



SNC • LAVALIN

Northwich

Section 19 Flood Investigation Report (October 2019 Flooding Event)

March 2021

5150735-DG-002



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Glossary

AEP	Annual Exceedance Probability ¹
the Trust	Canal & River Trust
CSO	Combined Sewer Overflow ²
CWaC	Cheshire West and Chester Council
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management
FDL	Flood Defence Level
FRR	Flood Risk Regulations (2009)
FWMA	Flood Water Management Act
GIS	Geographic Information System
LLFA	Lead Local Flood Authority
mAOD	Metres Above Ordnance Datum
PFRA	Preliminary Flood Risk Assessment
RMA	Risk Management Authority
UU	United Utilities
WRAP	Winter Rainfall Acceptance Profile

¹ The probability associated with a return period e.g. an event of return period 100 years (T=100), has an AEP of 1/T or 0.01 (1%)

² Combined Sewer Overflows allow the controlled discharge of sewerage to an open watercourse during high rainfall events to reduce the risk of flooding to people and property

Introduction

Cheshire West and Chester Council has commissioned Atkins (member of the SNC-Lavalin Group) to undertake a Section 19 flood investigation report in response to the October 2019 flooding event. This report is required to inform the Council and affected residents and businesses of progress including recommendations for review and improvement.

Executive Summary

The summer and autumn of 2019 were exceptionally wet; for England and Wales in the last 50 years only 2012 was wetter over the June – October timeframe. Above average rainfall fell in October 2019 across most catchments in England, with some catchments receiving over double the average monthly total. Soils were also wetter than average in all regions.

From the records provided after the event by affected people and by the Flood Risk Management Authorities (RMAs), 23 properties (either residential or business) were identified as having been affected by internal flooding between 26th – 27th October 2019 in Northwich and surrounding areas.

The purpose of this Section 19 Flood Investigation Report is to identify the flood mechanisms and flood infrastructure performance that occurred during this flood event; provide a strategic overview of the RMA responses; and provide a full list of recommended actions.

A Section 19 flood investigation is undertaken to identify and investigate whether the RMAs exercised their risk management functions as per Section 19 (1) of the Flood and Water Management Act (FWMA, 2010) and adhered to the Flood Risk Regulations (FRR, 2009).

The RMAs are Cheshire West and Chester Council (CWaC), as the Lead Local Flood Authority (LLFA) and Highways Authority; Environment Agency (EA); and United Utilities (UU). Other key stakeholders are identified as the Canal & River Trust (the Trust); riparian owners and local businesses and residents; the Police; and the Fire and Rescue service.

Flooding was reported in three main areas including:

- Northwich town centre
- Sandy Lane near Acton Bridge
- Lakeside Caravan Park near Winsford

The report refers to several sources of data including information provided by affected businesses and residents, other RMAs and stakeholders, site visits, surveys of the area, and river and rainfall telemetry during the flood event. The data has been compiled by Atkins, specialist consultants in flood risk management, who have also commented on the mechanisms that led to the flooding.

A series of conclusions have been formed on the flooding mechanisms, which are summarised below:

Northwich Town Centre

The flooding at London Road was likely to have resulted from the rainfall event itself combined with the elevated river levels which restricted the ability of UU, highway and privately owned assets to discharge effectively, via their outfalls, to receiving water bodies, with an element of reverse flows (as not all outfalls in the locality were confirmed as having functioning non-return flaps) and the Dock Road pumping station not operating at maximum capacity also being contributory factors.

The raised flood defences were not overtopped although there was a leak observed in the vicinity of Dane Bridge; leakage here is likely to have contributed to the water behind the defences in the Bull Ring which was attended to through the deployment of EA pumps. The flooding at the Bull Ring was likely to have resulted from the rainfall event combined with the elevated river levels which restricted the ability of privately owned assets to discharge effectively, via their outfalls, to receiving water bodies. During the event, water was observed to be coming up through a gully at the entrance to the Bull Ring.

The River Weaver did not breach or overtop the raised defences along Weaver Way. There is a single surface water drain that would not have contributed to the flooding as it is higher than peak water level in the area. The flooding at Weaver Way and High Street is likely to be a result of the rainfall event itself combined with the elevated river levels which restricted flows (river locking) from the highway drainage system, together with localised restrictions therein, potentially leading to surface water flooding and subsequent overland flow to the Weaver Way low ground. Any non-designed flows entering the system, or any restriction of flows within the system downstream of High Street and Witton Street, may have also contributed to flooding at High Street and Witton Street where ground levels are low

Castle Street did not flood as a direct result of out of bank flow from the River Weaver. Therefore, the cause of flooding at Castle Street would likely have been as a result of the rainfall event combined with the elevated river levels which restricted effective conveyance (through river locking) to receiving water bodies or caused

backflow from the highways, combined and surface water systems and subsequent overland flows to low ground.

Acton Bridge

Water levels were high on the River Weaver due to heavy rainfall. The notable rainfall event and the location of all of the properties within Flood Zone 3 will have contributed to the flooding of properties, and restrictions in conveyance may have been a contributory factor.

Lakeside Caravan Park

Flooding occurred at Lakeside Caravan Park due to water levels in the interconnected River Weaver and Bottom Flash. The caravans which flooded are the ones closest to the edge of the Flash, at the lowest ground levels. These are inside Flood Zone 3.

Summary of Recommendations

A series of recommendations have been identified for managing flood risk moving forward for each of the three areas investigated. They include:

- [Northwich Town Centre](#) - Collaborative planning and integrated modelling to determine an integrated approach to reduce and manage flood levels in the town centre and discuss opportunities for differing scale/timescale solutions to be developed.
- [Sandy Lane near Acton Bridge](#). Exploration of how the operation of navigation assets to improve conveyance during flood conditions can be embedded within the flood risk management functions of respective RMAs.
- [Lakeside Caravan Park](#). The Council and the Environment Agency work with the owners to identify more sustainable approaches to managing flood risk in the future.

In response to the flooding, community engagement was undertaken, and this will continue in order to ensure that all those affected have the opportunity to contribute to successful delivery of the recommended actions. All the RMAs together with the Trust are ready and willing to work with local community and business groups, MPs, elected members, and Town and Parish Councils to reduce flood risk.

1. Section 19 – Investigation Requirement

The Flood and Water Management Act 2010 provides for better, more comprehensive management of flood risk for people, homes and businesses, helps safeguard community groups from unaffordable rises in surface water drainage charges, and protects water supplies to the consumer. Serious flooding can happen at any time. Climate projections suggest that extreme weather will happen more frequently in the future. This Act aims to reduce the flood risk associated with extreme weather.

<https://www.gov.uk/guidance/flood-risk-management-information-for-flood-risk-management-authorities-asset-owners-and-local-authorities>

The Flood and Water Management Act (FWMA, 2010) defines the lead local flood authority for an area as the unitary authority or the county council.

Under Section 19 of the act:

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

The flooding incident that occurred in Northwich in October 2019 is considered to have met the criteria for Formal Investigation as defined in Section 19 of the FWMA (2010).

In addition to the FWMA (2010), the FRR (2009) were introduced by Government in 2009. CWaC as a LLFA is required to implement its provisions.

As a result of the FRR (2009), the LLFA has a duty to prepare a number of documents, including:

- Preliminary Flood Risk Assessment (PFRA).
- Flood hazard and risk maps.
- Flood Risk Management Plans.

This Section 19 report contributes to the continual development of flood hazard / risk maps and Flood Risk Management Plans.

2. Identification of Risk Management Authorities (RMAs) and Stakeholders

For managing flooding, the legal framework is distributed to multiple agencies. The responsibilities of each of the agencies are summarised below.

2.1. Cheshire West and Chester Council (CWaC)

CWaC is the LLFA and the Highways Authority for the area of this Section 19 investigation. CWaC is an RMA. The LLFA is responsible for developing, maintaining and applying a strategy for local flood risk management from the following sources:

- Surface water (pluvial)
- Groundwater
- Ordinary watercourses (fluvial)
- Highways drainage
- Canals.

The FWMA (2010) outlines the LLFA's powers to designate structures and features that affect flooding, in order to provide protection to assets that are relied upon for flood risk management from the aforementioned flooding sources. Once a feature is designated, the owner must seek consent from the authority to alter, remove or replace it (FWMA (2010) Schedule 1, Section 1).

The LLFA liaises regularly with the EA, as well as the other RMAs, to ensure that all sources of flooding in their administrative area are managed appropriately.

District and Borough Councils can carry out flood risk management works on minor watercourses, working with the LLFA. Through the planning processes, they control development in their area, ensuring that flood risks are effectively managed.

CWaC are the Highway Authority within the administrative area of the reported flooding locations. Under Section 41 of the Highways Act (1980), CWaC are responsible for maintaining adopted highway drainage and roadside ditches and must ensure that road projects do not increase flood risk. Highway maintenance includes that of the road drainage networks (drains and gullies).

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

2.2. The Environment Agency (EA)

The EA are responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion and are responsible for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea. The EA is an RMA.

The EA have prepared strategic plans which set out how to manage risk, provide evidence (e.g. online flood mapping) and advise local and national Government. Section 165 of the Water Resources Act (1991) states the EA have permissive powers to undertake maintenance or emergency works on the aforementioned flooding sources. The FWMA (2010) outlines that the EA has powers to designate structures and features that affect flooding in order to protect assets that are relied upon for flood risk management for Main River and tidal sources.

The Environment Agency:

- provides and operates flood warning systems.
- carries out works to manage flood risk from the sea and main rivers.
- carries out works in estuaries to secure adequate outfalls for main rivers.
- carries out surveys to inform Flood Coastal Erosion Risk Management (FCERM) works.

- issues permits for works on or near main rivers, and works affecting watercourses, flood and sea defences and other structures protected by its bylaws.
- advises planning authorities on the implications of development proposals on flood risk.
- designates structures and features of the environment that affect flood or coastal erosion risk.
- has the right to enter private land to carry out FCERM works.

Under the Civil Contingencies Act (2004), the EA are a Category 1 Responder and therefore have the statutory duty to put into action emergency plans and assess local risks to inform the emergency planning services.

2.3. United Utilities (UU)

UU (as Sewerage undertaker) has a statutory duty under Section 94 of the Water Industry Act (1991) to provide, improve and extend such a system of public sewers (whether inside its area or elsewhere) and so as to cleanse and maintain those sewers as to ensure that that area is and continues to be effectually drained.

UU is an RMA under the FWMA (2010) and is thus responsible for:

- managing the risks of flooding from their respective surface water, foul and/or combined sewer systems 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.

Since the late 1970s, and with the first publication of Sewers for Adoption in 1980, sewer systems have typically been designed and constructed to accommodate a rainfall event with a 1 in 30-year return period. A severe event is classified by Ofwat as a rainfall event which exceeds a 1 in 20 return period. During severe weather events that exceed the design capacity of the infrastructure, it is more likely that the sewer system would be unable to cope and the chances of significant system surcharge or flooding would be greater.

UU are a Category 2 responder under the Civil Contingencies Act (2004) and therefore has the responsibility to co-operate and share information with Category 1 responders to inform multi-agency planning frameworks.

2.4. Canal & River Trust (the “Trust”)

The Trust is a charity set up in 2012 to care for England and Wales’ 200-year-old waterways, holding them in trust for the nation forever. It has responsibility for over 3,200km of navigable canals and rivers, together with bridges, tunnels, aqueducts, docks and reservoirs, along with museums and archive collections. The Trust is not identified in FWMA as an RMA and:

- The Trust is not a Category 1 or 2 responder as defined by the Civils Contingencies Act 2004.
- The Trust does not have any specific statutory responsibilities in relation to flooding.

The Trust is not an RMA and have been consulted as a key stakeholder given responsibility for navigation assets that interact with the river and the Trust may therefore provide specific assistance in the event of a flood incident and support requests for input in a Section 19 flood investigation.

2.5. Riparian Owners

Riparian owners are those who own land or property adjacent to a watercourse. Riparian owners are not an RMA, though are considered relevant stakeholders. Riparian owners have a responsibility to:

- report an incident
- let water flow naturally
- prevent pollution
- protect wildlife
- maintain the bed and banks of the watercourse
- maintain any owned structures, such as trash screens, outfalls, flap valves, sluices and culverts

Section 25 of the Land Drainage Act (1991) outlines that where the flow of a watercourse is obstructed; the riparian owner is responsible to resolve the condition. Section 28 of the Land Drainage Act (1991) outlines the responsibility of the riparian owner to undertake maintenance of their watercourse if it is impeding the flow of water.

Riparian owners must let water flow through their land without obstruction and must accept flood flows through their land. Riparian owners have no duty in common law to improve the drainage capacity of a watercourse. Further information is contained within the EA guidance document *Owning a watercourse* (2018).

2.6. Local Residents and Businesses

Residents and businesses who are aware that they are at risk of flooding should take action to ensure that they and their properties are protected. Local residents and businesses are not an RMA, though are considered relevant stakeholders.

Residents and businesses should report flooding incidents or potential problems (such as blockages or sewer collapse) to the water authority or LLFA.

2.7. Cheshire Police, Fire and Rescue Service

The Police, Fire and Rescue Services are a Category 1 Responder under the Civil Contingencies Act (2004) and therefore have a responsibility, along with other organisations for developing emergency plans, contingency plans and business continuity plans to help reduce, control or ease the effects of an emergency. The Police, Fire and Rescue Services are not an RMA; however, are considered relevant stakeholders.

3. Catchment Characteristics

Around 340,500 people live in Cheshire West and Chester, a third of which live in rural areas. The borough covers approximately 906 km² of land and is characterised by attractive countryside, varied landscapes and diverse settlements ranging from the historic city of Chester, the towns of Ellesmere Port, Northwich and Winsford to small rural hamlets. Chester is the central urban area of the borough.

3.1. Land Use

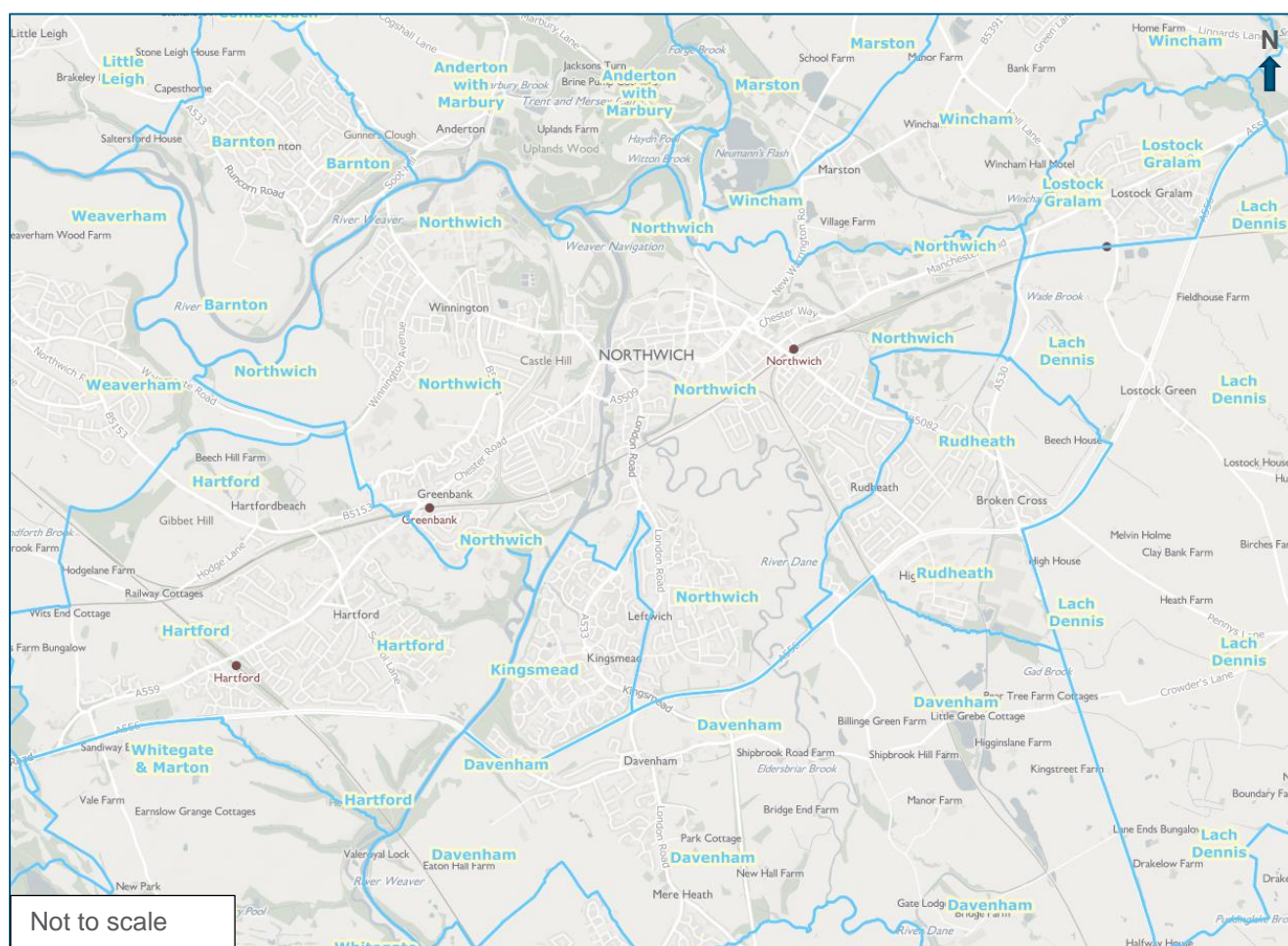
Northwich is a town and civil parish of approximately 20,000 people located at the confluence of the River Weaver and River Dane. Northwich has its own Town Council but is a part of the larger Cheshire West & Chester Council.

The town has well established river infrastructure, originally developed to transport locally produced salt, including the Anderton Boat Lift which links the River Weaver with the Trent and Mersey Canal. Following a period of subsidence, related to salt mining works, a program of stabilisation works in the town centre was completed in 2007.

Northwich is a historic market town with a busy pedestrian centre, surrounded by business, industrial and residential areas. Beyond the town lies the rural parishes of Anderton with Marbury, Marston, Wincham, Lostock Gralam, Rudheath, Davenham, Hartford, Weaverham and Barnton.

The town is well placed and served by good transport links. The railway station is located close to the town centre and is on the Mid-Cheshire line linking Northwich to Manchester and Chester. Roads and bus services link it with all parts of Cheshire with the M6 to the east and M56 to the north. The A533 runs north south through the town centre. The River Weaver is navigable from Winsford, through Northwich town centre to Runcorn where it joins the Manchester Ship Canal, providing access for boats through a lock system.

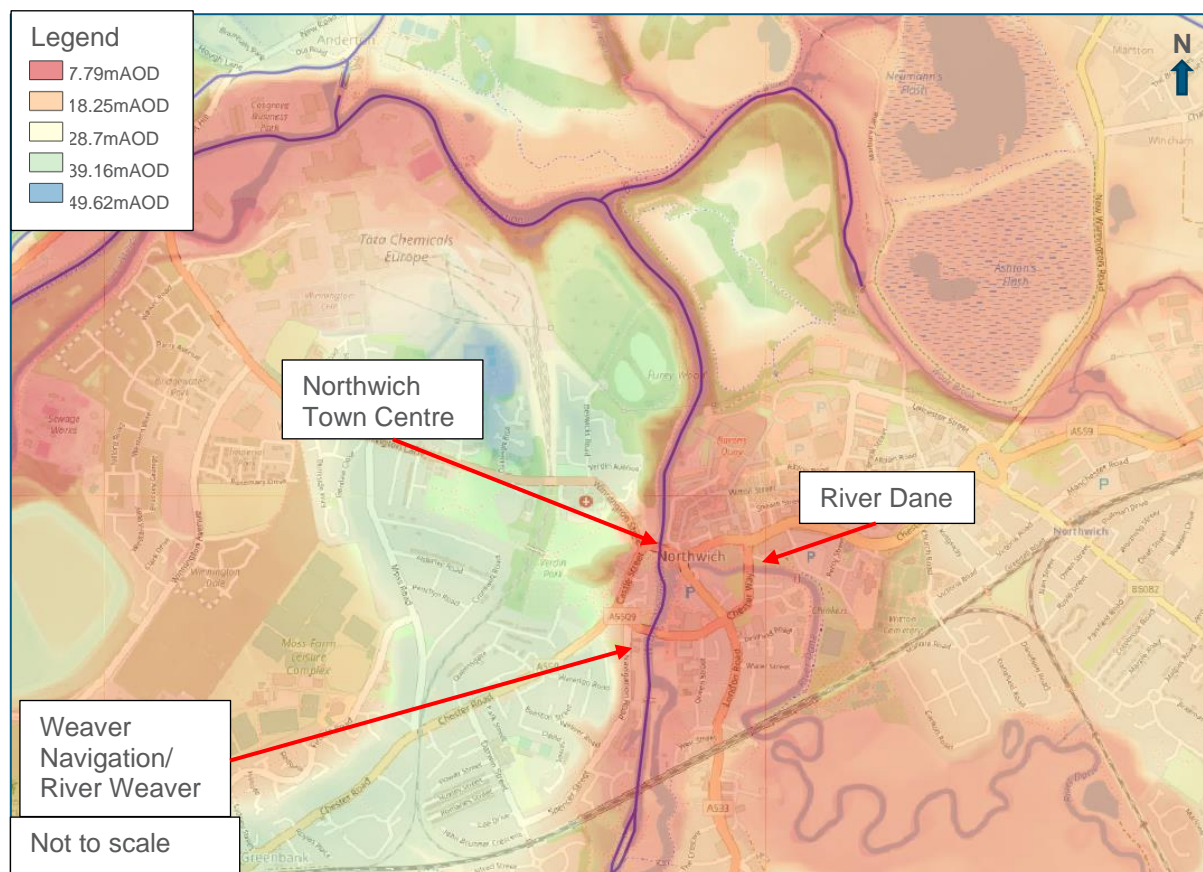
Figure 3-1 - Location Plan of Northwich Parish



3.2. Topography

Northwich Town Centre lies at the confluence of the River Dane and the River Weaver, which is in a low-lying area. The topographic map below indicates that elevation is generally lower closer to the rivers.

Figure 3-2 - Topography of Northwich



Source – DTM 1M LiDAR data, Environment Agency, 2020

3.3. Soils and Geology

Identification of the geology and soils underlying an area aids in determining the characteristics associated with both surface and ground water flooding. To assess if a flood alert/warning is required, this also helps develop a prediction to the time of concentration between the rainfall event and receiving watercourse.

The area of land in which Northwich is situated on can be divided into the following layers:

- Soils
- Superficial Deposits
- Parent Material
- Bedrock

3.3.1. Soils

The Wallingford Procedure Geological Survey Map identifies that the Northwich area is predominantly Class 4 soil, with a small amount of Class 1, of the Winter Rainfall Acceptance Potential (WRAP) classification. The characteristics of these classes are outlined in the soil class characteristics table below.

