Bolton Council
Flooding Investigation Report

Flooding at Horwich and Lostock on 16th May 2021

Bolton Council Flood Risk Management Office

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This Flood Investigation Report has been produced by Bolton Council as a Lead Local Flood Authority under Section 19 of the Flood and Water Management Act 2010

Revision History

Revision Ref	Amendments	Issued to:
1.0 – Draft		Environment Agency, United Utilities
2.0	Incorporates comments by United Utilities and Environment Agency	Bolton Council
3.0	Executive Cabinet Member Approval	Publication

Copyright Acknowledgement

Executive Summary

This Flood Investigation Report has been completed by Bolton Council, the Lead Local Flood Authority (LLFA) under the duties of Section 19 of the Flood and Water Management Act (FWMA) to publish reports of flood investigations.

The aim of the investigation is to identify the community affected, to determine why the properties flooded, review responses during and post event and to recommend further action for each Risk Management Authority to consider going forward.

The rainfall that occurred over the Horwich and Lostock areas of Bolton on Sunday 16th May 2021 between 1730 and 1830 (BST) was as a result of extremely intense rainfall over a short time period due to a localised thunderstorm. The rainfall was extremely intense and is estimated to have a return period of once in 100 years.

Flooding impacted over 110 properties to varying degrees. Approximately 59 properties suffered from major flooding resulting in complete or substantial inundation of ground floor or basement areas. Of these more than 27 were commercial premises including 3 schools which caused substantial damage and temporary closures of these facilities. At Lostock Lane and Poplar Avenue the depth of the flooding was significant at around 1 metre depth in some properties. The flooding impacted many roads resulting in the closure of De Havilland Way (A6027) for several hours.

The conclusion of the investigation is that flooding was due to an intense short duration storm event across an area between Bolton and Horwich. The area where the most rain fell is largely undeveloped, and its predominant use is for agriculture. There are several small watercourses that drain the area, where these enter the urban area they become culverted in underground pipework. The inlets to the culverts received large flows of water which overwhelmed their capacity, or the large flows of water carried large amounts of debris downstream, this debris gathered at culvert inlets causing blockage to debris screens. This resulted in large overland flows of water through the urban areas that exist parallel to north east of Chorley New Road causing flooding to property. Ordinarily these overland flows entering the urban area would normally be contained within the culverted watercourses.

The report recommends general and specific actions to help reduce or mitigate the impact of future flooding within the area for each Risk Management Authority to consider. The delivery of these actions will be dependent on the authorities securing funding and other internal priorities. In addition, the authorities will continue to work together with the community affected to identify all potential options to reduce flood risk.

Flooding to properties in the Sudbury Drive / Ashridge Close area has occurred previously. The Environment Agency are currently developing an Outline Business Case for the area, if the Business Case indicates a scheme can be built, it will progress with a project to improve flood resilience and reduce flood risk.

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1. Introduction

1.1 Lead Local Flood Authority Investigation

Bolton Council as the Lead Local Flood Authority (LLFA) has a responsibility to investigate flood incidents and publish the results of its investigation as detailed within Section 19 of the Flood and Water Management Act 2010 (FWMA):

1.2 Section 19 Requirements

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 report provides a concise review of the duties and responsibilities of all risk management authorities involved, and an outline of their past or proposed actions, if any. It also makes recommendations.

Bolton Council as the Lead Local Flood Authority (LLFA) has a policy to carry out investigations into flooding incidents and publish the results when 5 or more properties in the same location are flooded.

The LLFA will:

- Identify and explain the likely cause/s of flooding.
- Identify which authorities, communities and individuals have relevant flood risk management powers and responsibilities.
- Review the actions a Risk Management Authority undertook.
- Provide recommendations for each of those authorities, communities and individuals.
- Outline whether those authorities, communities or individuals have or will exercise their powers or responsibilities in response to the flooding incident.

The LLFA:

- Are not responsible for resolving the flooding issues or providing designed solutions.
- Cannot direct a Risk Management Authority to undertake any of the recommended actions.

1.3 Risk Management Authorities

Risk Management Authorities (RMA's) have specified responsibilities, duties and powers related to local flood risk management. Within the Bolton Council area the relevant RMA's are indicated in the table below

Flooding Type	**Description**	**Party Responsible for Managing the Risk**
Surface Water Flooding	Flooding from intense downpours of rain that result in large volumes of run-off from land or when drainage systems cannot cope with the amount of rainfall.	Bolton Council
Groundwater Flooding	Occurs when the ground water-table rises causing flooding.	Bolton Council
Highway Flooding	Occurs when the highway drainage system or the sewers they discharge to cannot cope with the amount of rainfall entering the system, or when gully's become blocked.	Bolton Council (as Local Highway Authority), United Utilities, and Highways England (on Motorways)
Ordinary Watercourses	Flooding from intense downpours of rain that result in large volumes of run-off from land causes streams and culverts not marked on the main river map to overflow.	Bolton Council
Main River	Flooding from rivers or streams on the main river map	Environment Agency
Reservoirs	Flooding from reservoirs falling under the provisions of the Reservoirs Act	Environment Agency
Sewer Flooding	Occurs when the amount of water entering the sewer system exceeds its design capacity or when the system becomes blocked.	United Utilities
Canal and Inland Waterway Flooding	Flooding from assets operated by Inland Navigation Authorities	Relevant Inland Navigation Authority (eg Canal and Rivers Trust)

Bolton Council as the Lead Local Flood Authority

The LLFA leads in managing local flood risks (that is, risks of flooding from surface water, ground water and ordinary (smaller) watercourses). This includes ensuring co-operation between the Risk Management Authorities in their area. Under the Flood and Water Management Act 2010, LLFAs are required to:

- prepare and maintain a strategy for local flood risk management in their areas, coordinating views and activity with other local bodies and communities through public consultation and scrutiny, and delivery planning.
- carry out works to manage local flood risks in their areas (a discretionary power)
- maintain a register of assets – these are physical features that have a significant effect on flooding in their area.

- investigate significant local flooding incidents and publish the results of such investigations.
- have powers under the Land Drainage Act 1991 to regulate ordinary watercourses to maintain a proper flow by:
    - issuing consents for altering, removing or replacing certain structures or features on ordinary watercourses; and
    - enforcing obligations on riparian owners to maintain flow in a watercourse and repair watercourses, bridges and other structures in a watercourse.
- undertake a statutory consultee role providing technical advice on surface water drainage to local planning authorities during major developments (10 dwellings or more)
- co-operate with other Risk Management Authorities

Bolton Council also play a lead role in emergency planning and recovery after a flood event. Local authorities are ‘category one responders' under the Civil Contingencies Act and must have plans to respond to emergencies, and control or reduce the impact of an emergency.

Bolton Council are also a highway authority and have duty to maintain the local road network which include a responsibility to drain the highway.

Environment Agency

The Environment Agency has a strategic overview of all sources of flooding and coastal erosion (as defined in the Flood and Water Management Act 2010). It is also responsible for flood and coastal erosion risk management activities on main rivers and the coast, regulating reservoir safety, and working in partnership with the Met Office to provide flood forecasts and warnings.

The Environment Agency's work includes:

- Developing long-term approaches to Flood Risk Management. This includes developing and applying the national flood and coastal erosion risk management strategy.
- Allocation of national Government funding to projects to manage flood and coastal erosion risks from all sources.
- Delivering projects to manage flood risks from main rivers and the sea.
- Working with others to prepare and deliver Flood Risk Management Plans (FRMPs). FRMPs explain the risk of flooding from rivers, the sea, surface water, groundwater and reservoirs, and set out how the Environment Agency, Lead Local Flood Authorities (LLFAs) and other Risk Management Authorities work with communities to manage those risks.

- Providing evidence and advice to support others. This includes national flood and coastal erosion risk information, data and tools to help other Risk Management Authorities and inform Government policy.
- Being a Statutory Consultee on Planning applications.
- Granting permits to undertake works on main river.

United Utilities as a water and sewerage company

United Utilities is a RMA and plays a major role in managing flood and coastal erosion risks. They manage the risk of flooding to water supply and sewerage facilities and flood risks from the failure of their infrastructure.

The main roles of United Utilities in managing flood and coastal erosion risks are to:

- make sure their systems have the appropriate level of resilience to flooding, and maintain essential services during emergencies.
- maintain and manage their networks to control the impact and reduce the risk of flooding and pollution to the environment. They have a duty under Section 94 Water Industry Act 1991 to ensure that the area they serve is “effectually drained”.
- provide advice to LLFAs on how water and sewerage company assets impact on local flood risk.
- work creatively with partners “upstream” as a means of effectively draining their area and delivering multiple benefits where possible
- work with the Environment Agency and LLFAs to coordinate the management of water supply and sewerage systems with other flood risk management work.

Where there is frequent and severe sewer flooding, sewerage undertakers are required to address this through their capital investment plans, which are approved and regulated by Ofwat.

2. Scope of the report

This Flood Investigation Report is:

- an investigation into the flooding that took place on Sunday 16th May 2021.
- 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.
- provide a complete description of what happens next.

The Flood Investigation Report outlines recommendations and actions that various organisations and authorities can do to minimise flood risk in the affected areas. Once agreed, the report 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.

3. Event Overview

Overview

During the late afternoon of Sunday 16th May 2021, an area on the eastern side of Horwich and the western side of Lostock was heavily impacted by a thunderstorm. This affected properties over a relatively small area and resulted in significant flash flooding, traffic disruption and many reports of internal and external property flooding.

Type	Number
Major Internal (Residential)	33
Major Internal (Commercial)	27
Minor Internal (Residential)	36
Integral Garage	9
Outbuildings and External Garages	11
Major Highway (A Class Road)	2

Source: Contains Bolton Council, Environment Agency and United Utilities data.

A total of 105 properties had some internal flooding. However, it is recognised that there is likely to be some level of under reporting where incidents were not reported to an RMA.

The number of commercial properties that received major internal flooding in the above table include 3 schools; St Mary's RC Primary School, Chorley New Road Primary Academy, and St Joseph's RC Secondary School.

Chorley New Road was flooded to around 0.4 m deep in places preventing vehicle passage. De Havilland Way at its junction with Mansell Way was flooded to around 0.75 metres deep preventing vehicle passage and resulting in its north bound closure for 24 hours due to deposits of debris.

3.1 Flood Locations

The geographic extent of this report is for the two locations below.

3.1.1 Horwich and Lostock

The main area of flooding is approximately 4 square kilometres in size. The location of properties impacted by the flooding is shown on the plan below.

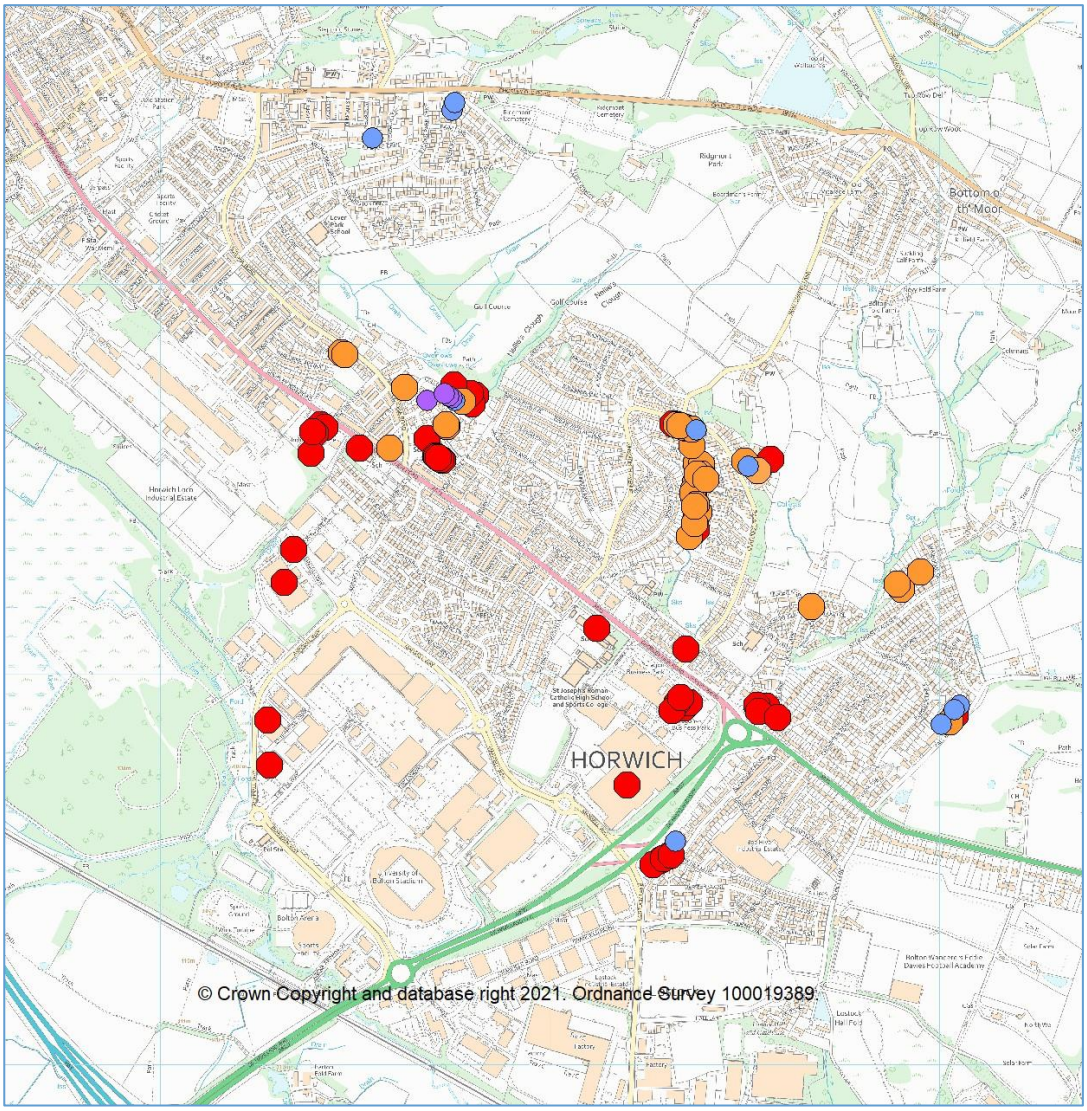
Map Key

● Red dots indicate major flooding to internal areas (*a major flood is complete inundation to the whole of the ground floor*)

● Amber dots indicate minor flooding to internal areas.

● Integral Garage ● External Garage or Outbuilding

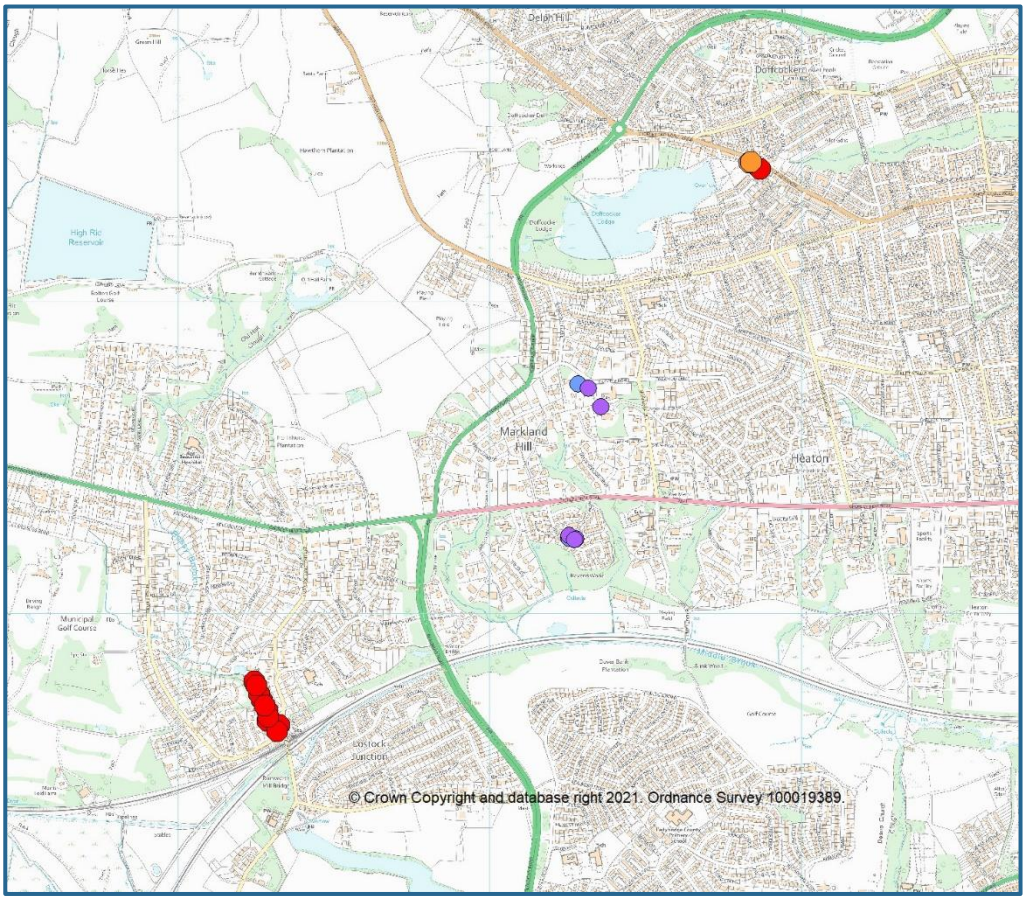
Figure 1: Location of Properties impacted by flooding.



3.1.2 Lostock, Markland Hill and Doffcocker

Areas further east were also impacted in the Lostock, Markland Hill and Doffcocker areas. The locations are shown on the plan below.

Figure 2: Location of properties impacted by flooding.



3.2 Area Characteristics - Topography

The topography of the area is dominated by Winter Hill and Smithills Moor to the north and east of Horwich, much of the catchment is moderately steep hillside which drains southwest wards to the Middlebrook watercourse. The region between Horwich and Bolton along the Chorley New Road corridor is generally flat but soon steepens as you leave Chorley New Road and head northwards.

Rain falling on these slopes runs off quickly, before entering small watercourses that head towards and through the urban corridor along Chorley New Road; it is these characteristics that make the area prone to flash flooding events.

3.3 Area Characteristics - Soils

Most of the area is characterised by shallow clayey soil overlying sandstone and mudstone. The result of having only shallow underlying strata for rainfall to drain into results in the area typically having wet poorly drained soils that are prone to waterlogging during periods of prolonged rainfall. During periods when the soils are saturated any additional rain falling on the soil will run off very quickly.

4. Flooding History and Flood Risk Maps

4.1 Previous Flooding Incidents

Horwich and Lostock along Chorley New Road

There is a previous newspaper record of flash flooding in the area that resulted in flooding to properties from 1964. It states that 50 mm of rain fell locally during a Saturday morning. This is a similar amount of rain that fell on the16th May 2021.

The Horwich and Westhoughton Journal of Friday 24th July 1964 reported the following:

- a flood more than 18 inches deep between the Claypool Road and the Bee Hive Hotel, waterfalls over Moorgate Quarry,
- flooding a foot deep in Nuttall Avenue.
- The Fire Brigade answering calls to Higher Austins Lane, Lee Lane, Chorley New Road, Dale Street and Bolton Fold Farm.
- The Fire Brigade attending highway flooding at Chorley New Road, Mill Lane, Winter Hey Lane and Alexandra Road.

Mansell Way

There are records of repeated flooding incidents to commercial premises on Mansell Way since this area was developed in the 1990's.

Boxing Day 2015

Storm Eva occurred on 26th December 2015 and caused widespread flooding across the north west. This storm released a large rainfall total but over many hours, most of the flooding caused by the storm were a result of river flooding. In the Horwich and Lostock areas this storm resulted in flooding to the old site of Chorley New Road Primary School, to residential properties at Bessy Brook near Lostock Station and to commercial properties around Pearl Brook in Horwich town centre.

