that is, downstream of the A55, provide protection against a 1 in 30 chance event. There is a significant risk that flooding could recur without measures being taken to reduce the risk of overtopping at that location.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Improvement works carried out to the River Elwy defences at St Asaph would also reduce the likelihood of flooding at Rhuddlan. There might also be opportunities to direct flood water away from properties in the event that the defences are overtopped. Since the flood, Natural Resources Wales has carried out a defence crest level survey that has fed into the St Asaph modelling work. Natural Resources Wales is currently considering the options and a range of solutions to reduce the risk of flooding in the area.

Lower Denbigh Road

The investigation of the flooding from the River Elwy that affected properties south of St Asaph, near Lower Denbigh Road, shows that the flood occurred as a consequence of the river overtopping its banks. Up to 7 properties were flooded, with a further 14 experiencing a 'near miss'. Natural Resources Wales is currently assessing the options available to reduce the risk in future.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which resulted in the River Elwy overtopping its banks and spilling onto the flood plain. There are no formal flood defences in this location and none of the flooded properties had individual property protection.

How likely it is for that scale of flooding to happen again?

The event is believed to have had between a 1 in 100 and 1 in 200 chance of occurring in any one year.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Given the relatively small number and the isolated nature of the properties affected, it is unlikely that Natural Resources Wales would be able to justify the cost of providing raised flood defences to protect against a 1 in 100 chance event. However, it might be possible for the risk of flooding to be reduced to an acceptable level by installing individual property protection. In addition, residents should be encouraged to sign up to the Environment Agency's flood warning service (operated on behalf of Natural Resources Wales).

2.2 Brookhouse, Denbigh

The investigation has identified that the River Ystrad overtopped its banks, causing flooding to 7 residential and 1 commercial property at Brookhouse Terrace. A number of properties had already invested in individual property protection, but this was only partially successful during the event. There is also evidence of a backflow of flood water through the drainage system of the adjacent pedestrian tunnel under the A525.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which resulted in the River Ystrad overtopping its banks, exacerbated by backflow up the pedestrian tunnel beneath the A525.

How likely it is for that scale of flooding to happen again?

There is insufficient information available to determine the precise scale of the event. However, the Environment Agency's flood map shows that the properties would flood in a 1 in 100 chance event.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Natural Resources Wales is currently considering the options available to reduce the risk in future, although these are likely to be limited to individual property protection, due to the probable high cost of formal flood defences. The Council has installed non return valves to prevent backflow at the pedestrian tunnel.

2.3 Llanynys

Three isolated properties were affected when the River Clwyd overtopped its banks. Each property had individual property protection, which worked to varying degrees.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which resulted in the River Clwyd overtopping its banks at multiple locations.

How likely it is for that scale of flooding to happen again?

The event is believed to have had between a 1 in 100 and 1 in 200 chance of occurring in any one year. The River Clwyd has no formal flood defences at this location, which means that a flood could occur with less than a 1 in 100 chance. The floodwater overtopped the individual property protection installed at one property.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

It is unlikely that formal flood defences would be cost effective to defend a small number of isolated properties, which already have individual property protection installed. However, the affected residents should be encouraged to sign up to the Environment Agency's flood warning service (operated on behalf of Natural Resources Wales).

2.4 Gellifor

The investigation has concluded that the flooding of a single property occurred as a consequence of high quantities of flow coupled with culvert blockages in a ditched watercourse running alongside the public highway. A number of options have been recommended. These include more robust maintenance, by the Council and private landowners, some measures to prevent water entering the property during an extreme event and further studies of road levels and the upstream catchment.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rain leading to high volumes of water entering a culverted watercourse with insufficient capacity to deal with an extreme event.

How likely it is for that scale of flooding to happen again?

No information is available with respect to the scale of the flood event. However, the nearby River Clwyd is understood to have experienced a 1 in 100 to 1 in 200 chance event.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

The Council should contact the riparian landowners to explain their obligation to maintain the culverted watercourse to reduce the risk of flooding. Individual property protection could further reduce the risk of floodwater entering the property during an extreme event. Further studies of road levels and the upstream catchment are also recommended.

