Flood & Water Management Act 2010
Section 19
Flood Investigation Report

Date of Incident: 23rd July 2017
Location: Oxton, Claughton, Bidston, Prenton, Birkenhead & Bromborough

WIRRAL

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Executive Summary

Wirral Council, as the Lead Local Flood Authority (LLFA), has a responsibility to record and report flood incidents under Section 19 of the Flood and Water Management Act (2010). Wirral Council adopted its Section 19 Flood Investigation Policy in April 2012 which sets out when the Council deems a flooding incident to be 'significant' and therefore to carry out a formal Section 19 Flood Investigation.

This Section 19 Flood Investigation Report has been prepared for the significant flooding incident covering the areas of Oxton, Bidston, Prenton, Claughton, Birkenhead and Bromborough, of Sunday 23rd July 2017 during which 74 properties were flooded; 35 properties were internally flooded and 39 properties externally flooded.

On 23rd July 2017 a total of approximately 28mm of intense rainfall fell between 06:00 BST and 10:00 BST across the eastern side of Wirral from Birkenhead through to Bromborough. This volume and intensity of rainfall has an annual exceedance probability (AEP) of 0.125%; the equivalent of a 1 in 800 year rainfall event. There was no advanced warning ahead of the rainfall.

The rainfall event resulted in internal flooding and property damage in, but not limited to, Claughton, Prenton, Oxton, Birkenhead and Bromborough. The flooding incident also caused disruption to transport routes.

The intensity of rainfall meant that rain water was unable to infiltrate to the ground quickly enough as it does during smaller rainfall events causing surface water runoff. Additionally, the capacity of the sewerage network may have been exceeded in places by the intensity of rainfall causing the sewers to surcharge and this water to also flow overland. It was this excess water which flowed overland and caused localised flooding and damage to property. In many locations surface water flooding issues were combined with sewer flooding.

The Risk Management Authorities (RMAs) provided incident response during and after the flood incident and Merseyside Fire and Rescue Authority, a Category 1 responder under the Civil Contingencies Act 2004, also provided incident response during the incident.

This Section 19 Flood Investigation has identified a need for Wirral Council LLFA to formalise the request for information from all those involved in the flood incident in line with Section 14 of the Flood and Water Management Act so that :

- A decision as to whether the event meets the threshold for significance for a formal investigation can be made.
- Any ongoing risk causal to the incident can be identified and resolved as soon as possible.

Additionally a number of strategic and site-specific actions have been identified to address:

- Site-specific problems arising as a result of surface water run-off from public and private land;
- Prioritisation of call-outs to highway flooding incidents, and;
- A review of highway cleansing regimes.

A S19 Flood Investigation Report had been prepared for a significant flood incident in September 2015. A review of the cause(s) of that incident and the recommendations arising from the report has been undertaken and concluded that

- The July 2017 incident differed in that the rainfall occurred over a shorter period and was more intense, leading to rapid onset of surface water flooding. In September 2015 rainfall over a longer, 12 hour period caused flooding from multiple sources including river, sewer and surface water.
- The recommendations from September 2015 have, in the majority been implemented, however due to the different nature of this incident there were no measures which could have reduced the impact of the flooding.

1. Introduction & Background

Section 19 of the Flood and Water Management 2010 places a duty on Wirral Council as the Lead Local Flood Authority (LLFA) to record, investigate and report flood incidents where it considers it 'necessary and appropriate'.

Section 19: Flood and Water Management Act 2010

1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate—
   a) Which risk management authorities have relevant flood risk management functions, and
   b) Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

2) Where an authority carries out an investigation under subsection (1) it must—
   a) Publish the results of its investigation, and
   b) Notify any relevant risk management authorities.

This section of the Act leaves the determination of the extent of flood investigation to the LLFA. It is not practical or realistic for Wirral Council to carry out a detailed investigation into every flood incident that occurs, but the LLFA will, at a minimum, record details of every flood incident of which it is made aware.

Wirral Council adopted its Section 19 Flood Investigation Policy in April 2012. This sets out when the Council, as LLFA, deems a flooding incident as 'significant' and therefore will undertake a formal Section 19 Flood Investigation and publish the results of this investigation.

Wirral Council Flood Investigation Policy (2012)

For the purpose of reporting Flood Investigations, a flooding incident is deemed significant if it:

- Caused internal flooding to 8 or more residential properties/business premises within a kilometre square area;
- Flooded one or more items of critical infrastructure e.g., a pumping station, an emergency services station, electricity sub-station, hospital etc, or;
- Caused a transport link to be totally impassable for a significant period.
    - **Category 1:** highways (motorways) and rail links – 1 hour or more
    - **Category 2 and 3a highways:** 2 hours or more
    - **Category 3b, 4a, 4b highways:** 4 hours or more

This Section 19 Flood Investigation Report has been prepared for the significant flooding incident of Sunday 23rd July 2017 which resulted in flooding to 74 properties and to highway infrastructure.

2. Role and Responsibilities of Risk Management Authorities and Others

The legal framework for managing flood risks lies with a number of different 'risk management authorities' as defined under Section 6(13) of the Flood and Water Management Act 2010. The key responsibilities for each risk management authority are outlined in the sections below.

2.1 Wirral Council

Under the Civil Contingencies Act (2004), Wirral Council are a Category 1 Responder and therefore have the duty to put in place emergency plans and assess local risks to inform emergency planning. Wirral Council are also required to make information available to the public about civil protection matters and maintain arrangements to warn and advise the public in the event of an emergency.