A Greater Manchester wide Section 19 Report for this event is available of the Bolton Council website at:

https://www.bolton.gov.uk/flooding-drainage/flooding-drainage-1

Relevant actions from the 2015 report are listed below.

Flood Risk Management Authority / Body	**Suggested Actions**
Greater Manchester RMAs	Risk Management Authorities will continue to meet at a Greater Manchester level. Flood Recovery will form an important part of these discussions and how organisations work together. This partnership working will guide and help to co-ordinate resources which will seek to enhance preparedness, mitigate flood risk and inform incident management. Engagement with affected communities is a key part of understanding the issues and developing and choosing appropriate options.
LLFA	Identify blocked and / or collapsed ordinary watercourse culverts as a result of the flooding that pose significant flood risks or land drainage problems. Continue resolution of flooding issues that relate to private landowners.
EA	Consultants have been engaged since Boxing Day to investigate possible improvements to the design of the Bessy Brook debris screen. The Environment Agency will apply its 'Communities at Risk' approach in developing any future proposals to mitigate flood risk. Communities at Risk uses a risk based approach to identify hotspots of flood risk. It allows risk to be identified across whole catchments and assessment of all potential options, including natural flood management, engineered solutions and community resilience. The Environment Agency plans to share this programme with LLFAs in the coming months so that RMAs can work together to identify additional opportunities for funding. This will ensure that places most at risk (higher number of properties, or more frequent flooding, or combinations of these) anywhere in Greater Manchester and beyond are considered as the higher priorities.

4.2 Flash Flooding and Surface Water Flood Risk Maps

What is flash flooding?

Flash floods occur extremely quickly - much faster than other forms of flooding - and with massive force. They can move rocks, tear out trees, sweep away vehicles and destroy buildings and bridges. They tend to happen when heavy rainfall runs off land and quickly swells rivers and streams. Water can also build up quickly in urban areas when rainfall is unable to drain away.

How to recognise a flash flood

Flash flooding is characterised by:

- heavy rainfall
- a short time between the rainfall and flooding
- large amounts of fast flowing water
- damage to buildings and structures
- dangers presented by debris
- there is a threat to life.

Unlike flooding from rivers, flash (or surface water) flooding can happen many miles from a river, often in places that people wouldn't expect because it is a long way from a river or stream – it happens simply because there is nowhere else for the rainwater to go.

In urban area it happens when rainwater does not drain away through the normal drainage systems as these are quickly overwhelmed by the amount of water, and there is often little time or opportunity for the water to soak into the ground, so it flows overland instead.

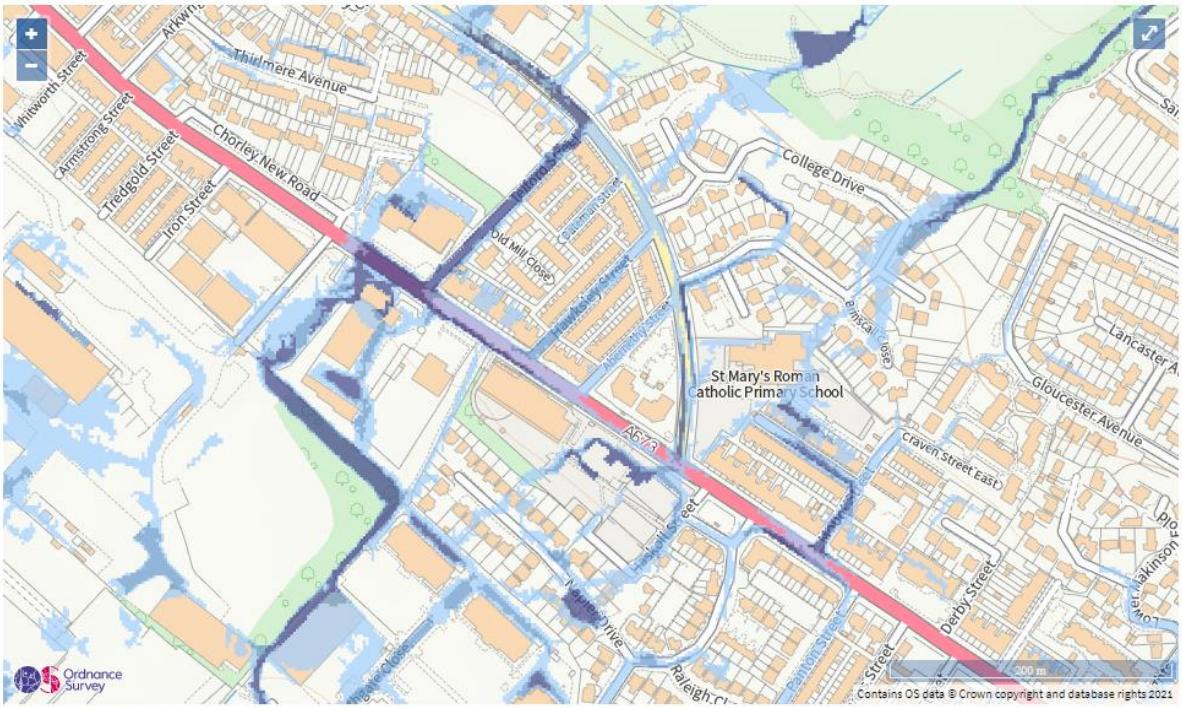
Maps showing the risk of flooding from surface water have been produced by the Environment Agency on behalf of government, using information and input from lead local flood authorities. To create the map the latest improvements in data, technology and modelling have been used.

The government has made available maps showing long term flood risk at properties. These maps are available to the public and can be viewed at: https://flood-warning-information.service.gov.uk/long-term-flood-risk

There are a number of different maps available showing the flood risk from rivers, surface water run-off and from reservoirs.

The following plans reproduced from the government website show the areas at risk of flooding from surface water; the areas shaded light blue and dark blue. The areas correlate with those areas that experienced flooding.

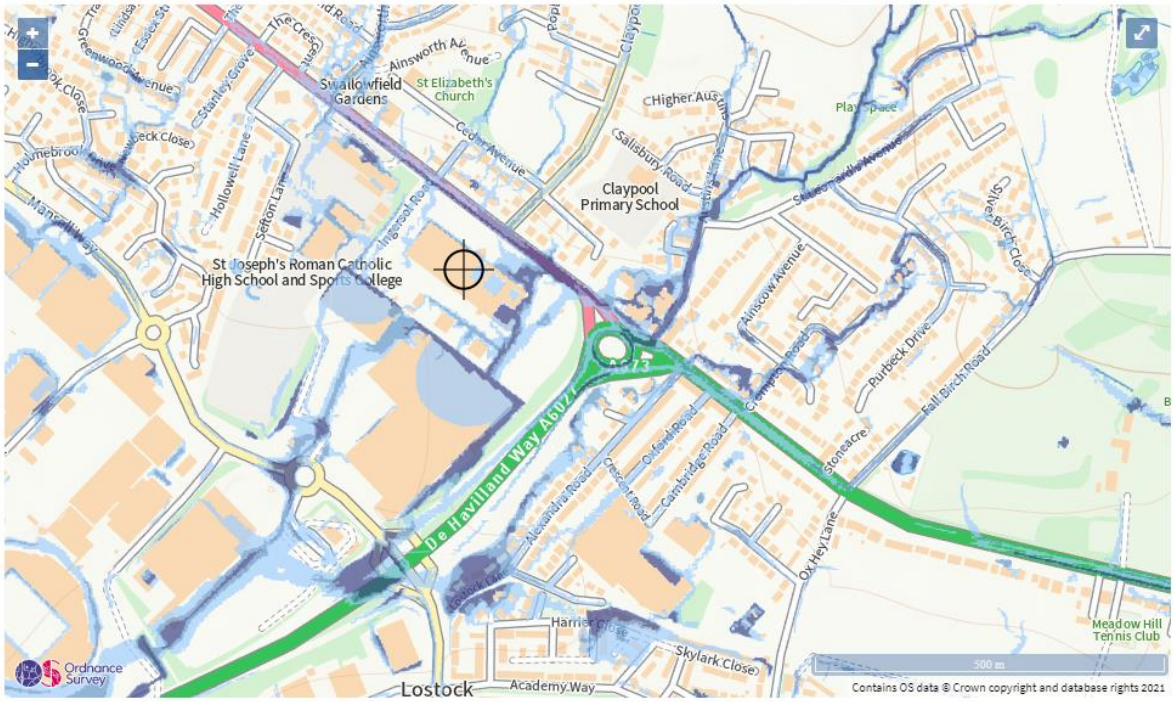
Figure 3: Plan showing the risk of surface water flooding in the Victoria Road / Chorley New Road area.



Extent of flooding from surface water

High Medium Low Very low Location you selected

Figure 4: Plan showing the risk of surface water flooding in the Chorley New Road / Austins Lane / Beehive/ De Havilland Way Area.



Extent of flooding from surface water

High Medium Low Very low Location you selected

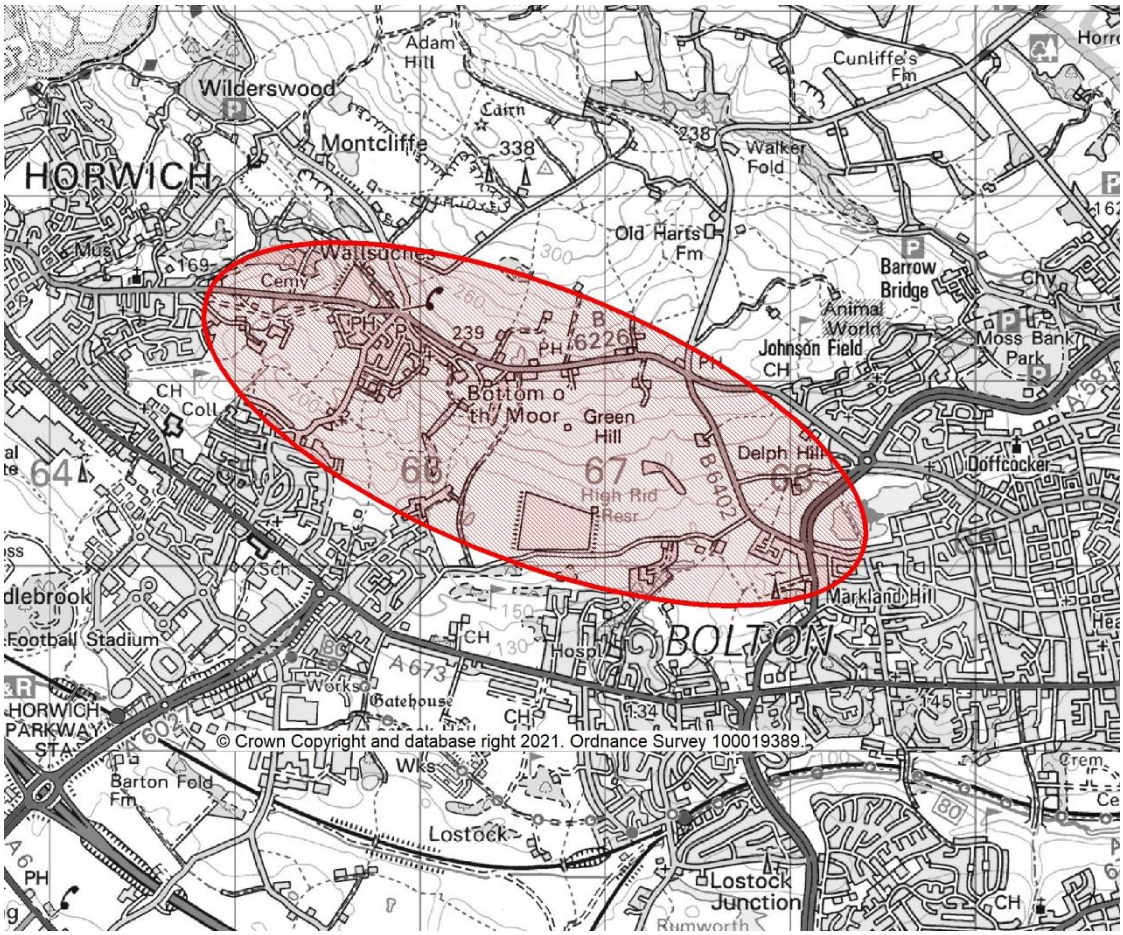
5. Rainfall Data

5.1 Rainfall Analysis and Discussion

On Sunday 16th May 2021 the UK was under an area of low pressure, it was forecasted that the weather may produce in areas torrential rain, thunderstorms and flash flooding. During the afternoon several thunderstorms built up over the north west. One of these storms is recorded as creating lightning activity in the Horwich and Lostock area of Bolton between 1730 and 1745 (BST). Extremely intense rainfall and hailstone was seen in the area.

From observation of flood damage, debris fields, photograph and video evidence taken by the public, it is assessed that the approximate area that received the most intense rainfall is shown shaded red on the plan below.

Figure 5: Location of intense rainfall.



5.2 Rainfall Data

In order to understand the significance of the rainfall event on 16th May 2021 detailed records of the rainfall over the Bolton area have been obtained/inspected from the EA and other sources.

Rainfall radar data indicates that over 60 mm of rainfall fell within 4 hours over Horwich. The highest hourly rainfall intensity was 37 mm. The average monthly rainfall for the whole month of May is around 70mm. Most of this rainfall was limited to a 1 hour period and some witnesses state the rainfall occurred over only a 30 minute period. The general weather forecast for the day was cool with heavy and thundery showers. It was predicted that downpours will result from cumulonimbus formations developing over the country as a result of daytime heating.

Rainfall events are often described in terms of being the largest in a given period of time. So, a 1 in 5 year event is the largest rainfall event to occur on average every 5 years, that is, it occurs on average only once in every 5 years.

For the area of Horwich, 38 mm of rainfall falling in 60 minutes equates to the largest rainfall event to occur only once in 100 years.

In a thunderstorm rainfall is often very localised with some areas even short distances away experiencing very different rainfall intensities. So not every area of Horwich and Lostock will have received the same rainfall. This is illustrated by the rain gauge data below. There are three rain gauges nearby at Rivington, Sweetloves Reservoir, and at Ringley; at all three sites only modest rain fall was recorded.

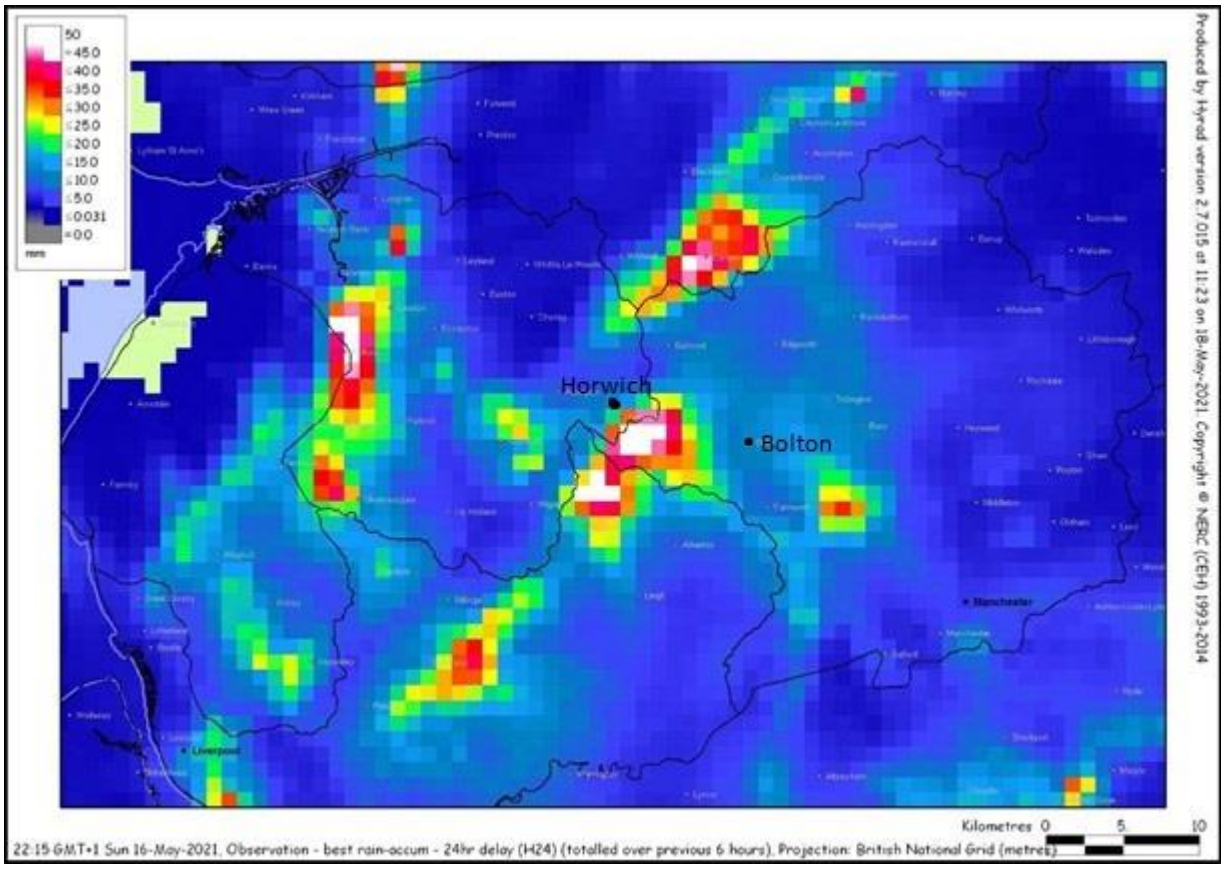
	Rivington	Sweetloves	Ringley	Radar Data
Easting	363113	370953	376722	365748
Northing	421218	412620	404896	410497
Rain for the period 15:00-18:00 16/05/2021, mm	11.14	5.2	13.4	56.19

A rainfall radar map has been provided by the Environment Agency which is shown below, this shows rainfall totals over a 6 hour period. An estimate of the local rainfall can be made from this data with reference to the amount of rain known to have fallen at the rainfall gauge locations.

The map indicates the cumulative rainfall which is shown as a graduated increasing scale from blue to yellow to red and then white. Blue is low rainfall areas, red higher rainfall

and white the highest cumulative total. The map shows a white area to the south-east of Horwich town centre receiving over 50mm of rain in a 6 hour period.

Figure 6: Rainfall Radar cumulative rainfall total previous 6 hours



Source: Environment Agency

5.3 Preceding Hydrological Conditions

The National Hydrological Monitoring Programme (NHMP) produces the monthly Hydrological Summary of the UK. This regular report describes the hydrological conditions during the preceding month, using the data holdings of the National River Flow Archive and National Groundwater Level Archive. Focusing on rainfall, river flows, groundwater levels and reservoir stocks, it places the events of each month, and the conditions at the end of the month in a historical context.

Monthly Hydrological Summary for the UK – April to May 2021[1]

April was an exceptionally dry, sunny and cool month, an unusual combination of low rainfall and temperatures for the time of year. Rainfall in the north west was 18 % of the long term average for the time of year. Soil moisture deficits (SMDs) increased across the UK in April and soils were substantially drier than average for the time of year.

[1] https://nrfa.ceh.ac.uk/monthly-hydrological-summary-uk

However, substantial rainfall over the first fortnight of May provided respite from the sustained dry weather of spring. Across most of the UK, by mid-May average monthly rainfall had already been recorded (and substantially exceeded in the north and west).

This would have led to the ground being saturated in the days leading up to the 16th May.