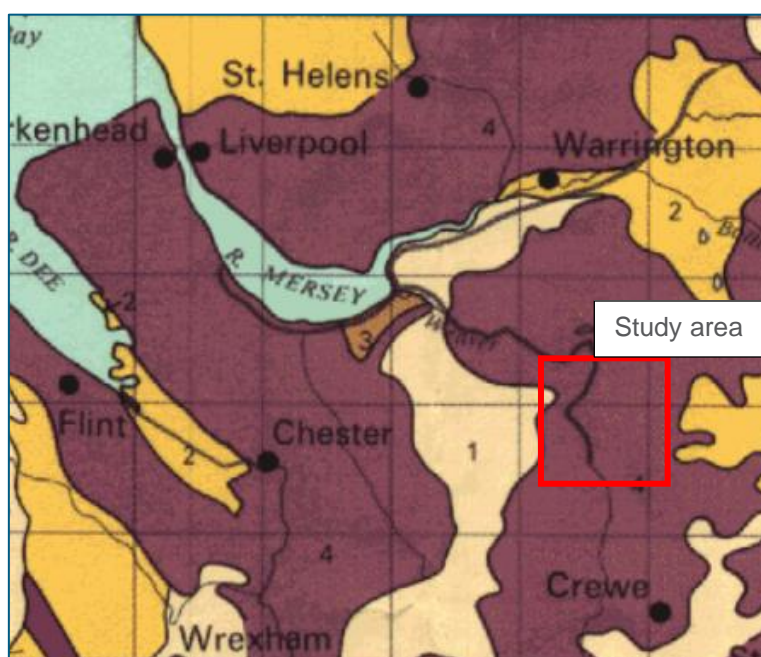
Table 3-1 - Soil Type Characteristics

W.R.A.P Class	General Description of Map Units
1	<ul style="list-style-type: none"> Well drained permeable sandy or loamy soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts. Earthy peat soils drained by dikes and pumps. Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.
2	<ul style="list-style-type: none"> Very permeable soils with shallow groundwater. Permeable soils over rock or fragipan, commonly on slopes in western Britain associated with smaller areas of less permeable wet soils. Moderately permeable soils, some with slowly permeable subsoils.
3	<ul style="list-style-type: none"> Relatively impermeable soils in boulder and sedimentary clays, and in alluvium, especially in eastern England. Permeable soils with shallow groundwater in low lying areas. Mixed areas of permeable and impermeable soils, in approximately equal proportions.
4	<ul style="list-style-type: none"> Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.
5	Soils of the wet uplands with: <ul style="list-style-type: none"> Peaty or humose surface horizons and impermeable layers at shallow depth. Deep raw peat associated with gentle upland slopes or basin sites. Bare rock cliffs and screes Shallow, permeable rocky soils on steep slopes

Source – National Water Council (1981)

Figure 3-3 - Soil Type Map of CWaC Area - Winter Rain Acceptance Potential Soil Map

Based on the New Wallingford Procedure Runoff Model



Source – National Water Council (1981)

3.3.2. Superficial Deposits

Underlying the soil, the superficial deposits are mostly Tidal Flat Deposits (clay, silt and sand), Till (Devensian-Clay, sandy, gravelly, cobbly), Glaciofluvial deposits (Devensian – sand and gravel).

Superficial Deposits map of CWaC Area is contained in Appendix A.1.

3.3.3. Parent Material

Underlying the superficial deposits, the parent materials are riverine clay and floodplain sands and gravel, Glacial till, Glaciofluvial deposits, patches of claystone/mudstone and area of a sand/gravel floodplain.

Parent Material map of CWaC Area is contained in Appendix A.2.

3.3.4. Bedrock

Underlying the parent material, the bedrock is Northwich Halite (halite, stone and mudstone) and Bollin Mudstone (mudstone).

Bedrock map of CWaC Area is contained in Appendix A.3.

3.4. Watercourse Network

3.4.1. Main Rivers

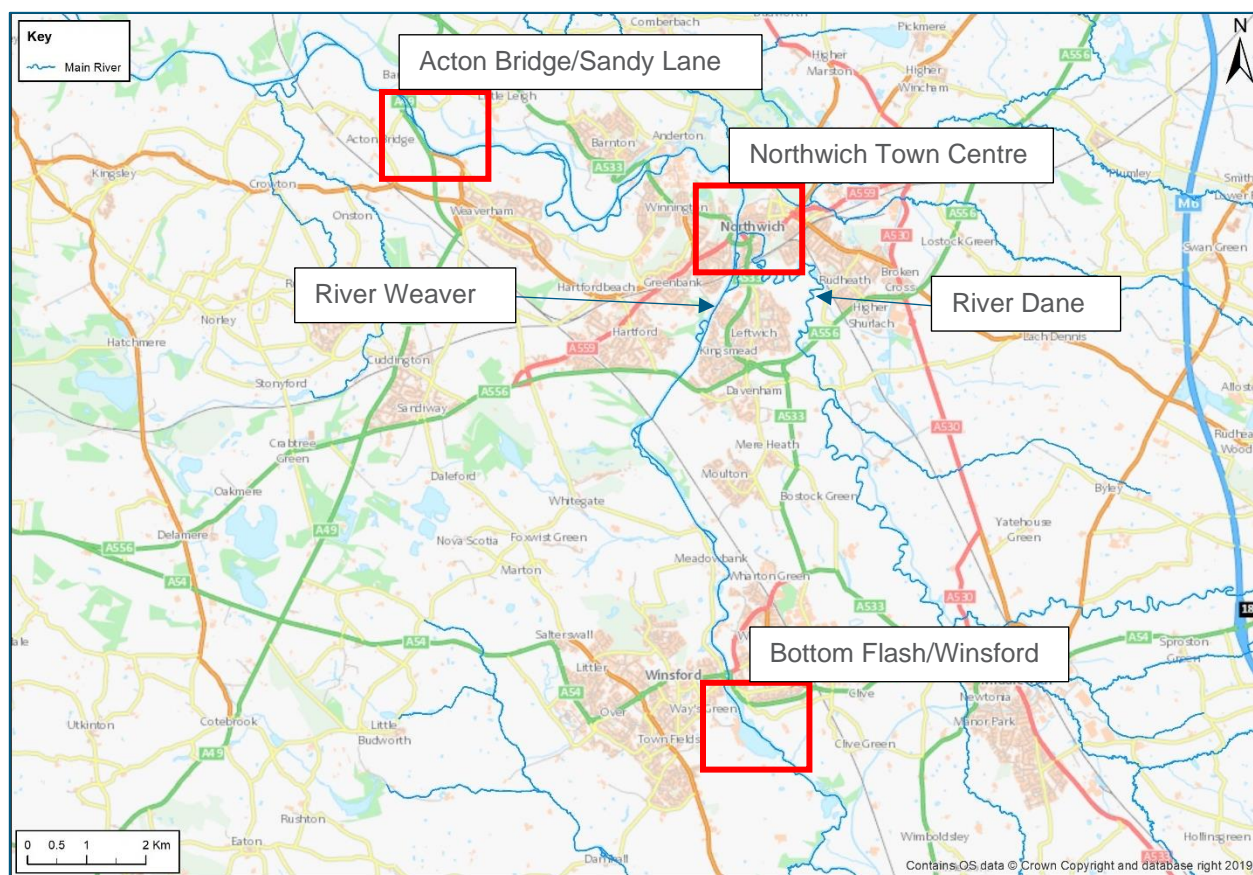
There are two Main Rivers affected by the flooding in Northwich and the outlying areas, for which the Environment Agency have jurisdiction. These are:

- River Dane – Northwich town centre
- River Weaver – Northwich town centre, Bottom Flash near Winsford, Acton Bridge/Sandy Lane

The River Weaver has been made navigable (Weaver Navigation) from Winsford and flows northwards to the Manchester Ship Canal at Runcorn. River levels on the Weaver and Navigation are controlled by a series of sluice gate and lock assets owned and operated for navigation purposes by the Trust. The River Dane is a fast flowing, natural river which brings high peak flows through Northwich. In contrast, the Weaver Navigation is slower and carries a greater volume of flow.

The main river map (Figure 3-4) illustrates the main river sections which flow through Northwich town centre, Bottom Flash near Winsford and Acton Bridge area.

Figure 3-4 - Main River Map



Source: EA Main River Map, 2020

3.4.2. Ordinary Watercourses

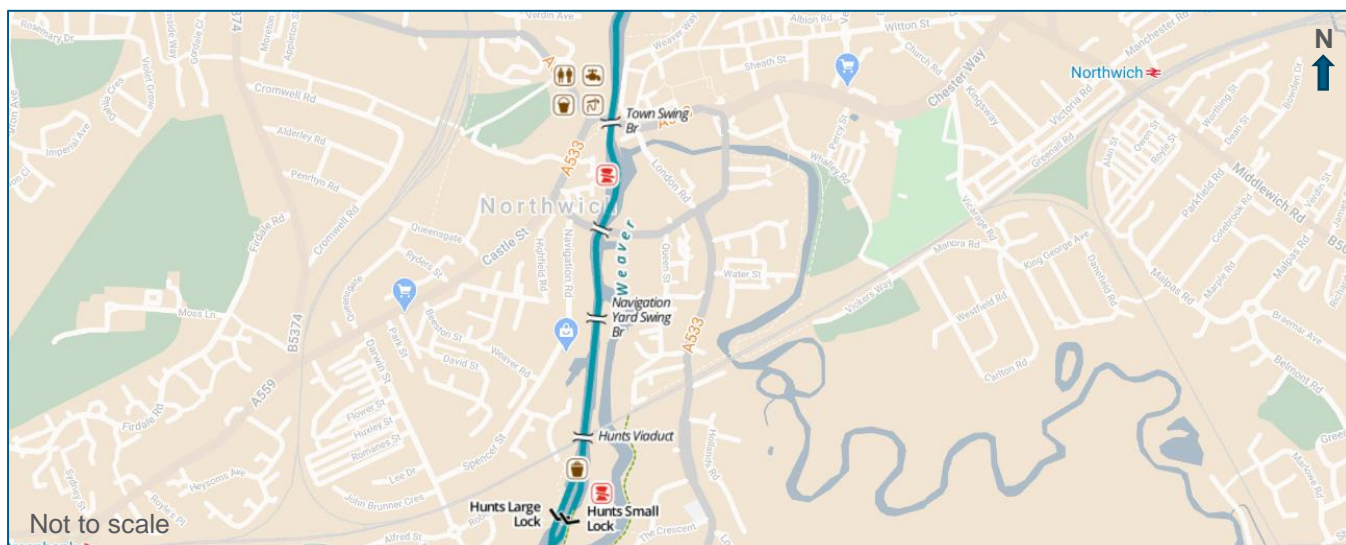
Ordinary watercourses are any watercourses that are not designated Main River, they vary in size and can include rivers, streams, ditches, drains, culverts, cuts, dikes, sluices, sewers and passages through which water flows. There are a number of ordinary watercourses in the affected areas, though there have been no previous reports of flooding in Northwich or the areas of Weaverham or Winsford from ordinary watercourses.

3.4.3. Canals/Navigable Waterways

Though not a canal, the River Weaver Navigation runs through Northwich Town Centre. The River Weaver Navigation runs from Winsford Bridge to the Manchester Ship Canal at Weston Marsh Lock and Weston Point Docks and connects to the Trent and Mersey Canal via Anderton Boat Lift.

Five sluices at Hunts Lock (four normal, and one deep) act as flow control structures upstream of Northwich town centre. The River Weaver Navigation is 20 miles (32 km) long and has 5 locks. Figures 3-5 to 3-7, from the Trust network online mapping service, indicate the navigable sections of River in the relevant areas affected by the October 2019 event.

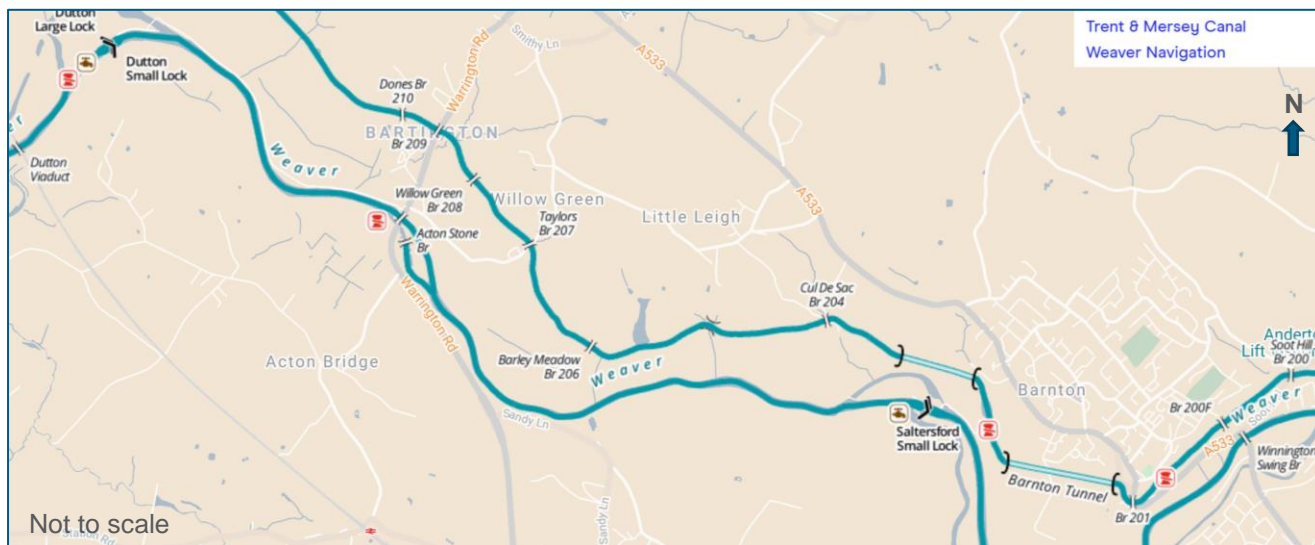
Figure 3-5 - Navigable Waterway Map Northwich Town Centre



Source: The Trust, 2020 <https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network>

The Trent & Mersey Canal & River Weaver run parallel to each other. The Dutton sluice gates and locks act as flow control downstream of Acton Bridge. Three sluices at Winnington, Barnton and Saltersford act as flow controls for the upstream navigation pound that includes Northwich Town centre.

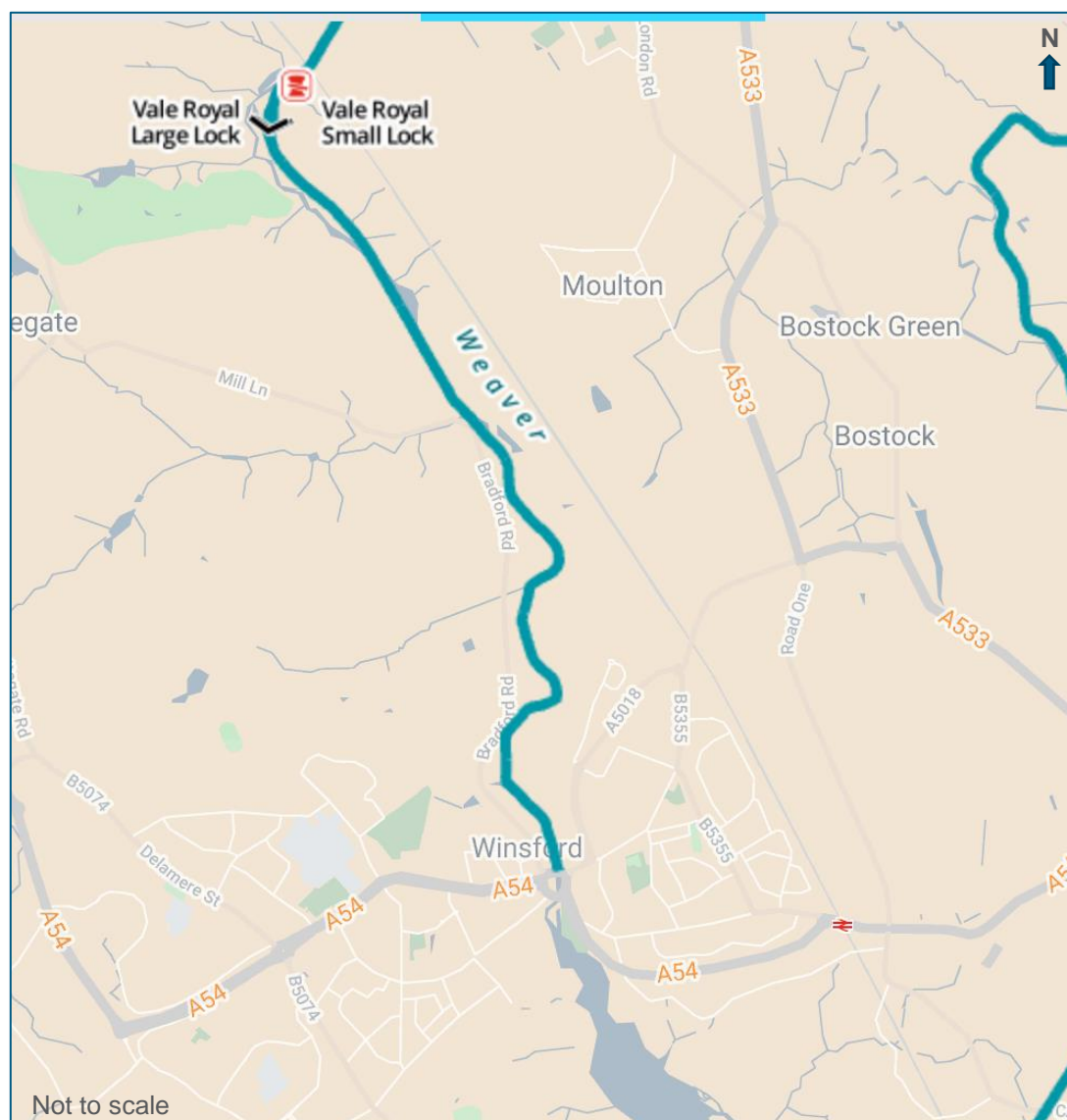
Figure 3-6 - Navigable Waterway Map Acton Bridge Area



Source: The Trust, 2020 <https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network>

South of Northwich, the River Weaver Navigation ends at Winsford, downstream of Bottom Flash. Vale Royal sluice acts as a flow control structure downstream of Winsford.

Figure 3-7 - Navigable Waterway Map Winsford Area



Source: The Trust, 2020 <https://canalrivertrust.org.uk/enjoy-the-waterways/canal-and-river-network>

3.5. Flood Risk

Flood risk across Northwich and outlying areas comprises of predominantly fluvial flooding (river flooding) from the River Dane and River Weaver, as well as surface water flooding from run-off due to limited open spaces or greenfield areas.

The combined foul and surface water sewers are at risk of surcharge (overloading of the sewer beyond its design capacity), as well as drain blockage. Risk of flooding from canals is considered residual and would occur from leakage, collapse of structures, overtopping or blockage of conduits. These risks are evaluated and presented in detail in CWaC's Level 1 Strategic Flood Risk Assessment.

The EA Flood Maps for Planning service (Figure 3-8 to Figure 3-10) illustrate the path of the River Weaver and River Dane, and the flood risk areas in which the affected areas of the October 2019 event are situated. The Flood Zones shown on the EA's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of surface water flood risk, climate change and consequent changes in the future probability of flooding. The following table explains the Flood Zones which appear on the maps:

Table 3-2 - Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments area of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Source: EA, 2020 <https://www.gov.uk/guidance/flood-risk-and-coastal-change#flood-zone-and-flood-risk-tables>

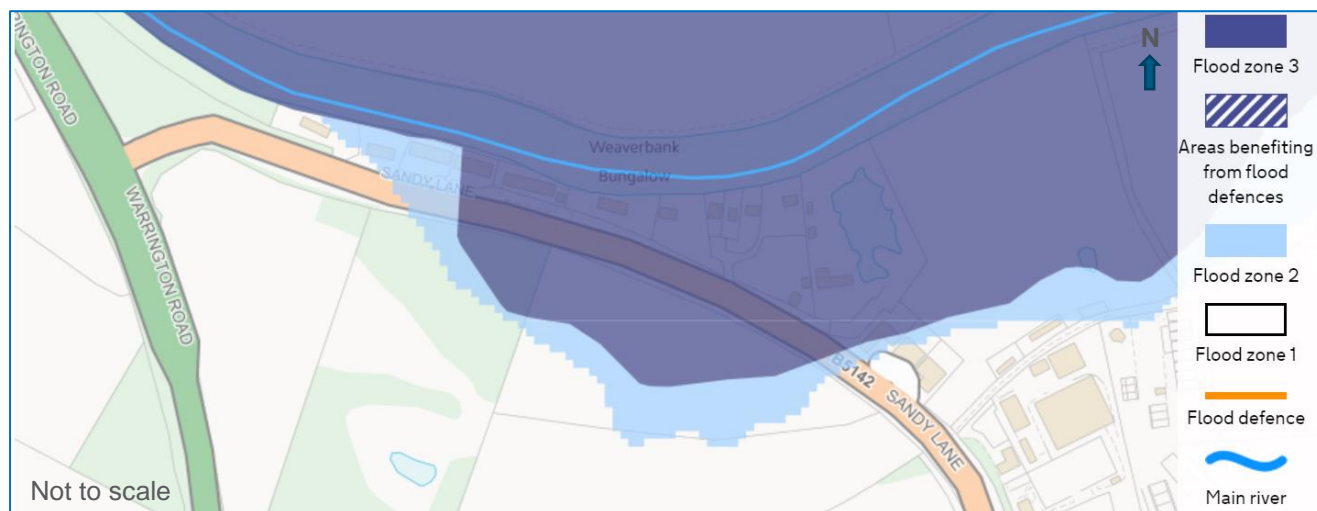
Northwich town centre area is largely within the EA's Flood Zones 2 and 3 and is at risk from fluvial flooding from the River Weaver and River Dane as shown in Figure 3-8. Following previous flood events in 2015, flood defences were constructed in Northwich town centre. The areas benefitting from these flood defences is shown in the figure below. More detail in relation to the flood defence infrastructure has been included in section 4.1.4.

Figure 3-8 - Flood Risk Map Northwich Town Centre


Source: EA, 2020 <https://flood-map-for-planning.service.gov.uk/>

The Acton Bridge area flood map shows properties in Flood Zones 1, 2 and 3, at risk of fluvial flooding from the River Weaver.