2.5 Glasdir, Ruthin

The investigation into the flooding at Glasdir is ongoing at the time of this report. The independent investigators concluded at an early stage in the investigation that a detailed knowledge of the River Clwyd hydrology would be essential to their understanding of why the flood happened, the chances of it occurring again and what

action should be taken to reduce the likelihood of flooding in future. Natural Resources Wales was, at the time of the flood, already carrying out a review of the hydraulic model of the River Clwyd in the Ruthin area. Data recorded during the flood has enabled further calibration and refinement of the model. The work carried out by Natural Resources Wales is currently being reviewed by the independent investigators. It is anticipated that the investigation will be complete by September 2013.

As an interim measure, and following discussions with Natural Resources Wales, the Council has removed the security screens from the 5-way culvert which passes beneath the relief road. A telemetry enabled water gauge has been installed at the entrance to the culvert to improve the flood warning system and a hardstanding has been built above the culverts to allow easy access to remove debris during a flood.

2.6 Park Place/Mwrog Street/Maes Ffynnon, Ruthin

The investigation has identified that a low spot in the flood defence bund at Cae Ddol allowed flood waters to overtop the defence, leading to the flooding of 1 residential and 1 commercial property. This defence has now been raised to the same height as adjacent defences.

Flood water was also observed to be coming from highway gullies in Park Place / Mwrog Street, which is now known to have been caused by the backing up of flows in Mwrog street culvert as a result of high levels in the River Clwyd. The installation of no-return valves to these gullies has been instructed.

A masonry wall, which forms the eastern boundary to properties at Maes Ffynnon and acts as an informal flood defence, was unable to fully retain the River Clwyd behind it and was observed to be permeable during the flood, leading to the unconfirmed flooding of 2 properties. Natural Resources Wales is considering the designation of the wall as a formal flood defence and has commenced work to re-point the wall to reduce its permeability.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which resulted high water levels in the River Clwyd. The river overtopped its defences at Cae Ddol and caused backing up in Mwrog Street culvert. Floodwater also permeated a boundary wall at Maes Ffynnon.

How likely it is for that scale of flooding to happen again?

The event is believed to have had between a 1 in 100 and 1 in 200 chance of occurring in any one year.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Work has already been carried out by Natural Resources Wales to increase the height of a local low point in the defences at Cae Ddol. Work by Natural Resources Wales is underway to upgrade the boundary wall at Maes Ffynnon and plans are in place by the

Welsh Government to install non return valves to reduce the risk of floodwater backing up in Mwrog Street.

2.7 Llanbedr DC

One residential property was flooded during the event. The investigation has concluded that the cause of flooding was the inability of the watercourse at Lon Cae Glas and adjacent to the A494 to retain flow within its banks. This was the result of under capacity combined with culvert blockages and collapses. Some repair work has been carried out, with plans in place to increase the capacity of one of the culverts. The Council has submitted details of its investigation to the Welsh Government. This follows the submission of project appraisal report in 2011 which identified a preferred option to significantly reduce the flood risk by replacing or upgrading the majority of the culverts.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which exceeded the capacity of the ordinary watercourse at Lon Cae Glas. This, combined with culvert blockages and collapses led to floodwater flowing along the A494 and entering a property at Smithy Corner.

How likely it is for that scale of flooding to happen again?

No information is available with respect to the scale of the flood event. However, the nearby River Clwyd is understood to have experienced a 1 in 100 to 1 in 200 chance event.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Denbighshire County Council should seek assurances from the Welsh Government regarding the availability of grant funding to assist the Council in carrying out an improvement scheme and should explore whether short term measures could be carried out to reduce the risk until a scheme is implemented.