Wirral Council hosts two risk management authorities:

(i) Lead Local Flood Authority (LLFA)

As the Lead Local Flood Authority (LLFA), Wirral Council is responsible for managing the risk of flooding from 'local' sources which includes surface water, groundwater and watercourses that are classified as 'ordinary watercourses'.

The LLFA has a responsibility to investigate flood incidents where it is considered 'necessary and appropriate'. As part of this role, Wirral Council holds Operational Flood Group Meetings with other flood Risk Management Authorities (RMAs) to discuss and report on flood risk management.

The LLFA does not have an active role in responding to flooding during a flood incident, however it does have a post-event responsibilities.

(ii) Highway Authority

As the Highway Authority, Wirral Council is responsible for managing the risk of flooding on the adopted highway.

The Highway Authority has a duty to maintain adopted highways within their administrative area under Section 41 of the Highways Act 1980. Highway maintenance includes that of the road drainage networks (drains and gullies).

The Highway Authority does have an active role in responding to flooding from the highway during flood incidents and will respond to call outs during flood incidents.

2.2 Environment Agency

The Environment Agency has a strategic overview role and responsibility for flood and coastal erosion risk management in England. The Environment Agency is also a risk management authority with responsibility for managing the risk of flooding from watercourses classified as 'Main Rivers' and the sea.

The Environment Agency also has permissive powers to carry out emergency or maintenance work on watercourses classified as 'Main Rivers' under Section 165 of the Water Resources Act (1991).

The Environment Agency has permissive powers to issue flood warnings to communities at risk of flooding. It should be noted that is a permissive power and is not a statutory duty.

The Environment Agency has an active role in responding to flooding from Main Rivers and the sea during flood incidents.

2.3 United Utilities and Dŵr Cymru Welsh Water

United Utilities (UU) and Dŵr Cymru Welsh Water (DCWW), as Water and Sewerage Companies, are responsible for managing the risk of flooding from their respective surface water, foul and/or combined sewer network where the sewer flooding is wholly or partly caused by an increase in the volume of rainwater (including snow and other precipitations) entering or otherwise affecting the system.

United Utilities and Dŵr Cymru Welsh Water have a duty to provide and maintain a system of public sewers so that the areas for which they are responsible are effectually drained (Water Industry Act, 1991).

Sewerage systems are not, however, designed to accommodate flows from severe weather events. During severe weather the capacity of the sewerage network may be exceeded and result in localised surcharging and/ or flooding. United Utilities classify severe weather as rainfall that exceeds a 1 in 20 year return period. Larger, more intense storms would therefore be expected to result in surcharging of the sewer network.

United Utilities and Dŵr Cymru Welsh Water are required to deliver a significant reduction in sewer flooding incidents by 2020. Their performance commitment includes flooding caused by hydraulic inadequacy of sewers, and other causes of flooding such as blockages, collapses and equipment failures. This commitment does not differentiate between the causes as they have the same impact on the customer.

United Utilities investigates all flooding incidents that are reported to them and undertakes a verification exercise to understand the issues and flooding mechanisms. This may include a site visit and CCTV survey to determine if there were any blockages in the network. Any blockages encountered during the investigations are cleared to ensure that the flow is reinstated.

2.4 Riparian Owners

The owner of land abutting a watercourse is known as a "riparian owner". Riparian owners have responsibilities which have been established over time at common law. These responsibilities may not appear on the Land Registry title to the land, but will automatically pass on a conveyance of the land in question and include maintaining the bed and banks of the watercourse; this includes maintenance of any owned structures, such as trash screens or culverts. If a riparian owner fails in their duty to maintain a watercourse for which they have responsibility, the LLFA has statutory powers under the Land Drainage Act 1991 and may enforce such works.

Riparian owners must let water flow through land without any obstruction and must also accept flooding on their land even if this is caused by inadequate downstream capacity. A landowner is under no obligation to improve drainage capacity in a watercourse that is in their ownership, only to ensure the flow is unobstructed.

2.5 Local Residents

Where residents are aware that they are at risk of flooding it is their responsibility to ensure that they and their properties are protected. Residents should report flooding incidents or potential problems (such as blockages) to the LLFA or appropriate organisation if known.

3. Flood Incident Details

3.1 Overview

On Sunday 23rd July 2017 a band of intense rainfall moved eastwards from Liverpool across the Mersey Estuary to the eastern side of Wirral. Whilst the whole of the Wirral experienced rainfall the areas from Bromborough through to Birkenhead experienced intense rainfall between 06:00 BST and 10:00BST.

The rainfall event resulted in internal flooding and property damage in Claughton, Prenton, Oxton, Birkenhead and Bromborough. Internal property flooding was also reported in Upton, Pensby and Heswall.

The incident also caused disruption to transport routes with Woodchurch Road affected by flood water (but remained passable). Merseytravel also reported flooding to the Wallasey Tunnel approach roads (but remained passable).

Press reports have also identified flooding throughout Birkenhead Park and on adjacent roads.

3.2 Meteorological Conditions

Information received from the Met Office confirmed that rainfall progressed from Liverpool towards the Wirral between 06:00 and 07:00 BST. This band of rainfall intensified and roughly aligned along the direction of the Wirral peninsula by 07:30 BST.

The rainfall band was still in place across the Wirral at 08:00, 08:30 and 09:00 before it started to ease and move away westwards at 09:30 and had largely departed by 10:00.