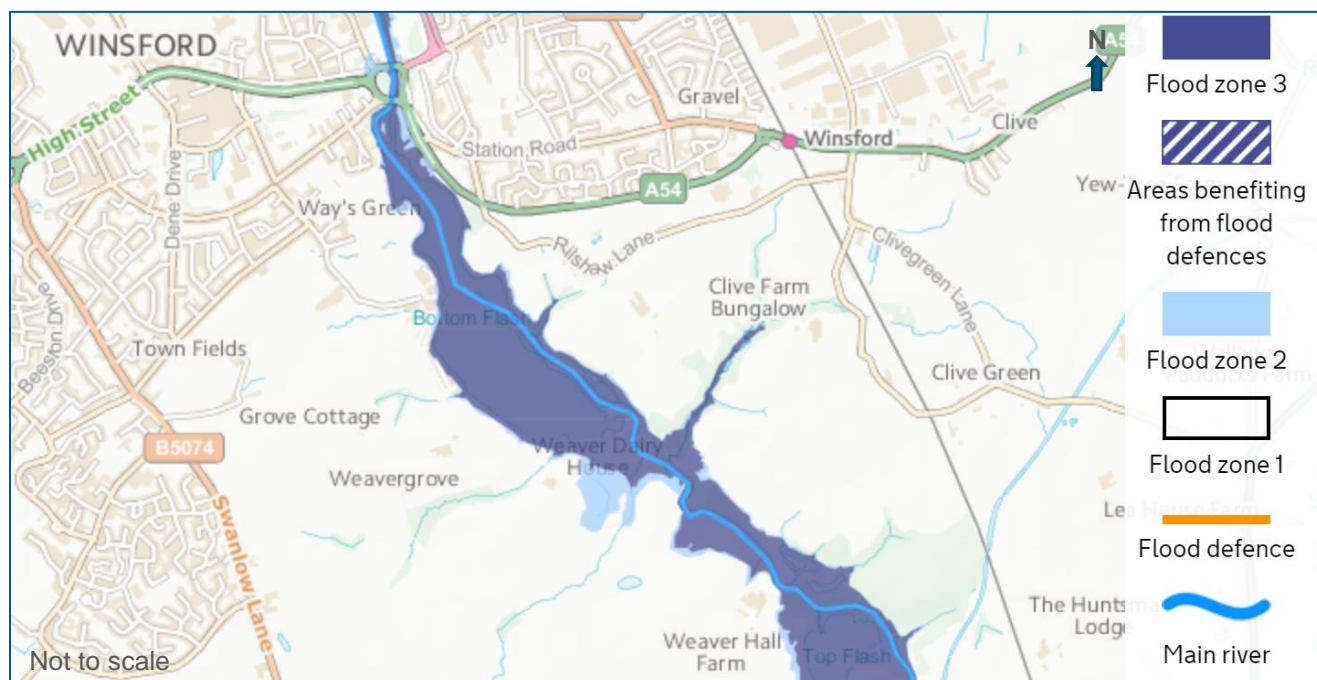
Figure 3-9 - Flood Risk Map Sandy Lane Acton Bridge Area



Source: EA, 2020 <https://flood-map-for-planning.service.gov.uk/>

The River Weaver flows south to north. To the south of Winsford is Bottom Flash, a large lake formed in a depression caused by subsidence after salt mining and/ or brine extraction. The lake covers some 34 hectares and is formed by the River Weaver which extends across the bottom of a relatively low lying, steep sided but narrow valley. The landscape is characterised by fields and agricultural grass land, wooded valley sides and urban development.

Figure 3-10 - Flood Risk Map Winsford Area

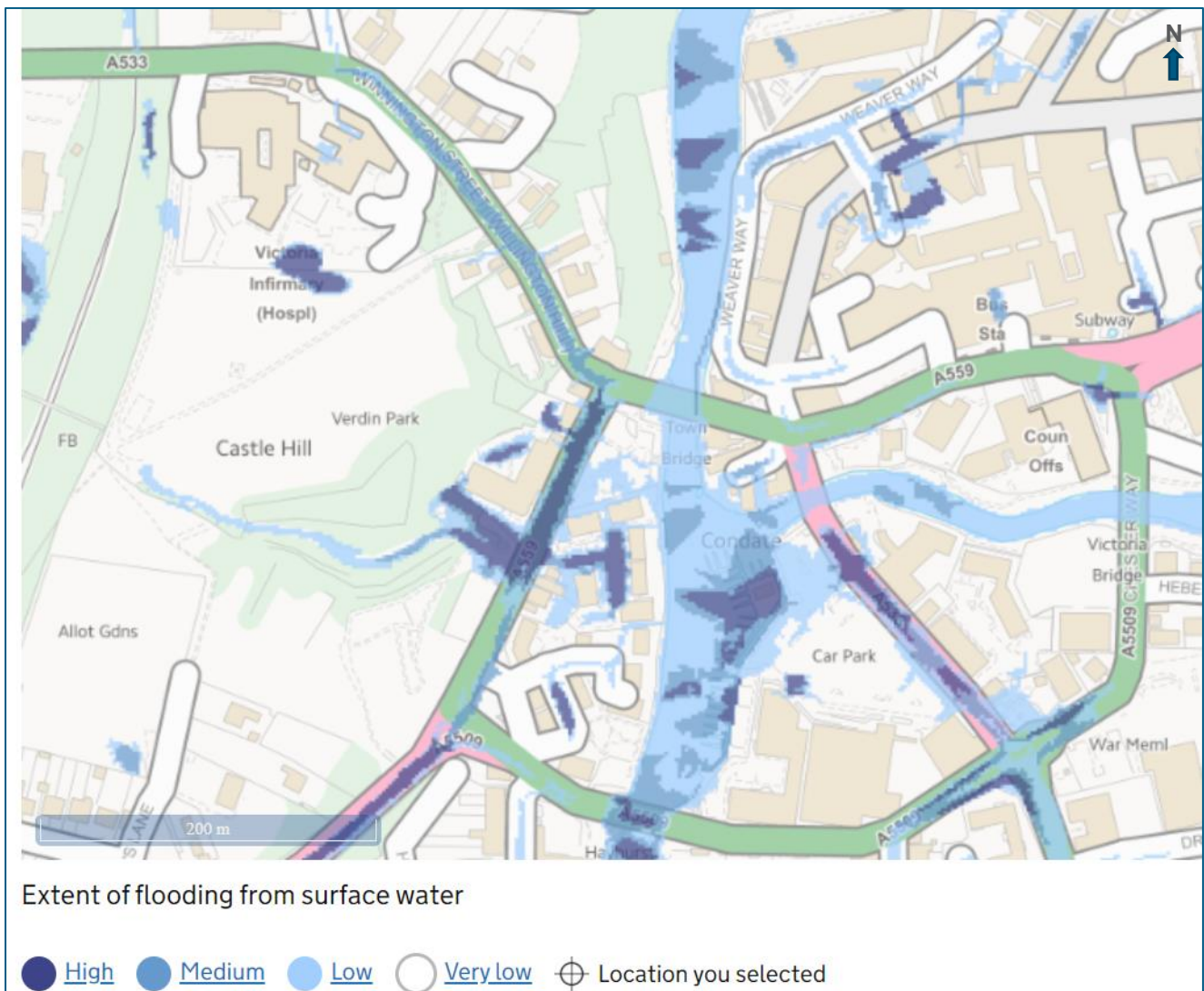


Source: EA, 2020 <https://flood-map-for-planning.service.gov.uk/>

The EA Flood warning service also produces surface water flood risk maps. High risk means that each year this area has a chance of flooding of greater than 3.3%. Medium risk means that each year this area has a chance of flooding of between 1 and 3.3%. Low risk means that each year this area has a chance of flooding of between 0.1 and 1%. The Northwich town centre area appears to have certain areas of low to high risk, refer to Figure 3-11.

Surface water flooding, sometimes known as flash flooding, happens when heavy rain cannot drain away, is difficult to predict as it depends on rainfall volume and location, can happen on high ground and away from rivers and other bodies of water, and is more widespread in areas with harder surfaces like concrete.

Figure 3-11 – Surface Water Flood Risk Map Northwich Town Centre – EA



Source: EA, 2020 <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=341532&northing=556913&map=SurfaceWater>

3.6. Flooding History

There have been several recorded flood events in Northwich Town Centre with the most severe occurring in 1946, and recent events occurring in 2000, 2012 and 2015. The 1946 event was estimated to be in excess of a 1 in 100 probability flood event and the flooding was widespread. In 2000 and 2012, flooding of the Bull Ring and old Floatel site (now replaced with the new Waitrose car park) occurred with waters escaping onto the main roads through the town centre causing major disruption and road closures.

4. Existing Infrastructure

The below introduces the relevant infrastructure in the areas affected by the flooding in the October 2019 event.

4.1. Northwich town centre

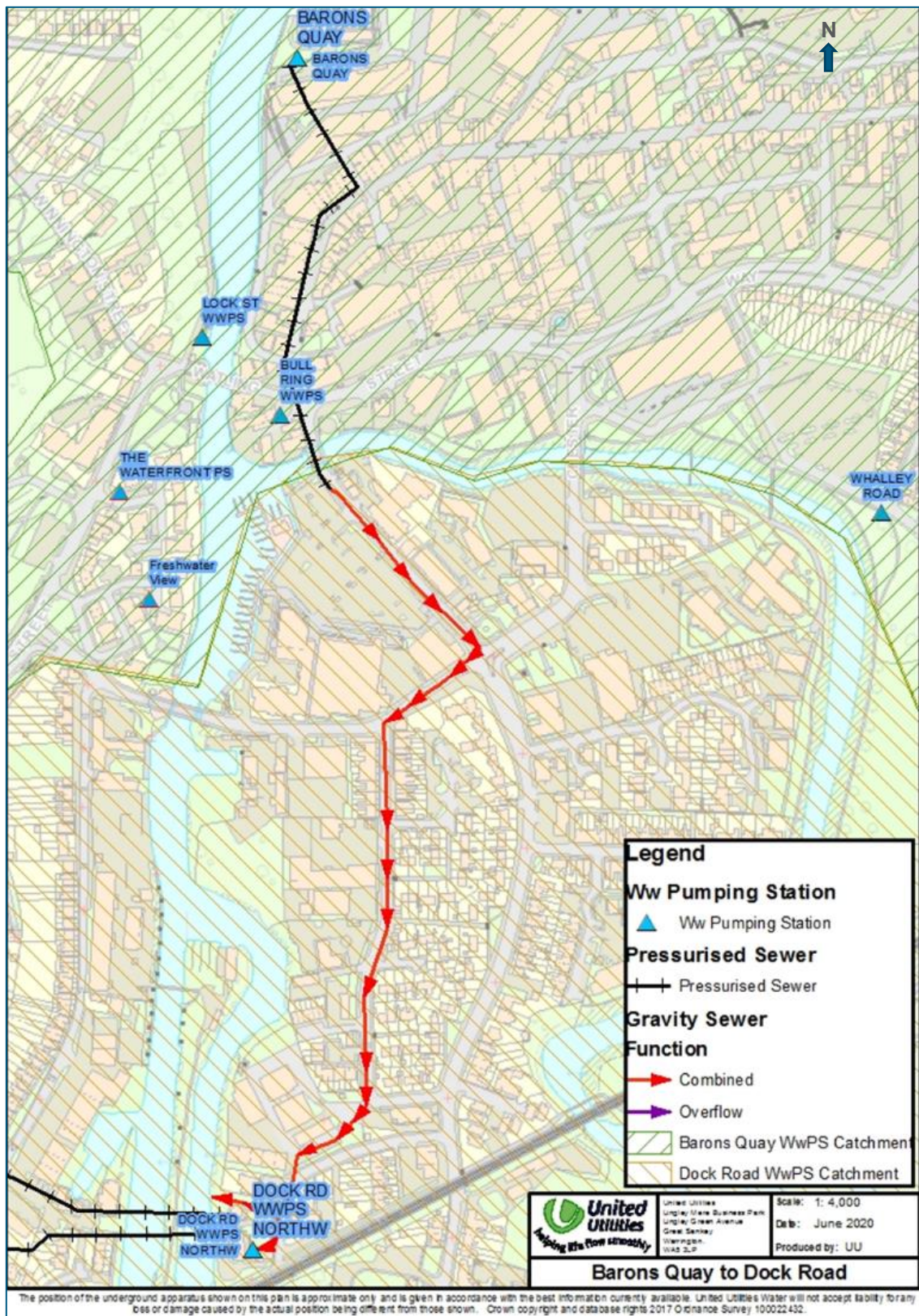
Northwich town centre is protected by raised flood defences built by the EA in 2015-2016 (officially opened in June 2017) and has a large network of combined sewers owned by UU. There is highways drainage owned by CWaC and private drainage in the area as well.

4.1.1. UU Sewer Network

Drainage in Northwich town centre is predominantly made up of a combined sewer system which takes both foul and surface water, a number of smaller network pumping stations with two larger last in line wastewater pumping stations: Barons Quay pumping station which pumps flow from Dane Street until it meets London Road and then flows via gravity to Dock Road pumping station, which then pumps flow on to Northwich Wastewater Treatment Works. This is illustrated in Figure 4-1 below. For both stations, flows above the pass forward flow limits are permitted to be discharged to river. A schematic drawing of the UU network is presented in Figure 4-2. The catchment descriptions that follow are as described by UU.

Asset information for UU outfalls to the Rivers Weaver and Dane is provided in Appendix B, and where appropriate the drains referred to are referenced in Section 8.

Figure 4-1 - UU Pumping Station Location Plan



Source: UU data 2020

Figure 4-2 - UU Network and Outfalls– Northwich Town Centre



4.1.1.1. Barons Quay Catchment

Barons Quay catchment encompasses:

- A rising main that receives flows from Great Budworth, Wincham, Marston and Lostock Gralam at the north east of the catchment.
- Combined Sewer Overflow (CSO) points at Winnington Hill, Lock Street, Castle Street and Chesterway.
- Wastewater pumping stations at Lock Street, Bull Ring, Whalley Road and Barons Quay.

Barons Quay pumping station includes:

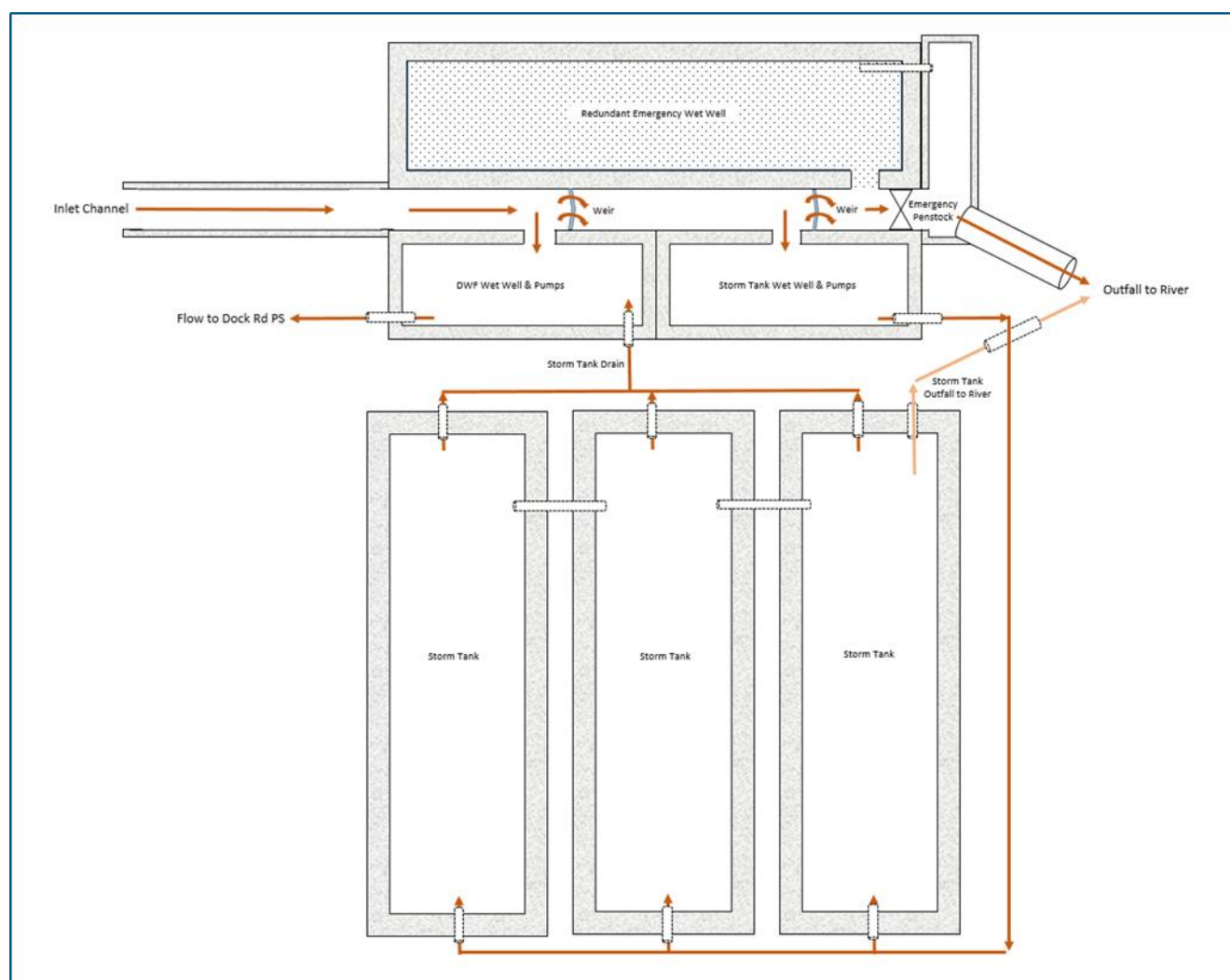
- Five dry weather pumps that operate on a Duty, Assist, Assist, Assist, Standby arrangement (if pumping demand exceeds capacity for the Duty pump, then an Assist pump will be enabled to assist with the delivery. If the demand continues to increase, additional assist pumps will start). Flows up to 10 times dry weather flow are pumped to Dock Road Pumping Station.
- There are three storm pumps which pump flows in excess of the 10 times dry weather flow to storm tanks located on site.

Barons Quay pumping station's emergency systems:

- There is an emergency penstock which is automatically opened in a storm event to allow excess flow to river, when the outfall is not 'river locked' or blocked by water in the river at a higher level.
- This outfall is at 9.69 metres above ordnance datum (mAOD).

Figure 4-3 shows a schematic plan of the arrangement at Baron's Quay pumping station.

Figure 4-3 - Baron's Quay Pumping Station Arrangement



Source: UU data 2020

4.1.1.2. Dock Road Catchment

Dock road catchment encompasses:

- Pumping stations at Monarch Drive and Dock Road.
- CSO points at Weir St, Dane Nurseries, Carlton Road, Middlewich Road and Marlow Road.
- Rudheath Trunk Sewer which receives sewage from Rudheath area, Lach Dennis and Lostock Green.
- Davenham Trunk sewer which receives flows from South Leftwich, Davenham and Moulton.

Dock Road is a last in line pumping station to Northwich wastewater treatment works and is permitted to pass forward 510l/s. Dock Road Pumping Station has:

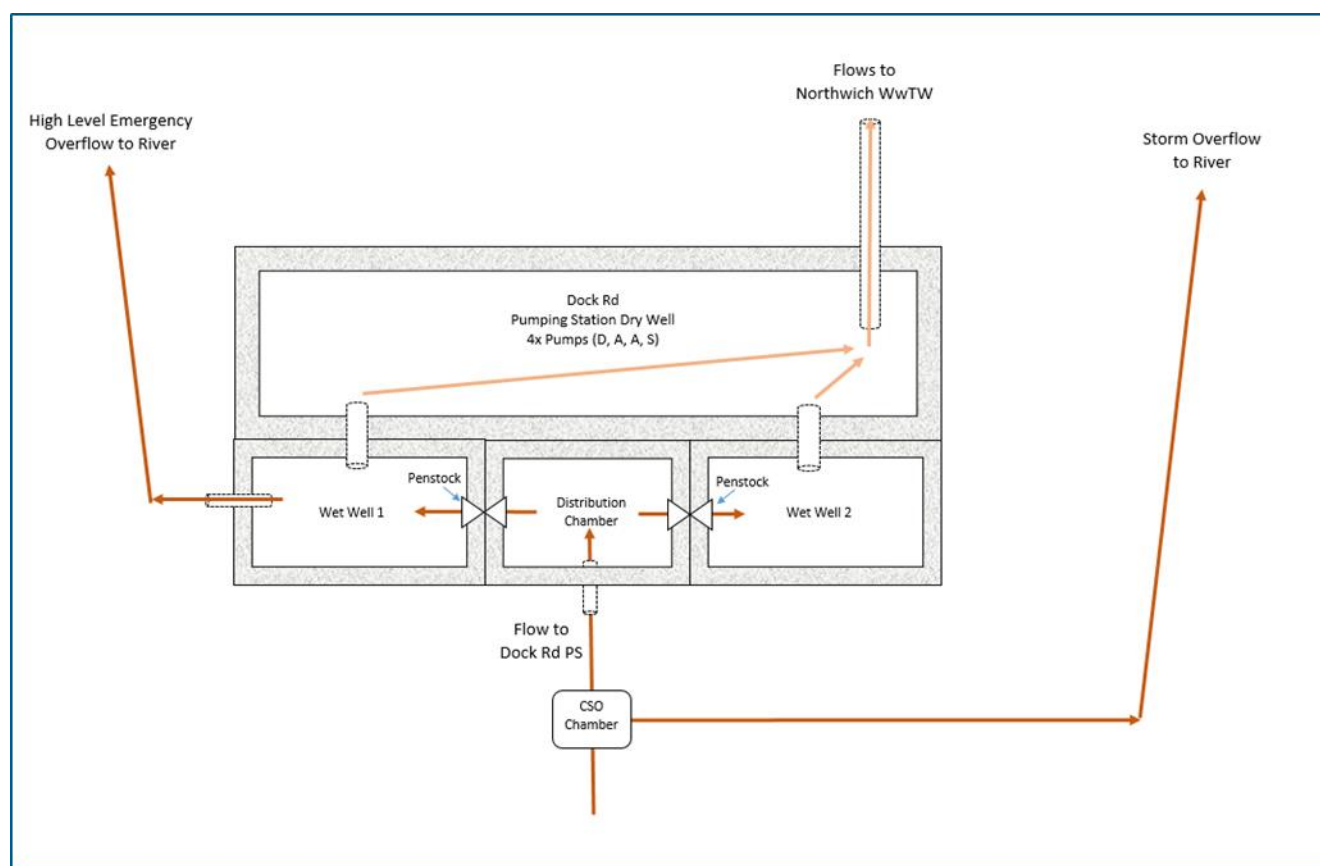
- Four sewage transfer pumps that operate on a Duty, Assist, Assist, Standby arrangement (a standby pump is a backup in the event of the duty and assist pumps failing to meet the pumping requirement).
- Pump 3 was replaced in August 2019 by a hire pump to act as a manually operated standby pump.

Dock Road pumping station's emergency systems:

- There is an emergency penstock which opens when the incoming flows are in excess of 510l/s in the rising main.
- When incoming flows to Dock Road exceed the pass forward rate, a network CSO upstream (Weir Street CSO, VRY0102) acts to relieve surcharge in the system by discharging to watercourse. The relief weir crest level is at 10.16mAOD. Levels of protection provided by the CSO can be reduced at lower river levels than this crest level, as the hydraulic gradient in the outfall pipe is forced higher.
- An additional emergency overflow exits directly from the pumping station's wet well in case the emergency penstock fails to open.

Ultrasonic sensors in the wet wells provide signals to the electronic control system which in turn controls the pumps. Figure 4-4 shows an elevation view of this arrangement.