5.4 Flood Warning Information issued prior to the event

There were no flood warnings issued for this rainfall. Flash floods can happen very quickly and there is often no time to issue flood warnings in advance. Even when warnings are possible, there may be little time to act.

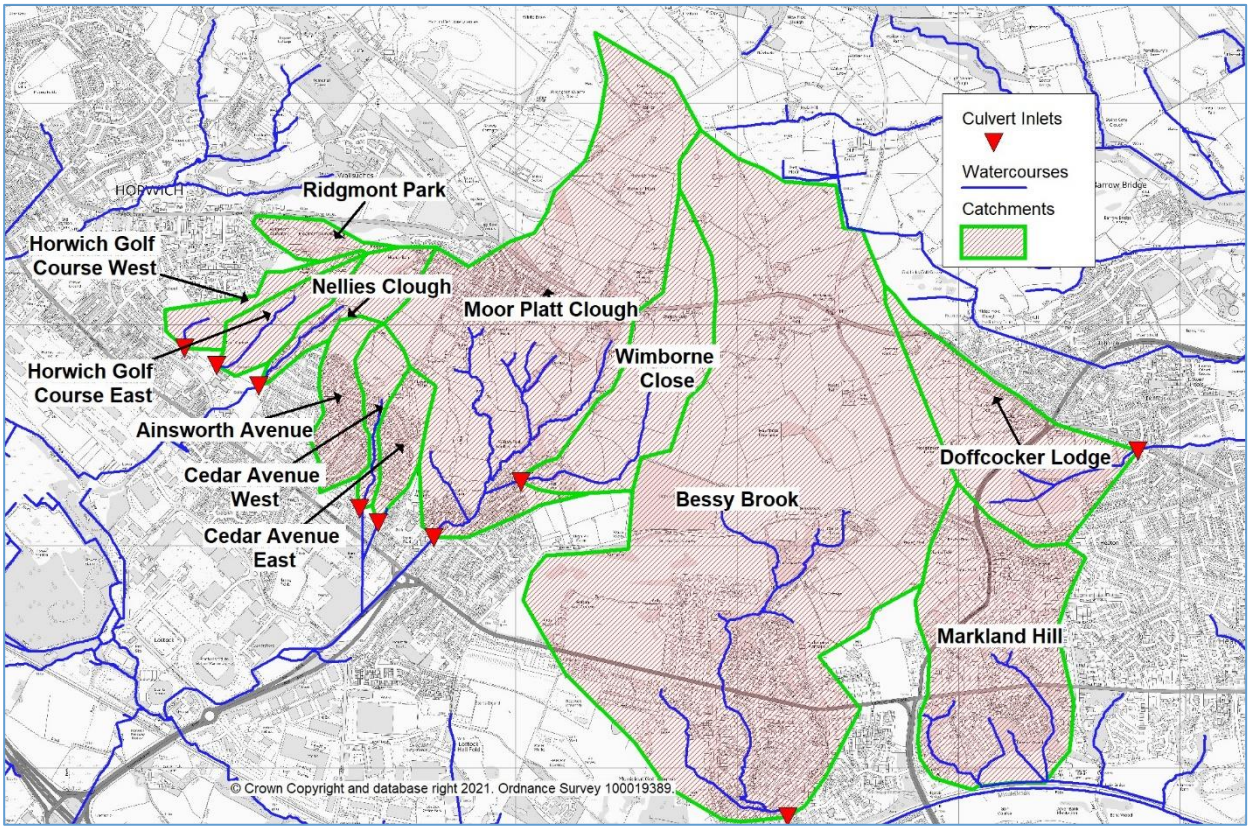
Warnings are generally given on river catchments where real time data from river levels are observed and used to predict flooding before it happens. In this case, the flooding was caused by a sudden downpour from a thunderstorm, which by their nature act in an unpredictable way and therefore it is difficult to forecast where they will occur. Currently, weather forecasting is unable to predict such events with any accuracy. But it was stated in forecasts on the day that such events were likely to occur.

6. Investigation of Flooding by Area

Following the incident site visits were made by the LLFA to examine the routing and cause of flooding. Many members of the public provided photographic evidence and testimony of their experiences. This provided evidence and insight into how the storm impacted the community.

The affected area is drained by numerous small watercourses the catchment areas of these watercourses, the line of the watercourse and the inlets to culverts under the urban areas are shown on the plan below.

Figure 7: Map of Horwich and Lostock showing local watercourses and their catchments.

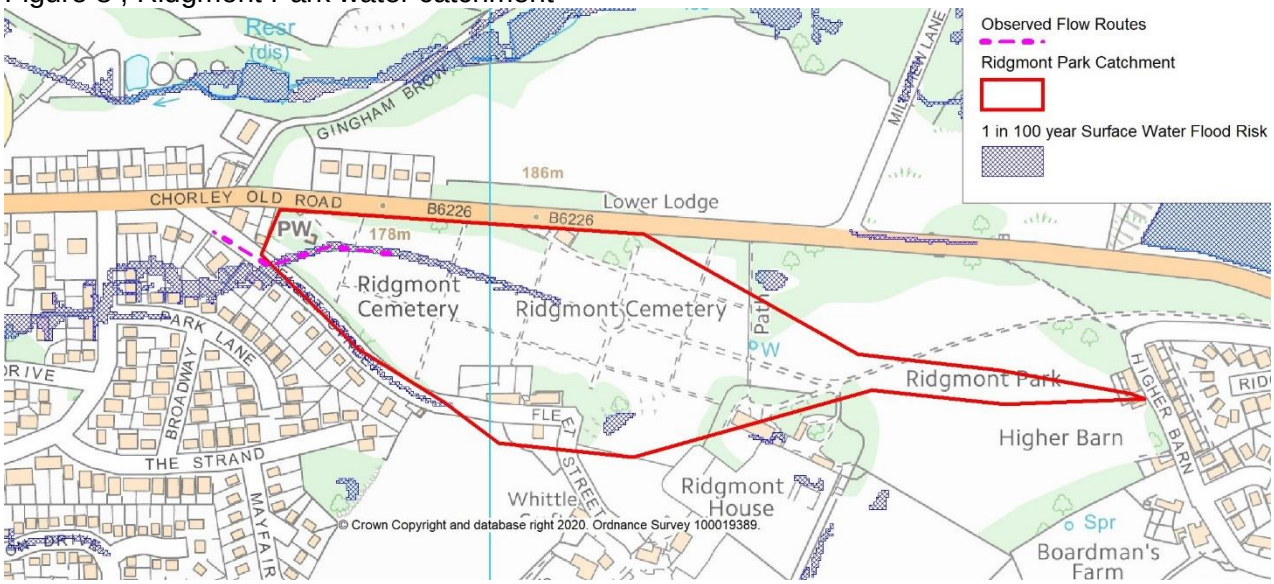


At seven of the nine culvert inlets shown on the map above the large amount to water flow in the watercourses upon reaching the downstream culvert entrance overwhelmed the capacity of the culvert or the initial deluge carried debris downstream which caused debris screens to block leading to flow bypassing the drainage system and continuing to flow overland through property and highways resulting in flooding within the urban area.

Each of the ten catchments is examined in more detail below.

6.1 Ridgmont Park Catchment

Figure 8 ; Ridgmont Park water catchment



The catchment shown outlined in red on the plan above is approximately 7 hectares. The catchment is principally occupied by Ridgmont cemetery so is largely a greenfield area.

There is no watercourse present to which surface water can drain to, nor is there a large drainage system present into which the site could effectively be drained. There is a limited drainage present on the access road within cemetery which drains to a sewer in Fleet Street.

It is estimated that the run-off rate from Ridgmont Cemetery on to Fleets Street during a 1 in 30 year event is 141 l/s and during a 1 in 100 year event 173 l/s.

The modelled data shown on the plan above agrees with the path of overland flow that was observed except there was also a significant flow along Fleet Street and on to Chorley Old Road.

6.1.1 Flooding impacts

Downstream impacts of the overland flow running from this area resulted in internal flooding to:

2 external garages
1 Integral garage within a building and
1 outbuilding

There was a sewer surcharge on Medway Drive that resulted in flooding to an external garage which was attributed to a sewer blockage.

6.1.2 Recommendations

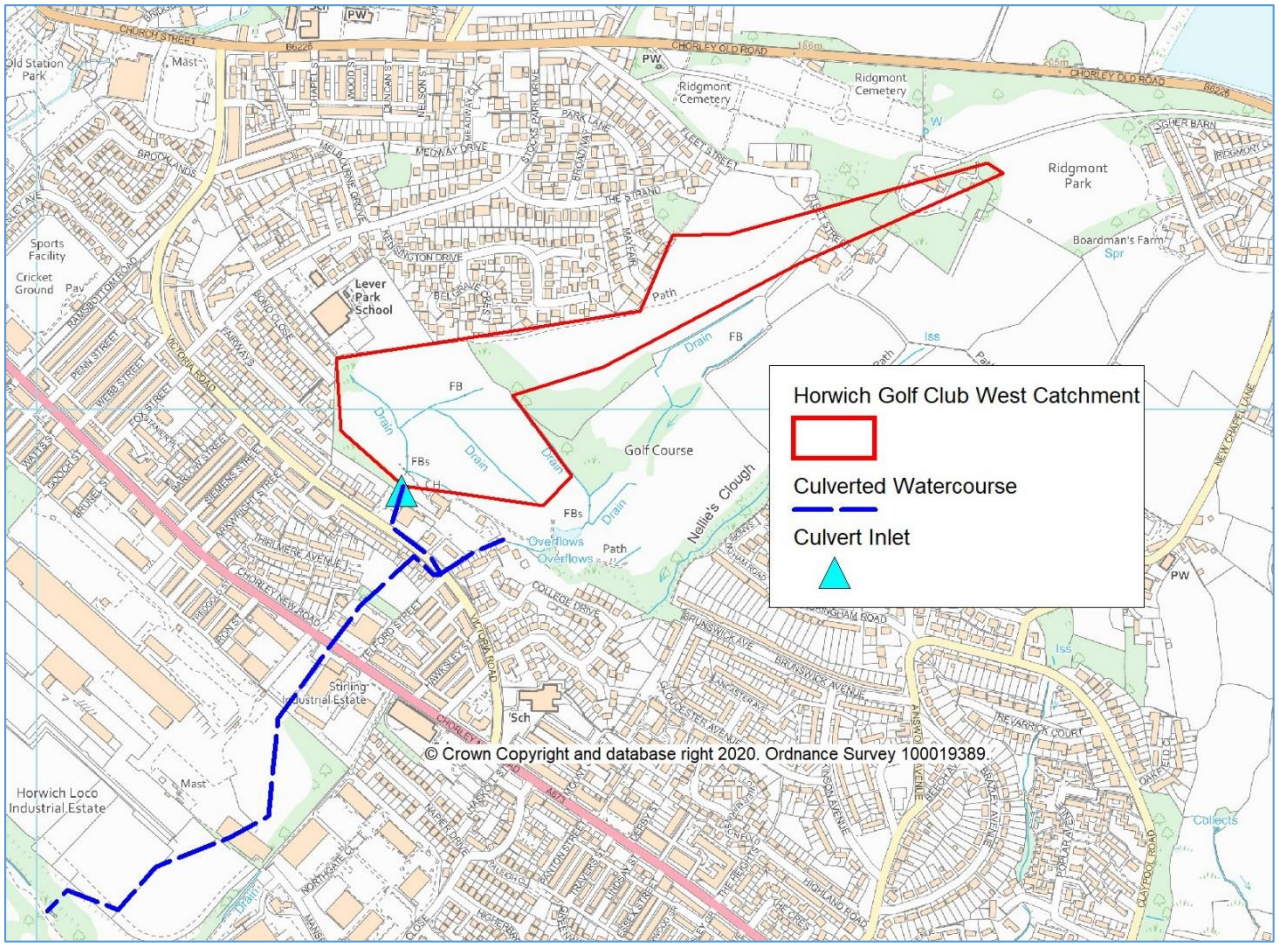
It would be beneficial for the Highway Authority to consider more frequent routine gully cleaning on Fleet Street.

6.2 Horwich Golf Course West

6.2.1 The catchment

The catchment shown outlined in red on the plan below is approximately 10 hectares, the area is drained by a culverted watercourse shown as a blue dashed line. The catchment is predominantly part of the Horwich Golf Course and is undeveloped greenfield land.

Figure 9: Map of the location of the Horwich Golf Course western catchment, culvert inlet and route of the downstream culvert.



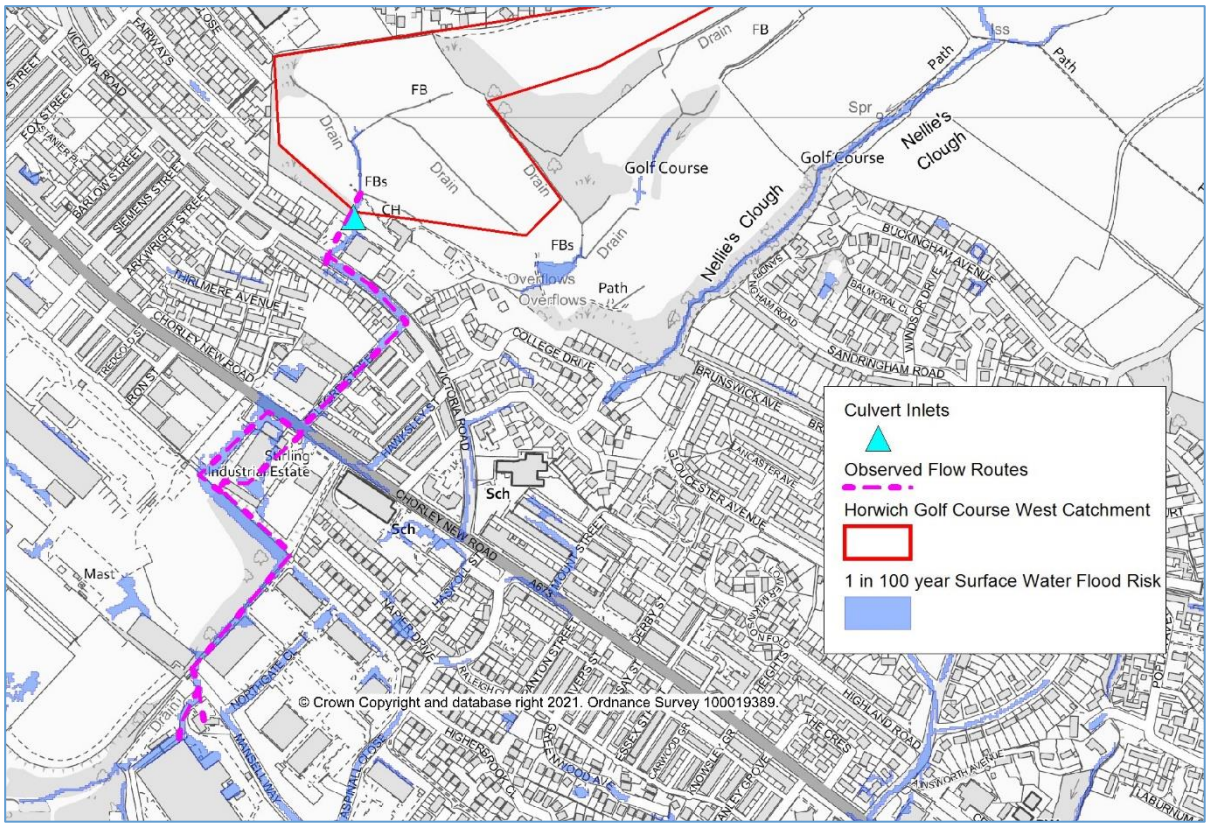
This catchment drains to a privately owned culvert inlet at the rear of St John's Church on Victoria Road. It is then carried in a culvert in a south-west direction passing under private property, then under Chorley New Road, and the Horwich Loco Works site before connecting to the Nellies Clough watercourse within the Loco Works site.

It is estimated that the rate of run off of water for this catchment during a 1 in 30 year storm is 192 l/s and for a 1 in 100 year storm 235 l/s.

6.2.2 Overland flow routes

The plan below shows the predicted surface water flooding map and the route of observed overland flows.

Figure 10: Map of the Horwich Golf Course western catchment, the predicted surface water flood extent for a 1 in 100 year event and the observed overland flow route.



6.2.3 Flooding impacts

During the event significant flows were observed issuing from the Golf Course site on to Victoria Road through the St Johns Church site, it is clear the capacity of the culvert had been overwhelmed. This resulted in overland flow down Telford Street causing significant highway damage. This flow then pooled on the much flatter land at Chorley New Road.

Downstream impacts of the overland flow running from this area contributed to internal flooding to:

12 Commercial premises (including 1 school building)
3 Residential properties

6.2.4 Observations and Post Event Actions

The culvert inlet at the rear of St Johns Church on Horwich Golf Course was overwhelmed by water and debris. The debris in the form of soil and silt led to the blinding of the culvert inlet resulting in increased overland flow. An inspection of the culvert inlet after the event showed that the condition and design of the inlet is poor.

The LLFA has met with the Golf Club and the site landowners who have agree to undertake work to improve the condition of inlet structure.

After the event a CCTV survey of the downstream culvert by the LLFA showed that a section of the culvert near Victoria Road had a partial blockage due to tree root ingress. The tree roots were removed, and the culvert is now fully operational.

6.2.5 Recommendations

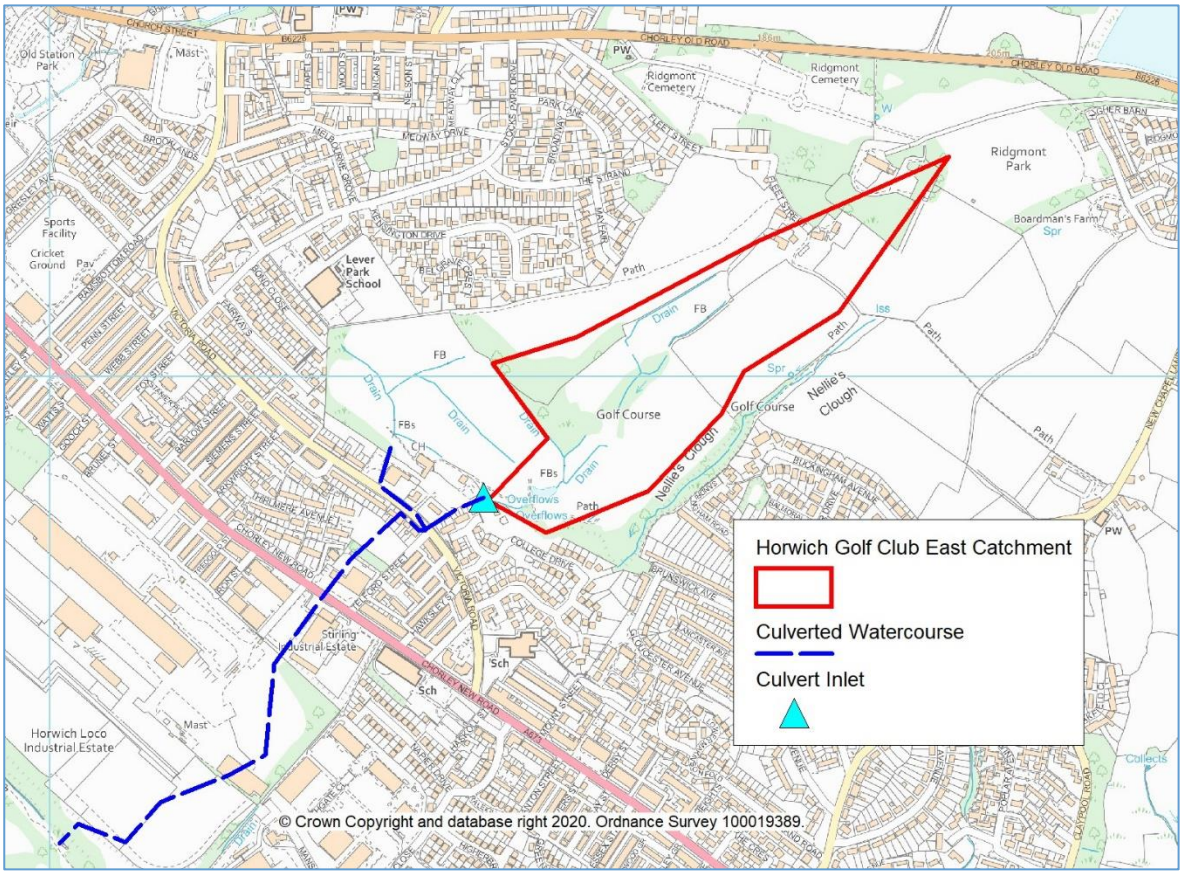
The LLFA work with landowners to ensure that culverted watercourses and culvert inlets are adequately performing.