Met Office analysis of the Environment Agency rain gauge, situated at Moreton identified that only 7.8mm of rain fell there between 05:00 and 13:00. This amount of rainfall would not normally be associated with flooding. The Met Office concluded that the rainfall that caused flooding must have been localised and heavier than the rainfall recorded at Moreton.

3.3 River Flow Data

The Environment Agency maintains a series of river depth gauges across the Wirral however there are no gauges currently positioned within the watercourses of The Fender or The Dibbinsdale Brook, which are the two watercourses closest to the most intense rainfall and the majority of the reported flooding incidents.

Figures 1 and 2 relate to river flows in The Birket at Davies Road, Moreton and at the entrance to the Great Culvert. Flows from The Fender converge with those within the Birket immediately upstream of the Davies Road gauge.

It can be seen that the river catchment responded to the localised flooding in Birkenhead area some 3 to 4 hours after the rainfall ceased, with peak river level recorded at approximately 12:00 GMT.

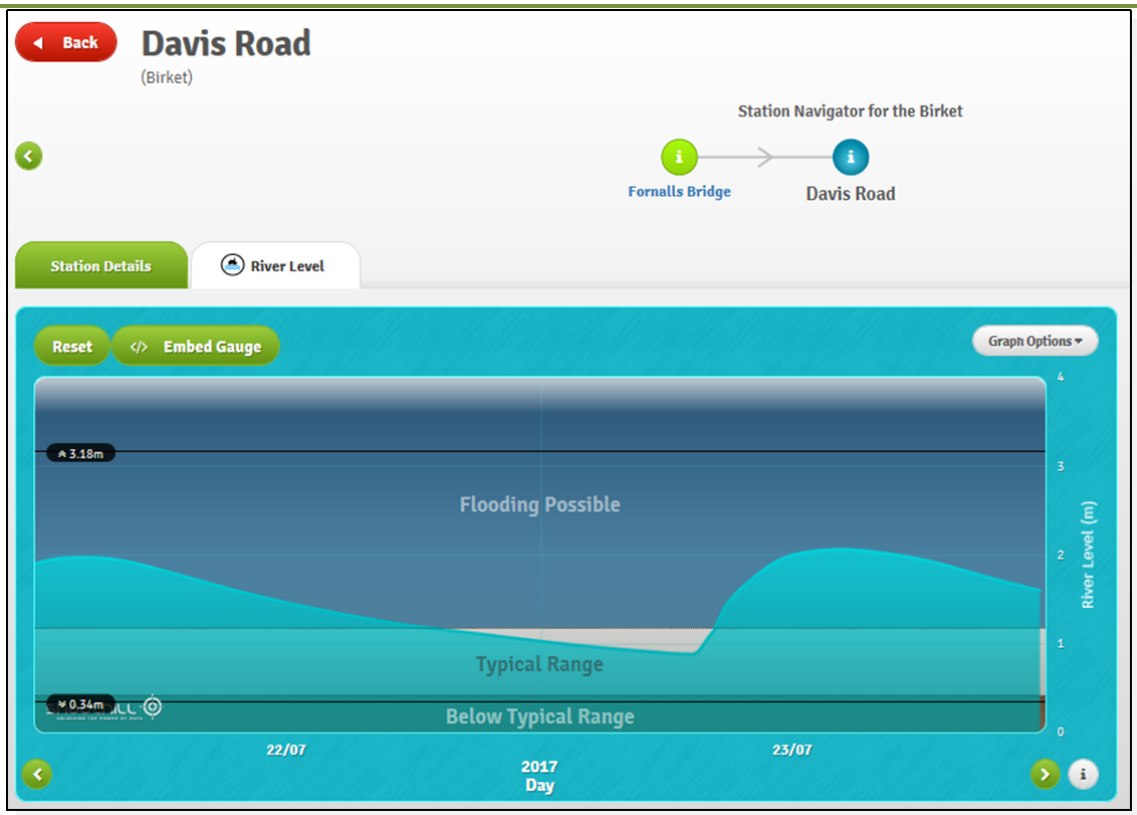


Figure 1 : Davis Road River Level Gauge

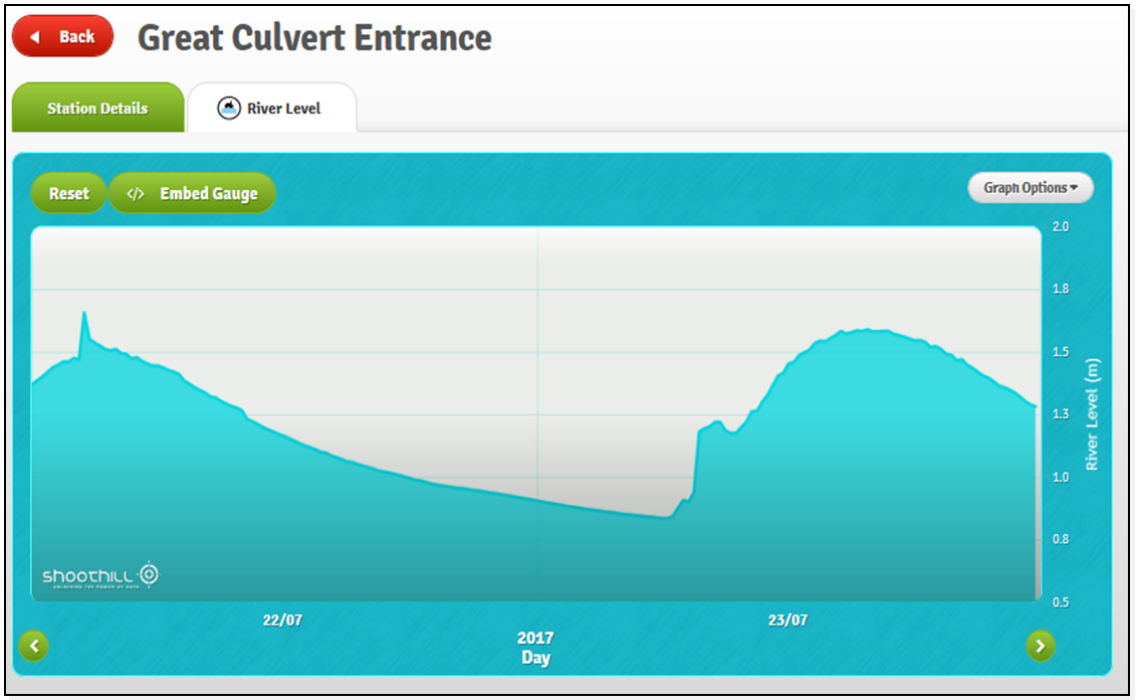
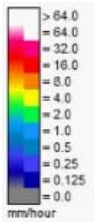