2.8 Loggerheads

The investigation has found that the cluster of Denbighshire County Council owned properties at Loggerheads Country Park were flooded when the River Alyn overtopped its flood defences.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding was caused by heavy, prolonged rainfall falling on saturated ground which led to water levels in the River Alyn exceeding the level of the flood defences.

How likely it is for that scale of flooding to happen again?

No information is available with respect to the scale of the flood event. However, the nearby River Clwyd is understood to have experienced a 1 in 100 to 1 in 200 chance event.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Denbighshire County Council should assess whether more robust individual property protection is required

2.10 Corwen

The investigation has found that flooding occurred from the River Dee and affected Green Lane, resulting in a road closure that separated the north and south sides of the town. Flooding at Green Lane is a regular occurrence and will be a difficult issue to resolve. Natural Resources Wales will investigate whether individual property protection is a viable option, although this would do nothing to reduce the impact on Green Lane itself. In addition, there was some surface water flooding of the A5 near the Police, Ambulance and Fire Station, which is under investigation by the North and Mid Wales Trunk Road Agency on behalf of the Welsh Government.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

The flooding of Green lane was caused by high levels in the River Dee which overtopped its banks and entered the flood plain which is crossed by Green lane. The A5 flooding is thought to be the result of surface water being unable to flow away from the area due to high levels in the River Dee.

How likely it is for that scale of flooding to happen again?

Green Lane floods, on average, two to three times every year. It is likely that the A5 could flood with similar frequency if the cause is linked to high levels in the river Dee.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

There is very little that can be done to prevent the flooding and subsequent temporary closure of Green Lane. However, property owners at risk of flooding from the River Dee in the vicinity of Green lane should consider installing individual property protection. Further studies will be required to establish the precise cause of the A5 flooding.

2.10 Glyndyfrdwy

The investigation has shown that two isolated properties were flooded, each related to surface water.

Considering the three key questions to be addressed by the investigation:

Why did the flooding happen?

Prolonged and heavy rainfall cause high volumes of surface water flow from private land onto the public highway and subsequently enter the properties.

How likely it is for that scale of flooding to happen again?

There is no information available to determine the scale of the event. Based on the information gathered in relation to the other flooding locations across the county, it would be reasonable to assume that this was an extreme event.

What improvement actions are needed to ensure flood risk in the County is appropriately managed in future?

Further studies are required to look at ways to reduce surface water runoff and to direct floodwater away from properties. In addition, advice should be given to the property owners with respect to individual property protection and measures to make the properties more resilient to flooding.

3 Conclusion

The heavy and prolonged rainfall which fell on the already saturated catchments of the Rivers Elwy and Clwyd during the 26th and 27th November 2012, led to the worst flooding in Denbighshire for over a decade.

In the aftermath of the flood event, all of the relevant flood risk management authorities worked closely together to investigate why the flooding occurred and to determine the likelihood of it happening again. The investigation, which was led by Denbighshire County Council as the Lead local Flood Authority and coordinated by a multi agency working group, has, with the exception of Glasdir, been able to make firm recommendations to reduce the risk of flooding in future. Regarding Glasdir, the complex hydrology of the River Clwyd and the circumstances surrounding the flood event mean that the investigation of that particular location is taking longer than was originally anticipated. However, it is hoped to be able to report fully on this final part of the investigation by September 2013.

Looking beyond the site specific recommendations, it has become clear during the investigation that there are some general actions which should be taken to reduce the risk of flooding in future, including:

Overall River Maintenance and Management

- Establish a River Management Partnership, which would bring together a broad range of stakeholders, such as risk management authorities and riparian landowners, to establish guiding principles regarding river management and develop a range of measures which would be implemented through catchment level flood risk management plans. This would also create a forum to discuss the complex issues of roles and responsibilities under relevant legislation and create an opportunity to share knowledge of best practice.