6.3 Horwich Golf Course East

6.3.1 The catchment

The catchment shown outlined in red on the plan below is approximately 12 hectares, the area is drained by a culverted watercourse shown as a blue dashed line. The catchment is predominantly part of the Horwich Golf Course and is undeveloped greenfield land.

Figure 11: Map of the location of the Horwich Golf Course eastern catchment, culvert inlet and route of the downstream culvert.



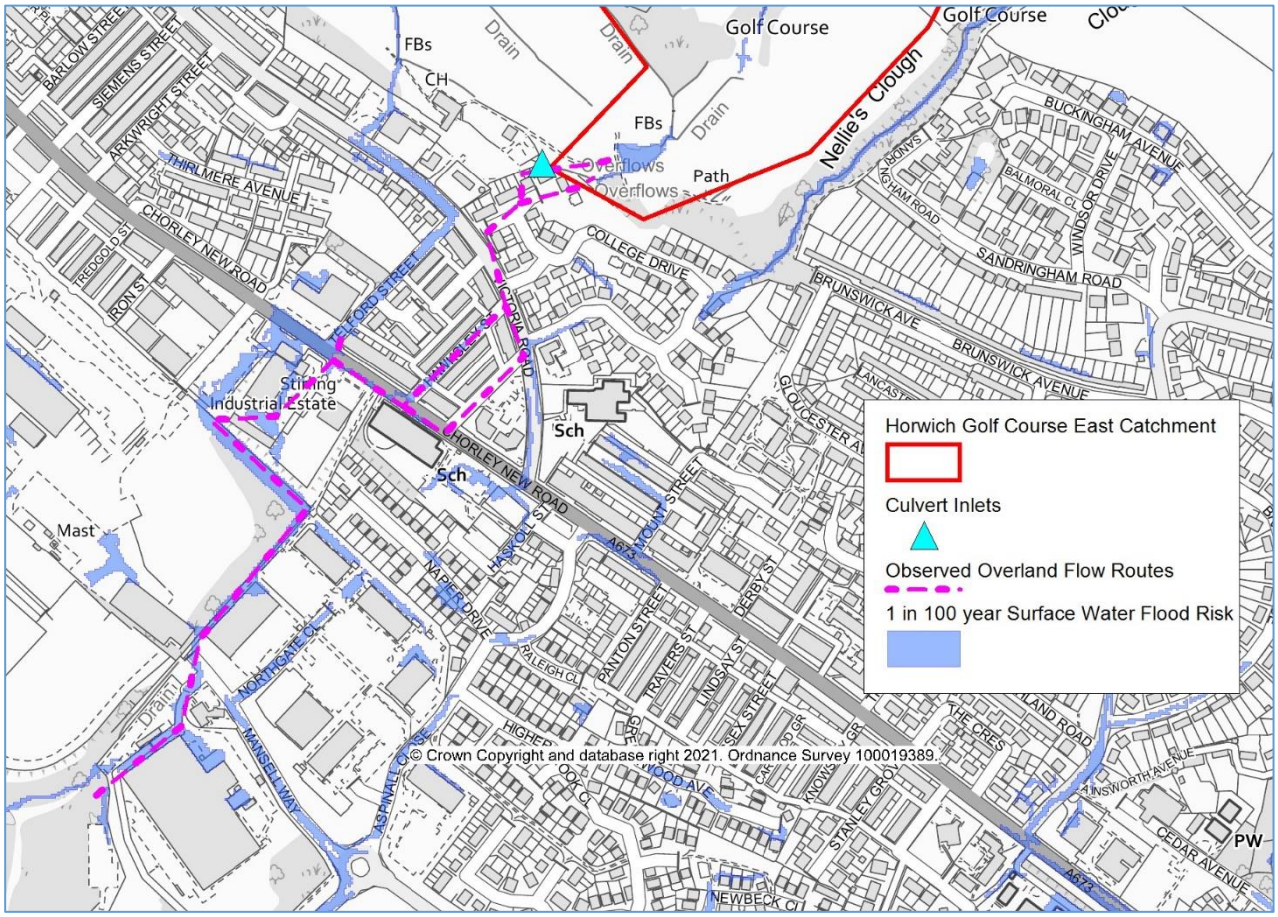
This catchment drains to a privately owned culvert inlet at the rear of Middlewich Close. It is then carried in a culvert in a south-west direction passing under private property, merges with the flow from the Horwich Golf Course western catchment, then under Chorley New Road, and the Horwich Loco Works site before connecting to the Nellies Clough watercourse within the Loco Works site.

It is estimated that the rate of run off of water for this catchment during a 1 in 30 year storm is 248 l/s and for a 1 in 100 year storm 304 l/s.

6.3.2 Overland flow routes

The plan below shows the predicted surface water flooding map and the route of observed overland flows.

Figure 12: Map of the Horwich Golf Course eastern catchment, the predicted surface water flood extent for a 1 in 100 year event and the observed overland flow route.



6.3.3 Flooding impacts

During the rainfall event significant water flows were observed issuing from the Golf Course site on to the rear of properties on Middlewich Close through the College Drive development site, and onto Victoria Road. This resulted in overland flow down Abernethey Street causing highway damage. This flow then pooled on the much flatter land at Chorley New Road where it merged with other flows resulting in property flooding.

Downstream impacts of the overland flow running from this area contributed to internal flooding to:

12 Commercial Premises includes 1 school building
3 Residential Properties

6.3.4 Observations and Post Event Actions

The development of Rivington Grange (College Drive and Middlewich Close) was in progress during the rainfall event. In order to construct a retaining wall at the rear of property a temporary piped drain was installed over a section of land where previously an open channel existed. This had the effect of preventing overland flow entering the culvert, resulting in flow past the pipework and into the development site rather than down the open channel and into the culvert.

The developer had not obtained Land Drainage consent as required by the Land Drainage Act for alterations to the open culvert prior to or during the construction phase of the development. Had the developer applied for Land Drainage Consent the temporary works solution adopted by the developer in its form at the time of the event would not be approved as the relatively small pipe also inhibits the flow of water from upstream.

The consequence of replacing the open channel with an enclosed pipe meant that there was no means of interception overland flow from the Golf Course and directing this into the downstream culvert. This resulted in overland flow from the higher golf course land into the Rivington Grange Estate at Middlewich Close. This caused extensive external flooding to gardens and some internal flooding to newly built property. The flow of water continued overland running along Victoria Road, Abernethey Street and on to Chorley New Road.

The developer has now made changes to the watercourse; removing the piped section and replaced with an open channel, so the risk of overland flow causing flood has been reduced.

6.3.5 Flooding to Chorley New Road Primary Academy

Flooding to the ground floor of the school was extensive and caused considerable damage. A significant component of the source of the flooding was backflow from a combined sewer in Chorley New Road into the school via toilets.

The combined sewer in Chorley New Road accepts foul water as well as rainwater from rooves and roads, nowadays sewers are designed to have separate foul and surface water systems. The sewer is likely to have been constructed in the early 1900’s when this practice was commonplace. The sewer has a limited capacity and when this is exceeded by intense rainfall the water level in the sewer rises. In this case, it rose to a height where backflow through the connection from the school occurred causing flooding to the school. The school was constructed in 2019/20 but unfortunately no anti-flood valve was fitted to the foul drainage connection between the school and the main sewer. United Utilities undertook a CCTV survey of the sewer which showed no restrictions in the network.

In addition, overland flow converged on the road outside the school. This may have caused some water to enter the school via doorways and is likely to have contributed to the flooding though most of the overland flow appears to have been kept within the kerbing to the road.

6.3.5 Recommendations

The owners of Chorley New Road Primary Academy should ensure the risk of sewer flooding from the foul sewer connection is reduced by the installation of an anti-flood valve.

The Highway Authority may consider examining the highway drainage capacity on the road outside the school and consider improvements to increase its capacity.

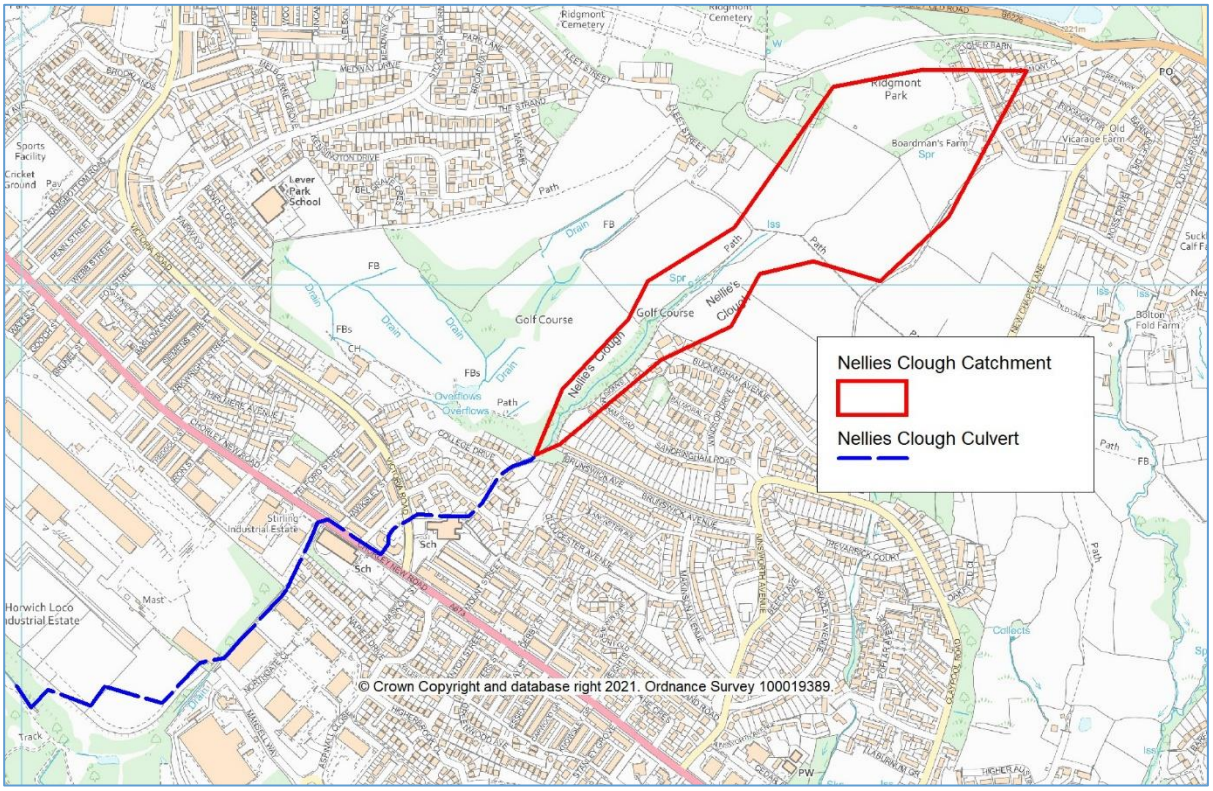
Developers should discuss temporary alterations to any watercourse with the LLFA during construction and obtain Land Drainage Consent where appropriate.

6.4 Nellies Clough

6.4.1 The Catchment

The catchment shown outlined in red on the plan above is approximately 14 hectares, the area is drained by a culverted watercourse shown as a blue dashed line. The catchment is predominantly undeveloped greenfield land.

Figure 13: Map of the location of the Nellies Clough catchment, culvert inlet and route of the downstream culvert.



This catchment drains to a privately owned culvert inlet at the rear of College Drive. It is then carried in a culvert in a south-west direction passing under private property, when it reaches Chorley New Road it is routed along the road in a westerly direction until it reaches Chorley New Road Primary Academy where it changes course and runs in a south-west direction under the Horwich Loco Works Site where it discharges to a tributary of Pearl Brook. In the Horwich Loco works site it merges with the flow from the Horwich Golf Course eastern and western catchments.

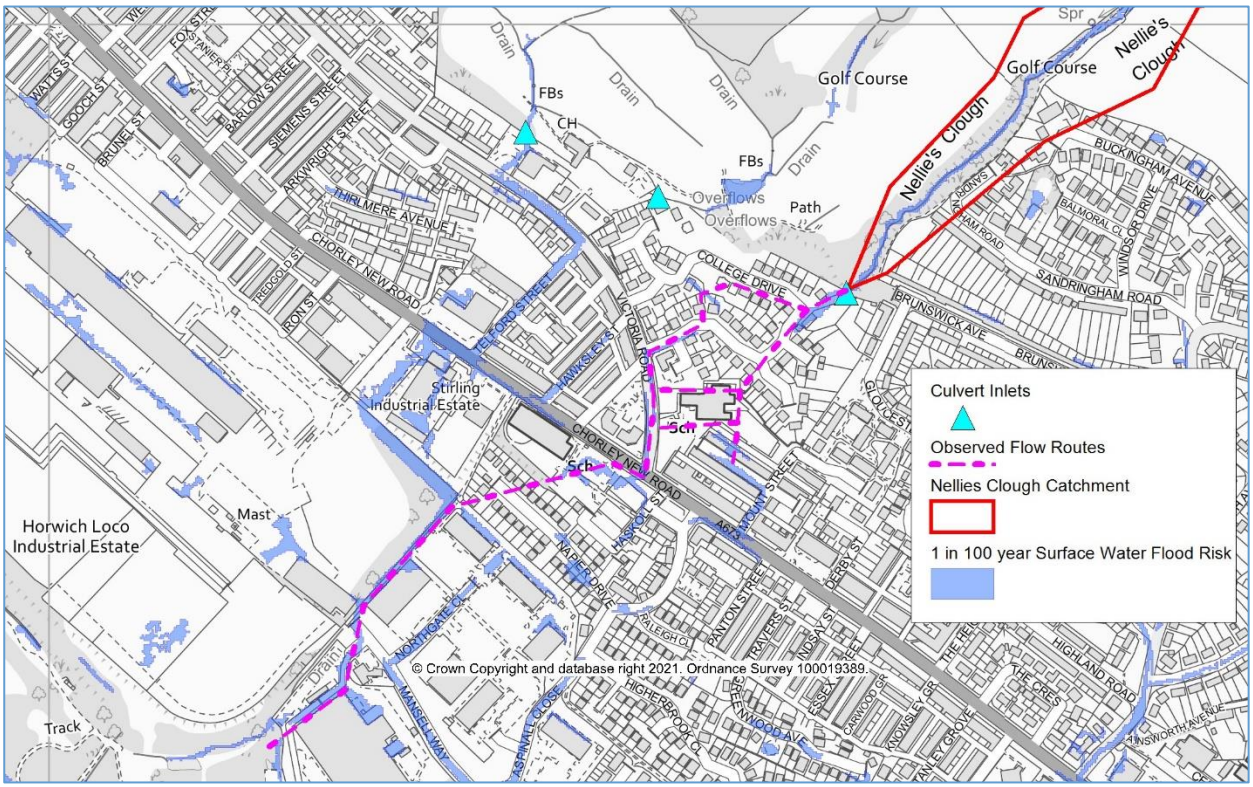
It is estimated that the rate of run off of water for this catchment at the inlet to the culvert at College Drive during a 1 in 30 year storm is 290 l/s and for a 1 in 100 year storm 355 l/s.

The culvert at the rear of College Drive has a diameter of 600mm is laid at a fairly steep gradient and has a flow capacity of around 675 l/s.

6.4.2 Overland flow routes

The plan below shows the predicted surface water flooding map and the route of observed overland flows.

Figure 14: Map of the Nellies Clough catchment, the predicted surface water flood extent for a 1 in 100 year event and the observed overland flow route.



6.4.3 Flooding impacts

During the rainfall event significant water flows were observed flowing overland from the culvert inlet from Nellies Cough at the rear of College Drive, this resulted in internal property flooding on College Drive, St Marys RC Primary School on Victoria Road and on Dale Street West. Water has then continued across Chorley New Road across the Primary School site and then flowed south through the Middlebrook development where it contributed to further flooding of property.

Downstream impacts of the overland flow running from this area caused internal flooding to:

2 Commercial Premises includes 1 school building
8 Residential Properties
6 Garages that are integral to properties

6.4.4 Observations and Contributing Factors

6.4.4.1 Nellies Clough

Nellies Clough is a steeply sided valley above which are open fields used for agriculture. A watercourse runs along the valley bottom draining the fields and hillside.

An inspection of the watercourse upstream of College Drive in the days following the storm showed that the stream bed of the watercourse had been visibly eroded over a length of approximately 340 metres. The stream bed had been scoured down to clean rock and earth, the previous stream bed which would have comprised rocks, stones and earth will have been washed downstream by fast flowing water (Photographs showing the stream bed after the storm are included in appendix 4). In addition, several small landslides to the stream embankments along the valley were observed, these would have occurred during the event and released additional earthen material to be washed downstream.

The debris load flowing downstream will have quickly blinded the debris screen on the inlet to the culvert at College Drive resulting in the overland flow that was witnessed. It was this overland flow that caused flooding to properties on the eastern side of College Drive, to St Mary's RC Primary School, and Dale Street West. The following day significant quantities of material were dug out from in front of the debris screen and disposed of.

6.4.4.2 The Horwich College Development / Rivington Grange

An outline planning permission for the redevelopment of the Horwich College Campus was approved by Bolton Council in June 2015. There are several subsequent applications that relate to Reserved Matters amendments and Discharge of Conditions. Construction of the development began in April 2018

At the end of Nellies Clough and just prior to the development the watercourse enters a culvert where an inlet headwall and debris screen has been constructed as part of the new development. Approximately 150 metres of culvert has been constructed within the development site to replace and realign an existing culvert that was present on the site. The new culvert connects to the existing culvert just north of the St Mary's RC Primary School Site.

Nellies Clough Culvert is a main river watercourse, the regulation and permitting of alterations to main river watercourses such as the extension of the culvert, construction of the culvert inlet headwall and debris screen is undertaken by the Environment Agency. The legal process of permitting of works to Nellies Clough is separate and independent of the granting of planning permission.

Flood Risk is a material consideration when assessing planning applications. When a planning application is made, certain information is required to be provided by the applicant. Flood Risk Assessments are provided to the LPA s and are used to inform the EA and LPA of site-specific flood risks and in which the applicant suggests mitigation measures.

For this development site there are 2 Flood Risk Assessments; one provided to support the initial outline planning application in 2014 and a second to support a subsequent reserved matters application made in 2016. Both these documents recognise the risk posed by the culvert and both suggest actions and mitigations.

Environment Agency Permit EPR/AB3450PU

The developer Jones Homes made an application to the EA for an Environmental Permit to undertake work on a main river in 2018 which was approved by the EA on 6th June 2018; the permit has the reference EPR/AB3450PU. It approved construction of the concrete headwall inlet structure and construction of a 600 mm diameter culvert diversion.