Figure 2 : Great Culvert Entrance River Level Gauge

3.4 Observed Rainfall

Observations from the Met Office confirm that measured rainfall at the Environment Agency rain gauge in Moreton was not representative of more intense localised rainfall elsewhere across Wirral on the morning of 23rd July 2017.

Rainfall radar has been used to supplement the analysis of observed rainfall and whilst not a direct substitute for observed data from a rain gauge it serves as a useful alternative where it is apparent that rainfall that has caused flooding has not been observed by traditional means.



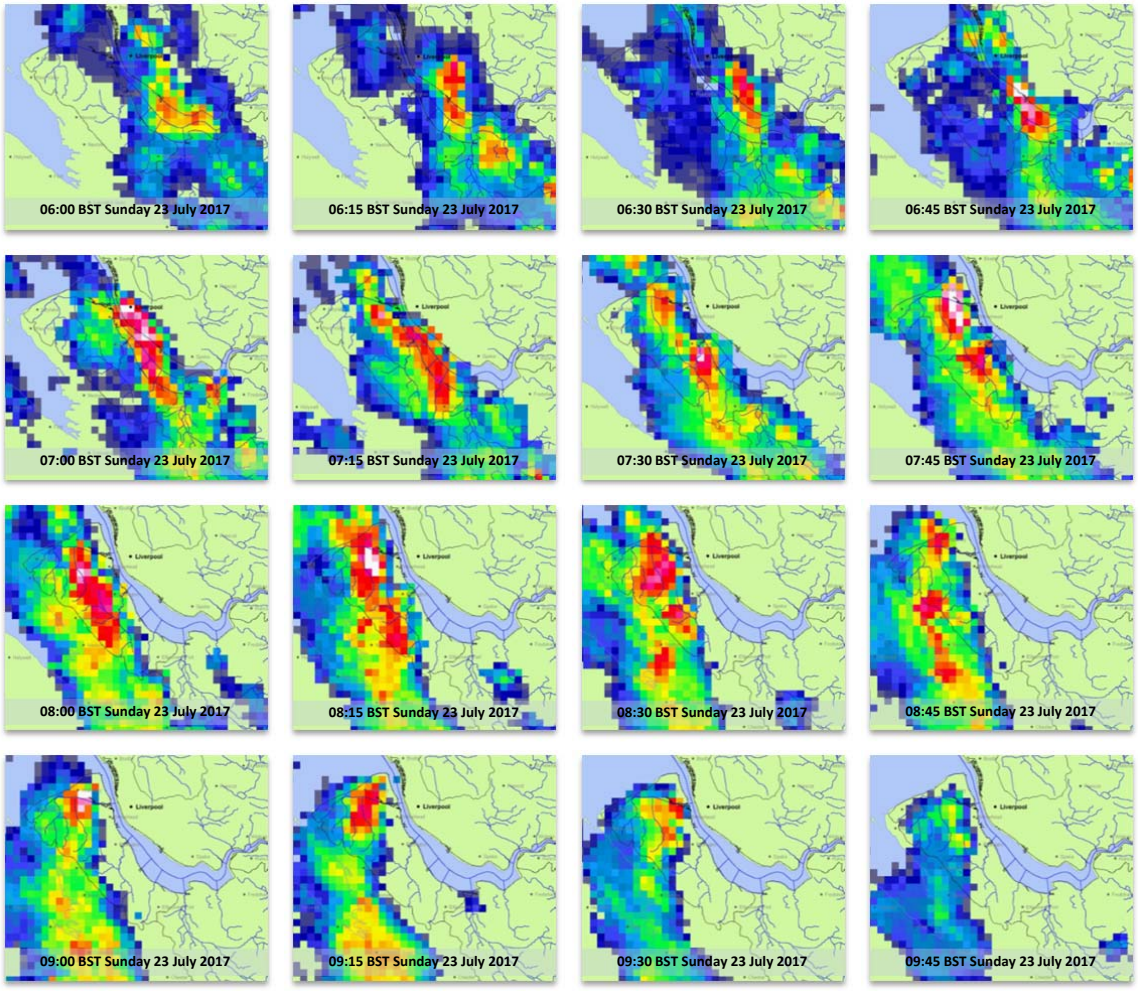


Figure 3 : Radar Rainfall Intensity Sunday 23rd July 2017 06:00 to 09:45 BST
(Imagery courtesy of Environment Agency)

Approximate analysis of the radar data for the Birkenhead and Oxton areas identifies that more than 27mm rain fell within the period 06:00 to 09:45 BST, with 20mm of this rainfall occurring between 07:45 and 08:15 BST.