Figure 4-4 - Dock Road Pumping Station Arrangement

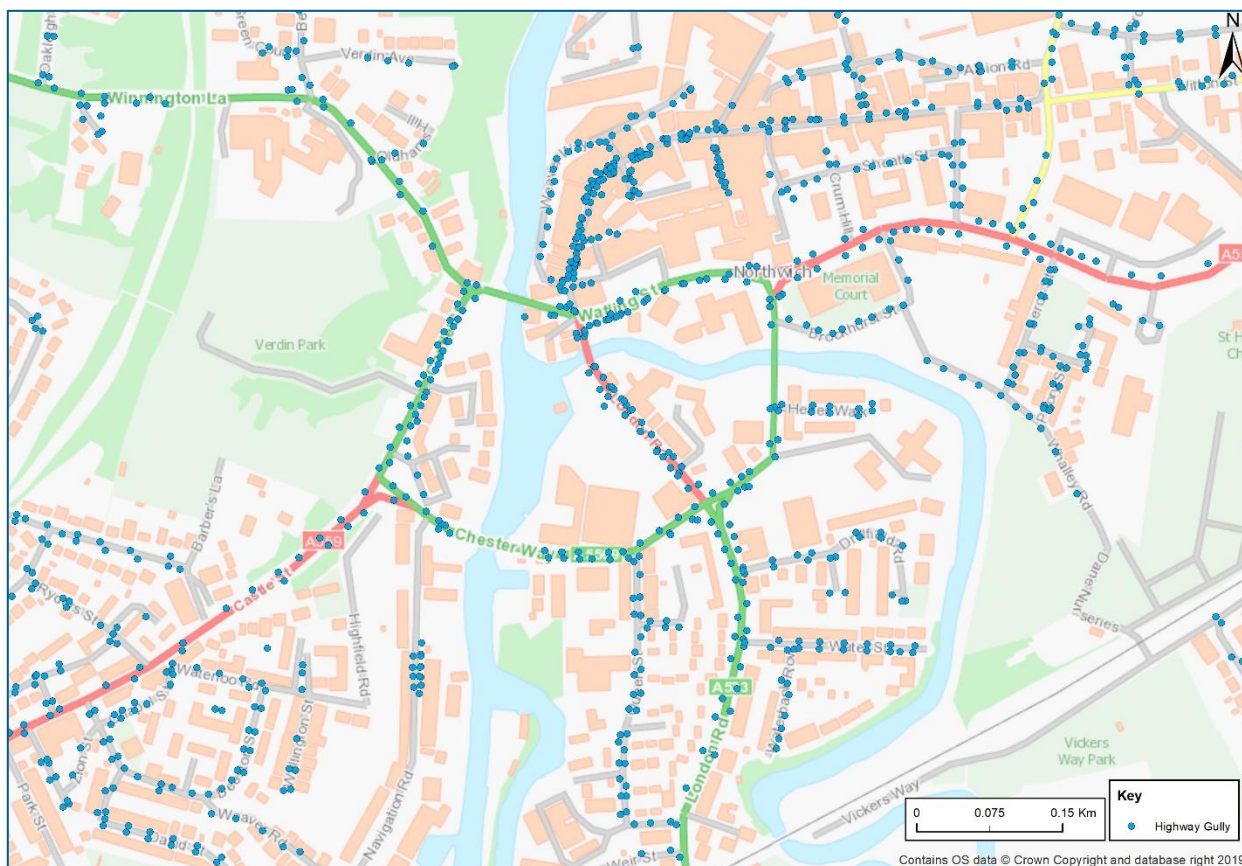


Source: UU data 2020

4.1.2. Highways Drainage

There are a number of highways drainage gullies which provide drainage to the roads in Northwich town centre. These are maintained by the Highways Authority, CWaC. Records of the highway drainage network, between gully and discharge, and condition are provided by way of a drainage CCTV survey undertaken in 2020 following recommendations of the S19 interim report. The location of the highway gullies can be seen in Figure 4-5 below. The schematic plan of the highway drainage network, as surveyed, is provided in Appendix C and the full CCTV survey undertaken in 2020 is available on request.

Figure 4-5 - CWaC Highway Gullies

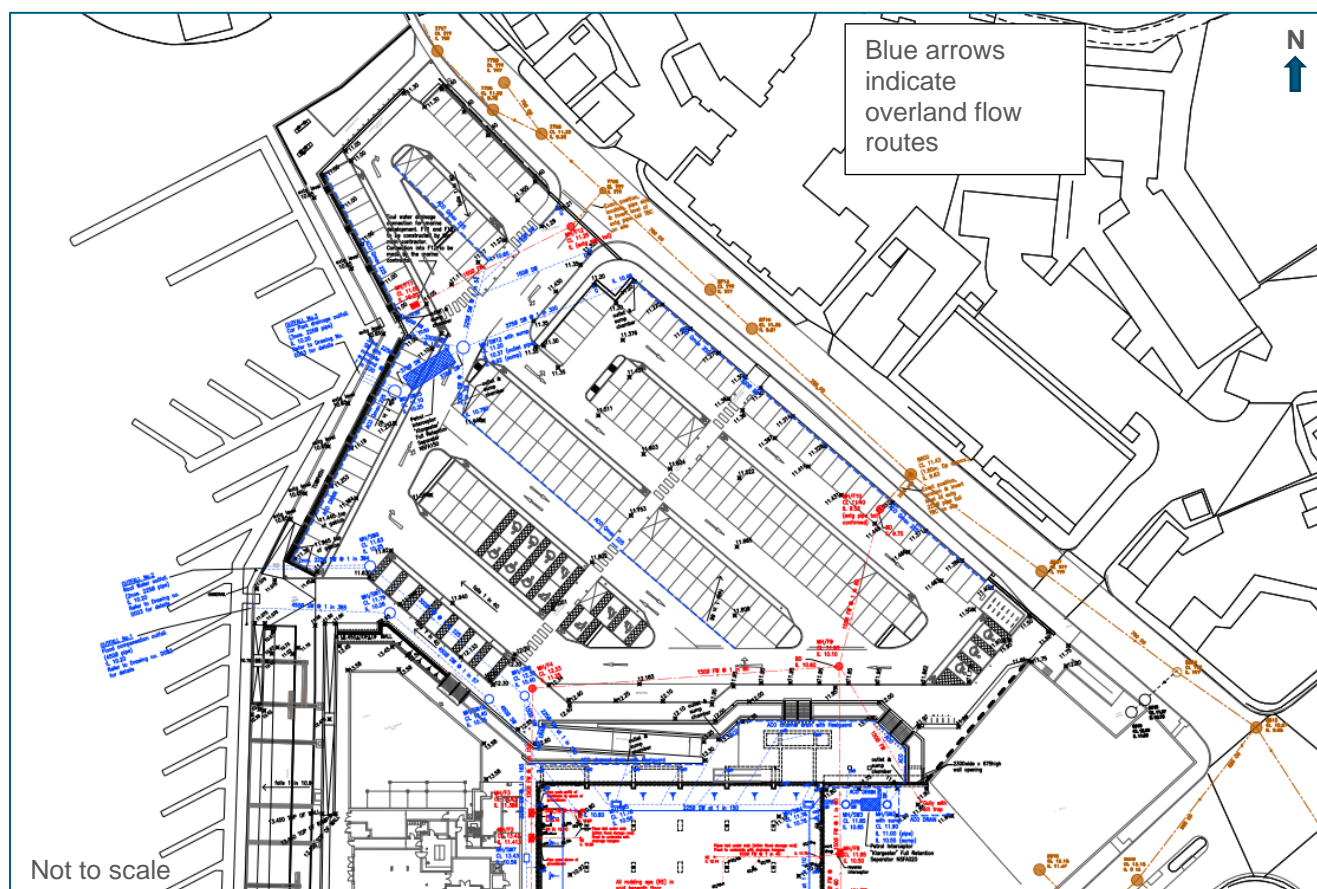


Source: CWaC, 2020

4.1.3. Waitrose Drainage

Detailed records of the privately owned, and operated, drainage within the carpark of Waitrose located at the confluence of the River Dane and River Weaver are not currently available. The drainage proposals submitted as part of the planning application are shown in Figure 4-6. Detailed 'As built' records were not available; however, it is understood that the invert levels of these outlets are all 10.2mAOD and they have non-return valves.

Figure 4-6 - Waitrose Drainage Plans



Source: Healey Consulting, 2013

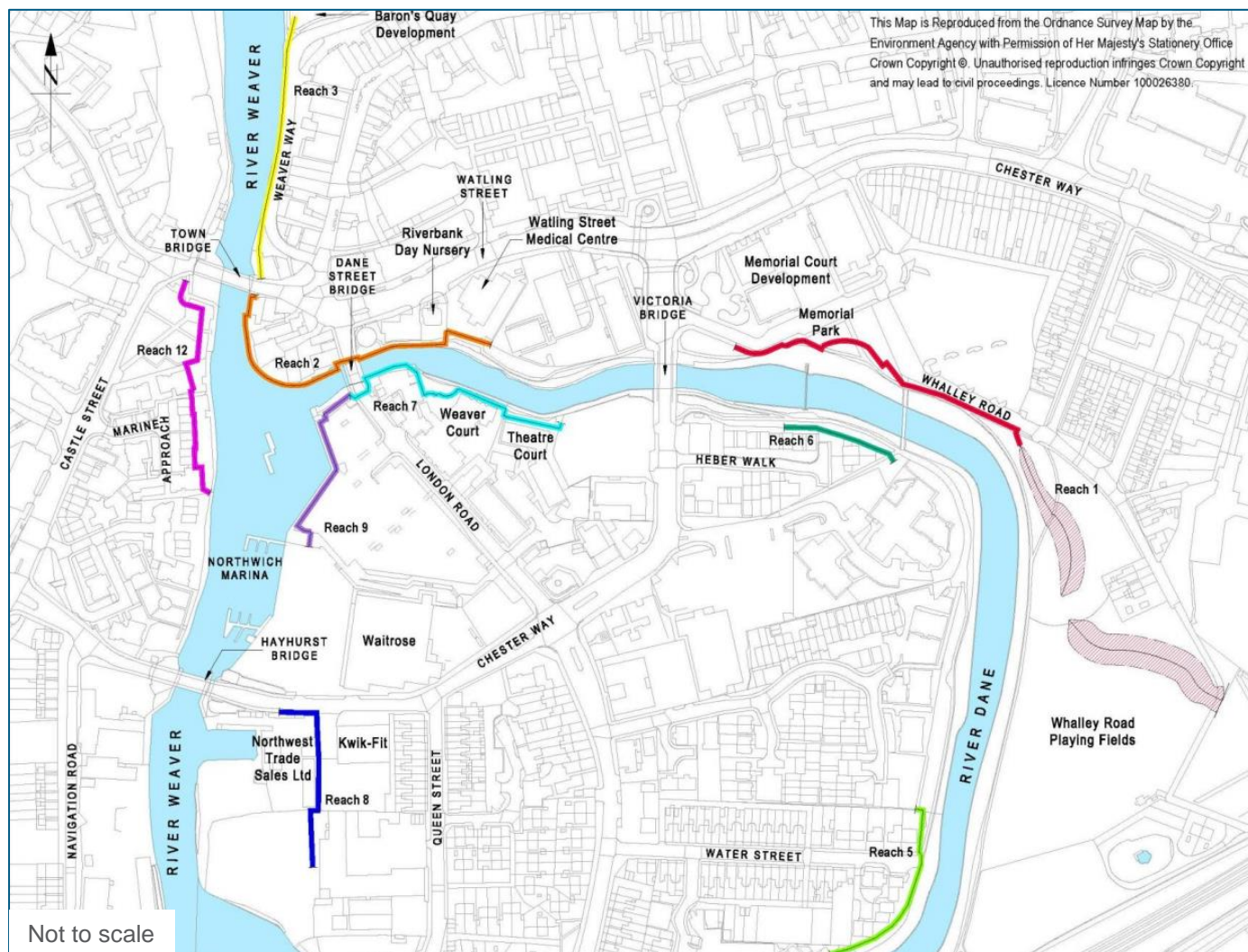
4.1.4. Flood Defences

1.7km of raised flood defences consisting of walls, embankments and demountable barriers were constructed in Northwich town centre along the River Weaver and Dane. The defences:

- Were built in 2015 and 2016 in response to flooding in 2012, which flooded the lower parts of the town centre including the Bull Ring and the now Waitrose car park.
- Were built to a FDL of 1% AEP at the time, plus 300mm of freeboard allowance.

An overview plan of the raised defences showing their alignment in coloured lines is provided in Figure 4-7.

Figure 4-7 - Northwich Town Centre Flood Defences



Source: EA, 2016

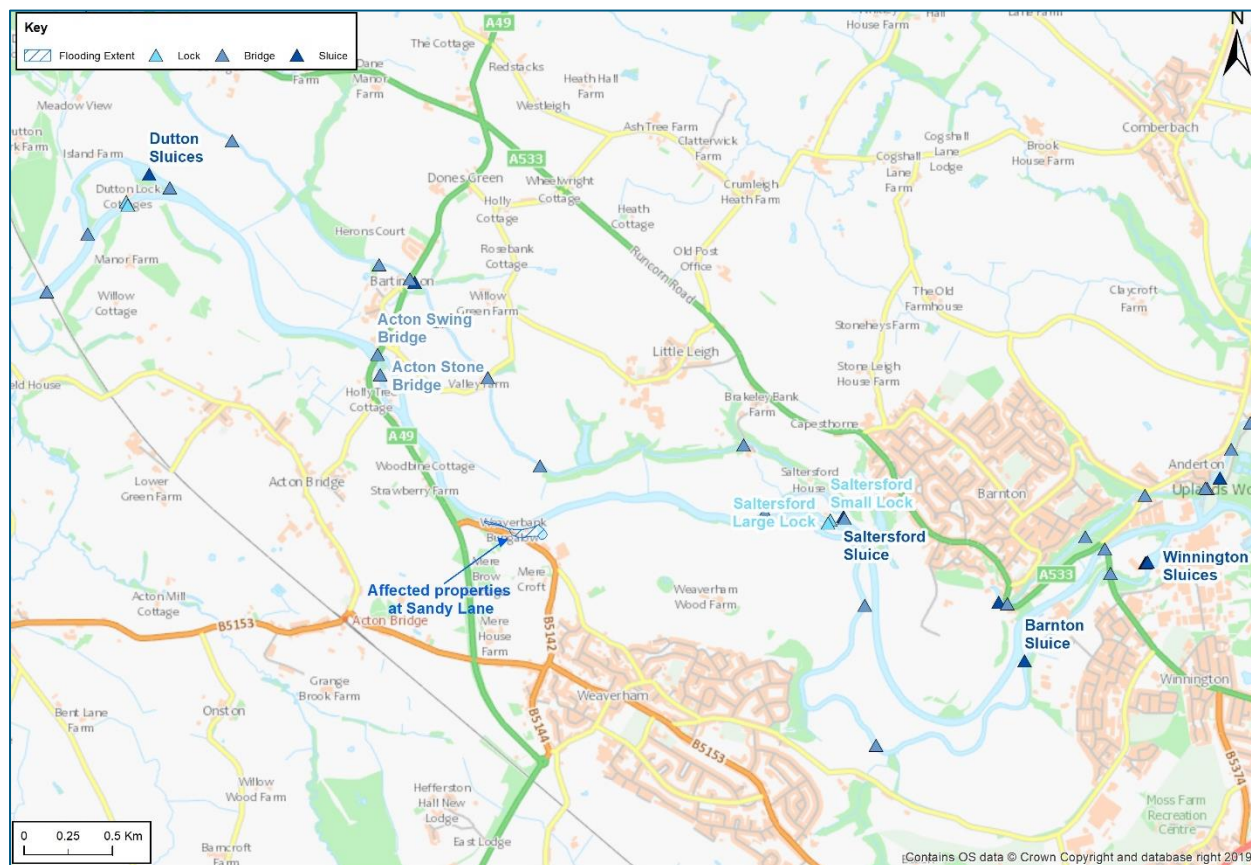
The flood defences were designed to protect 400 properties. Many of these areas benefitted from this flood protection in the flooding that occurred October 2019. The following three areas where flood defences were present were affected by flooding in October 2019:

1. Downstream of Town Bridge – Right Bank River Weaver
 - Demountable flood barriers founded on concrete grounding beam and sheet piles.
 - Continuous sheet pile wall with structural glass panels.
2. Upstream of Town Bridge to Dane St Bridge – Right Bank River Weaver / Right Bank River Dane
 - Continuous sheet pile wall with structural glass panels.
 - Demountable flood barriers across Dane St Bridge.
3. Northwich Quay to Dane St Bridge – Right Bank River Weaver / Left Bank River Dane
 - Continuous sheet pile wall with structural glass panels.
 - Demountable flood barriers and flood gate between Northwich Quay and Waitrose car park.
 - Demountable flood barriers across Dane St Bridge.

4.2. Sandy Lane, Acton Bridge Area

Approximately 2km upstream of the properties affected at Sandy Lane is the Saltersford Locks and Sluice Gate owned and operated by the Trust. The Acton Stone Bridge and Acton Swing Bridge are located 1.2km downstream of Sandy Lane properties, the Dutton Sluices are a further 2km downstream as shown in Figure 4-8.

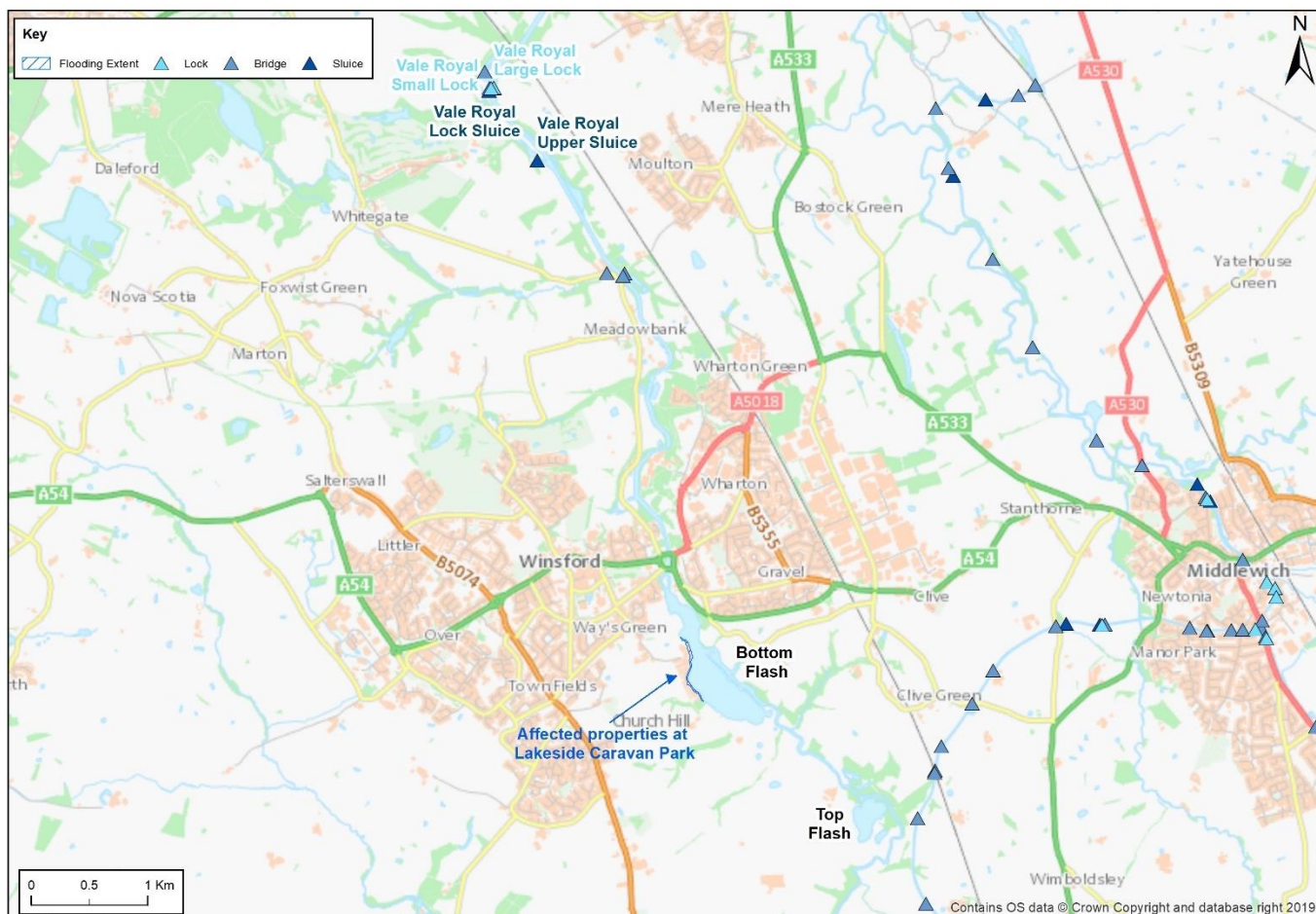
Figure 4-8 - Sandy Lane Area



4.3. Bottom Flash, Winsford Area

Bottom Flash is located downstream of Top Flash and upstream of the A54 Winsford Bridge (westbound and eastbound). The Vale Royal Locks and Sluice Gates are located 5.7km downstream of Bottom Flash, as shown in Figure 4-9 below.

Figure 4-9 - Bottom Flash Area



5. Data Collection Summary

CWaC, as the LLFA, collected data and began consultations with the RMAs, affected property owners and the public upon subsidence of the flooding. The following sections provide an outline to the process followed.

5.1. Consultation

Each of the following parties involved with the flood incident were contacted to provide information. Table 5-1 provides a summary of the information shared with CWaC.

Table 5-1 - Data Provided through Consultation

Consultee	Information Provided
Cheshire West and Chester Council	<ul style="list-style-type: none"> • Emails regarding flooding sent to LLFA • Multi-agency flood de-brief meeting notes • Photos of flood incidents • Waitrose indicative drainage plan • Highway gully plan • Road closure incidents
Environment Agency	<ul style="list-style-type: none"> • Evidence review and flood event timeline including incident response • Rain and river gauge data • Topographic survey, flood defence as built drawings and design report • Flap valve survey • Operations and maintenance plan for Northwich scheme defences
United Utilities	<ul style="list-style-type: none"> • Maps of assets • Timeline and performance summary of assets during flood event including incident response • Operation of UU last in line pumping station • Modelling for post incident analysis – UU and assumed third party surface water systems • Maintenance records • Drop-in session notes • Telemetry data during flood event • Post incident site investigations
Canal & River Trust	<ul style="list-style-type: none"> • Timeline and performance summary of assets during flood event • SCADA records
MET Office	<ul style="list-style-type: none"> • UK Monthly Climate Summary October 2019 • October 2019 Rainfall
Local Residents and Businesses	<ul style="list-style-type: none"> • Photographs and anecdotal evidence • Flood outlines

5.2. Data Review

Data collected confirmed the extents of flooding at the Lakeside Caravan Park, Winsford, Sandy Lane, Acton Bridge properties and in the Northwich town centre. Incident response and conditions of the weather event have been reviewed as part of this investigation.

Topographic survey and GIS data of the relevant assets were requested in order to map these against the flood outlines of the event.

5.3. Site Investigations

Site investigations were carried out by UU on the 12th November 2019, with surface water connectivity investigations and flap valve operation checks being completed.

A drop-in event was held by CWaC, EA, the Trust and UU on 19th November 2019 at the Memorial Court to provide information and advice to affected residents and businesses. Further consultations were undertaken with local residents and businesses, via the phone and at the properties affected, in March 2020 to further inform the understanding of flooding mechanisms.

CWaC and Atkins undertook site investigations in November 2019 to refine the understanding of the area's physical characteristics and to:

- Understand the area's topography and historic flood mechanisms.
- Engage with local residents and businesses to capture local knowledge of the flood event.

Residents and businesses directly affected by flooding were notified in advance of the site visits either verbally in person or through written communications. Local knowledge was captured through site consultations and shared notes, sketches and photographs.

Further network investigations were carried out by UU on 28th November 2019 on the pumping stations and emergency overflow outfalls.