With regard to the permitting of the work by the EA, the EA is not a landowner nor did the EA undertake the work to construct anything within the development, rather the EA was a statutory consultee for planning purposes and was the regulator in respect of the permit granted pursuant to the Environmental Permitting (England and Wales) Regulations 2016.

The EA granted the environmental permit in accordance with its duty to determine an application made to it under the Environmental Permitting (England and Wales) Regulations 2016. In its regulatory role the EA does not accept responsibility for third party designs; responsibility for the design and any structures built rests with the developer.

Under the conditions of the environmental permit the developer has responsibility for maintenance of the inlet debris screen. The developer also has an obligation to maintain records to evidence maintenance has been carried out.

6.4.5 Recommendations

The EA should undertake a review of the design of the headwall inlet structure to establish whether it is compliant with current best practice and work with the developer to make improvements so that its capacity to deal with debris flows is increased. The EA have stated that they: “cannot require the developer to follow best practice guidance, it can only strongly encourage the developer follows it. The EA cannot instruct the

developer how to apply the guidance, nor prescribe screen specifications, since this falls outside the EA's statutory remit and regulatory role".

The developer should also ensure that there is an adequate safe working access platform in order that the screen can be regularly and safely maintained.

The EA should consider whether an additional upstream debris screen is feasible or necessary.

The EA should work with the developer to ensure that overland flow routes through the site are improved. Consideration should be given to the creation of earth bunds, removing the speed table traffic calming within the site for alternative speed reduction measures and raising kerb heights so that they better retain overland flows within the carriageway.

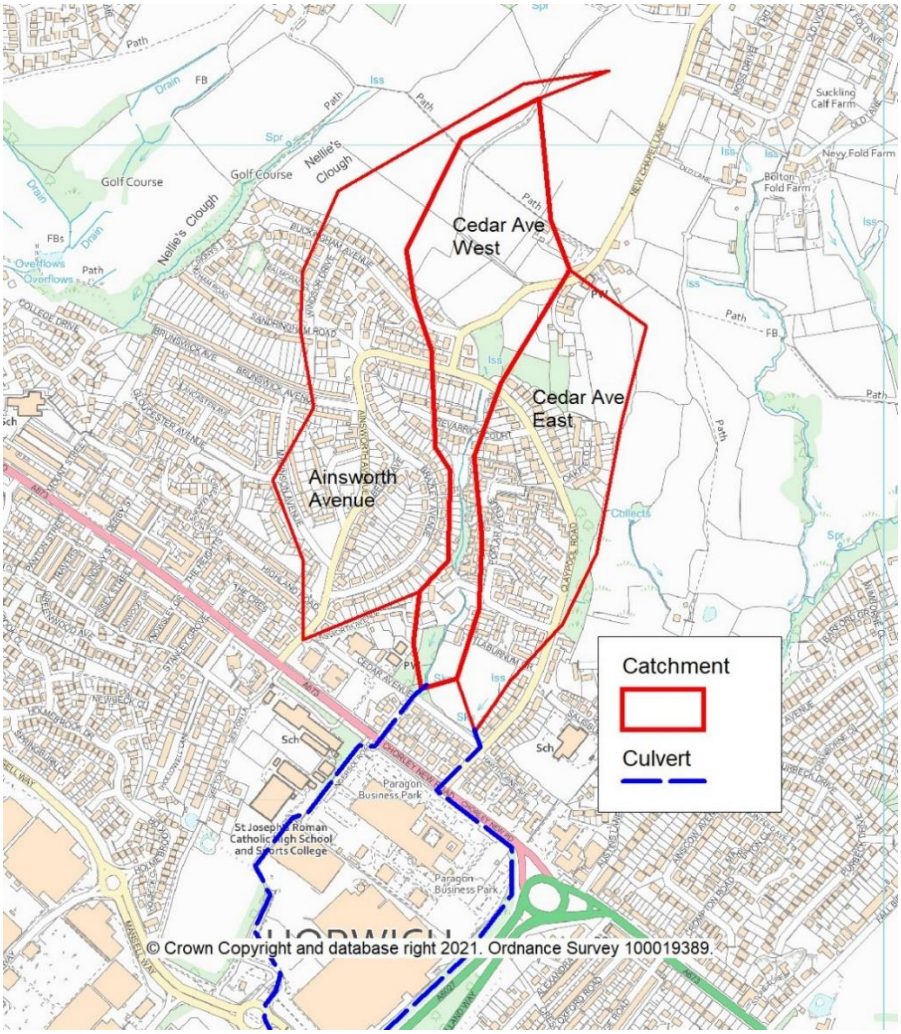
The LPA and LLFA to consider a policy to ensure that finished floor levels in developments at risk of surface water flooding are an adequate height above highway level.

6.5 Ainsworth Avenue to Claypool Road

6.5.1 The Catchment

The catchment shown outlined in red on the plan below is made up of three sub-catchments in total they are approximately 34 hectares, the area is drained by two watercourses shown as a blue dashed line. The catchment is in its upper reaches is predominantly undeveloped greenfield land, and in its lower reaches is residential development.

Figure 15: Map of the location of the catchment, culvert inlet and route of the downstream culvert.



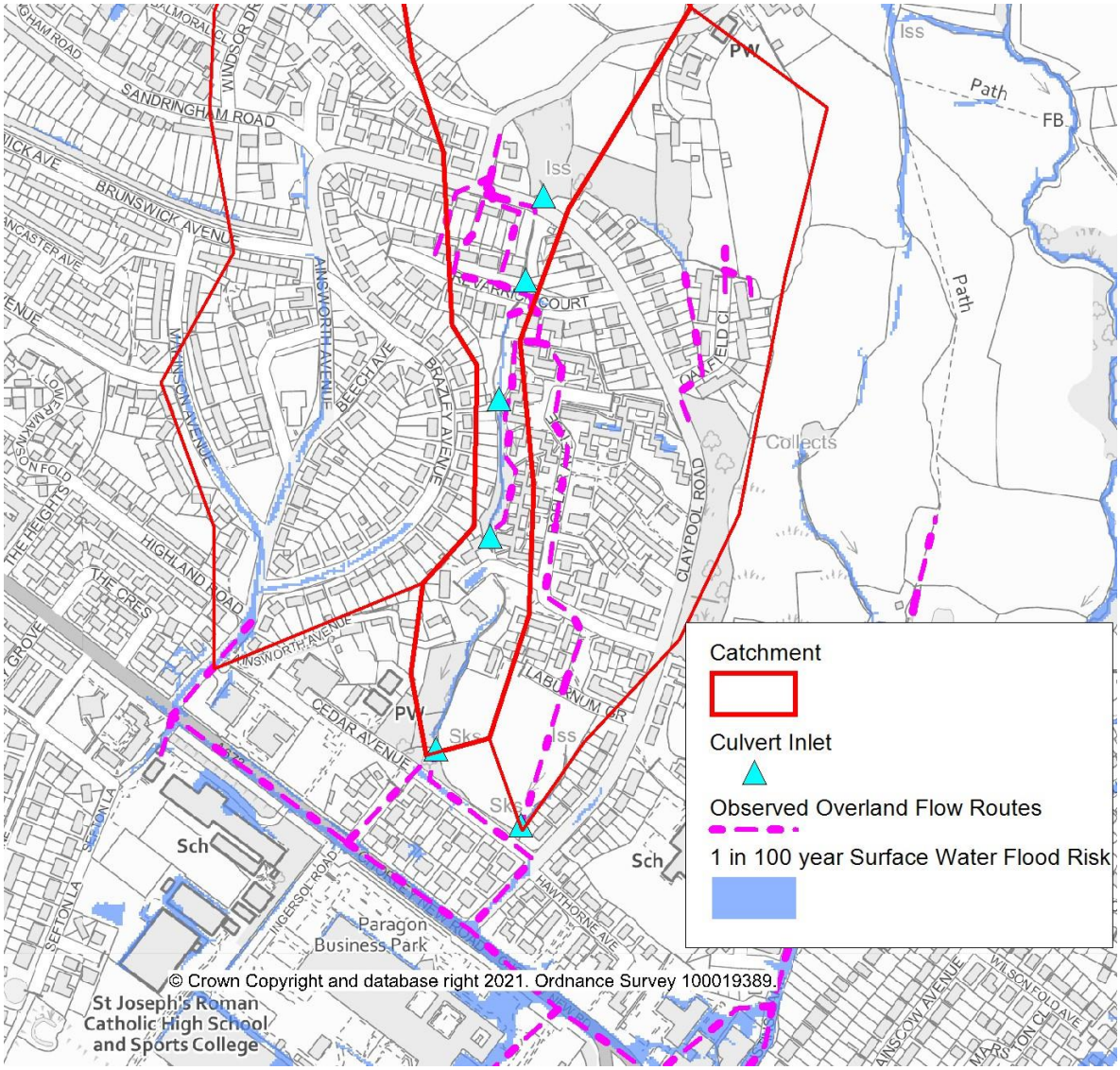
The developed areas are drained via highway drains and sewers. The catchment titled Ainsworth Avenue on the plan above is drained entirely by highway drains and sewers. The Cedar Avenue West catchment drains to a culvert within Bolton Council land at the western end of Cedar Avenue. The Cedar Avenue East catchment drains to a culvert within Bolton Council land at the eastern end of Cedar Avenue,

The culvert from the Cedar Avenue West catchment continues in a south-west direction under Chorley New Road, entering land between St Joseph's RC Secondary School and industrial premises, it continues until it discharges to the Moor Platt Clough culvert within the Superstore land. The culvert from the Cedar Avenue East catchment continues in a south east direction along Chorley New Road and discharges to the Moor Platt Clough culvert in De Havilland Way.

6.5.2 Overland flow routes

The plan below shows the predicted surface water flooding map and the route of observed overland flows

Figure 16: Map of the catchment, the predicted surface water flood extent for a 1 in 100 year event and the observed overland flow route.



6.5.3 Flooding impacts

Flooding occurred within the catchment as a result of a significant overland flow from land either side of New Chapel Lane this flow of water headed in a southerly direction from the top of Claypool Road through the urban area.

In the upper reaches of the Cedar Avenue West catchment the fast flow of water along the watercourse resulted in the damage to river training walls leading to their collapse and the supporting private gardens and banks. The culvert inlet on Cedar Avenue received a significant quantity of debris that was washed into the screen resulting in the screen being blinded to around 85% of its screen area. Flow then continued overland eventually pooling on Chorley New Road and contributing to the flooding of industrial premises.

In this catchment there were significant overland flows of water that did not enter the watercourse due to obstacles or topography and as a result flowed through private gardens and along pathways and roads, in particular at Poplar Avenue where a high number of properties were affected by internal flooding.

Within the catchments overland flow running through this area caused internal flooding to:

26 residential properties.

Downstream of the catchments the flows also contributed to causing internal flooding to:

1 Residential Property
7 Commercial Premises including a School
2 A Class Roads

6.5.4 Observations and Post Event Actions

Significant flows were recorded by residents issuing from the southern end of New Chapel Lane into the Claypool Road area, flow was sufficiently high to cause damage to the footways at the junction of New Chapel Lane and Claypool Road. Most of this overland flow will have been surface water flows from pasture land in the north of the catchment on to the highway.

The majority of New Chapel Lane does not have any highway drainage installed or formal locations where water can be directed overland into watercourses. This led to water being channelled along the road into the urban area. On reaching the urban area the informal obstacles of roads, houses and fences prevented flows entering the watercourse. This created a cascade of flooding impacts as water surrounded one property after another as it flowed downhill.

In the eastern part of the catchment overland flow from fields to the east of New Chapel Lane entered the Oakfield Close area. Historic ad hoc alterations to a watercourse by residents has compromised the capacity of a culvert.

6.5.5 Recommendations

The Highway Authority may consider the following actions:

1. Make drainage improvements to New Chapel Lane including making interventions to better manage surface water overland flows along the carriageway.

2. Ensure the culvert inlet north of Claypool Road is regularly inspected and maintained.

3. At Poplar Avenue on the adopted footways west of the property consider changing the camber of footways so they shed water away from property and into the open watercourse. Ensure that highway drainage on the walkways around Poplar Avenue receive regular routine maintenance.

4. Examine the highway drainage between Ainsworth Avenue and the Beehive roundabout and consider whether improvements could be made to reduce the risk of highway flooding.

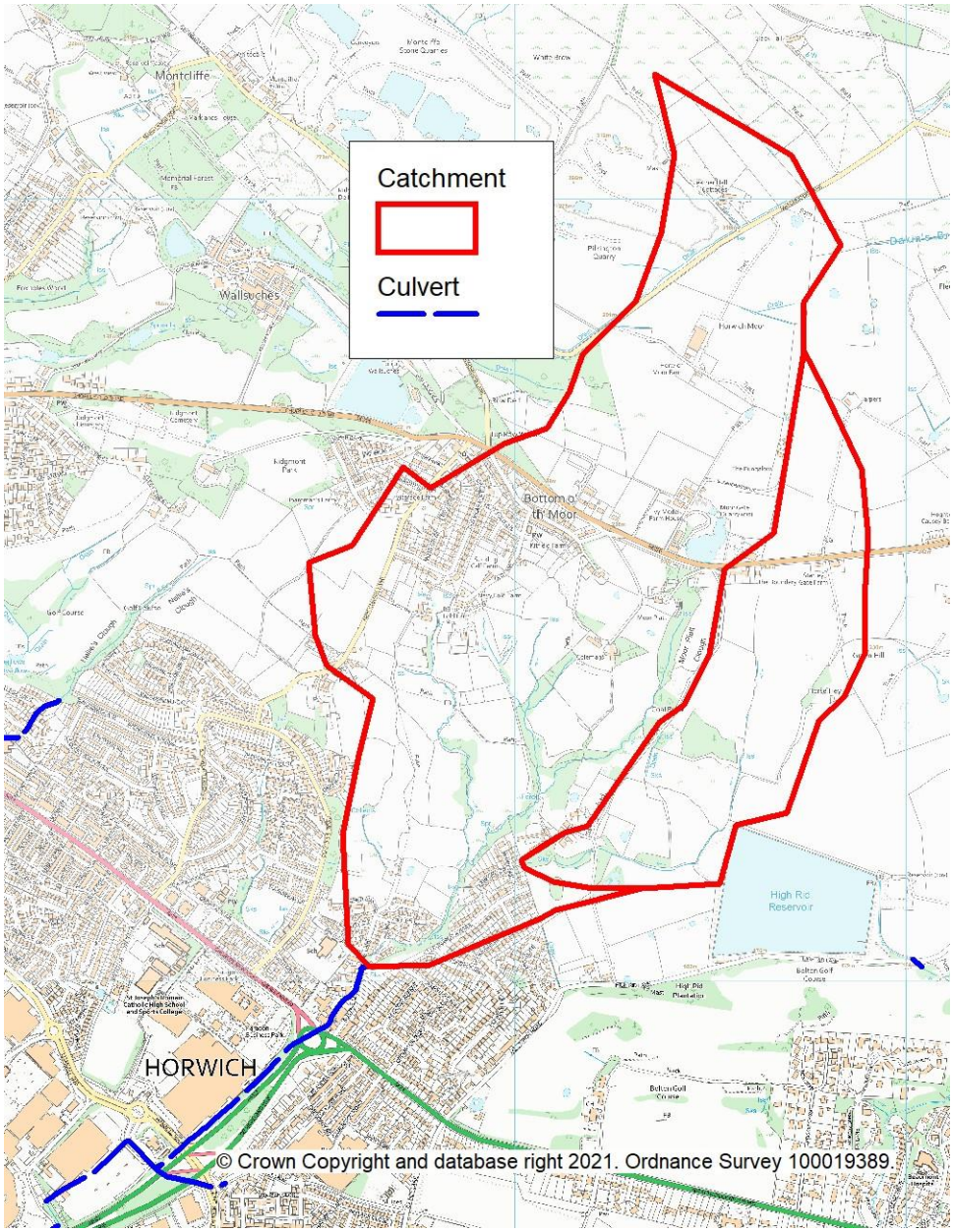
Oakfield Close / Claypool Road residents as riparian owners are advised to undertake improvements to the watercourse at the rear of the property to remove any constraints to the flow of water and ensure that the watercourse is free flowing at all times.

6.6 Moor Platt Clough

6.6.1 The Catchment

The catchment shown outlined in red on the plan below is approximately 188 hectares, it is made up of two sub catchments with the one to the east draining to a culvert at Barford Grove, which discharges into the Moor Platt Clough Stream. Both areas are drained by a single culvert shown as a blue dashed line. The catchment upstream of the culvert is predominantly undeveloped greenfield land.

Figure 17: Map of the location of the Moor Platt Clough catchment, culvert inlet and route of the downstream culvert.



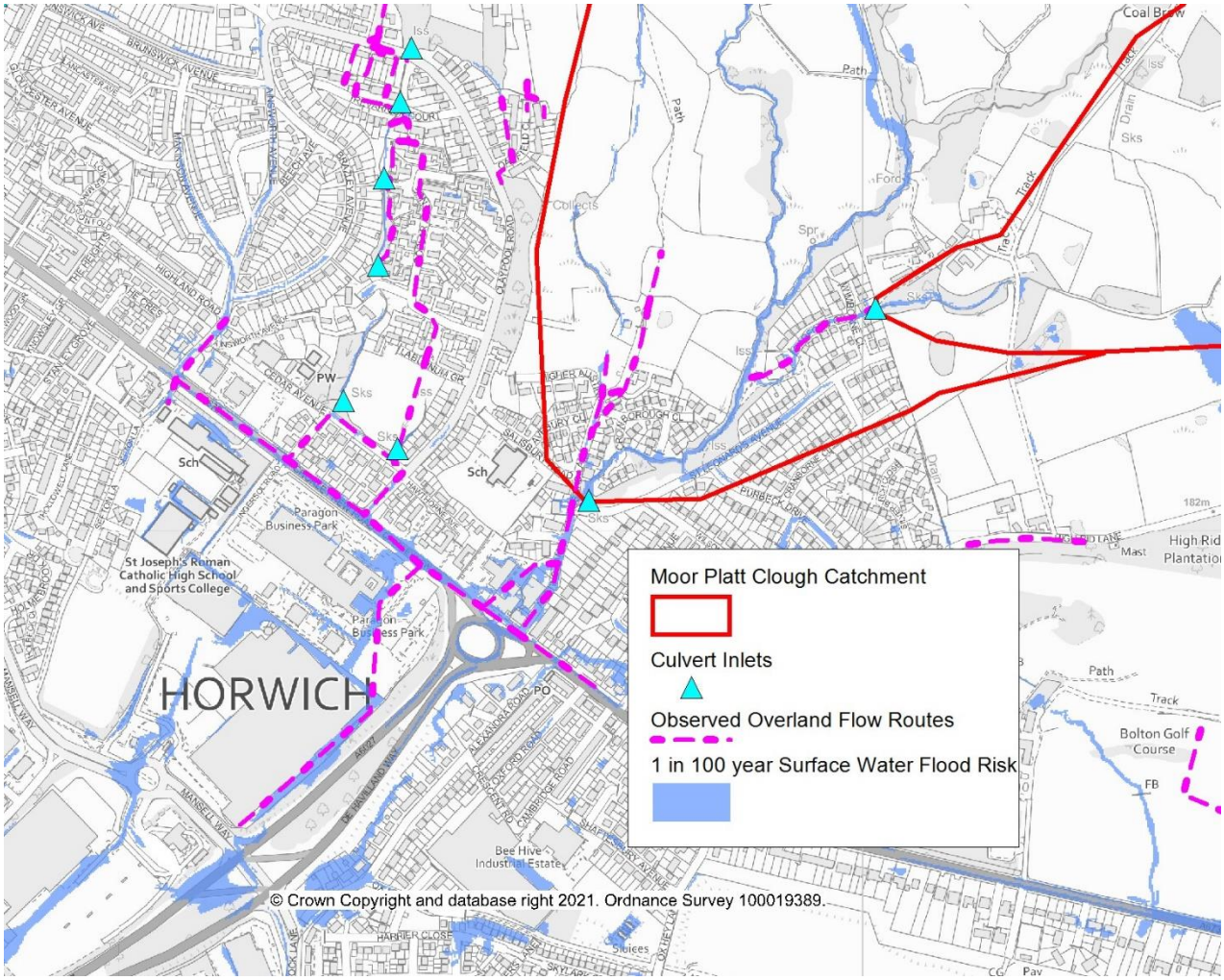
The catchment drains in mostly in open watercourses until it enters a culvert within Bolton Council land at the junction of Austins Lane and St Leonard's Avenue, Lostock. The culvert continues in a south-west direction under the Beehive Public House, then continues alongside De Havilland Way until it discharges to Middle brook near Horwich Parkway Train Station.