3.5 Annual Exceedance Probability (AEP)

United Utilities have undertaken analysis of the rainfall that fell on the early morning of 23rd July 2017. Classification of the event initially identified the rainfall to be severe and extreme which reflects the high volume of rainfall that fell in a short period of time.

Statistical analysis based upon the rainfall totals identifies the Annual Exceedance Probability of the event to be approximately 0.125% or a 1 in 800 year rainfall event.

3.6 Weather Warnings

There were no National Severe Weather Warnings in place for the 23rd July 2017. The Met Office had previously issued an update on 19th July 2017 advising of *"locally intense thundery downpours"* for Merseyside for the afternoon and evening of the 19th July 2017.

The Met Office confirms that no National Severe Weather Warnings or local updates were issued and that the rainfall on 23rd July 2017 was very localised.

The Environment Agency did not issue any Flood Alerts or Flood Warnings for the Flood Warning Areas in the Wirral for 23rd July 2017. The Environment Agency, however, will only warn of flooding from rivers or the sea. They are not able to issue warnings for surface water flooding.

4. Data Collection

4.1 Consultation

This Flood Investigation Report has been undertaken in consultation with Risk Management Authorities and others.

Data was requested and received from Risk Management Authorities, Emergency Responders and others involved in the flooding. Table 1 summarises the data provided for use during this Section 19 Flooding Investigation.

In addition, Wirral Council held a meeting with United Utilities on 28th July 2017 and held conversations with Dŵr Cymru Welsh Water during the week commencing 24th July 2017.

Table 1: Data Sources

Consultee	Information
Dŵr Cymru Welsh Water	• Relating to flooding incidents in Heswall area
Environment Agency	• Rainfall data
Local Residents	• Photographs • Flooding reports • Anecdotal evidence
Met Office	• Report on weather situation on 23rd July 2017
Merseyside Fire & Rescue Authority	• Call Out Log from 23rd July 2017
United Utilities	• Flooding Data for 23rd July 2017
Wirral Council	• Call Out Log for 23rd July 2017 • Incidents reported to the LLFA Inbox • Incidents reported via Local Councillors to LLFA • Reports for 23rd July 2017 from public sources

This Section 19 Flood Investigation has identified a need for Wirral Council LLFA to formalise the request for information from all those involved in the flood incident in line with Section 14 of the Flood and Water Management Act so that :

- A decision as to whether the event meets the threshold for significance for a formal investigation can be made.
- Any ongoing risk causal to the incident can be identified and resolved as soon as possible.

Data requests will set out the powers under which the request is made, the timescale for response and the detail and format of data to be supplied.

4.2 Data Review

In addition to the data provided in Table 1 the post-incident Operational Flood Group Meeting with United Utilities on 28th July 2017 and conversations with Dŵr Cymru Welsh Water during the week commencing 24th July 2017 were used to understand flooding type and discussions around flooding cause based on understanding of their networks and any previous history of flooding and / or hydraulic incapacity.

Flooding incidents have been mapped using Mapinfo Geographic Information System (GIS) to help understand the spatial variation of the event. The output from this mapping can be seen in Figure 4 below. Internally flooded property is denoted by a red star whereas a black star identifies external flooding.

All data relating to regions of highway flooding, internal and external flooding that has been verified following investigation has been entered into the LLFA flooding register.