6. Flood Incident Details

This section provides a summary of the environmental conditions that led to flooding in the October 2019 event. The following information has been reviewed:

- EA Water Situation Reports – a monthly national report.
- Met Office October 2019 Rainfall data.
- Met Office Monthly UK Climate Summary October 2019.
- National Hydrological Monitoring Programme. 2019. Hydrological summary for the United Kingdom: October 2019. Wallingford, UK Centre for Ecology & Hydrology. <http://nora.nerc.ac.uk/id/eprint/525904/>

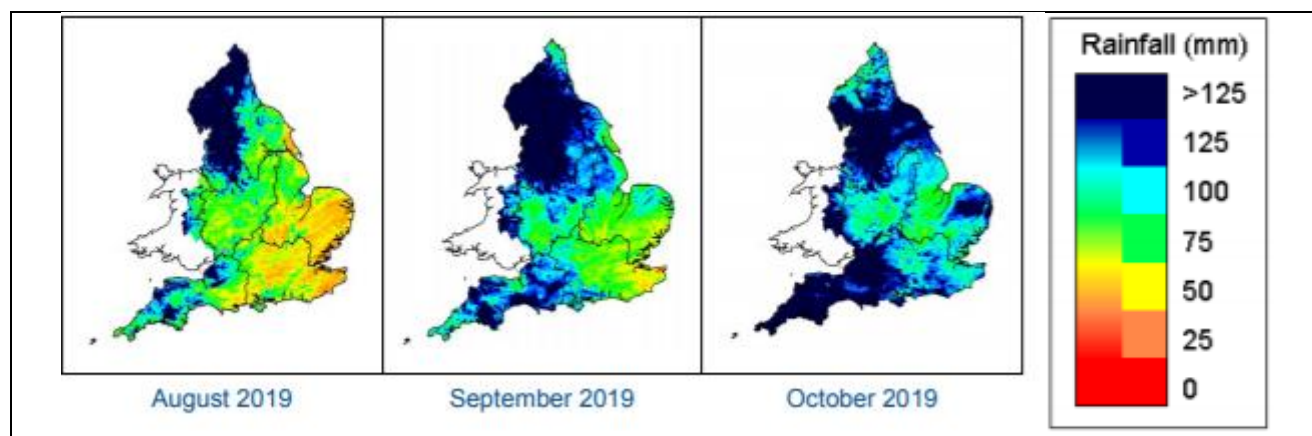
6.1. Rainfall Summary

Above average rainfall fell in October across most catchments in England, with some catchments receiving over double the average monthly total:

- The rainfall total for England was 125mm representing 162% of the 1961 – 1990 long term average (EA Water Situation Report, October 2019).
- Soils were also wetter than average in all regions, with the soil moisture deficit across most of England smaller than average by at least 26mm (EA Water Situation Report, October 2019).
- The summer and autumn of 2019 were exceptionally wet; for England and Wales, in the last 50 years only 2012 was wetter over the June – October timeframe (CEH October hydrology report).

From the beginning of October until the 20th, the weather was unsettled with rain belts crossing the country. The 21st to the 23rd were quiet but rain fell between the 24th and 27th. The weather was cold, dry and sunny for most of the country from the 27th to the 30th (Met Office, October 2019 Climate Summary).

Figure 6-1 - Monthly rainfall across England and Wales



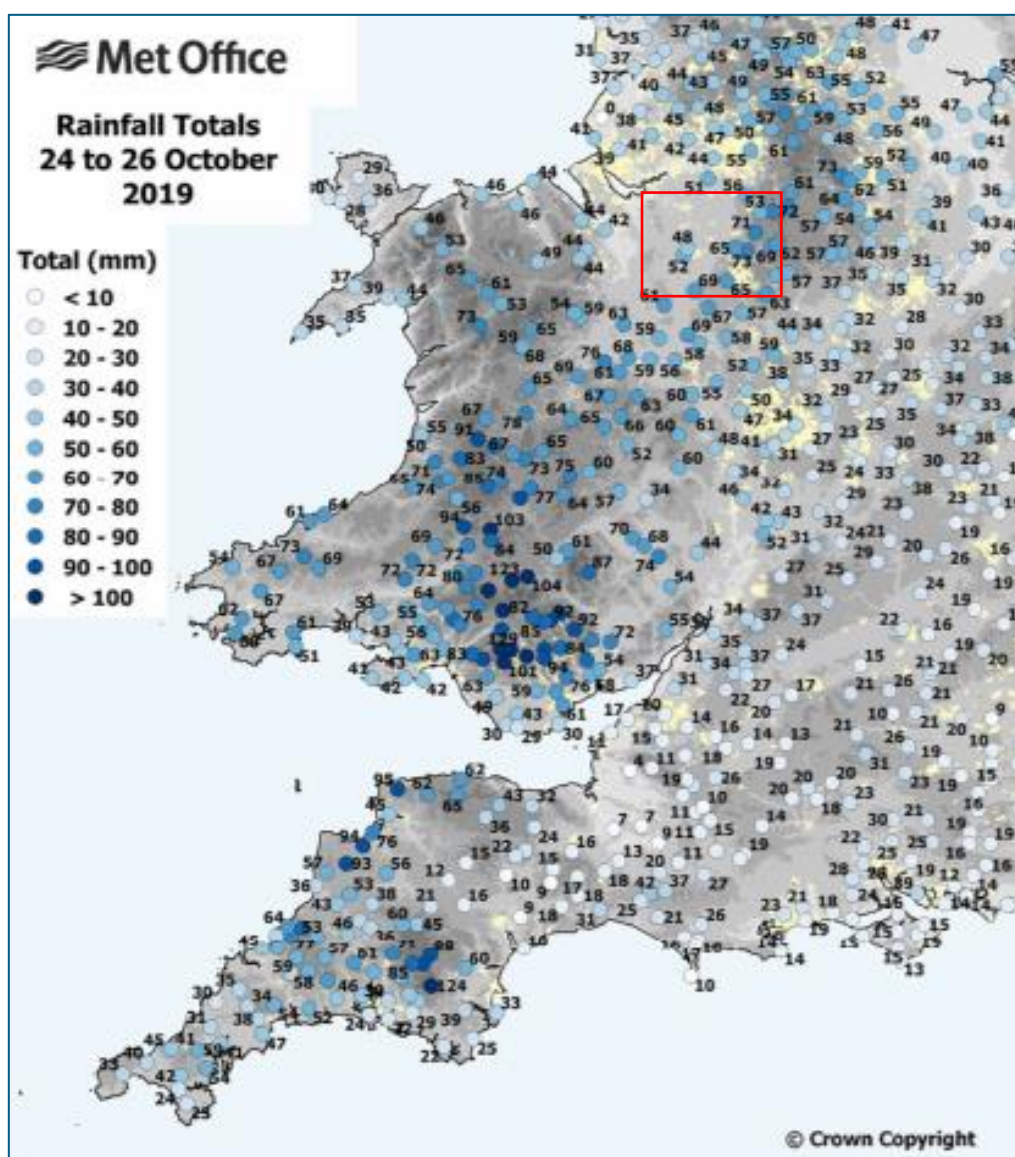
Source: UKPP radar data, Met Office

Persistent heavy rainfall, as a result of a slow-moving front fell from 26th – 27th October 2019:

- Some locations across Wales and Northern England received 75% or more of the monthly average rainfall during this period (Met Office October 2019 rainfall report).
- The front was associated with a large temperature gradient (Met Office October 2019 rainfall report). On the 26th October, the daily maximum temperature was 7 degrees Celsius in Birmingham, and 17 degrees Celsius in London (Met Office October 2019 rainfall report).

Figure 6-2 illustrates the rainfall over the period immediately prior to, and during, the flood event. It shows that high rainfall fell in the River Dane's upper catchment in the Peak District.

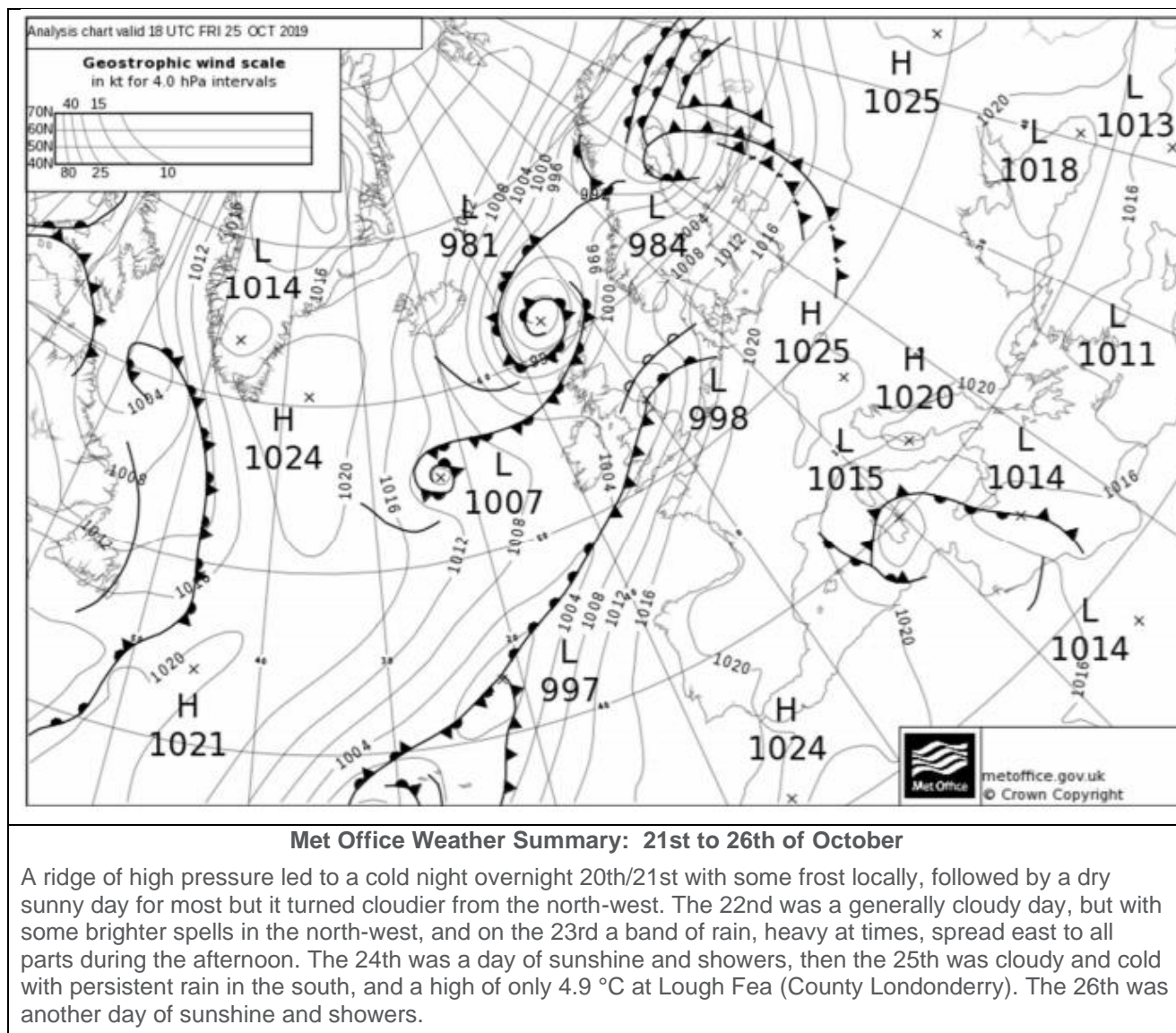
Figure 6-2 - Rainfall totals 9am 24 Oct to 9am 27 Oct 2019



Source: Met Office October Rainfall 2019 Report

Figure 6-3 illustrates the slow-moving front stretching from South Wales to Lincolnshire on 25 October 2019.

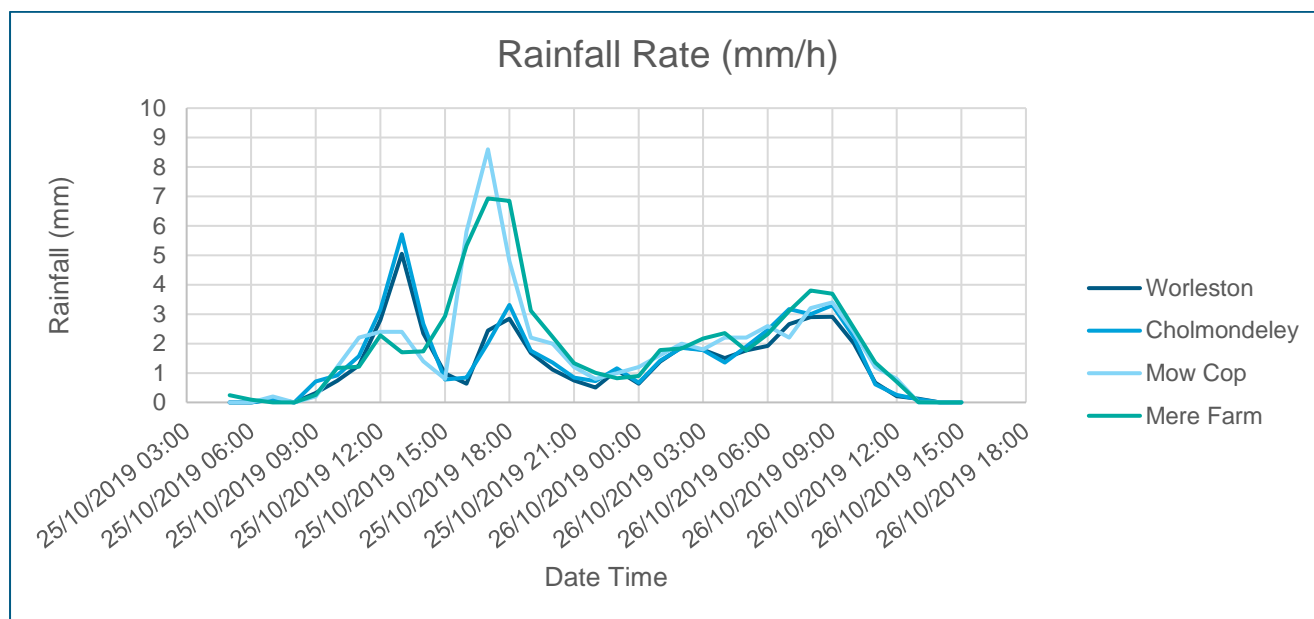
Figure 6-3 - UK Weather Summary 24-26 October 2019



Source: Met Office October Rainfall 2019 Report

Figure 6-4 presents graphs of the Environment Agency rain gauge data recorded during this period. Table 6-1 presents rainfall totals from the rain gauge data for this event. Figure 6-5 provides a location plan of these gauges in relation to Northwich.

Figure 6-4 - Rain Gauge Data

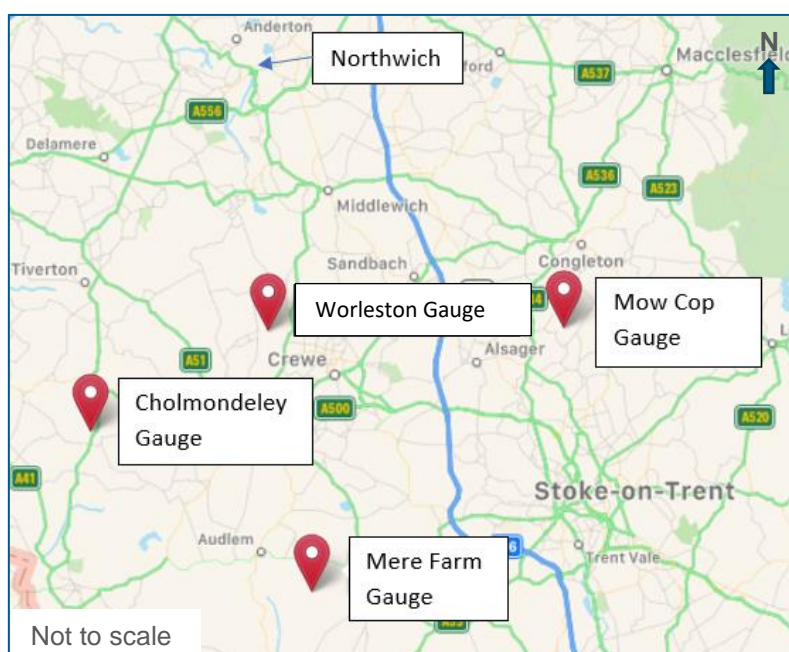


Source: Environment Agency, 2020

Table 6-1 – Rainfall Summary

Station	Event Rainfall Total (mm) from 25/10/2019 0:00 to 26/10/2019 23:59
Worleston	47.03
Cholmondeley	51.71
Mow Cop	64
Mere Farm	67.53

Figure 6-5 - Rain Gauge Location Map



6.2. Watercourse Data

River flows were substantially above average in October 2019, monthly mean river flows being classed as exceptionally high at just over a third indicator sites. These sites are constantly monitored by the EA to gauge river flows across the country (Water report, EA).

Table 6-2 provides details of the river gauges which have hydraulic connectivity and relevance to the areas affected by flooding. Figure 6-6 shows the location of these gauges, and Figure 6-7 indicates the river level at the gauge locations over the period of October flooding.

Table 6-2 - River Gauge Stations

Station	Comment
Rudheath River Dane Station No. 681210 366757, 371787	Typical levels for October 2019 – 13 – 15mAOD Incident date: the water levels exceeded the above range. Flooding was reported in the nearby areas of the River Dane and Weaver confluence.
Ashbrook River Weaver Station No. 680504 367172, 263508	Typical levels for October 2019 – 17 – 18mAOD Incident date: the water levels exceeded the typical range. Flooding was reported at the Lakeside Caravan Park
Hayhurst Bridge River Weaver Station No. 680525 365682, 373589	Typical levels for October 2019 – 9.5 – 11mAOD Incident date: the water levels exceeded the typical range. Flooding was reported in the nearby areas of the River Dane and Weaver confluence.
Pickerings Cut River Weaver Station No. 682223 357573, 376266 * No absolute levels available	Typical levels for October 2019 – 4.5 – 5.5mAOD Incident date: the water levels exceeded the typical range. Flooding was reported at Sandy Lane near Acton Bridge.

6.3. Weather/Flood Warning

The FWMA (2010) dictates that the EA has permissive powers, but not a statutory duty, to issue flood warnings to communities at risk of flooding. Northwich and surrounding areas are covered by the EA's Flood Warning service and Flood Alert Areas. The Flood Warning Area is applicable to all Main Rivers. Flood Alert Areas are applicable to all Main Rivers and some adjacent discrete watercourses.

The table below shows the warnings and alerts that were issued by the EA in the area from the 26th October 2019 to 27th October 2019.

Table 6-3 - EA Flood Alerts and Warning Summary

Alert/Warning	Code	Name	Date	Time
Alert	013WAFWE	Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich	26/10/2019	07:37
Alert	013WAFDEE	The River Dee Catchment in England from Whitchurch to Chester	26/10/2019	07:40
Alert	013WAFGO	River Gowy catchment including areas around Frodsham	26/10/2019	10:27
Warning	013FWFCH34	Weaver Navigation at Winsford	26/10/2019	11:23
Warning	013FWFCH40	River Weaver at Anderton	26/10/2019	15:30
Warning	013FWFCH37	River Weaver at Pickerings Bridge	26/10/2019	22:16
Warning	013FWFCH41	River Weaver at Acton Bridge and Weaverham	26/10/2019	22:21
Warning	013FWFCH48	Weaver Navigation at Sutton Dock	26/10/2019	22:21

There are three flood warning codes depending on the severity of flooding expected. They are also issued at different intervals in advance of flooding, based on level thresholds set at warning gauges:

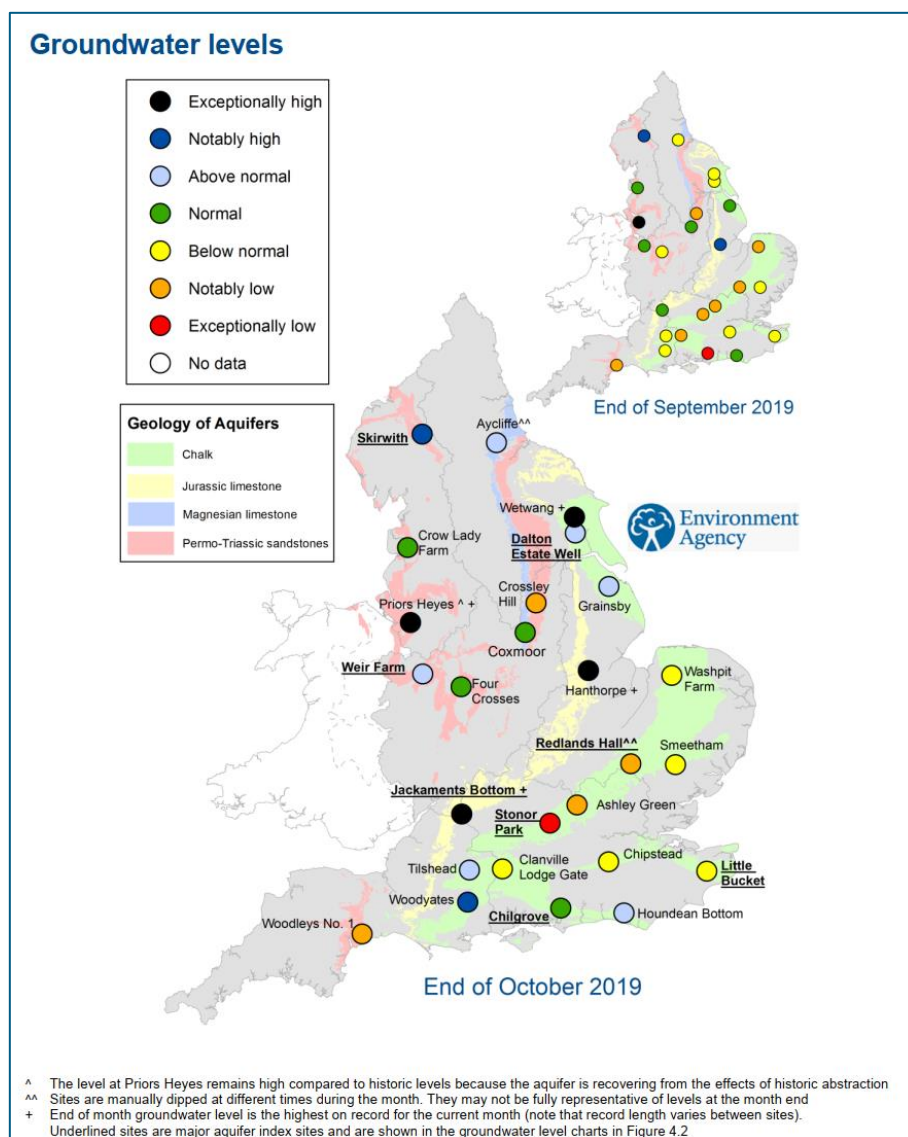
- A Flood Alert might be issued two hours to two days in advance of flooding and means that flooding is possible and to tell recipients to be prepared.
- Flood Warnings mean that flooding is expected, and immediate action is required, these are often issued half an hour to two hours in advance of flooding.
- Severe Flood Warning means that there is a risk of severe flooding and there is a danger to life. It is used when flooding poses a significant risk to life or significant disruption to communities.

*Flood Warnings for Northwich town centre (013FWFCH24 River Weaver at Northwich Marina, 013FWFCH25 River Weaver at Weaver Way, 013FWFCH26 River Weaver at Marina Approach and Chester Way and 013FWFCH27 Rivers Weaver and Dane at Northwich) were not issued as these are triggered at a level where the defences are expected to be overtopped.

6.4. Groundwater Conditions

Groundwater levels throughout England were classed as above normal or higher for the time of year. Although Figure 6-8 shows groundwater levels nearest Northwich from the EA report in October were recorded as 'Exceptionally High', it should be noted that these levels are considered high compared to historic levels because the aquifer is recovering from the effects of historic abstraction (Water Report, EA).