The watercourse from a point 260 metres upstream of the culvert inlet at the junction of Austins Lane and St Leonard's Avenue is classed as main river. Consequently, the culvert inlet debris screen is maintained by the Environment Agency.

6.6.2 Overland flow routes

The plan below shows the predicted surface water flooding map and the route of observed overland flows

Figure 18: Map of the Moor Platt Cough catchment, the predicted surface water flood extent for a 1 in 100 year event and the observed overland flow route.



6.6.3 Flooding impacts

This catchment is the second largest of those impacted by the storm and observations indicate that this was the catchment that produced the greatest volume of flood water.

Flooding occurred within the catchment as a result of a significant overland flow from land north of Austins Lane and as a result of a culvert inlet being overwhelmed at Barford Grove / Wimborne Drive.

Most of the flooding and the properties most significantly impacted were downstream of the St Leonard's Avenue debris screen. The fast flow of water along the Moor Platt Clough watercourse resulted in the significant damage to river training walls supporting private gardens and to river banks. The culvert inlet on Austins Lane received a significant quantity of debris that was washed into the screen resulting in the screen being blinded. A considerable flow of water then continued overland down Austins Lane on to Chorley New Road and contributing to the flooding of numerous industrial premises. The flow of water also caused flooding to the De Havilland Way (A6027) and Mansell Way junction resulting in the road being closed to north bound traffic for 24 hours.

Within the catchment overland flows caused internal flooding to:

2 residential properties
2 integral garages

Downstream impacts of the overland flow running from this area contributed to causing internal flooding to:

10 Commercial Premises

6.6.4 Observations and Post Event Actions

Culvert at Wimborne Drive / Barford Grove

The culvert inlet and debris screen at the rear of Wimborne Drive was overwhelmed by the amount of flow resulting in overland flow which ran down a public right of way footpath and on to Barford Grove. The debris screen on the inlet was inspected after the event and was found to be around 50% blinded with debris. Observations from residents at the outfall of the culvert indicate the culvert was running freely during the event.

A CCTV of the culvert that runs from the rear of Wimborne Drive along Barford Grove and outfalls to the Moor Platt Clough watercourse showed the culvert to be clear and in good condition other than a small amount of debris in the lower reaches.

Culvert inlet at St Leonards Avenue / Austins Lane

A considerable amount of debris was washed into the debris screen resulting it the screen being blinded and ceasing to allow the passage of water. An EA operational team attended site on the 17th May to remove sufficient debris to allow water to begin flowing down the culvert. Over the following days additional teams continued to remove debris from the site.

The EA operate an inspection and maintenance routine at the site, which comprises a monthly visual inspection for debris and a more detailed annual inspection on the structure.

The EA have undertaken a survey of the culvert downstream of the inlet to its outfall at Middlebrook; no major issues were found.

6.6.5 Recommendations

The Environment Agency should consider the following actions:

1. At the culvert inlet and debris screen at St Leonard's Avenue review the inspection and maintenance regime.

2. Consider whether an additional debris screen upstream would be appropriate.

3. Consider whether CCTV monitoring of screen debris levels would be appropriate.

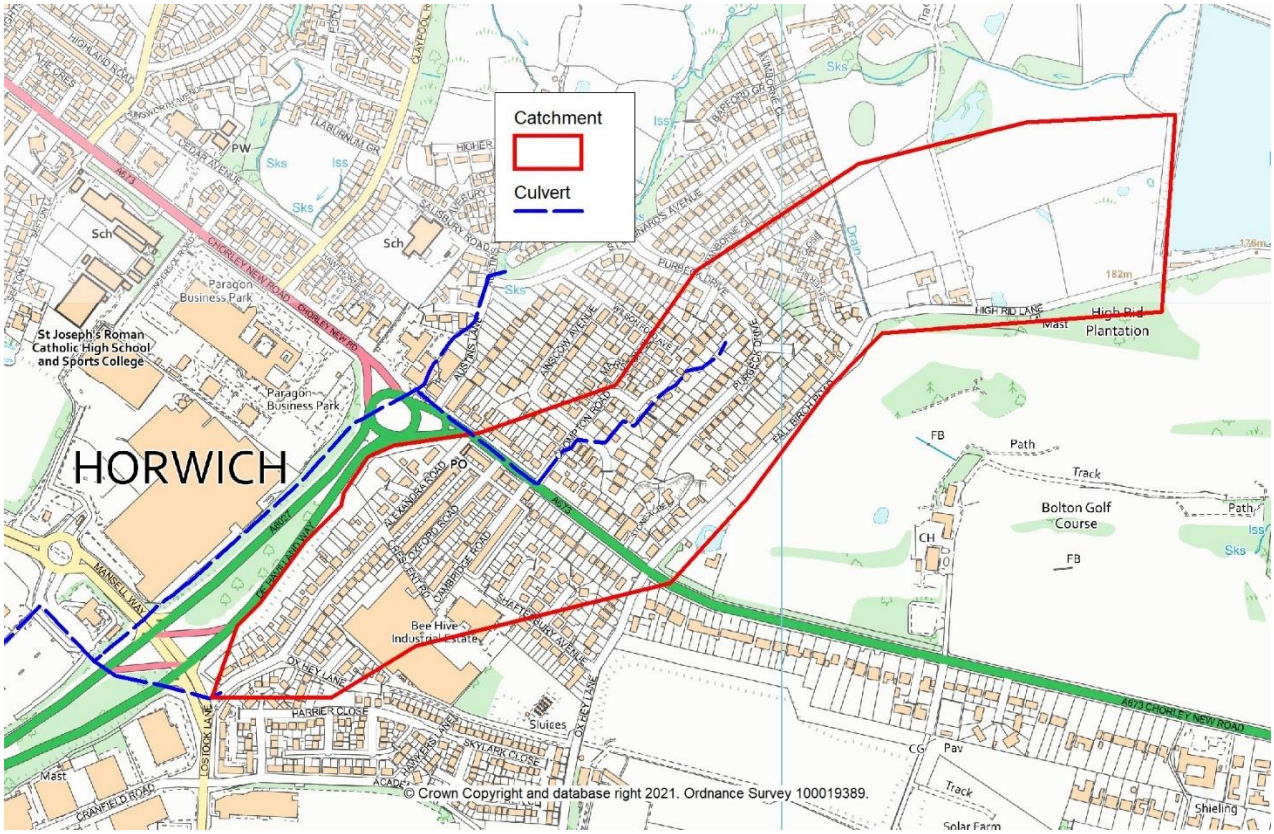
4. Monitor and inspect the condition of upstream private structures to reduce the potential for collapse and the production of debris during flood events.

6.7 Fall Birch Road / Lostock Lane

6.7.1 The Catchment

The catchment shown outlined in red on the plan below is approximately 33 hectares, other than at the upper most part of the catchment, most of the area is developed and there are no open watercourses, most of the surface drainage is sewer.

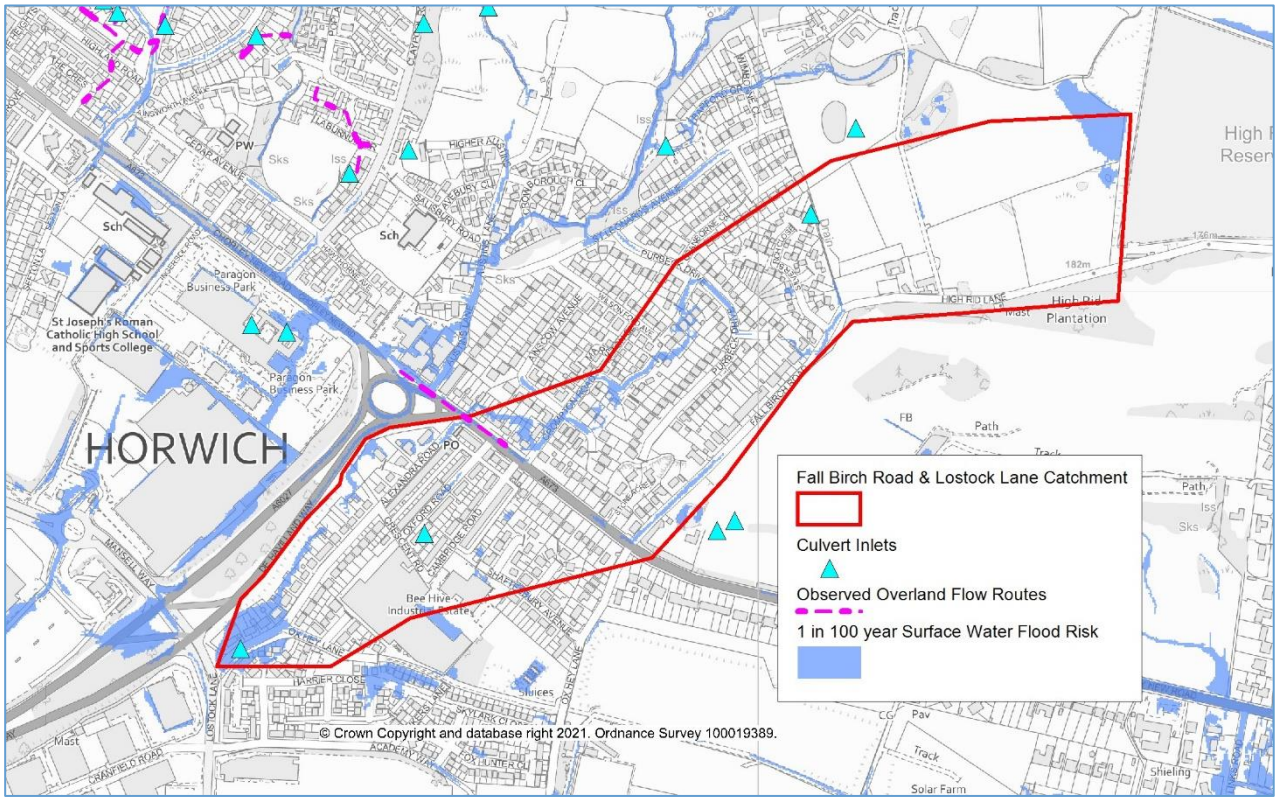
Figure 19: Map of the location of the catchment, culvert inlet and route of the downstream culvert.



6.7.2 Overland flow routes

The plan below shows the predicted surface water flooding map and the route of observed overland flows

Figure 20: Map of the Fall Birch Road / Lostock Lane catchment, the predicted surface water flood extent for a 1 in 100 year event and the observed overland flow route.



6.7.3 Flooding impacts

At the upper reaches of the catchment overland flow from the fields to the west of High Rid Reservoir entered the developed area causing flooding to property and gardens.

Lower in the catchment flooding occurred on Lostock Lane, Horwich surface water flows coupled with sewage flooding in the road caused internal flooding to 5 properties.

The surcharge of the sewer in Lostock Lane caused significant road damage, resulting in its closure for 2 days until emergency repairs could be made.

Within the catchment there occurred internal flooding to:

5 residential properties
2 external garages

6.7.4 Observations and Post Event Actions

Lostock Lane / Alexandra Road

At Lostock Lane the capacity of the sewer system was exceeded resulting in overflow to the surface (or surcharged), this was so great that water flow was observed spouting out of manholes and water was forced under the carriageway surface resulting in severe highway damage. The road on Lostock Lane was closed for several days until temporary carriageway repairs could be made.

There is a reduction in pipe capacity in the combined sewer just downstream of where the flooding occurred and this, along with the intense rainfall, contributed to the cause of the sewer surcharge. This reduction in capacity is due to the presence of other utilities service pipes and cables constraining the size of the sewer.

The flood at this location caused internal flooding to 5 properties and external flooding to garages, at a few properties the flooding was up to 1 metre deep. The flooding has displaced the residents of 2 properties as the buildings were no longer habitable.

Whilst overland flow will have contributed to the flooding a significant component will have been as a result of sewer surcharge. A survey of the sewers following the incident found no operational problems.

The current design standards for sewers is to not cause flooding up to a 1 in 30 year event. In this case, the rainfall was estimated to have a return period of 1 in 100 years so it will have exceeded the designed capacity of the sewer system resulting in flooding.

6.7.5 Recommendations

The Highway Authority should consider the following actions:

1. At Fall Birch Road consider alterations to the Kerbing, height and or camber of the road to ensure that surface water is contained in the carriageway.

2. Consider the surface water food risk to properties when undertaking highway maintenance works and in particular when proposing overlays to existing highway surfaces.

3. Consider making highway drainage improvements to the current system to reduce the risk of property flooding.

4. At Lostock Lane consider making highway drainage improvements at this high surface water risk area to reduce the risk of highway and property flooding.

Whilst acknowledging the Sewerage Undertaker United Utilities regards the sewer in Lostock Lane to be satisfactory due to the absence of historical flooding, they should consider the following actions:

1. Review the sewer network at Lostock Lane, in particular, whether the limitation in pipework capacity can be removed, or additional capacity installed.

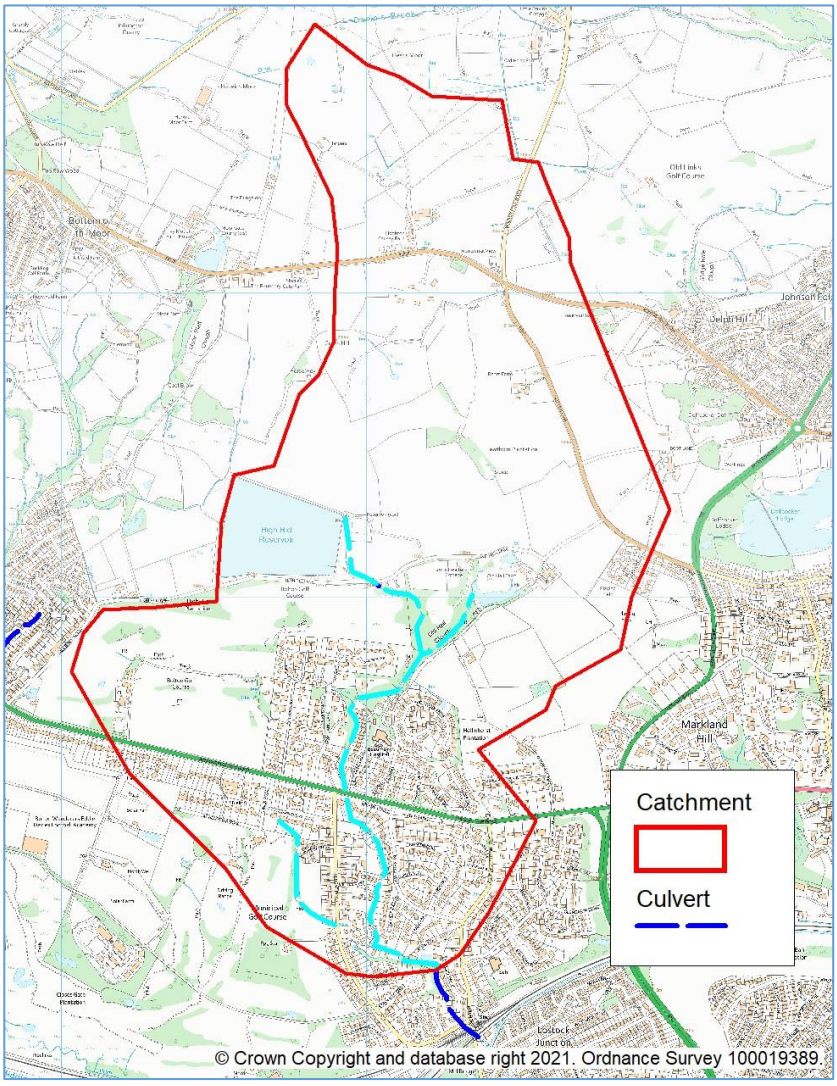
6.8 Bessy Brook

6.8.1 The Catchment

The catchment shown outlined in red on the plan below is approximately 316 hectares, most of the catchment is not developed and contains mainly pastural agricultural land. There is a large reservoir called High Rid Reservoir within the catchment, initially used for the collection and storage of water to feed the water supply network, it is no longer used by United Utilities.

The catchment drains via open watercourse to Middlebrook near Lostock Railway Station, just prior to the station the watercourse is culverted at Sudbury Drive / Ashridge Close.

Figure 21: Map of the location of the Bessy Brook catchment, culvert inlet and route of the downstream culvert.



6.8.2 Flooding impacts

Flooding in this catchment occurred lower down the catchment at Sudbury Drive / Ashridge Close and was as a result of fluvial flooding from the Bessy Brook watercourse. The flooding at this location has occurred several times and is generally due either to a blockage of a debris screen at a culvert inlet or under capacity in a section of culvert. In this case, the indication is that the capacity of the culvert was overwhelmed on this occasion.

Bessy Brook is Main River at this location and the EA is working on a project to reduce flood risk to properties at this location. The project is currently at Outline Business Case which considers all possible solutions for the project and picks a preferred solution. Once this is complete, the EA will move on to producing the Full Business Case.

Additional external flooding occurred in the Chorley New Road / Links Road area. A CCTV inspection after the event shows tree roots and other faults in a section of privately owned watercourse will have contributed to the problem.

The river flooding resulted in internal flooding to

11 Residential Properties

6.8.3 Observations and Post Event Actions

At Sudbury Drive residents observed that the flooding was not as a result of blockage to the debris screen at the Sudbury Drive culvert inlet. It is likely in this case that the capacity of the culvert was exceeded.

In the week following the event the EA attended site to visit properties and gather information from residents such as photos and videos.