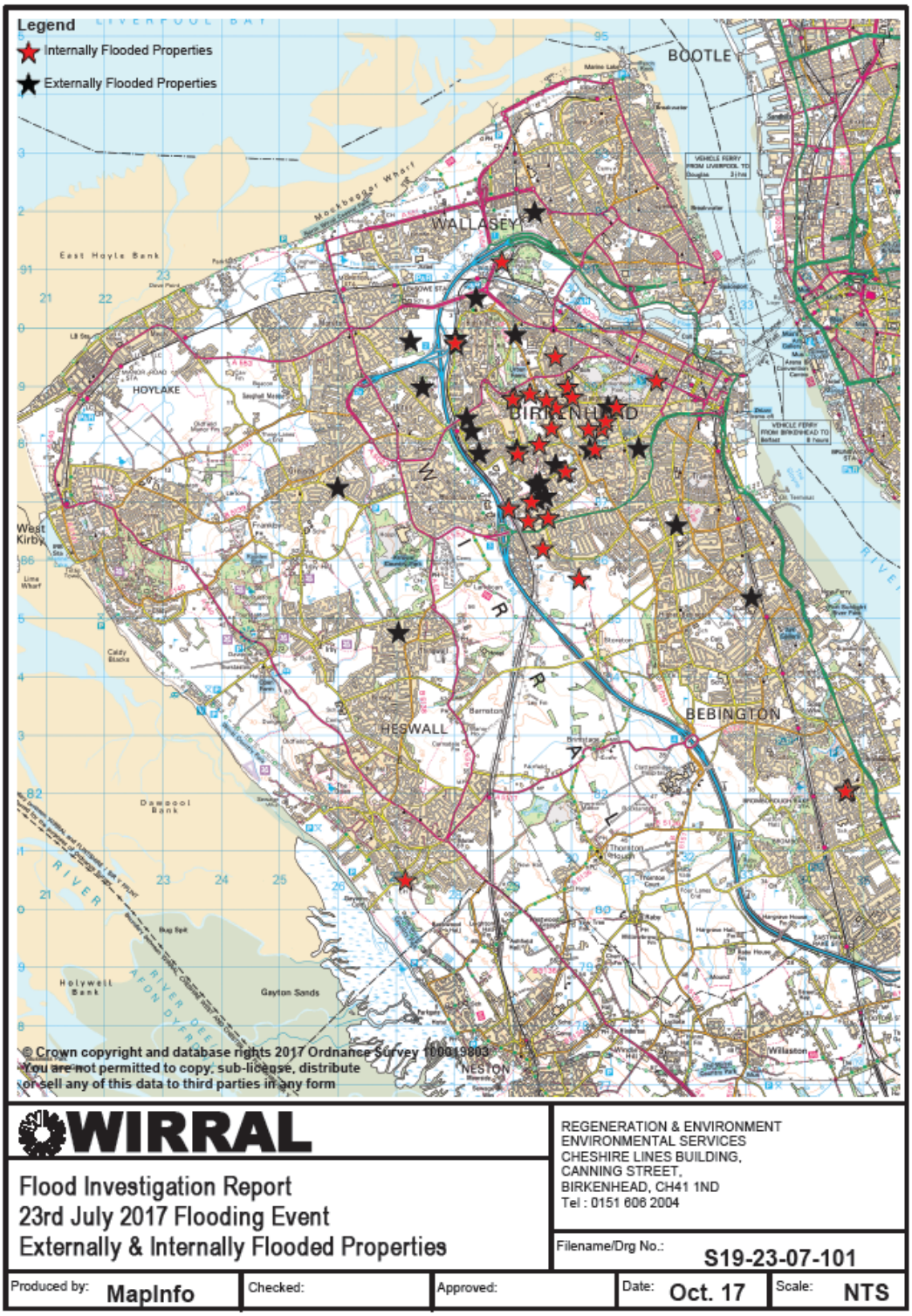


Figure 4: Location of Flooded Properties

5. Flooding Mechanisms

5.1 Definitions

The following types of flooding are relevant to this Section 19 Investigation Report:

- **Surface Water** – Overland flow of water over areas that are usually dry. The overland flow of water is caused by rainfall that cannot permeate into sub-soil or cannot enter into drainage systems

- **Watercourse** – Flooding that occurs because water cannot be retained within a watercourse, either because the watercourse capacity is exceeded or because of an operational problem with the watercourse

- **Sewer** – Water that surcharges from a combined or surface water sewer either because of hydraulic incapacity, an operational problem or because the design capacity is exceeded.

- **Combination** – Any combination of flooding types that can result in flooding.

This investigation has not identified the following sources of flooding:

- **Groundwater**
- **Sea**

5.2 Findings of Investigation at Flooding Locations

For the purposes of this report the findings on type, cause and consequence are grouped together into the areas below.

Bromborough

Two reports of internal flooding were initially received for the Bromborough area. Data collection along The Rake identified a further five properties that were affected.

A desktop exercise identified historical flooding at some of the properties affected and a collaborative investigation was conducted between Wirral Council Highway Authority and United Utilities. This identified the following:

- Properties were flooded by surface water unable to enter the highway drainage system
- Surface water from an adjacent car park was also flowing onto the highway thereby exacerbating the problem
- Dye testing and tracing of gullies showed the majority to be functioning correctly and discharging to United Utilities' combined and surface water sewers. One gulley was found to be discharging slowly
- CCTV inspection of the United Utilities' sewers identified blanked off connections from two gullies as a result of lining repairs to the sewer

Conclusion

Flooding at The Rake in Bromborough was caused by a combination of excessive rainfall exceeding the capacity of drainage assets (highway gullies and United Utilities sewers) and an operational problem on the combined sewer. The excessive rainfall also caused additional flows from an adjacent car park area to discharge surface water onto the highway thereby increasing the volume of water to be served by the highway drainage assets on The Rake.

Recommendations

1) United Utilities to reconnect the highway gulley to their sewer by removing the lining at the point of connection
2) Wirral Council to review the cleansing frequency of car park gullies in Bromborough and also to consider modifications to prevent the flow of water onto the highway.

Birkenhead, Bidston, Claughton, Oxton, Prenton

The majority of reports of flooding cover these areas. Discussions have taken place with United Utilities to determine the cause of the flooding in conjunction with site visits where this was unclear.

Flooding in this area was well reported in the press with the flooding causing structural damage to highways at Townfield Lane in Oxton and Shrewsbury Road in Claughton.

Significant overland flow was also reported through Birkenhead Park which led to flooding of properties and businesses on adjacent roads at Park Road North and Conway Street.

Figure 5: Overland Surface Water flow in Birkenhead Park, 23rd July 2017

In Claughton the investigation has determined that flooding to properties and also damage to the highway at Shrewsbury Road was caused by intense rainfall which exceeded the design capacity of drainage assets. United Utilities investigation also identified displaced bricks in their 620mm brick egg combined sewer however it is unlikely that the size of obstruction in a relatively large sewer was a causal factor in the flooding.
In Oxton 17 properties are confirmed to have flooded internally. The rainfall intensity in Oxton was the highest across the whole of Wirral and this is the primary cause of the flooding.