Figure 6-8 - Groundwater levels October 2019



Source: EA, Water Situation report October 2019

There are several groundwater monitoring stations on the outskirts of the area, as shown in Figure 6-9. The groundwater monitoring stations are operated by the EA.

Figure 6-9 - Location map of groundwater monitors near Northwich

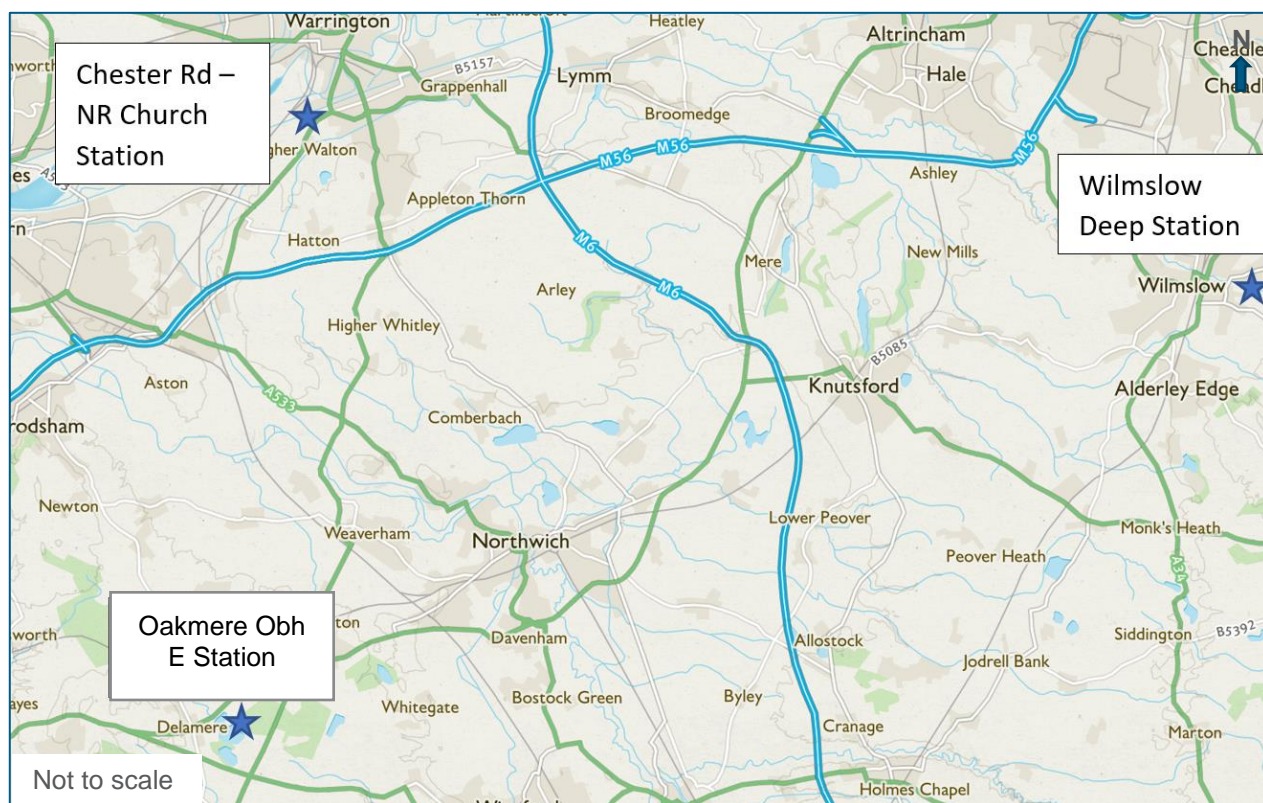
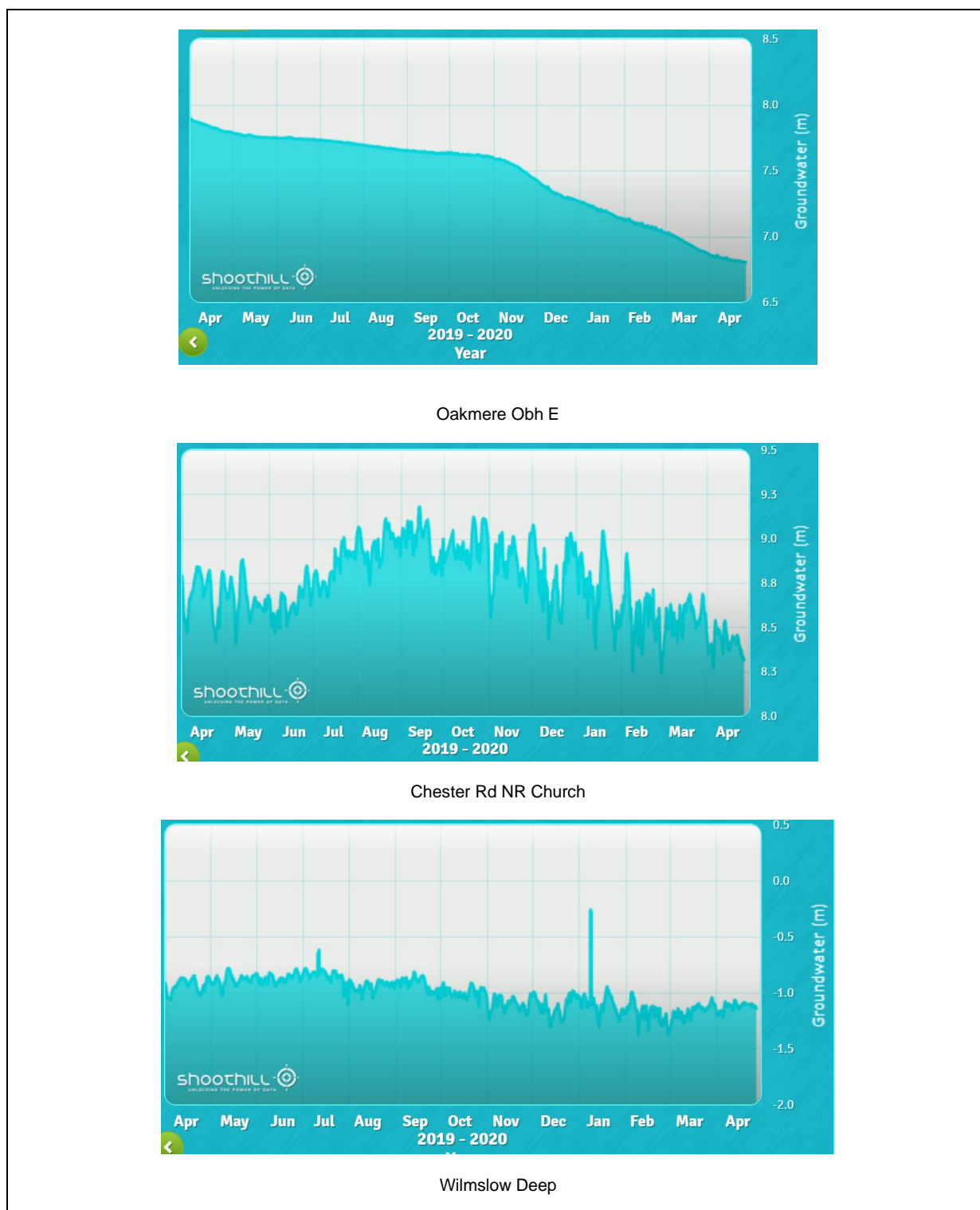


Figure 6-10 illustrates the groundwater levels nearby Northwich over the 2019 to 2020 period.

Figure 6-10 - Groundwater monitoring data



Source: Flood Assist, 2020

By inspection, the results above indicate that the groundwater levels at the time of the flood event were not significantly higher than average, at Wilmslow Deep and Oakmere Obh E stations, and only slightly above average at Chester Rd NR Church station.

7. Flooding Review

Key statistics are summarised in Table 7-1. Three separate locations in Northwich and surrounding areas are reported to have been affected by the flooding in October 2019. A detailed timeline of the flood event can be found in Appendix D.

Table 7-1 - Flood Impact Summary

Area	Sub Area	Internal	External	Highway	Comment
Winsford – Lakeside Caravan Park	-	6	1	-	6 caravans were flooded internally
Acton Bridge – Sandy Lane	-	4	7	3	Warrington Road, Acton Lane, Sandy Lane closed.
Northwich Town Centre	London Road	2	1	1	
	Weaver Way and High Street	9	-	2	
	Bull Ring	2	-	2	
	Northwich Quay	-	-	-	19 residents evacuated, 5 chose to remain
Total		23	9	8	

CWaC established a Council Recovery Co-ordination Group and multi-agency Strategic Recovery Co-ordination Group. This group met multiple times after the event to coordinate the response, which included:

- Meeting affected residents and businesses to provide any support
- Recovery actions by various Council Services and all partners
- Clean up operations
- Multi agency drop-in session on 19th November 2019 to provide information, advice and support to affected residents and businesses

7.1. Affected Areas

Flood outline maps that detail the extent of the flooding have been developed in consultation with CWaC and affected property owners, these can be found in Appendix E.

7.1.1. Northwich Town Centre

Multiple locations in Northwich were affected by the flooding. This area has been split into four separate areas as shown on Figure 7-1.

Figure 7-1 - Location map of sub areas in Northwich Town Centre

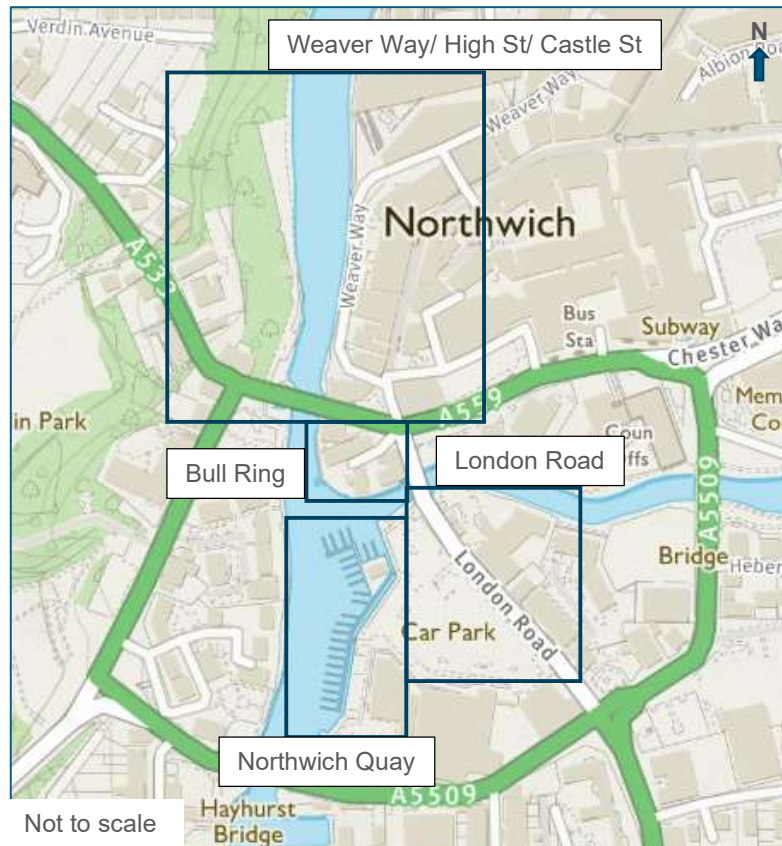
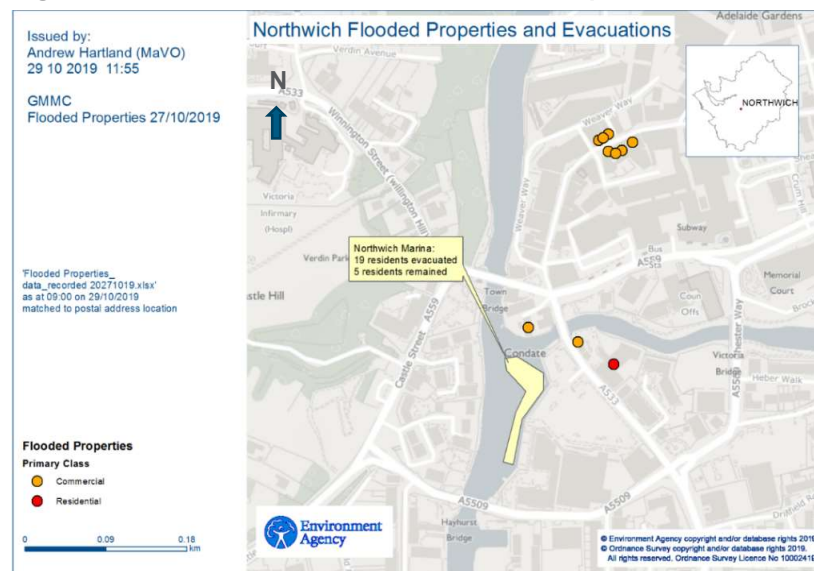


Figure 7-2 illustrates the location of the properties flooded in the Northwich Town Centre as recorded by the EA after the flood event in October 2019.

Figure 7-2 - Northwich Town Centre Flooded Properties Location Plan



Source: EA, 2020

Table 7-2 provides a brief summary of the flood event, impact and response at the London Road area in the Northwich town centre.

Table 7-2 - London Road Flooding

London Road	
Date	<ul style="list-style-type: none"> Saturday 26th – Sunday 27th October, 2019
Affected Roads	<ul style="list-style-type: none"> London Road
Description	<ul style="list-style-type: none"> Topography falls west towards the River Weaver, area benefits from both permanent and demountable flood defences west and across Dane Bridge that were deployed during this event. Low spots are along London Road by the entrance into Weaver Court and in the Waitrose carpark.
Flood Zone	<ul style="list-style-type: none"> In an area benefitting from flood defences protecting against river flooding
Flood Alert / warning issued?	<ul style="list-style-type: none"> Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich - Flood Alert Issued 26/10/2019 07:37 Flood Warnings for Northwich town centre (013FWFCH26 River Weaver at Marina Approach and Chester Way and 013FWFCH27 Rivers Weaver and Dane at Northwich) were not issued as these are triggered at a level where the defences are expected to be overtopped.
Flooding Incident Information	<ul style="list-style-type: none"> 12:30pm 26/10/2019 surcharging of manholes on London Road in the vicinity of Weaver Court. Cars driving through flooded road. London Road flooded – from Chester Way to Dane Bridge Butcher and Barlow and the Weaver residential home were flooded – water coming up through drains, gullies, tarmac and concrete.
Flooding Impacts and Observations	<p>Total numbers</p> <ul style="list-style-type: none"> Highway Flooding – x 1 (London Road) disruption to traffic during peak time on main road. Main access route. External Flooding – 1 (Waitrose car park) Internal Flooding – x 2 (1 commercial property and 1 residential home)
Summary of Flooding Incident Response During Event For detailed account of flooding response refer to Appendix D	<ul style="list-style-type: none"> EA on site to deploy Phase 1 and Phase 2 demountable flood defences. CWaC implemented Northwich Traffic Management emergency plan in conjunction with EA. EA supported Weaver residential home to secure entrance via demountable flood barriers, provided pumps to pump ponding water on dry side back to river. EA operations/Fire Service evacuated members of residential care home. UU attended site upon receipt of high-level alarm and reports of foul flooding and EA escalation. 3rd pump (pump 4) restarted in manual.

Photographs that illustrate the extents of the flood event at London Road, provided by the EA, can be seen in Figure 7-3.

Figure 7-3 - Photograph evidence flooding at London Road





 <p>20:15 26/10/2019 London Road Source: EA</p>	 <p>01:53 27/10/2019 Dane Bridge Source: EA</p>
 <p>20:02 27/10/2019 London Road Source: EA</p>	 <p>12:53 27/10/2019 Waitrose Source: EA</p>

Table 7-3 provides a brief summary of the flood event, impact and response at the Northwich Quay area in the Northwich town centre.

Table 7-3 - Northwich Quay Flooding

Northwich Quay	
Date	<ul style="list-style-type: none"> Saturday 26th – Sunday 27th October, 2019
Affected Roads	<ul style="list-style-type: none"> N/A
Description	<ul style="list-style-type: none"> There is a floating pontoon dock attached to dolphin piles, which is a docking point for boats.
Flood Zone	<ul style="list-style-type: none"> Zone 3
Flood Alert / warning issued?	<ul style="list-style-type: none"> Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich Flood Alert Issued 26/10/2019 07:37 013FWFCH24 River Weaver at Northwich Marina was not issued as this is triggered at a level where the defences are expected to be overtopped.
Flooding Incident Information	<ul style="list-style-type: none"> 26/10/2019 operatives started to install demountable flood defences 4pm 26/10/2019 river level started to rise in Marina and at Dane Bridge. EA advised marina residents to get out or stay put. Phase 1 closed completely. Narrow boats were evacuated at 4am due to risk of the floating pontoon capsizing – 19 people evacuated, 5 chose to remain.
Flooding Impacts and Observations	<ul style="list-style-type: none"> Total numbers N/A 19 people evacuated, potential risk of dock floating above dolphin piles identified.
Summary of Flooding Incident Response During Event For detailed account of flooding response refer to Appendix D	<ul style="list-style-type: none"> Evacuation of marina by Cheshire Fire and Rescue Service and communications by police and risk identification by EA on river levels. CWaC staff opened up Emergency Rest Centres at Rudheath Leisure Centre and Northwich Memorial Court receiving displaced residents from the Marina in Northwich. Displaced residents were also accommodated at hotels in the Northwich area.

Photographs that show the extent of the flooding at Northwich Quay and response, can be seen in Figure 7-4.

Figure 7-4 - Photograph anecdote of flooding at Northwich Quay


Table 7-4 provides a brief summary of the flood event, impact and response at the Bull Ring area in the Northwich town centre.

Table 7-4 – Bull Ring Flooding

Bull Ring	
Date	<ul style="list-style-type: none"> • Saturday 26th – Sunday 27th October, 2019
Affected Roads	<ul style="list-style-type: none"> • Watling St, Dane St, Weaver Way
Description	<ul style="list-style-type: none"> • Ground falls away more steeply towards River Weaver and River Dane confluence. Permanent flood defences built up along the river edges. Low ground occurs just behind the flood defences.
Flood Zone	<ul style="list-style-type: none"> • In an area benefitting from flood defences protecting against river flooding
Flood Alert / warning issued?	<ul style="list-style-type: none"> • Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich Flood Alert Issued 26/10/2019 07:37 • Flood Warnings for Northwich town centre (013FWFCH25 River Weaver at Weaver Way, 013FWFCH26 River Weaver at Marina Approach and Chester Way) were not issued as these are triggered at a level where the defences are expected to be overtopped
Flooding Incident Information	<ul style="list-style-type: none"> • Northwich Fireplace Centre. <ul style="list-style-type: none"> ○ Seepage through flood wall and around defence under Dane Bridge observed.
Flooding Impacts and Observations	<ul style="list-style-type: none"> • Total numbers <ul style="list-style-type: none"> ○ Highway Flooding – x 2 (Watling St, Dane St/Weaver Way) Disruption to traffic during peak time on main road. Main access route. ○ External Flooding – 0 ○ Internal Flooding – x 2 (2 commercial properties)
Summary of Flooding Incident Response During Event For detailed account of flooding response refer to Appendix D	<ul style="list-style-type: none"> • Sump pump provided by EA to pump water over into the River. • UU engineer dispatched to check all pumps working upon receipt of high-level alarm. This confirmed the pumps were working as expected.

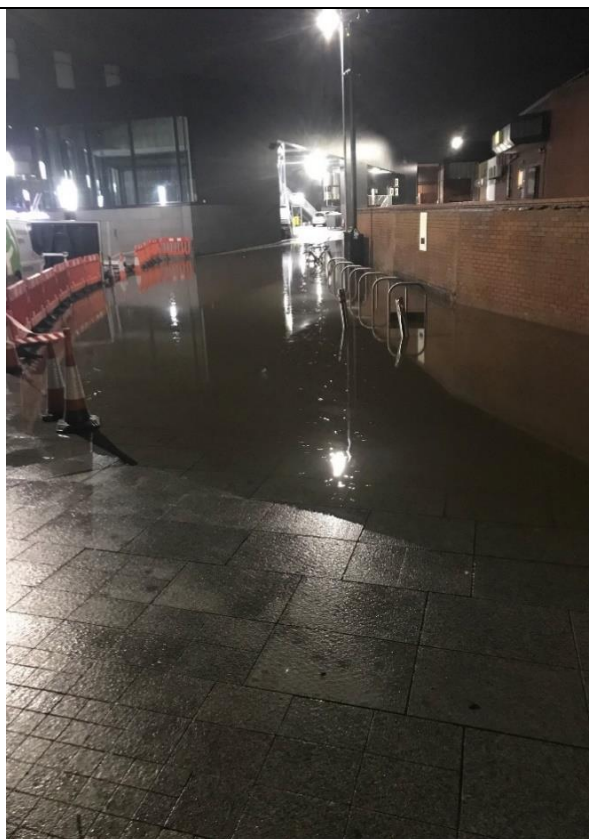
Table 7-5 provides a brief summary of the flood event, impact and response at the Weaver Way and High Street in the Northwich Town Centre.

Table 7-5 - Weaver Way/High Street/Castle St Flooding

Weaver Way/High Street/Castle St	
Date	<ul style="list-style-type: none"> Saturday 26th – Sunday 27th October, 2019
Affected Roads	<ul style="list-style-type: none"> Weaver Way, High St/Witton St, Castle St
Description	<ul style="list-style-type: none"> Witton St rises towards Bull Ring, land slopes towards Weaver Way/River Weaver.
Flood Zone	<ul style="list-style-type: none"> In an area benefitting from flood defences
Flood Alert / warning issued?	<ul style="list-style-type: none"> Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich Flood Alert Issued 26/10/2019 07:37 Flood Warnings for Northwich town centre (013FWFCH25 River Weaver at Weaver Way, 013FWFCH26 River Weaver at Marina Approach and Chester Way and 013FWFCH27 Rivers Weaver and Dane at Northwich) were not issued as these are triggered at a level where the defences are expected to be overtopped
Flooding Incident Information	<ul style="list-style-type: none"> Significant flooding on Witton Street and behind Wildwood at Barons Quay – from rising drains U-Mobile, Holland and Barrett, Bratts, Cash Generator, Admiral, Salty Dog (Water ingress into cellars), Bella Boutique (possibly water ingress into cellars) <ul style="list-style-type: none"> Reports of water backing up through manholes and coming from the streets. Relish Tandoori on Castle St reports of 4-6ft of flooding from Saturday night to Sunday night in cellar through hole in floor. Moss Haselhurst on Castle St.
Flooding Impacts and Observations	<ul style="list-style-type: none"> Total numbers <ul style="list-style-type: none"> Highway Flooding – x 2 (Weaver Way, High St/Witton St) External Flooding – 0 Internal Flooding – x 9 reported commercial properties flooded
Summary of Flooding Incident Response During Event For detailed account of flooding response refer to Appendix D	<ul style="list-style-type: none"> EA deployed flood defences. LLFA officer attended day after flooding. Sandbags provided after some time on request.

Figure 7-5 shows evidence of the flooding that occurred on Weaver Way and the High Street in Northwich Town Centre.

Figure 7-5 - Photograph evidence of flooding at Weaver Way/ High St



01:08 27/10/2019

Baron's Quay

Source: EA



11.00 27/10/2019

High St

Source: EA

7.1.2. Sandy Lane, Acton Bridge

Figure 7-6 outlines the area affected by the flooding at Sandy Lane.