6.8.4 Recommendations

The Environment Agency should consider the following actions:

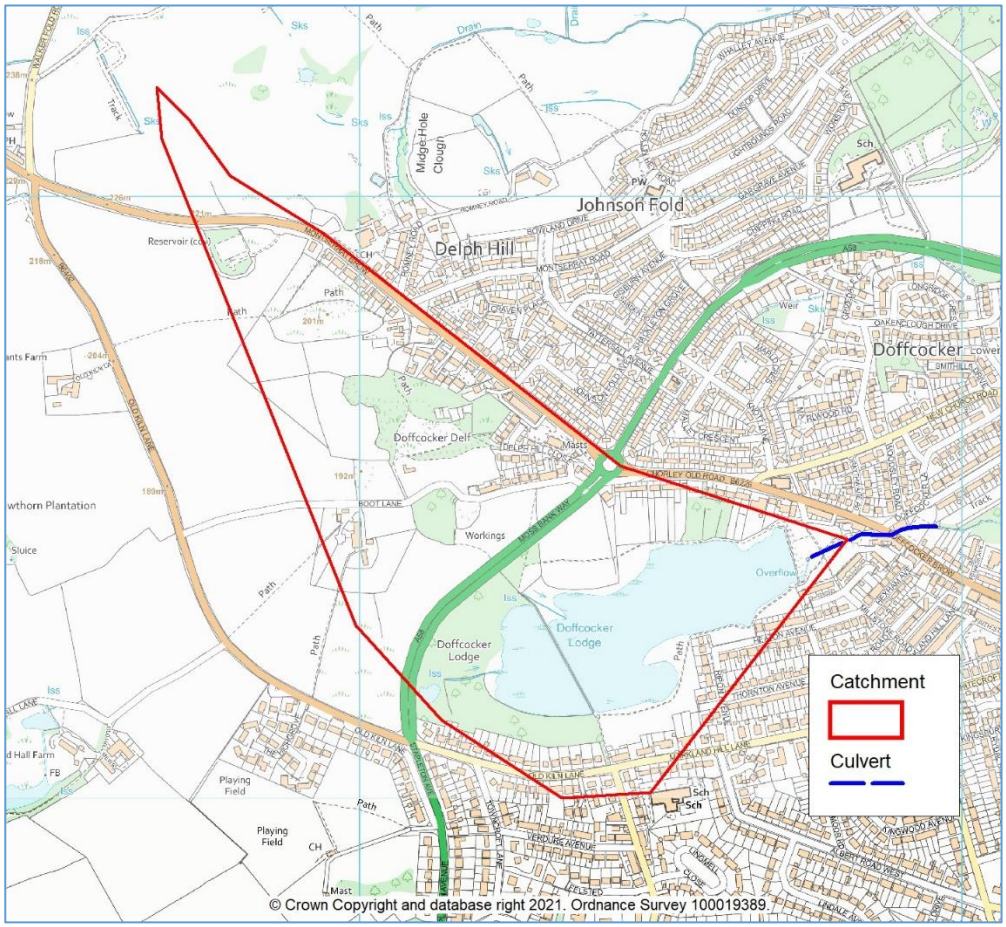
1. Continue to work with partners to progress the Outline Business Case to identify a preferred option to reduce the flood risk on Bessy Brook, Lostock.

6.9 Doffcocker Lodge

6.9.1 The Catchment

The catchment shown outlined in red on the plan below is approximately 49 hectares, most of the catchment is not developed and contains mainly pastural agricultural land. There is a reservoir called Doffcocker Lodge within the catchment. The lodge was historically used for the collection and storage of water to supply a mill, it is now used only as a nature reserve and for recreation.

Figure 22: Map of the location of the Doffcocker Lodge catchment, culvert inlet and route of the downstream culvert.



6.9.2 Flooding impacts

Flooding occurred in the catchment as a result of outflow from Doffcocker Lodge overwhelming a culvert under Chorley Old Road.

Downstream impacts of the overland flow running from this area resulted in internal flooding to:

2 Residential Properties
1 Commercial Property
2 B Class road

6.9.3 Observations and Post Event Actions

An inspection of the culvert downstream of Doffcocker Lodge revealed the accumulation of debris in a manhole which constrained flow through the culvert and may have contributed flooding; the debris was removed. This debris may have accumulated during the event, but this is uncertain.

6.9.4 Recommendations

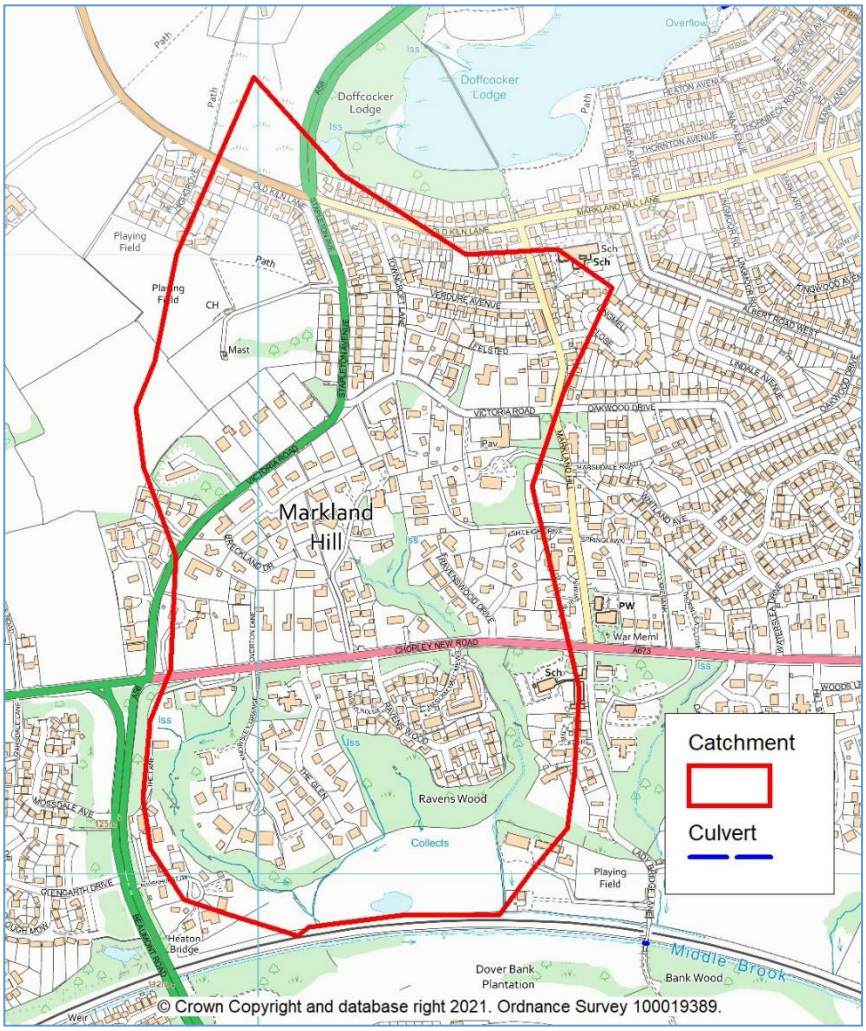
Bolton Council to consider regularly monitoring debris and silt in the culvert and making improvement to the culvert downstream of Doffcocker Lodge to improve its capacity and ensure that large overflows from the lodge do not result in flooding to property immediately downstream.

6.10 Markland Hill

6.10.1 The Catchment

The catchment shown outlined in red on the plan below is approximately 76 hectares, most of the catchment is developed and drained via the sewer network.

Figure 23: Map of the location of the Markland Hill catchment.



6.10.2 Flooding impacts

Flooding occurred in the catchment as a result of overland surface water flow and some sewer surcharge.

Impacts of the overland flow running from this area resulted in internal flooding to:

2 Garages integral to properties

1 External Garage

6.10.3 Observations and Post Event Actions

Flooding was confined to locations where there are low spots in the highway or as a result of run off from highways. A CCTV survey was undertaken by United Utilities of sewers and no operational problems such as blockages were identified.

6.10.4 Recommendations

Bolton Council to consider making improvement to drainage at the junction of Chorley New Road and Haslam Hall Mews to reduce the risk of highway flooding and ensure that large overflows do not result in flooding to property immediately downstream.

7. Asset Performance

7.1 Sewers - United Utilities Assets

United Utilities are responsible for the maintenance of the sewer network, which includes the main drains that generally run along streets and the minor drains that drain more than one property.

In the majority of locations, flooding was the result of surface water flooding, this occurs following intense rainfall that runs off surfaces such as fields, roofs and roads. This results in large overland flows that are unable to enter the sewerage network as surface inlets to the system such as highway gullies are quickly overwhelmed. At the following locations sewer flows contributed to flooding; Lostock Lane, Chorley New Road Primary School and Medway Drive.

7.2 Highway Drainage – Bolton Council Assets

Bolton Council as the Highway Authority are responsible for the maintenance of road gullies and the piped connection between gullies and the public sewer. At some locations the Highway Authority is responsible for watercourses where they pass under the highway.

Observations and surveys after the event showed that most gullies remained operational and unblocked. Though some due to large debris flows into the gully required emptying after the event. A gully emptying team concentrated on emptying the gullies on the affected roads, which took three weeks to complete.

Highway gullies have a limited capacity which when exceeded leads to overland flow; on roads with steep gradients fast flowing water can often jump over gullies leading to additional overland flow. This results in water routing down roads and gathering on highways at low spots or where the gradient is flatter.

Areas of significant highway flooding

A6027 De Havilland Way
A673 Chorley New Road – Beehive
A673 Chorley New Road – Chorley New Road Primary school
A673 Chorley New Road – Lostock / Links Road
A673 Chorley New Road – Haslam Hall Mews
B6226 Chorley Old Road – Doffcocker Lodge
Georges Lane
Mansell Way

Victoria Road
College Drive
Telford Street
Abernethy Street
Lostock Lane / Alexandra Road
Mason Street / Vale Avenue
New Chapel Lane / Claypool Road / Ainsworth Avenue
Links Road
Sudbury Drive/ Ashridge Close

Alexandra Road/ Lostock Lane

An inspection of gullies showed 7 of 19 gullies to be full of debris. Whilst this would have contributed to overland flow being more than normal. It will have reduced the amount of water entering the sewer.

There is only a single gully at the sag point in the highway, current design good practice [2] is to install at least two gullies at low points to improve flow capacity and silt collection capacity.

Adopted Link Footway between Greenstone Avenue and Mason Street
An inspection of the small bridge carrying the walkway over Pearl Brook showed that this causes a restriction on the brook and is a source of flooding to Mason Street and Vale Avenue.

7.3 Ordinary Watercourses – Bolton Council

Bolton Council undertakes regular routine inspection of watercourse inlets and debris screens where they are the landowner or the inlet is a highway authority asset.

The table below contains the location of debris screens we inspect, the date it was last inspected prior to 16/05/21 along with Notes and Actions from the last inspection.

Location	Date of previous inspection prior to 16/05	Notes and actions from inspection prior to 16/05/21
North of Trevarrick Court	5/03/21	Screen Clear
Cedar Ave east	6/05/21	<25% debris
Cedar Ave west	6/05/21	50 % debris , screen cleaned on 14/05/21
Rear of Wimborne Drive	6/05/21	<25% debris
Bolton Golf Course	6/05/21	Screen Clear

[2] Highways England (2020) CD526 “Spacing of Road Gullies”

7.4 Main River Watercourses –Environment Agency and Riparian owners

The EA undertake a policing and maintenance role with regard to ensuring landowners fulfil their obligations. They deliver projects to manage flood risks from main rivers, and undertake maintenance at key sites.

5-year maintenance plans by the Environment Agency can be viewed at the website below:
https://www.gov.uk/government/publications/river-and-coastal-maintenance-programme

This includes local assets on Middlebrook. Maintenance actions in the catchments are generally:

- Inspection and clearance of debris screens
- Maintenance check of open channel to ensure water conveyance is not impeded.

St Leonard's Avenue Debris Screen

The St. Leonard's Avenue Debris Screen is located at the junction of Austins Land and St Leonard's Avenue downstream of Moor Platt Clough. The screen is regularly inspected and maintained by the EA, currently the inspection regime is as follows:

- All of EA debris screen have monthly scheduled maintenance. In addition to clearing the screen of debris and ensuring the asset is operating as expected, this maintenance includes; ensuring there are no obstructions in the watercourse immediately upstream, maintaining the compound, ensuring the screen is secure, checking for vandalism etc.

EA Debris screens are however commonly visited more frequently, as a precaution before a forecast of heavy rainfall.

Location	Date of previous inspection prior to 16/05	Notes and actions from inspection prior to 16/05/21
St Leonards Avenue	12/05/21	Screen Clear
Sudbury Drive	12/05/21	Screen Clear

8. Summary of Impacts and Findings

The flooding impacted approximately 110 properties in some way. These are summarised as follows:

59	Residential properties internally flooded
27	Commercial premises internally flooded
9	Integral garages to residential property
11	Detached garages or outbuildings

Critical infrastructure

2	A Class Roads flooded for more than one hour
3	Schools internally flooded

Flooding occurred as a result of flash flooding either directly or as a result of drainage systems being overwhelmed beyond their design capacity.

9. Incident Response and Post Event Actions

9.1 Bolton Council - Flood Incident Response

The Bolton Council Civil Contingencies Team, on receipt of multiple incidents to Bolton Council's Security and Response telephone number, responded by deploying a Forward Incident Officer to Horwich at approximately 6pm on 16th May. Their role is to represent the Council at the scene and to liaise with the emergency services and to offer practical advice and support to residents whose homes have been flooded. The GMFRS evacuated families from three properties. A resident from one of the properties was admitted to hospital.

Over the following days from Monday 17th May to Tuesday 18th May highway maintenance teams along with street cleansing teams visited various locations, where flooding had been reported, to remove debris from culvert inlet debris screens, empty highway gullies and remove surface debris from the highway.

Also, in the following days officers identified any vulnerable persons that had been impacted by the event and passed their details to the Council's Adult Services who provided welfare checks and follow up services to those displaced from their homes.

Additional highway inspections were undertaken to identify damaged highway assets along with watercourses and culvert inlets to assess the impact of the flood and to record debris fields.

CCTV surveys of culverted watercourses were undertaken during the week commencing 14th June to assess potential blockages caused by debris and the structural condition of the pipework. This resulted in contacts being made with relevant authorities and riparian owners to undertake maintenance activities.

Bolton Council's Flood Recovery Group

Following the incident Bolton Council set up a Flood Recovery Group led by Public Health Strategic Lead and supported by other Public Health teams, the Lead Local Flood Authority, Environment Agency, Highway Authority and Greater Manchester's Civil Contingencies and Resilience Unit. The purpose of the group was to undertake the strategic coordination of the recovery phase which included but not limited to:

- Repair of Authority Assets
- Support to Children's services regarding the impact on schools
- Continuing Welfare checks and vulnerable residents
- Communication
- Seeking central government support.

Flood Recovery Framework

In a severe weather event with significant wide area impacts, local authorities can obtain central government support to help their communities and businesses return to normal. This is done under central government's Flood Recovery Framework and provides residents and businesses financial assistance to recovery in the form of grants or council tax and business rates relief. The decision to determine when this support will be available is made at ministerial level in the government.

In the cases where minimal numbers of flooded or affected households occur, it is expected that the relevant the local authority will manage the community recovery.

The Councils lead on our Recovery Group requested via the Ministry of Housing, Communities and Local Government, the local activation of the flood Recovery Framework, however, despite the numbers of properties impacted and the significant damage to schools and roads, the scheme was not made available.

Property Flood Resilience Scheme

The Department of Environment Food and Rural Affairs (Defra) operates a scheme which offers grants to householders of up to £5,000 to enable properties to become more resilient to future flooding events, such as installing flood doors and re-wiring of electrics

(such as socket points) above the flood level. This scheme previously operated following Storms Eva, Dennis, Ciara and Christophe which impacted large parts of the country. It is a Ministerial decision whether to activate the scheme, however in this instance the scheme was not activated. Bolton Council's actions in response to the flooding event comprised:

- Urgent cleaning of carriageways and footways
- Urgent gully cleaning on affected streets
- Urgent safety inspections of Rights of Way, carriageways and footways
- Undertaking emergency repairs to carriageways and footways
- Visiting and advising residents where flooding of flood damage was reported
- Ensuring vulnerable adults received appropriate care and rehousing
- Undertaking CCTV inspections to culverts
- Establishing a Flood Recovery Group to coordinate activities

The cost estimate of dealing with the emergency response and clean-up is £57k. Repair damages to Council Infrastructure such as highways is estimated at £63k.

9.2 Environment Agency – Flood Incident Response

On Monday 17th May Environment Agency teams attended the debris screen at St Leonards Avenue to remove debris and inspect the watercourse upstream of the inlet. This work continued over the following days.

The same day EA officers visited the sites of reported flooding carrying out door to door enquiries to record the impact of the flooding at individual properties and to advise residents. Photographic evidence of flow paths and rack lines were recorded.

On Tuesday 18th May a topographical survey team attended various sites in Horwich to record flood levels at individual properties.

In the following week EA officers visited Sudbury Drive and Ashridge Close to meet residents and gather information on the flooding.

The EA undertook a CCTV survey of Nellies Clough culvert in the following weeks to identify if the storm had resulted in any issues such as partial blockages by debris being washed down from further upstream. This was followed up with EA officers contacting various riparian owner to inform them that maintenance was required to remove debris. A partial blockage was identified in land on the former Horwich Locomotive works site. Culverts are the responsibility of the landowner, however, in exercise of its discretionary statutory powers, the EA has undertaken works to partially relieve this blockage.

The EA are planning to undertake a survey of the culvert downstream of Moor Platt Clough to identify any operational problems.

9.3 United Utilities – Flood Incident Response

United Utilities attended properties that had reported flooding to them in the days following the event. Follow up CCTV was undertaken at various locations but no significant operational issues such as blockages were found that could have caused or contributed to the flooding.

10. Conclusion

Flooding occurred on Sunday 16th May 2021 as a result of flash flooding following an intense thunderstorm. Prior to the event, no weather warnings were issued due to the unpredictable nature of thunderstorms with regard to location or rainfall intensity.

The very intense rainfall caused a flash flood of run off from land particularly from the undeveloped land to the north-west of Horwich. This run off overwhelmed the design capacity of existing drainage infrastructure, particularly at the transitions between the rural and urban areas. In many cases where open watercourses enter piped underground drainage the debris screens at the inlets were quickly blocked by debris being washed into them from further upstream. This resulted in large overland flows from culvert inlets which entered property and flooded roads.

The rainfall event was rare and is estimated to be a once in a lifetime occurrence and having a return period of 1 in 100 years (or having an Annual Exceedance Probability (AEP) of 1%).

Scientists have warned that with climate change this type of flash flooding will become more commonplace. Measures to cope with the impacts of extreme weather are urgently needed to reduce the impact on businesses and householders. Adapting to the impacts will require an overhaul of drainage systems to ensure they are not overwhelmed. Unfortunately, the sources of funding to make these changes are limited.

Householders impacted by the event should take steps to ensure they protect their property in future by taking appropriate flood protection measures. Information on flash flooding events is contained below in Appendix 5.

11. Recommendations

The method for prioritising works on drainage systems and watercourses varies for each RMA involved, dependant on factors such as resources available, operational area, and interpretation of flood risk. It is therefore important that all RMAs are open and honest with the community about what actions will or will not be taken, and why. Bolton Council as the LLFA are in a position to facilitate sharing of information between RMA's, and the community, if required. We also suggest the actions summarised within Table 1 below.

Table 1: Suggested Actions

Flood Risk Management Authority / Body	Suggested Actions
Resilience forum	Review and update plans to enable homes and businesses to be better prepared for flooding and reduce the impact of flooding. Ensure residents are aware of the risk of flash flooding
Highway Authority (Bolton Council)	Use Surface Water Flood Maps to inform future highway maintenance schemes. Ensure that new highways incorporate surface water attenuation and are designed to cope with climate change predictions. Consider highway schemes to improve the management of overland flows. The Highway Authority should also consider the following actions: 1. More frequent routine gully cleaning on Fleet Street. 2. Make drainage improvements to New Chapel Lane including making interventions to better manage surface water overland flows along the carriageway. 3. Ensure the culvert inlet north of Claypool Road is regularly inspected and maintained. 4. At Poplar Avenue on the adopted footways west of the property consider changing the camber of footways so they shed water away from property and into the open watercourse. Ensure that highway drainage on the

Flood Risk Management Authority / Body	Suggested Actions
	walkways around Poplar Avenue receive regular routine maintenance. 5. Examine the highway drainage between Ainsworth Avenue and the Beehive roundabout and consider whether improvements could be made to reduce the risk of highway flooding. 6. At Fall Birch Road consider alterations to the kerbing, height and or camber of the road to ensure that surface water is contained in the carriageway, and make highway drainage improvements to the current drainage to reduce the risk of property flooding. 7. Review the surface water food risk to properties when undertaking highway maintenance works and in particular when proposing overlays to existing highway surfaces. 8. At Lostock Lane consider making highway drainage improvements at this high surface water risk area to reduce the risk of highway and property flooding. 9. Make improvements to the culvert downstream of Doffcocker Lodge to improve its capacity and ensure that large overflows from the lodge do not result in flooding to property immediately downstream. 10. Make improvements to drainage at the junction of Chorley New Road and Haslam Hall Mews. 11. At Chorley New Road between its junctions with Telford Street and Victoria Road examine the highway drainage capacity on the road outside the school and consider improvements to increase its capacity. And work with UU to examine a scheme to remove highway drainage flows from the sewer network.