Property Protection

- Encourage property owners in areas at high risk of flooding to consider installing Individual Property Protection. Denbighshire County Council and Natural Resources Wales should continue to build on their established working partnership to ensure that every resident at risk of flooding in Denbighshire is made aware of the options available. Further efforts should be made to encourage the adoption of Community Flood Plans by at risk communities.
- Develop a Denbighshire County Council policy on the use and distribution of sandbags. The Council will currently try to issue sandbags as a temporary protection measure during a flood event, but this is very much dependant on the availability of resources and is difficult to manage, particularly if the whole county is affected by flooding, as happened in November 2012. Sand bags are generally more effective if used to protect multiple rather than individual properties and the policy will need to reflect this. Unfortunately, because sandbags begin to decay once filled, it isn't possible to assemble a stockpile of sandbags "just in case". The policy should also give consideration to the problem of post-flood collection and disposal of sandbags, which are often contaminated through contact with floodwater.

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Flood Risk Management

- Review the flood investigation methodology agreed between Denbighshire County Council and Natural Resources Wales. During the course of the investigation, valuable lessons have been learned regarding the steps and procedures necessary to carry out an effective investigation in accordance with the requirements of the Flood and Water Management Act. There is need for further discussion, probably nationally, regarding the criteria for investigating flood events, to ensure that the concerns of rural landowners at risk of flooding are properly considered. Steps should be taken to encourage affected residents to report flooding incidents by highlighting the importance of the information received in developing measures to reduce the risk.
- Ensure that the Denbighshire Flood Risk Management Strategy reflects the lessons learned from the November 2012 floods.

4 Summary of Recommendations

4.1 Location Specific Recommendations

St Asaph

- Short term interim measures should be considered, such as the removal of trees and vegetation to increase the capacity of the river and the localised raising of defences to address low spots.
- Longer term measures, currently under consideration by Natural Resources Wales, should be implemented to reduce the flood risk to an appropriate level.

Rhuddlan, including Sarn Lane

- Improvement works should be carried out on the River Elwy at St Asaph to prevent floodwater overtopping the defences and flowing towards Rhuddlan.
- Options should be considered to divert floodwater away from properties in the event that the defences are overtopped.

Lower Denbigh Road

- Residents should be encouraged to sign up to the Environment Agency's flood warning system and consider installing individual property protection.

Brookhouse, Denbigh

- Natural Resources Wales should continue to explore options to reduce the risk in future, including the installation of individual property protection.

Llanynys

Residents should be encouraged to sign up to the Environment Agency's flood warning service.

Gellifor

- The Council should contact the riparian landowners to explain their obligation to maintain the culverted watercourse to reduce the risk of flooding.
- Individual Property Protection should be recommended to the resident.
- Further studies of road levels and the upstream catchment should be carried out.

Park Place/Mwrog Street/Maes Ffynnon, Ruthin

- Works to reduce the risk have either been carried out, are underway or have been instructed.

Llanbedr Dyffryn Clwyd

- Denbighshire County Council should seek assurances from the Welsh Government regarding the availability of grant funding to assist the Council in carrying out an improvement scheme and should explore whether short term measures could be carried out to reduce the risk until a scheme is implemented.

Loggerheads

- Denbighshire County Council should assess whether more robust Individual Property Protection is required

Corwen

- Property owners at risk of flooding from the River Dee in the vicinity of Green lane should consider installing Individual Property Protection.
- Further studies should be carried out to establish the precise cause of flooding on the A5 near the Police, Fire and Ambulance Station.

Glyndyfrdwy

- Further studies are required to look at ways to reduce surface water runoff and to direct floodwater away from properties.
- Advice should be given to the property owners with respect to Individual Property Protection and measures to make the properties more resilient to flooding.

4.2 General Recommendations

- Establish a River Management Partnership
- Encourage property owners in areas at high risk of flooding to consider installing Individual Property Protection.
- Develop a Denbighshire County Council policy on the use and distribution of sandbags.
- Review the flood investigation methodology agreed between Denbighshire County Council and Natural Resources Wales.
- Ensure that the Denbighshire Flood Risk Management Strategy reflects the lessons learned from the November 2012 floods.