Figure 7-6 - Sandy Lane location plan

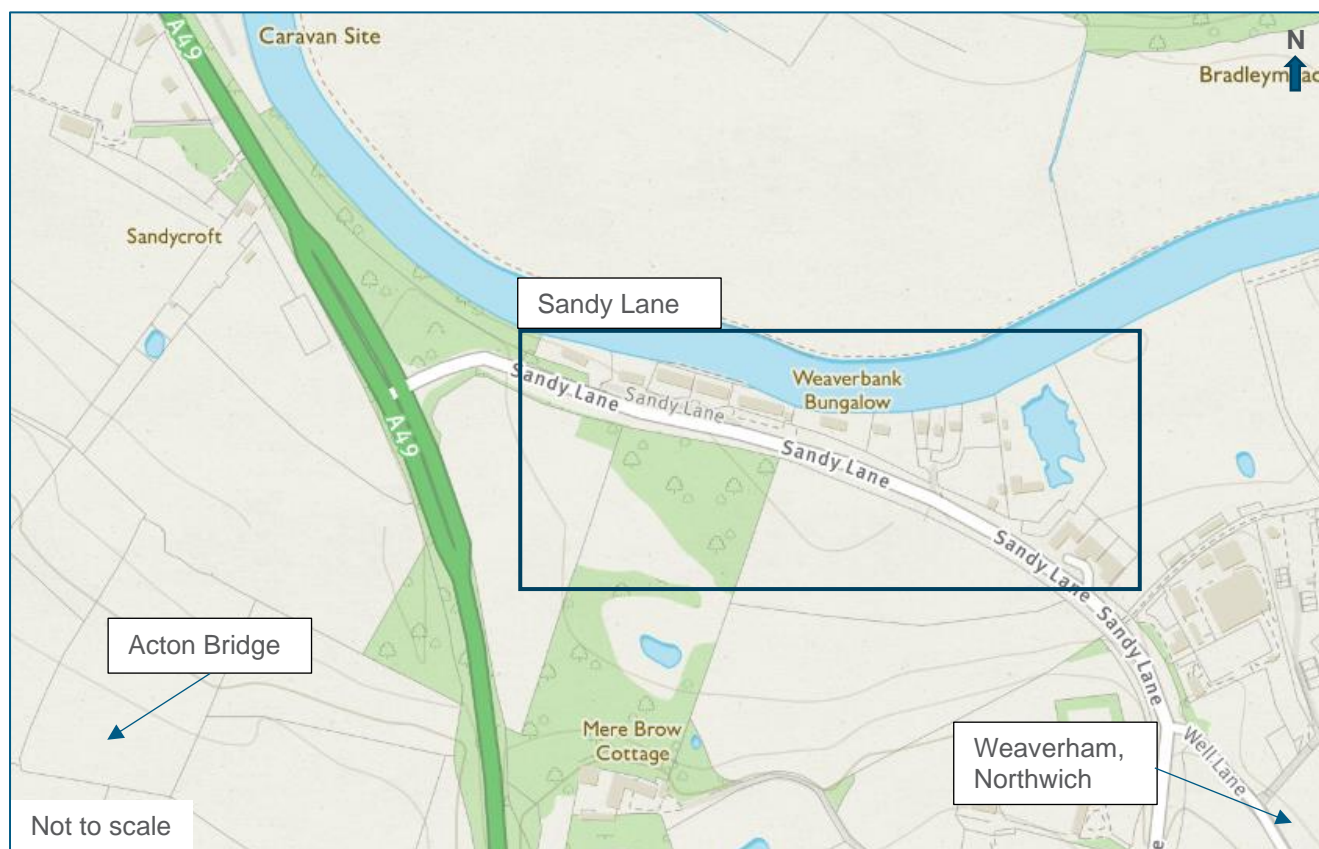


Table 7-6 provides a brief summary of the flood event, impact and response at the Sandy Lane area.

Table 7-6 - Sandy Lane Flooding

Sandy Lane	
Date	<ul style="list-style-type: none"> Saturday 26th – Sunday 27th October, 2019
Affected Roads	<ul style="list-style-type: none"> Sandy Lane, Acton Lane
Description	<ul style="list-style-type: none"> Residential properties backing on to the River Weaver just east of the A49. Some properties have docks with boats, no confirmed protection from flooding.
Flood Zone	<ul style="list-style-type: none"> Mostly Flood Zone 3 (few properties in zone 2, zone 1)
Flood Alert / warning issued?	<ul style="list-style-type: none"> Weaverham Area Flood Warning Issued 26/10/2019 22:21
Flooding Incident Information	<ul style="list-style-type: none"> Sandy Lane - Road flooding, 4 properties flooded internally and 7 properties experienced external flooding. Water flowed in from the River Weaver behind properties. Acton Lane – Highway flooding.
Flooding Impacts and Observations	<ul style="list-style-type: none"> Total numbers <ul style="list-style-type: none"> Highway Flooding – x 2 (Sandy Lane, Acton Lane) External Flooding – x 7 Internal Flooding – x 4 reported residential properties flooded
Summary of Flooding Incident Response During Event	<ul style="list-style-type: none"> Flood warning issued to Sandy Lane residents. Residents monitored water levels and moved/tied boats as needed.
For detailed account of flooding response refer to Appendix D	<ul style="list-style-type: none"> Residents contacted the Trust in relation to Dutton sluice operation, who responded to confirm that all operable sluice gates were open. CWaC provided sandbags to one property on request.

Figure 7-7 depicts the flooding that occurred at Sandy lane properties.

Figure 7-7 - Photograph evidence of flooding at Sandy Lane



27/10/2019

Sandy Lane property

Source: Leaders of the local flood action group



27/10/2019

Sandy Lane property

Source: Leaders of the local flood action group

7.1.3. Winsford Area - Lakeside Caravan Park

Figure 7-8 outlines the area affected by flooding at Lakeside Caravan Park.

Figure 7-8 - Lakeside Caravan Park location plan



Table 7-7 provides a brief summary of the flood event, impact and response at the Lakeside Caravan Park area.

Table 7-7 - Lakeside Caravan Park Flooding

Lakeside Caravan Park	
Date	<ul style="list-style-type: none"> Saturday 26th – Sunday 27th October, 2019
Affected Roads	<ul style="list-style-type: none"> N/A
Description	<ul style="list-style-type: none"> Topography falls east towards Bottom Flash
Flood Zone	<ul style="list-style-type: none"> Mostly Zone 1 though closest row of caravans to water in Zone 3
Flood Alert / warning issued?	<ul style="list-style-type: none"> Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich Flood Alert Issued 26/10/2019 07:37
Flooding Incident Information	<ul style="list-style-type: none"> Reported flooding of the Ark Pub. Flooding to Lakeside Caravan Park occurred on Saturday as water rose from Bottom flash over the docks and up the banks. Boats were stranded on the banks in front of the caravans. The electric was tripped for the park, and some residents woke up in the middle of the night in ankle deep water.
Flooding Impacts and Observations	<ul style="list-style-type: none"> Total numbers: <ul style="list-style-type: none"> External Flooding – x 1 commercial property Internal Flooding – x 6 caravan units

Summary of Flooding Incident
Response During Event
For detailed account of flooding
response refer to Appendix D

- Flood warnings/ alerts were not registered for at this point. Manager of Holiday Park was in touch with the Trust who confirmed all gates were open downstream.

Figure 7-9 provides evidence of the flooding that occurred at Lakeside Caravan Park.

Figure 7-9 - Photograph evidence of flooding at Lakeside Caravan Park



26/10/2019

Lakeside Caravan Park

Source: Business manager of the Lakeside Caravan Park



27/10/2019

Lakeside Caravan Park

Source: Owner of the Lakeside Caravan Park



27/10/2019

Lakeside Caravan Park

Source: Owner of the Lakeside Caravan Park

8. Flooding Mechanisms

The river levels reportedly were typical of a 5% (1 in 20) AEP event and the rainfall return period was approximately a 17% (1 in 6) AEP event for the town centre.

This section provides a summary of the potential flood mechanisms for each area. Appendix F provides more detailed information upon which these conclusions are drawn.

8.1. Northwich Town Centre

8.1.1. Post Event Hydraulic Modelling

Post event hydraulic modelling was carried out by UU to simulate the October 2019 event and is presented below. This was not a fully integrated model, nor has it been reviewed or verified as part of this Section 19 process. It consisted of the UU sewer network and the following additional drainage components that UU identified following site investigations:

- highway drainage along Weaver Way
- private drainage in Waitrose car park
- private surface water outfall to Weaver Court

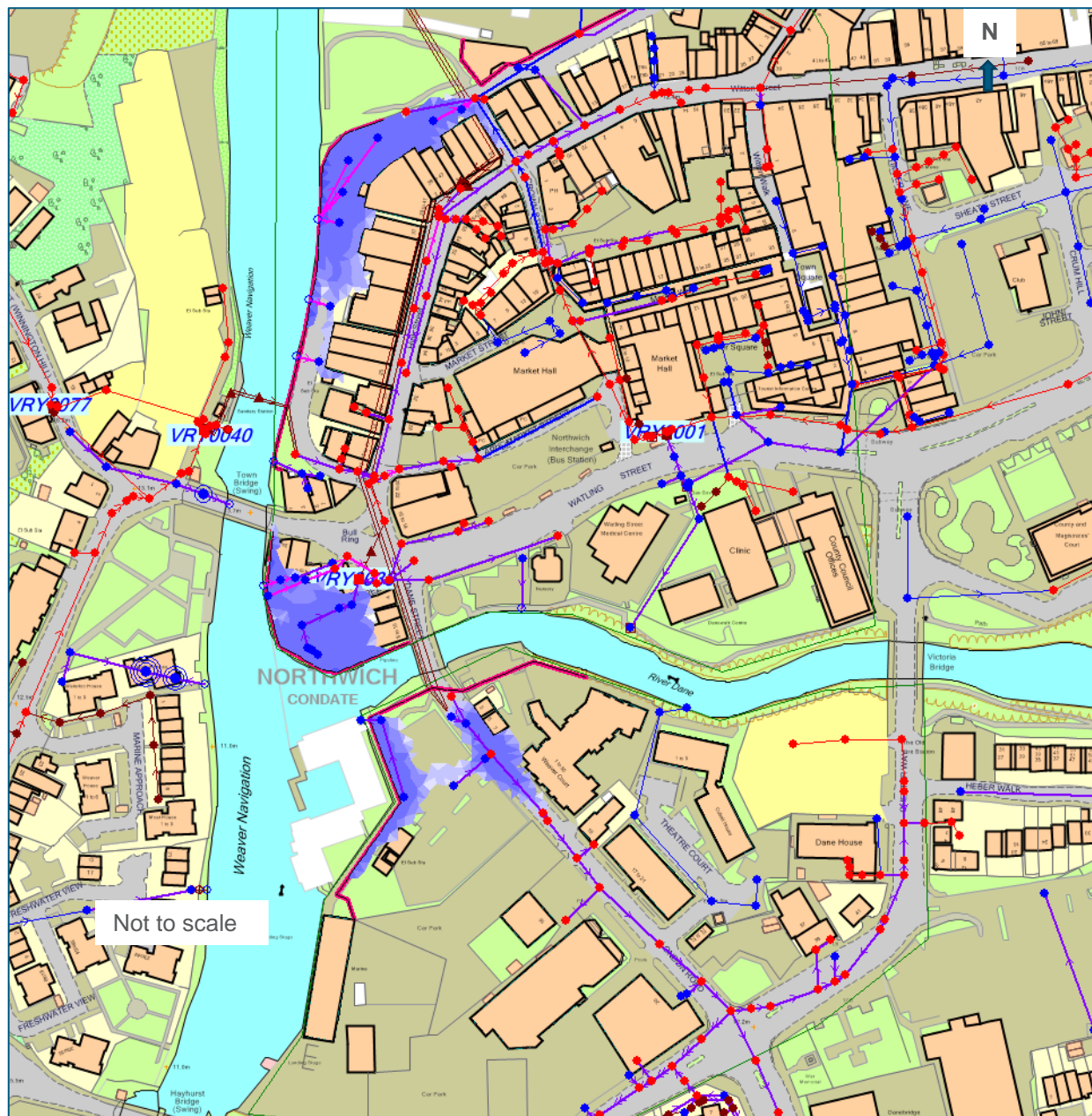
8.1.1.1. Scenario 1

Initial modelling (Scenario 1) was carried out to understand performance of the sewer network in isolation of the highway and private drainage systems. It was modelled with the observed rainfall from the event and no sewer flooding was predicted. It was also modelled with the observed rainfall and the observed river levels, with some flooding predicted.

8.1.1.2. Scenario 2

Scenario 2 in Figure 8-1 below was produced by UU as part of their post incident review of their network's performance. This flood extent map illustrates the impact of the rainfall and elevated river levels experienced through the weekend of October 2019. It assumes all pumps and flap valves, where they exist, operated as intended. The modelling indicates that flooding to the top of Weaver Way is due to elevated river levels causing backflow through the highway drainage system (assuming no flap valve in situ). The flooding to the Bull Ring is assigned to elevated river levels. The flooding in Waitrose car park is assigned to surface water collection (assuming flap valves installed).

Figure 8-1 - Surface Water Flood Scenario 2 Map – Northwiche Town Centre – UU

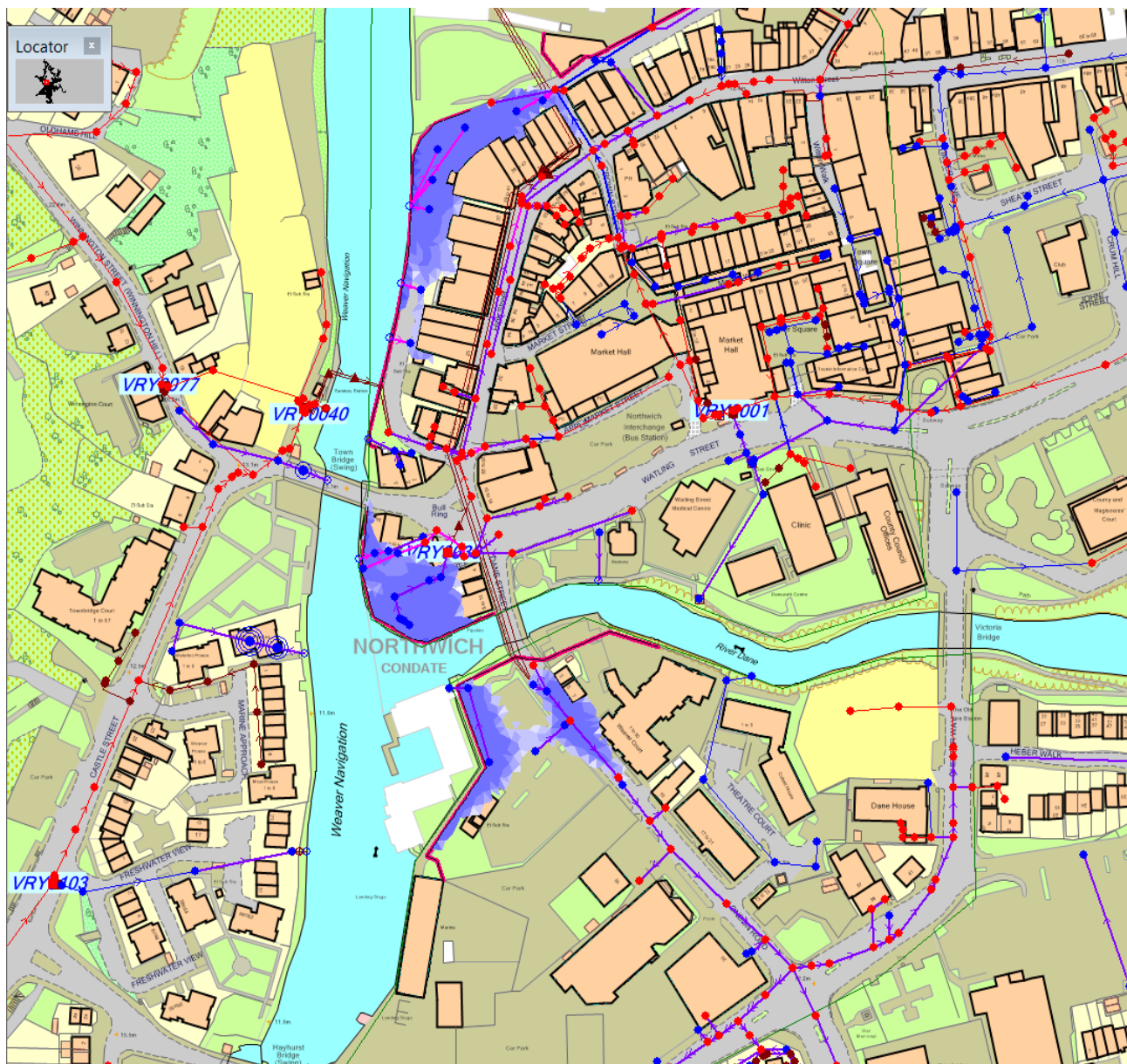


Source: UU, 2020

8.1.1.3. Scenario 2a

Scenario 2a in Figure 8-2 below is similar to that of Scenario 2 but this modelling illustrates the impact of a single pump failure and generates minor differences to flood extent.

Figure 8-2 - Surface Water Flood Scenario 2a Map – Northwich Town Centre – UU

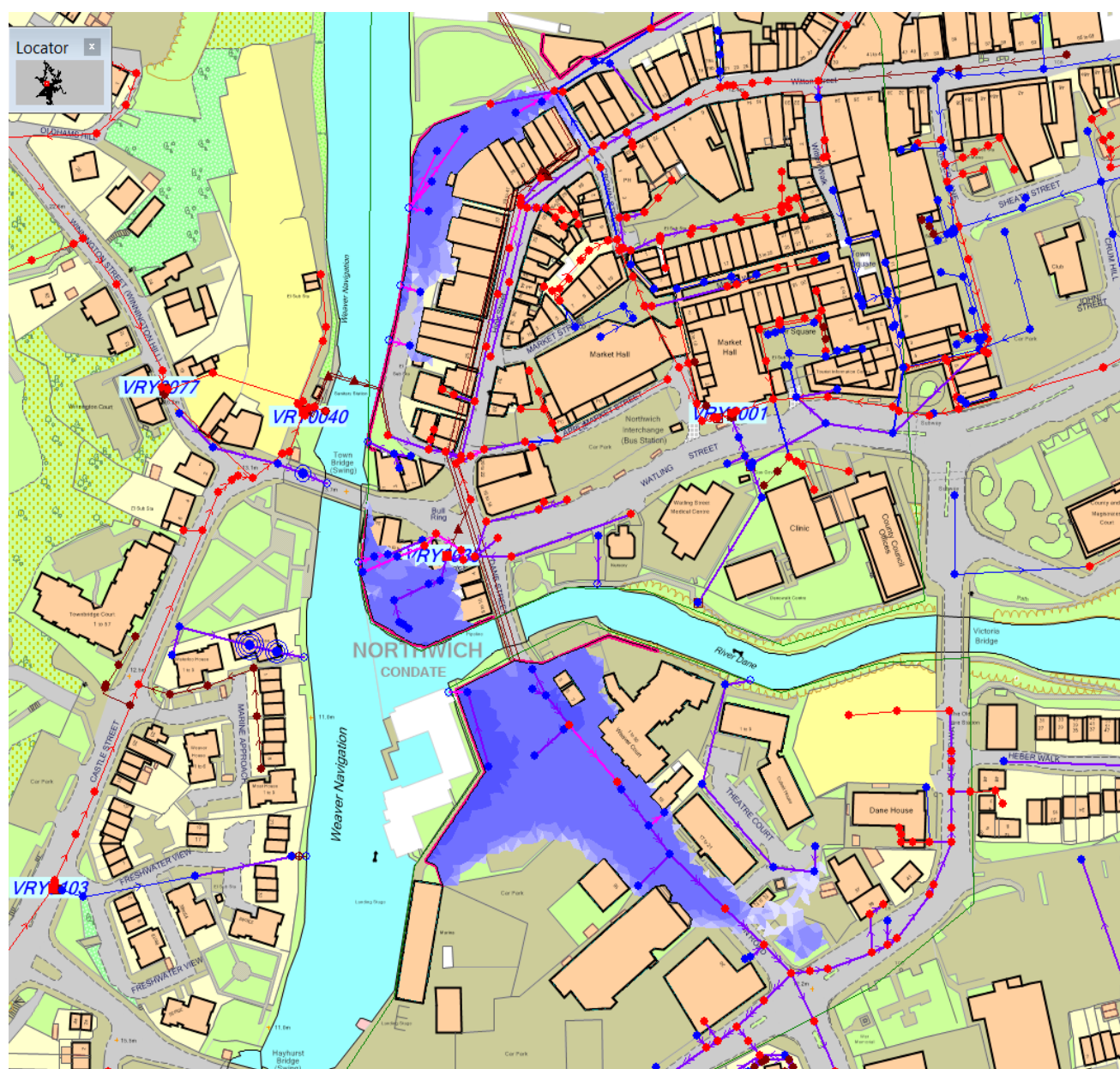


Source: UU, 2020

8.1.1.4. Scenario 3

Scenario 3 modelling in Figure 8-3 below illustrates the impact of the elevated river levels and rainfall on the combined system. This flood extent is witnessed when the elevated river levels restricts storm flow relief at the Weir Street CSO, the Waitrose car park flap valves are partially open, the private drainage in Theatre Court allow reverse flow from the River Dane and there is one pump down at Dock Road Pumping Station. This flood extent broadly represents the flooding experienced during the event save for the witnessed impact on High Street.

Figure 8-3 - Surface Water Flood Scenario 3 Map – Northwich Town Centre – UU



Source: UU, 2020

8.1.2. London Road

8.1.2.1. Fluvial Flooding

The river level was lower than the ground levels on London Road at the onset of flooding: the river level was 10.919mAOD whereas the ground levels in this area are between 11.0mAOD and 12.07mAOD. Phase 1 and Phase 2 of the EA demountable defences were installed before the river level reached the flooding threshold. The conclusion, therefore, is that London Road did not flood as a result of a failure or overtopping of the raised flood defences in Northwich Town Centre.

8.1.2.2. Private Surface Water Drains

The three private drains which discharge surface water from the Weaver Court area to the River Dane all have flap valves. Following the event, one of these flap valves was reported (but unconfirmed) to be seized open which may have allowed back flow from the river and overflow out of the lowest level manhole cover at 11.4mAOD at Theatre Court - the drain size is 300mm in diameter. The flap valved drains were river locked and would have backed up within the system but there were no reports of flooding here at Theatre Court.

8.1.2.3. Waitrose Car Park Surface Water Drains

All three surface water drains discharging to the River Weaver have flap valves and appeared to be river locked during the majority of the event. This resulted in excess surface water from rainfall in the car park unable to drain to the river and being held behind the raised defences.

8.1.2.4. CWaC Highways Drains

The highway drainage on the Weaver Court side of London Road between Weaver Court and the River Dane flows north and discharges directly to the River Dane, it is unknown whether there is a flap valve on this drain. If this is not flap valved, then back-flow from the river could have contributed to flooding on London Road. The drainage survey undertaken in 2020 by CWaC identified that this section was heavily silted, which could have restricted flow and is likely to have led to some surface water not being able to drain from the area before and after the outlet was river locked.