Flood Risk Management Authority / Body	Suggested Actions
Environment Agency	<u>At Nellies Clough</u> 1. Work with the developer to make improvements to the current inlet structure, so that its capacity to deal with debris flows is increased. Ensure that there is adequate safe access in the future so that the screen can be regularly maintained. 2. Work with the developer to ensure that overland flow routes through the site are improved through the construction of bunds or raising kerb heights. Consideration should be given to removing the speed table traffic calming within the site for alternative speed reduction measures that retain overland flows within the carriageway. At St Leonard's Avenue the EA should consider the following actions: 1. At the culvert inlet and debris screen at St. Leonard's Avenue, review the inspection and maintenance regime. 2. Consider whether an additional debris screen upstream would be appropriate. 3. Consider whether CCTV monitoring of screen debris levels would be appropriate. 4. Monitor and inspect the condition of upstream private structures to reduce the potential for collapse and the production of debris during flood events. At Bessy Brook the EA should consider the following actions: 1. Continue to develop the project and explore the Business Case for undertaking works to reduce the flood risk on Bessy Brook at Sudbury drive/ Ashridge Close.
United Utilities	The Sewerage Undertaker United Utilities should consider the following actions: 1. Ensure that where sewer surcharge was observed and where it caused an external or internal flooding incident,

Flood Risk Management Authority / Body	Suggested Actions
	that the incident is recorded to inform and provide evidence to justify future investment in sewerage schemes to reduce flood risk. 2. Review the sewer network at Lostock Lane, in particular whether the limitation in pipework capacity can be removed.
Residents	Report, document and photograph any flooding incidents or near misses. Report fly-tipping in watercourses or debris build up in watercourses. Take measures to protect themselves and their property when they believe flooding may occur. Consider whether it is appropriate for Property Flood Resilience measures to be fitted to the property to improve flood resilience. (eg Flood Barriers, Flood Resistant Airbricks) Individuals can consider what actions they can take to mitigate against flooding can access practical and realistic advice at the North Wests Flood Hub at www.thefloodhub.co.uk
Bolton Council - LLFA	Consider the routine inspection of watercourses upstream of debris screens to identify debris and fly tips that may present a problem during flash flooding. Consider routine CCTV inspections of culverted watercourses to ensure that riparian owners are undertaking maintenance and confirming they are flowing freely. Monitor development sites containing watercourses to ensure developers do not alter or amend them without obtaining Land Drainage Consent. Record details of any flooding incidents or near misses.
Bolton Council – Local Planning Authority (LPA)	Introduce a policy to ensure at development sites where there is a risk of surface water flooding that the Finished Floor Levels are an adequate height above the flood level and that properties are not lower than the footway level outside the property.

Flood Risk Management Authority / Body	Suggested Actions
	The LPA should ensure that when Flood Risk Assessments are approved which contain recommendations with regard to future work that is required in order to better understand the flood risk at a site or that flood risk should be incorporated into the topographical design of a development site with regard to layout and finished floor levels, that the developer undertakes the actions recommended in the FRA.
Landowners	The owners of Chorley New Road Primary Academy should ensure the risk of sewer flooding from the foul sewer connection is reduced by the installation of an anti flood valve Oakfield Close / Claypool Road residents as riparian owners are advised to undertake improvements to the watercourse at the rear of the property to remove any constraints to the flow of water and ensure that the watercourse is free flowing at all times. Horwich Golf Club / Peel Investment should ensure that drainage infrastructure on their land is adequately maintained, operational at all times, and that culvert inlets are constructed in accordance with current best practice.

12. Disclaimer

This report has been prepared as part of Bolton Council's responsibilities under the Flood and Water Management Act 2010. It is intended to provide context and information to support the delivery of the local flood risk management strategy and should not be used for any other purpose.

The findings of the report are based on a subjective assessment of the information available by those undertaking the investigation and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event. Bolton Council expressly disclaim responsibility for any error in, or omission from, this report arising from or in connection with any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the time of preparation and Bolton Council expressly disclaim responsibility for any error in, or omission from this report arising from or in connection with those opinions, conclusions and any recommendations.

The implications for producing Flood Investigation Reports and any consequences of blight have been considered. The process of gaining insurance for a property and/or purchasing/selling a property and any flooding issues identified are considered a separate and legally binding process placed upon property owners and this is independent of and does not relate to the Council highlighting flooding to properties at a street level.

Bolton Council does not accept any liability for the use of this report or its contents by any third party.

Appendix 1: Glossary

Term	Definition
Building Regulations	The UK Building Regulations are rules of a statutory nature to set standards for the design and construction of buildings, primarily to ensure the safety and health for people in or around those buildings, but also for purposes of energy conservation and access to and about other buildings
Catchments	An area that serves a river with rainwater, that is every part of land where the rainfall drains to a single watercourse is in the same catchment.
Climate change	The change in average conditions of the atmosphere near the Earth's surface over a long period of time.
Combined Sewer	Underground pipes which collect both surface water run off and foul wastewater.
Critical Infrastructure	Infrastructure that supplies essential services, for example, water, energy, communications, transport.
Cultural Heritage	Buildings, structures and landscape features that have an historic value.
Culvert	A covered structure under a road, embankment etc, to direct the flow of water.
Defences	A structure that is used to reduce the probability of floodwater affecting a particular area (for example a raised embankment)
Defra	Department for Environment, Food and Rural Affairs
Drainage Authorities	Organisations involved in water level management, including Internal Drainage Boards, local authorities, the Environment Agency, and RFCCs.
External Flooding	The flooding of gardens, detached garages and outbuildings, streets and open spaces.
FCERM	Flood and Coastal Erosion Risk Management
Flood	The temporary covering by water of land not normally covered with water
FWMA	Flood and Water Management Act
GMFRS	Greater Manchester Fire and Rescue Service
Internal Flooding	Flooding arising from flood water entering a commercial or residential property. It is usually limited to the flooding of habitable living space and not garages or storage areas.
LLFA	Lead Local Flood Authority. The local authority responsible for taking the lead coordinating role on local flood risk management.
LPA	Local Planning Authority
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has powers.
NFM- Natural Flood Management	Natural Flood Management is the use of natural interventions that reduce the rate of surface water run-off, such as the use of leaky dams and temporary storage ponds.
Ordinary Watercourses	All watercourses that are not designated Main River for which are the Local Drainage Authority has powers.
Ofwat	The Water Services Regulator
Reservoir	A natural or artificial lake where water is collected and stored until needed. Reservoirs can be used for irrigation, recreation, providing water supply for municipal needs, hydroelectric power or controlling water flow.
Resilience	The ability of the community, services, area or infrastructure to avoid being flooded or lost to erosion, or to withstand the consequences of flooding or erosion taking place.
RFCC	Regional Flood and Coastal Committee
Riparian Owner	Person who owns land or has property adjacent to a watercourse whether open or culverted running through their property.

Term	Definition
Risk	Measures the significance of a potential event in terms of likelihood and impact. In the context of the Civil Contingencies Act 2004, the events in question are emergencies
Risk Assessment	A structured and auditable process of identifying potentially significant events, assessing their likelihood and impacts, and then combining these to provide an overall assessment of risk, as a basis for further decisions and action.
RMA - Risk Management Authorities	Organisations that have a key role in flood and coastal erosion risk management as defined by the Flood and Water Management Act (2010). These are the Environment Agency, lead local flood authorities, district councils where there is no unitary authority, internal drainage boards, water companies, and highways authorities.
River Flooding	Flooding resulting from river levels exceeding the natural or constructed banks or defence level of a river or stream, typically caused by prolonged and/or heavy rainfall across catchments over days and weeks.
Sewer Flooding	Flooding caused by blockage or overflow of a sewer, or capacity issues or electro- mechanical failure of pumping stations. This includes flooding from storm / surface water and combined sewers.
Standard of protection	The flood event return period above which significant damage and possible failure of the flood defences could occur.
Surface Water Flooding	Sometimes called pluvial or urban flooding. Flooding from intense rainfall falling on impermeable or saturated surfaces and/or exceeding the ability of any drainage system to manage flows, typically caused by short period storms over a matter of hours or less.
Surface water Sewer	Separate underground pipe system designed specifically for transporting excess rain and surface water from houses, commercial buildings and roads for disposal. Usually managed by the local sewerage undertaker United Utilities.
Watercourse	A channel (natural or artificial) along which water flows usually from a natural source. Watercourses include all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows.

Appendix 2: Summary of Relevant Legislation and Flood Risk Management Authorities

The Flood Risk Regulations 2009 and the Flood and Water Management Act 2010 (the Act) have established Bolton Council as the Lead Local Flood Authority (LLFA) . This has placed various responsibilities on Bolton Council 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.

Flooding Type	**Description**	**Party Responsible for Managing the Risk**
Surface Water Flooding	Flooding from intense downpours of rain that result in large volumes of run-off from land or when drainage systems cannot cope with the amount of rainfall.	Bolton Council United Utilities (if from surface water sewers)
Groundwater Flooding	Occurs when the ground water-table rises causing flooding.	Bolton Council
Highway Flooding	Occurs when the highway drainage system or the sewers they discharge to cannot cope with the amount of rainfall entering the system, or when gullies become blocked.	Bolton Council (as Local Highway Authority), United Utilities, and Highways England (on Motorways)
Ordinary Watercourses	Flooding from intense downpours of rain that result in large volumes of run-off from land causes streams and culverts not marked on the main river map to overflow.	Bolton Council
Main River	Flooding from rivers or streams on the main river map	Environment Agency

Flooding Type	Description	Party Responsible for Managing the Risk
Reservoirs	Flooding from reservoirs falling under the provisions of the Reservoirs Act	Environment Agency
Sewer Flooding	Occurs when the amount of water entering the sewer system exceeds its design capacity or when the system becomes blocked.	United Utilities
Water Supply Flooding	Occurs when water mains burst.	United Utilities
Canals	Breaches of embankments supporting canals can result in flooding.	Canal and River Trust
Railways	Flooding from intense downpours of rain that result in large volumes of run-off from land on to the railway or when drainage systems on the rail network cannot cope with the amount of rainfall.	Network Rail

The following information provides a summary of each Risk Management Authority's roles and responsibilities in relation to flood reporting and investigation.

Central Government

Defra develop national policies to form the basis of the Environment Agency's and Local Government's work relating to flood risk.

Environment Agency (EA)

The EA 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 the LLFA).

The EA has permissive powers to carry out maintenance work on Main Rivers under Section 165 of the Water Resources Act. However, the frequency of EA maintenance activities is primarily risk based, and for many areas these activities can comprise annual vegetation management, debris screen maintenance and clearance of blockages as and when is required. Any third-party assets on main rivers, such as access structures and pipe bridges, are neither owned nor maintained by the EA. The EA's policy on third party assets is to notify third party owners of their asset forming part of a flood risk system, and assist by inspecting the assets and advising third party owners on their condition. The EA will also encourage third party asset owners to maintain their property in appropriate condition and will take enforcement action where it is appropriate. They may consider undertaking maintenance or repair of third-party assets only where it can be justified in order to safeguard the public interest and where other options are not appropriate.

Lead Local Flood Authorities (LLFA's)

Bolton Council is the LLFA. 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 Bolton Council by the Local Flood Risk Management Team.

Bolton Council is also the Land Drainage Authority for the area, under the Land Drainage Act Bolton Council has permissive powers to take action against riparian owners for contraventions of the Act and has permissive powers to carry out maintenance work

Riparian landowners are those who own land containing or adjoining a watercourse. As detailed within the EA document 'Living on the Edge', riparian landowners have certain rights and responsibilities, including the following:

- they must maintain the bed and banks of the watercourse, and also the trees and shrubs growing on the banks;
- they must clear any debris, even if it did not originate from their land. This debris may be natural or man-made;
- they must keep any structures that they own clear of debris. These structures include culverts, trash screens, and weirs;
- if they do not carry out their responsibilities, they could face legal action.

As already discussed, riparian landowners must be aware that any works in, over, under or within ordinary watercourse, require formal consent from the LLFA under the Land Drainage Act. They must not carry out work without consent. If they do, the LLFA could reclaim from them the cost of removing, altering or demolishing works. Works in, over or under, or alterations to Main River require the formal consent of the EA under the Water Resources Act.

Water and Sewerage Companies

The local water and sewerage company United Utilities 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.

Sewerage companies own significant and extensive flood risk assets. Nearly every street contains sewers which convey surface water. These sewers are susceptible to collapses on aged infrastructure, their limited capacity coupled with increased demand from new development and climate change can all increase the risk of sewer flooding occurring.

The companies are regulated by the Office for Water Services whose objectives are to ensure that standards of service are met and that bills are affordable whilst meeting investment demands.

Highway Authorities

There are two highway authorities within the administrative area of Bolton; Bolton Council who managed the local roads and Highways England who manage the national strategic roads (M61). 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. In some cases, 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.

Bolton Council has a duty to maintain the highway under Section 41 of the Highway Act 1980. In respect of flood risk this duty primarily includes the maintenance of roadside gulley's, connecting pipework, roadside grips and ditches.

Regional Flood and Coastal Committee

Each Regional Flood & Coastal Committee (RFCC) is a committee established by the Environment Agency under the Flood & Water Management Act 2010. The Environment Agency must consult with RFCCs about flood and coastal risk management (FCRM) work in their region and take their comments into consideration. RFCCs approve the annual programme of FCRM work in their region and set the local levy that funds FCRM activities within the region that are a local priority.

Each RFCC brings together members appointed by Lead Local Flood Authorities (LLFAs) and independent members with relevant experience who are appointed by the Environment Agency. The Committee's chair is appointed by Defra. There are currently 12 RFCCs across England, each covering a distinct regional area based on river catchments

Appendix 3: Useful Contacts and Links

Bolton Council (Lead Local Flood Authority)

General Enquiries	01204 333333 (Mon-Fri, 9am - 5pm)
Out of Hours incidents	01204 336690
Highways Incident Line	01204 336600 (Mon-Fri, 9am - 5pm)

Environment Agency

General Enquiries	03708 506 506 (Mon-Fri, 8am - 6pm)
Floodline	0845 988 1188 (24-hour service) or Type talk 0845 602 6340

Browse: Flooding and extreme weather - GOV.UK (www.gov.uk)

United Utilities

General Enquiries 0345 672 3732 (24 hour service) http://www.unitedutilities.com/

Legislation

Highways Act 1980: http://www.legislation.gov.uk/ukpga/1980/66/contents

Water Resources Act 1991: http://www.legislation.gov.uk/ukpga/1991/57/contents

Land Drainage Act 1991: http://www.legislation.gov.uk/ukpga/1991/59/contents

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

Government Guidance on Owning a Watercourse: a guide to the rights and responsibilities of riverside occupation:
https://www.gov.uk/guidance/owning-a-watercourse

Government Guidance – "Am I at risk of flooding?" maps of flood risk from main rivers and surface water
https://flood-warning-information.service.gov.uk/long-term-flood-risk

EA - River and Coastal Maintenance Programmes:

Asset Information and Maintenance Programme (data.gov.uk)

Government Guidance - Prepare for Flooding:

What to do.
https://www.gov.uk/prepare-for-flooding
https://www.bolton.gov.uk/flooding-drainage/flooding-advice/1

Flood Risk in Bolton:

https://www.bolton.gov.uk/flooding-drainage/flood-defence

The North West Regional Flood and Coastal Committee have created a website that provides information and resources to support homes businesses and communities across the north west in becoming more flood resilient.

http://www.thefloodhub.co.uk/

Flood Re

We're also aware that some people are finding it difficult to get insurance that covers flooding, or are facing large increases in premiums when their policies come up for renewal. It's worth taking a look at Flood Re, a national scheme established in the last couple of years to ensure people living in flood risk areas have access to affordable home insurance: https://www.floodre.co.uk/

The Flood Advisory Service provide a step by step guide for homeowners to help them to understand their flood risk and advise how to make homes more resilient.

https://floodadvisoryservice.co.uk/

Appendix 4: Photographs from the Investigation

College Drive - Overland flow

Source : photo shared on social media by local residents

Nellis Clough – Scouring of stream bed

Nellies Clough – scour of stream bed and erosion

Nellies Clough – Scour to stream bed

Nellies Clough – Landslip and erosion

Nellies Clough Culvert inlet and debris screen (photo taken 17th May after partial clean)

Victoria Road – at St Johns Church

Austins Lane (downstream of Moor Platt Clough)

Source : photo shared on social media by local residents

Chorley New Road at Junction of Claypool Road

Source : photo shared on social media by local residents

Appendix 5: The Dangers of Flash Flooding and how to stay safe.

What is flash flooding?
Flash floods occur extremely quickly - much faster than other forms of flooding - and with massive force. They can move rocks, tear out trees, sweep away vehicles and destroy buildings and bridges.

They tend to happen when heavy rainfall runs off land and quickly swells rivers and streams. Water can also build up quickly in urban areas when rainfall is unable to drain away.

How to recognise a flash flood:

- heavy rainfall
- a short time between the rainfall and flooding
- large amounts of fast flowing water
- damage to buildings and structures
- dangers presented by debris
- there is an urgent threat to life.

Three steps to safety
1. Be aware and know the signs
Flash flooding can happen suddenly. You may have to act before the Environment Agency can issue a warning, or before emergency services can reach you. It's important to know what signs to look for so you can act fast.

Signs to watch for:

- heavy rain or severe weather reports
- rising water levels with churning, dark water
- a build up of debris in rivers or streams.

People particularly at risk are those:

- in basements or single-storey properties
- in a mobile home, tent, caravan, boat or wooden structure
- unfamiliar with the area, eg. tourists.

2. Do not walk or drive through flood water
In a flash flood most injuries and deaths happen when people try to cross flood water on foot or in a vehicle.

Never underestimate the danger of a flash flood:

- It only takes 15cms (six inches) of fast-flowing water to knock an adult over
- It only takes 60cms (two feet) of water to lift and sweep away a 4 x 4 car or small lorry
- There may be hidden dangers in the water including rubble, vegetation and exposed drains.

3. Plan where to go if you get caught in a flash flood
The greatest danger occurs when people panic or are uncoordinated in their response to flash flooding, particularly before the emergency services arrive. If you plan what you would do in advance, you are more likely to be able to stay safe.

If you are in a building with at least two storeys and believe it is safer to stay where you are, you should:
• move to a higher storey of the building
• wait for instructions from the emergency services

If you are in vulnerable accommodation such as a bungalow, caravan, tent or caught outside you should:
• seek shelter in the nearest two-storey building or go to higher ground
• call 999 if you are trapped

Flood warnings - Flash floods can happen very quickly and there's often no time to issue flood warnings in advance. Even when warnings are possible, there may be little time to act. We will be looking at the warning options available to your community and helping you to plan what to do and how to stay safe.

For more information about how to prepare for flooding or to check your flood risk phone Floodline on 0345 988 1188.

You can check the flood risk at a property at the Government's flood warning information service at the webpage below.
https://flood-warning-information.service.gov.uk/long-term-flood-risk/postcode

The above information is taken from the EA and government publication of flash flooding at the following website:
https://www.gov.uk/government/publications/flash-flooding