The rainfall in Oxton was severe and extreme and analysis identifies it to have had an Annual Exceedance Probability (AEP) of 0.125% which is a 1 in 800 year rainfall event. This is well in excess of the 5% AEP (1 in 20 year rainfall event) to which drainage assets are designed nationally. Drainage assets, such as sewers and highway gullies, simply could not cope with the volume of water which fell in such a short time and the water could not drain away and consequently flowed overland across highways and property driveways and gardens and sometimes into property.

Elsewhere in Oxton, adjacent to Oxton Cricket Club and Wirral Golf Club the flooding mechanism was different in that intense rainfall, exceeding the infiltration rate and capacity of soil that was already saturated, generated significant volumes of surface water runoff, which due to local topography then flowed overland from playing fields and directly into adjacent property.

At the Tesco Retail site in Bidston flooding occurred at the petrol station.

Figure 6: Surface Water flooding at Tesco Petrol Station, 23rd July 2017

United Utilities report that this flooding was caused by a blockage on the surface water sewer, the nature of the blockage being formed from oil and other hydrocarbon pollutants. United Utilities suspect that clearing the blockage to remove the flooding would have led to a pollution incident at the River Birket. The blockage was removed in a controlled manner once the flooding had abated.

Elsewhere at Prenton Dell Road in Prenton and also Christleton Close in Oxton known hydraulic capacity issues on United Utilities sewers were also a factor in the flooding of property. At Christleton Close United Utilities had previously fitted property level protection in the form of flood doors. It is understood that the seals of the flood doors failed resulting in internal flooding.

Wirral Council, as Lead Local Flood Authority also received a report of flooding from an ordinary watercourse adjacent to Roman Road in Prenton.

Highway flooding occurred at many locations, particularly in the Birkenhead area. Many of the reported locations were able to drain down once the rain had stopped. Wirral Council's Out of Hours Control Room issued instructions to the term highway maintenance contractor to attend incidents which did not clear naturally. In addition to the extreme rainfall the call-out log identifies that minor operational issues such as leaf debris across gulley covers may have impeded drainage.

Call out procedures ensuring priority attendance at locations where there was a risk of flooding and damage to property were activated and have been reported to have worked well with attendance at highway flooding incidents given lower priority. As already reported many highway flooding incidents drained down naturally however flooding at Woodchuch Road, a major dual carriageway, caused disruption into the afternoon of 23rd July 2017, although the road remained passable.

The problem at the low point of Woodchurch Road has been ongoing for several years. Historic investigations have identified an obstruction in the highway drain that is not easily rectified and further investigation is required to confirm the exact nature of the obstruction and develop a solution to reduce the highway flood risk at this location.

Figure 7: Flooding at Woodchurch Road, Prenton, 23rd July 2017

In summary, the investigation has identified that the causal factor for the flooding in the Birkenhead, Bidston, Oxton, Prenton and Claughton areas on 23rd July 2017 was the severe and extreme rainfall that occurred during the period 06:00 and 09:45 BST. The rainfall was of such intensity that the design capacity of drainage features was exceeded.

Other Areas

There were isolated reports of flooding outside the Bromborough and Birkenhead areas where rainfall was less intense than the 0.125% AEP / 1 in 800 year rainfall event.

In Irby, a recurrent issue with the threshold of the highway onto property led to water from the highway draining onto property. Property level protection and resilience measures employed by the householder prevented a reoccurrence of internal flooding.

In Gayton internal flooding to one property was recorded from a downstairs toilet. The same property is positioned lower than the highway. Surface water from the highway was not able to fully enter highway gullies because of a buildup of leaf debris in the channel and, as a result, passed the property threshold onto the driveway.

Both Wirral Council Highway Authority and Dŵr Cymru Welsh Water have conducted an extensive investigation into the performance of their assets and no significant operational issues or evidence of hydraulic incapacity have been identified other than the presence of leaf debris on the highway.

6. Response from Risk Management Authorities, Emergency & Other Responders

The following Risk Management Authorities had a role in managing flooding that occurred on 23rd July 2017

- Wirral Council
  - Lead Local Flood Authority
  - Highway Authority
- United Utilities
- Dŵr Cymru Welsh Water

This report will also consider the role of other responders to the flooding:

- Merseyside Fire and Rescue Authority
- Wirral Council Out of Hours Highway Maintenance Contractor

6.1 Wirral Council

Lead Local Flood Authority (LLFA)

Wirral Council has undertaken this Section 19 Flood Investigation into the significant flood incident. In doing so the LLFA, in accordance with Section 13 of the FWMA 2010, has worked in partnership with the other Risk Management Authorities involved in the incident.

In addition, Wirral Council LLFA has undertaken further investigation into surface water run-off from private land causing flooding in accordance with its responsibilities to manage flood risk from surface water.

Highway Authority

Wirral Council Highway Authority has undertaken post-event investigations into flooding on the highway. Whilst the majority of incidents were as a result of the design capacity of highway and sewerage assets being exceeded, any remedial works or operational problems identified either on the day through call-out arrangements with the term maintenance contractor or in the following week, have since been addressed.

Out-of-Hours Response

The out of hours response from Wirral Council prioritised internal flooding issues as a result of operational problems on the highway. However no further prioritisation was given to the flooding impacts on the highway network.

6.2 United Utilities

United Utilities provided an out of hours response during the flood incident and has undertaken post-event investigations into the reported flooding. United Utilities has worked in partnership with Wirral Council LLFA and made data regarding the flood incident and its investigations available.

6.3 Dŵr Cymru Welsh Water

Dŵr Cymru Welsh Water has undertaken post-event investigations into the reported flooding and has worked in partnership with Wirral Council LLFA and made data regarding the flood incident and its investigations available.

6.4 Merseyside Fire and Rescue Authority

Merseyside Fire and Rescue Authority provided an emergency response to reports of flooding to property.

Merseyside Fire and Rescue Authority have assisted in the investigation into the flood incident and have made information relating to their incident response available.

7. Conclusion and Recommendations

7.1 Conclusion

This investigation has concluded that the flooding incident which occurred on Sunday 23rd July 2017 was caused by intense rainfall over a short duration exceeding the capacity of highway gullies, United Utilities' sewers and the infiltration capacity of the soil causing surface water runoff. These factors caused flooding to properties.

Key findings are summarised as follows:

- The rainfall between 06:00 and 09:45 BST was severe and extreme with 27mm of rainfall in a 4 hour period.
- The Annual Exceedance Probability of this rainfall is 0.125% / 1 in 800 year storm
- The most intense rainfall fell in urban areas towards the east of Wirral
- The intensity of rainfall exceeded the design standard of United Utilities sewers
- The intensity of rainfall caused overland flow from sports fields in Oxton and Bidston
- The onset of the flooding was rapid, with no early warning or lead in time for residents, emergency responders or risk management authorities.

The September 2015 significant flood incident has also been assessed to determine whether there are any similarities between the two incidents and whether the lessons learnt from that incident have had an impact on the response to this July 2017 incident.

This assessment concluded that:

- The July 2017 incident differed in that the rainfall occurred over a shorter period and was more intense, leading to rapid onset of surface water flooding. In September 2015 rainfall over a longer, 12 hour period caused flooding from multiple sources including river, sewer and surface water. Furthermore, although the flooding locations from 2015 were Wirral-wide there were relatively few reported incidents in the Oxton and Birkenhead areas where the July 2017 incident was concentrated.
- The recommendations from September 2015 have, in the majority been implemented. However, due to the different nature of this incident, there were no measures which could have reduced the impact of the flooding.

7.2 Recommendations

A number of strategic and local recommendations have been identified as a result of this investigation and are summarised in Table 2.

The implementation of these recommendations will be monitored by Wirral Council Lead Local Flood Authority through Operational Flood Group Meetings.

Progress will be reported to Wirral Flood and Water Management Partnership.

Table 2: Recommendations

Strategic Recommendations				
	Recommendation	**Lead Responsibility**	**Timescale for Completion**	**Progress**
S1	Wirral Council Lead Local Flood Authority is to develop a formal 'request for information' procedure in accordance with the requirements under Section 14 of the Flood and Water Management Act 2010. Wirral Council to share the 'request for information' procedure with all partners for information, once completed and ahead of any future flood incident.	Wirral Council Lead Local Flood Authority		
Local Recommendations				
	Recommendation	**Lead Responsibility**	**Timescale for Completion**	**Progress**
L1	Wirral Council Highway Authority to review the gully cleansing frequency at Allport Road Car Park, Bromborough.	Wirral Council Highway Authority		
L2	Wirral Council Highway Authority to consider modifications to the perimeter wall at Allport Road Car Park to prevent discharge of surface water from the car park onto the highway at The Rake.	Wirral Council Highway Authority		
L3	Wirral Council Lead Local Flood Authority to write to Oxton Cricket Club requesting that they consider improving drainage systems and /or retaining surface water within their boundary to prevent run-off from their private land to neighbouring properties in Duddon Close.	Wirral Council Lead Local Flood Authority		
L4	Wirral Council Lead Local Flood Authority to work with Wirral Golf Club to further investigate the cause of flooding to property on Vyner Road South and to further work with WGC on a solution to alleviate	Wirral Council Lead Local Flood Authority		

	the ongoing flooding problem			
L5	Wirral Council Lead Local Flood Authority to write to residents affected by surface water run-off from private land advising them of : • the outcome of the investigation • the responsibilities of the landowner from where the run-off originates • how they can make their property more resilient to future flooding	Wirral Council Lead Local Flood Authority		
L6	Wirral Council Lead Local Flood Authority to write to the landowner of the ordinary watercourse at Roman Road, Prenton advising of their riparian responsibility.	Wirral Council Lead Local Flood Authority		
L7	Wirral Council Lead Local Flood Authority to write to the Church Commission for the United Reform Church to advise that the surface water run-off from their property at Alton Road increases the risk of flooding of the highway and properties on Alton Road, Oxton.	Wirral Council Lead Local Flood Authority		
L8	Wirral Council Highway Authority to review the highway sweeping and highway gulley cleansing frequency at Alton Road Oxton, Vyner Road South Bidston and Gayton Road Gayton.	Wirral Council Highway Authority		
L9	Wirral Council Highway Authority to review the prioritisation of response to flooding and highway flooding incidents and communicate this to relevant contact centres.	Wirral Council Highway Authority		
L10	United Utilities to ensure re-connection of highway drainage following sewer lining operations.	United Utilities		
L11	United Utilities to review performance of property level protection at Christleton Close with a view to correcting manufacturing or maintenance defects.	United Utlities		Complete & remedial measures undertaken

L12	Woodchurch Road – Wirral Council to develop and submit a Capital Funding bid to investigate and resolve ongoing highway flooding issues.	Wirral Council Highway Authority		

Progress	
	Not Started
	In Progress
	Complete

Timescale Post Incident	
	Short Term *(0- 4 months)*
	Medium Term *(5 -12 months)*
	Long Term *(12 months +)*