The drains south of Weaver Court and on the River Weaver side of London Road flow directly to the UU combined sewer flowing south towards Chester Way. The drainage survey identified that two of the gullies on this run contained debris which would have likely restricted flow and caused some localised surface water backup. The combined drain is discussed below.

8.1.2.5. UU Combined Sewer, Dock Road Pumping Station and Weir Street CSO

The Dock Road pumping station should have delivered 510 l/s of pass forward flow but due to one pump not operating delivered 374 l/s from the beginning of the event on the 26th October to 18:25 on the 27th October, this was a reduction of pass forward flow of 136 l/s.

The Weir Street CSO, alongside other CSOs, is purposefully designed to relieve the system when the capacity is exceeded. The Weir Street CSO can discharge over 380l/s for a similar rainfall event and was not able to operate due to river levels.

London Road has the lowest ground levels on the route between the River Dane and the Dock Road pumping station. Therefore, any resultant back-up of water within the system will have surfaced in this area and would therefore have contributed to the flooding on London Road. The retreat of water coincided with river levels dropping sufficiently to release the restriction at Weir Street CSO and the pump being turned on manually.

The post-event analysis undertaken by UU illustrates that there is sufficient capacity to convey storm flows much greater (1 in 100 year event) than those experienced in this rainfall event (1 in 6 year event) and indicates that significant flooding (to areas including London Road) would still have likely occurred due to the river level restriction of the Weir Street CSO even if Dock Road Pumping Station was operating at maximum capacity.

8.1.2.6. Summary

The flooding at London Road was likely to have resulted from the rainfall event itself combined with the elevated river levels which restricted the ability of UU, highway and privately owned assets to discharge effectively, via their outfalls, to receiving water bodies. An element of reverse flows (as not all outfalls in the

locality were confirmed as having functioning non-return flaps) and the Dock Road pumping station not operating at maximum capacity also being contributory factors.

8.1.3. Bull Ring

8.1.3.1. Fluvial Flooding

The raised flood defences on the River Weaver were not overtopped during the event. The Phase 2 defences on Dane Bridge were erected prior to water levels rising to the point where they would spill to the Bull Ring area. Therefore, flooding of the Bull Ring did not occur as a result of overtopping.

A leak through the EA defences was observed alongside the pipe crossing at Dane Bridge. This would have contributed to water behind the defences; the EA deployed mobile pumps during the event to over pump this water back to the river.

8.1.3.2. Private Surface Water Drains

The courtyard area that provides access to Riverside Cottage and adjacent properties from the Bull Ring does not form part of the adopted highway and contains private surface water drains with three outfalls that discharge to the river, which would have been river locked during the event and been unable to discharge surface water.

8.1.3.3. CWaC Highways Drains

There are no recorded highways drains in the Bull Ring.

8.1.3.4. UU Bull Ring Combined Sewer Pumping Station

The pumping station was operating at peak flow, directing 10 l/s of combined sewage to the Baron's Quay pumping station via High Street.

8.1.3.5. UU Surface Water Drainage

There is a UU surface water drain (UU ref. 6819) in the Bull Ring but it does not discharge to the River Weaver.

8.1.3.6. Summary

The raised flood defences were not overtopped although there was a leak observed in the vicinity of Dane Bridge; leakage here is likely to have contributed to the water behind the defences in the Bull Ring which was attended to through the deployment of EA pumps. The flooding at the Bull Ring was likely to have resulted from the rainfall event combined with the elevated river levels which restricted the ability of privately owned assets to discharge effectively, via their outfalls, to receiving water bodies. During the event, water was observed to be coming up through a gully at the entrance to the Bull Ring.

8.1.4. Weaver Way and High Street

8.1.4.1. Fluvial Flooding

The Phase 1 demountable defences were deployed before the River Weaver flowed out of bank. The defences were not breached, and no seepage occurred. Therefore, flooding was not a result of out of bank flow on Weaver Way.

Peak flood level at High Street was approximately 0.5m above the maximum river level.

8.1.4.2. CWaC Highways Drains

The highway drain which serves Weaver Way discharges directly to the River Weaver through a flow-controlled discharge. This drain was river locked and would have likely resulted in surface water backing up within the system. This outfall is fed from drains on Weaver Way, High Street, Witton Street and Crown Street.

Significant fat deposits were present within the drain leading directly eastwards through the narrow alley way to High Street and, although not a complete blockage of the drain, it would have restricted flow and contributed to backing up within the system on High Street. Similarly, localised defects and silt debris would have also contributed to restriction of flow. This would likely have led to surface water flooding alongside the defences on Weaver Way, as this has the lowest ground levels, and likely to have contributed to surface water flooding at the low spots on High Street.

8.1.4.3. UU Surface Water drainage

A surface water drain discharges to the River Weaver (UU Ref. 6811). It does not have a flap valve but would not have contributed to the flooding as it is at 12.5mAOD and thus higher than peak water level in the area.

8.1.4.4. UU Combined Sewer Drainage

The UU combined drainage system flows by gravity to Baron's Quay pumping station. This system serves a significant area to the east of the town centre and then follows Witton Street and High Street. Any non-designed flows entering the system, or any restriction of flows within the system downstream of High Street and Witton Street, may have also contributed to flooding at High Street and Witton Street where ground levels are low.

8.1.4.5. Summary

The River Weaver did not breach or overtop the raised defences along Weaver Way. There is a single surface water drain that would not have contributed to the flooding as it is higher than peak water level in the area. The flooding at Weaver Way and High Street is likely to be a result of the rainfall event itself combined with the elevated river levels which restricted flows (river locking) from the highway drainage system, together with localised restrictions therein, potentially leading to surface water flooding and subsequent overland flow to the Weaver Way low ground. Any non-designed flows entering the system, or any restriction of flows within the system downstream of High Street and Witton Street, may have also contributed to flooding at High Street and Witton Street where ground levels are low.

8.1.5. Castle Street

8.1.5.1. Fluvial Flooding

The River Weaver water levels were below ground level by over 1m. Water levels in the River Weaver did not cause the flooding on Castle Street. The peak water level in the River Weaver was 12.151mAOD, this was lower than the ground levels on Castle Street.

8.1.5.2. CWaC Highway Drainage

Highway drainage does exist on Castle Street, Winnington Street and the A533; however, there are no records available of the condition or outlet details to the River Weaver. It is considered likely that similar to the highways drainage elsewhere in Northwich, this system would likely have been under significant strain potentially contributing to localised flooding on the highways.

8.1.5.3. UU Surface Water Drainage

There are two surface water drains from Castle Street and one from Winnington Street that flow directly to the River Weaver. From the records available it is understood that the drain from Winnington Street that discharges beneath Town Bridge (UU Ref. 6818) does not have a flap valve. The drain at Freshwater View (UU Ref. 6600) has a flap valve and it is unknown whether the remaining drain at Marine Approach (UU Ref. 6703) has a flap valve. Given the ground levels on Castle Street compared to the maximum river levels, any backing up of the system, with or without non-return valves, may have contributed to the flooding.

8.1.5.4. UU Combined Sewer Drainage

Two combined sewer drains pass through the Castle Street area on the way to the Lock Street Pumping Station. Both of these drains have overflow systems to discharge to the River Weaver during high flows. Monitoring indicates that the Winnington Hill CSO did not discharge and therefore surcharging and subsequent flood of this drain is unlikely. No records are available for the Castle Street drain and therefore it is not known whether this drain surcharged and caused flooding.

The Lock Street Pumping Station was reported to be operational throughout the event, passing forward 20 l/s to the combined system on Weaver Way. An overflow at Lock Street pumping station discharges flows in excess of 20 l/s directly to the River Weaver, it is not known whether this operated during the event.

8.1.5.5. Summary

Castle Street did not flood as a direct result of out of bank flow from the River Weaver. Therefore, the cause of flooding at Castle Street would likely have been as a result of the rainfall event combined with the elevated river levels which restricted effective conveyance (through river locking) to receiving water bodies or caused backflow from the highways, combined and surface water systems and subsequent overland flows to low ground.

8.2. Acton Bridge

8.2.1.1. Fluvial Flooding

The source of flooding to properties on Sandy Lane was out of bank flow from the River Weaver.

This section of the watercourse is part of the Weaver navigation and the water levels are managed by the Trust to provide sufficient navigation depth through the operation of the Dutton Sluices. The Trust are not an RMA, and do not have any responsibility or duty to manage navigation assets for Flood Risk Management and do not have statutory powers to do so.

The Dutton Sluices are a series of eight sluice gates mounted within a masonry and cast-iron structure which spans the river. The normal operating rules of these gates for navigation purposes is that they respond to upstream levels via electronic measurement and software parameters.

The Trust data reports that three of the eight gates (no. 1, 3 and 6) were fully opened by 20:00 on the evening of the 26th October and remained open throughout the event. The Trust data reports that a further gate partially opened at 08:05 on the following morning. The remaining gates stayed closed but would have acted as weirs, allowing some water to pass.

Acton Bridge Cruising Club experienced significant damage during the event. One of the four boats that were significantly damaged during the event was washed downstream, eventually coming to rest across one of the open gates. This is shown on Figure 8-4.

It is worth noting that a power cut occurred between 22:25 on the night of the 26th October which affected the SCADA data. The Trust have provided assurances that the open gates remained open throughout the power outage until 07:35 the following morning. The Trust SCADA data indicates water levels reduced from 11:00 on the 27th October.

The EA have recently completed a hydraulic review of the October 2019 flood event within which the operation of the Dutton Sluice gates was investigated. The subsequent report³ concluded that:

“A good general fit with the observed river levels, (average) wrack marks and flooded properties was obtained, when the ‘3 Gates Open’ scenario was run with a Lower Weaver 3.3% (1 in 30) design event. The level data suggests that an optimal fit would likely be obtained from an event between 3.3% (1 in 30) and 2% (1 in 50) AEP. When running the ‘2 Gates Open’ scenario an optimal fit was obtained from an event between 5% (1 in 20) and 3.3% (1 in 30) AEP. These magnitudes of event are broadly consistent with the rainfall analysis in suggesting that the flooding in October 2019 was unlikely to have been a result of an extreme event. Hence, flooding was more likely to have been a consequence of a moderate return period event exploiting the Dutton Sluice Gates not functioning as per their normal operating rules.”

It is acknowledged however that the hydraulic review did not look at the impact of having the additional gates open at Dutton Sluices, either on the upstream water levels or the impact on flooding. Therefore, it is not possible to say to what extent the closed Sluice Gates contributed to the flooding experienced

³ Lower Weaver October 2019 Calibration Summary Final Report, September 2019. Produced on behalf of the Environment Agency by JBA Consulting.

Figure 8-4 - Dutton Sluices taken on 27th October 2019



8.2.1.2. CWaC Highway Drainage

Acton Lane was flooded in parts as a result of surface water ponding. It is unknown whether this was due to the sizing of the drains within the network or whether blocked gullies or debris within the drains restricted flow, or whether outfalls were prevented through river locking. The recent CCTV drainage survey did not extend to Acton Lane.

8.2.1.3. Summary

Water levels were high on the River Weaver due to heavy rainfall. The notable rainfall event and the location of all of the properties within Flood Zone 3 will have contributed to the flooding of properties, and restrictions in conveyance may have been a contributory factor.

8.3. Lakeside Caravan Park

Flooding occurred at Lakeside Caravan Park due to water levels in the interconnected River Weaver and Bottom Flash. The Vale Royal sluices are the key control on water levels in Bottom Flash and were opened fully by the Trust throughout the event. It is noted that the sluices are a navigation asset designed to manage levels for navigation purposes and are not designed to discharge flood water.

The caravans which flooded are the ones closest to the edge of the Flash, at the lowest ground levels. These are inside Flood Zone 3. It is understood that these are the most recent caravans to be installed at the Park.

Dredging of the Flashes would have had a minimal impact to the water levels and unlikely to have reduced the number of caravans affected. The Flashes do not provide conveyance capacity and as they are connected 'online' to the River Weaver channel the water levels in the Flashes would match those on the Weaver. Therefore, deepening and clearing silt would not reduce water levels, albeit it may provide some marginal increase in storage area.

9. RMA Response – Strategic Overview

This section outlines the RMA response to the flood event and identifies area for improvement of flood risk management within the CWaC administrative boundary. Consultations have been undertaken with the participating RMAs, local residents and business owners to inform this assessment.

9.1. Response and Resources

Phase 1 to 3 of the demountable flood defences were mostly deployed following the trigger level procedure held by the Environment Agency. One of the Phase 1 demountable barriers was not installed until 16:00 on the 26th October, 6.5 hours following the river trigger level for installation, in order to allow foot traffic from the Marina which was still occupied at that point. The threshold level of this demountable is 11.5mAOD and river levels were closely monitored to ensure water did not come behind the defence line through this pathway. Surface water pumps were deployed in the Waitrose Car Park by EA staff.

The EA contacted UU at 22:00 on the 26th October, to request them to check the operation of Dock Road Pumping Station. On the UU system it appeared to be working as it should. On the morning of 27th October, a UU Network Engineer attended the site to check the network and operation of the network pumping stations. On 27th October the EA escalated the issue of Dock Road Pumping Station with UU.

A UU engineer was deployed to site on the afternoon of the 27th October and found water damage to an instrument controlling pump 3, which was not running. The third pump was then switched on at 18:00 on the 27th October. UU helped with the clean-up response throughout the remainder of the evening, cleaning river silt throughout London Road, High street and Weaver Court. UU helped other RMAs by clearing CWaC highway gullies, for example, to expedite the removal of flood water.

CWaC Highways and StreetCare Teams had resources responding to calls, preparing and delivering sandbags, and had officers out making inspections. CWaC staff opened Emergency Rest Centres at Rudheath Leisure Centre and Northwich Memorial Court receiving displaced residents from the Marina in Northwich. Displaced residents were also accommodated at hotels in the Northwich area.

9.2. Communication and Multi – Agency Planning

Managing this flood event has highlighted the need for the LLFA to:

- Review data collection processes during and after an event and create a place where this multi-agency information can be stored in one central accessible hub.
- Review how the flooding information filtered down to residents/local flood wardens in order to increase resilience in the future. For example, marina residents need to be brought inside the defences once the Phase 1 defence trigger level is reached, to prevent the need for emergency evacuations and prevent the need to keep one of the demountable barriers open much later than planned. If this flooding event was much faster, this could have been an even more dangerous situation for the marina residents and emergency service personnel and increase the risk of fluvial flooding to those London Road properties.
- Review how the public will be made aware of the findings from the Section 19 Report and review the process to expedite release of information.
- Review the collective approach to manage surface water flood risk in the town centre.
- Work collaboratively with the EA to engage with landowners and residents of the Lakeside Caravan Park, Acton Bridge Cruising Club and Sandy Lane to communicate the flood risk that they are exposed to and what realistic and achievable measures are available to manage that risk.
- Collaborate with the Trust to explore the feasibility of integrating the operation of their sluice gates, particularly at Dutton Sluices, as part of a wider flood incident management strategy (to include stakeholders with responsibility for the downstream Manchester Ship Canal and other influential assets). Investigate the constraints within which the sluices operate to understand navigation requirements and explore whether additional funding sources could be explored to support the operation and maintenance of this integrated approach.

9.3. Community Resilience

Managing this flood event has highlighted the need for the LLFA to improve community resilience by:

- Reviewing how the LLFA disseminates information to promote an increased awareness of personal flood action plans, to increase wider community engagement with the RMAs.
- Review sandbag delivery process regarding timings and quantity as there were some reports from the High Street businesses that sandbags were either not available when requested or delayed until the Monday/Tuesday following the event.
- Increasing community engagement through open events in promoting awareness of flooding and individual action plans.

9.4. Positive Observations

The following items have been identified as positive observations that should be noted:

- All RMAs and other stakeholders/agencies were proactive in their individual response with the information and resources available to support this Section 19.
- EA installation of Phase 1 – 3 flood defences followed protocol where possible, barring one area which was kept open slightly longer due to a safety issue of trapping people on the wet-side of the flood defence.
- Emergency services were on site and provided invaluable assistance to residents in both the Marina and the London Road properties.
- All RMAs have consequently worked together in a collaborative partnership and provided post-event community support to affected residents.
- UU has commissioned independent modelling to understand the flooding mechanism from the sewer network.
- The Trust now provides live SCADA telemetry data feed to the EA for several water level sensors along the Weaver.
- CWaC completed a detailed inspection survey to inform the Section 19 report and completed a jetting exercise of the system to flush out silts and debris.
- CWaC and the RMAs have committed to undertaking actions identified within the interim report prior to the completion of the final report.

9.5. RMAs Actions Taken to Date

9.5.1. Environment Agency

9.5.1.1. Northwich

- Environment Agency Community Information Officers sent to site Monday 28th October 2019.
- Multi Agency Flood Drop-in event on the 19th November 2019.
- Currently working with CWaC regarding Northwich Marina Flood Plans.
- Undertaken sealing works around Dane Bridge, where defences seeped.
- Helped review surface water outfalls and checked flapped outfalls are working.
- Updated and have ready a contingency pumping plan should the same issues with drain surcharge arise.
- Currently updating Flood Warning areas.

9.5.1.2. Sandy Lane (Acton Bridge)

- EA Community Information Officers sent to site Monday 28th October 2019.
- Multi Agency Flood Drop-in event on the 19th November 2019.
- Currently working with community to review and update flood warning thresholds.

9.5.1.3. Lakeside Caravan Park (Winsford)

- EA Community Information Officers sent to site Monday 28th October 2019.
- Multi Agency Flood Drop-in event on the 19th November 2019.

- The EA have updated the flood warning area to include the caravan park.

9.5.2. United Utilities

- UU carry out regular asset inspections on all Network assets within Northwich town centre, to proactively maintain and identify any potential issues. Since 27th October 2019 the Network Pumping Stations, Lock Street Pumping Station and Bull Ring Pumping Station have had quarterly inspections and have had annual electrical and mechanical servicing completed.
- A proactive sewer cleaning programme is also active in several areas of Northwich town centre to prevent silt built up. The sewer network along London Road is on an intensive cleaning programme, on a monthly cycle.
- UU have committed to delivering Dynamic Network Management (DNM) to Northwich town centre in their next phase of roll out. DNM will see the installation of sewer and storm monitors to allow engineers to monitor the network in real time. The initial steps for the Northwich area have been completed.
- UU have installed dual validation level instruments at Dock Road Pumping Station and raised their position above the maximum abnormal water level to avoid pump control issues in future, additional dual resilience assets have been installed. The alarm management system has been adjusted so that it is more sensitive than normal to high level instrument readings or flat line readings thus promoting the site as a higher priority than normal on our UU's STS system.

9.5.3. Cheshire West and Chester Council

- CWaC commissioned a detailed drainage survey and jetting of their highways drainage system in Northwich.
- CWaC, as the LLFA, have been engaging with the RMAs and other key parties throughout to support the completion of the final report.
- Held consultation events for members of the public and affected communities.

10. Recommended Actions

10.1. Strategic Overview

The LLFA role is to coordinate the management of flood risk within their administrative area. It is suggested that the recommendations made within this report are taken on board by the relevant RMAs and other parties where listed and reviewed on a regular basis.

If, following a review of this Flood Investigation Report and its recommendations, and liaison with RMAs and other stakeholders, flood risk is considered to be unacceptable, CWaC should investigate, alongside those bodies, potential capital schemes which could provide flood alleviation within these areas.

Table 10-1 – Recommended Actions

ID	Action	Lead RMA (Support)
1	Collaborative planning and integrated modelling to determine an integrated approach to reduce and manage flood levels in Northwich town centre including Bull Ring, London Road, High Street, Weaver Way and Castle Street and discuss opportunities for differing scale/timescale solutions to be developed.	UU, EA, CWaC
2	Ensure Weaver and Theatre Court non-return valves are free of debris and in good working order, CWaC as LLFA to work with private owners of drains.	CWaC, maintainer
3	Continue a programme of highway drain inspections and cleaning activities and undertake programme of repairs to significant defects.	CWaC
4	Undertake drainage investigations to clear silt and debris, proving systems and outfalls on Acton Lane	CWaC
5	UU to investigate whether all of the UU surface water drains which discharge to the River Weaver or Dane have non-return valves and where required, take action to install.	UU
6	UU to assess the need for additional CSO monitors.	UU
7	Establish maximum capacity of UU pumping stations and permitted discharge details for all pumping stations and CSO's to inform recommendation 1.	UU, EA, CWaC
8	Investigate the source of fat deposits within the highway drain which discharges on Weaver Way. This is both a risk to the capacity of the drainage network and an environmental polluter and therefore liaison with the EA should be maintained.	CWaC, EA
9	Explore how the operation and maintenance of sluices on the Weaver Navigation and other downstream waterways and assets can be embedded within existing flood incident management. Additional funding mechanisms to support these activities may be required and there may be a need to develop a business case to support any subsequent funding applications.	CWaC, EA, (the Trust, Others)
10	Assess whether additional river level monitoring is required between Saltersford Lock and Dutton Lock, seeking additional funding support as appropriate.	EA (the Trust)
11	Undertake a high-level assessment to identify opportunities to install Sustainable Urban Drainage Systems (SUDs) to act to delay water's ingress into, or divert surface water away from, the drainage network.	CWaC
12	Undertake an education and information programme to explore with the local communities how small single or grouped property actions may be able to contribute to reducing the overall impact of flooding.	CWaC, UU
13	Action Plan: LLFA should look to develop an action plan that outlines timescales and milestones for delivering the recommendations made within this report.	CWaC (EA, UU)
14	Communication: Continue to encourage residents to report issues of flooding. Outline who this should be reported to (LLFA, UU, EA), and what mechanisms are available to report (phone, email, mobile app etc.). Additional information could be made available through the council website. This would be used to ensure as many records as possible are noted.	CWaC (EA, UU, residents and business owners)
15	Records: Ensure systems are set up at the council to efficiently record details of flooding. This is needed to gather as much information as possible about each incident at the time of flooding. This will be essential in ensuring the correct flooding mechanisms are understood.	CWaC
16	Stakeholder engagement and community resilience: Interested RMAs to work proactively with the local communities to improve awareness of flood risk and resilience to subsequent events. Emphasis should be placed on preparing for flooding before an event happens.	CWaC, EA, UU
17	Work with the owners of the caravan park to identify more sustainable approaches to managing flood risk in the future such as locating the caravans affected to higher ground.	CWaC, EA
18	Property level protection and resilience measures: As a quick win, residents should consider implementing property level protection where necessary, particularly on Sandy Lane, London Road, Bull Ring and High Street.	CwaC (Residents and businesses)
19	Site specific recommendations as identified by the LLFA or RMAs.	CWaC, UU, EA

10.2. Quick Wins

Many of the recommendations listed in Section 10.1 will take time to undertake and therefore, may not be implementable before the next period of high rainfall and river levels. The following quick wins are recommended to be taken which will deliver benefits fast:

- CWaC to undertake a high-level catchment wide assessment to identify opportunities for implementing SUDs solutions to slow the flow of urban runoff into the drainage systems of Northwich. Screen potential sites that deliver maximum benefit and seek funding to deliver.
- CWaC to undertake a drainage survey and cleansing of the highway drains on Sandy Lane and Acton Lane.
- Depending on water levels in the River Weaver and River Dane, CWaC and UU to investigate the outfalls for which it is uncertain whether they have flow control mechanisms. If outlets are identified which are not controlled, install devices as and when it is safe to do so.
- UU to install a CSO monitor in the Castle Street CSO to provide information on the operation of the CSO during future events.

10.3. Immediate Actions

All of the above recommendations will take time to implement. If another large event, like that experienced on the 20th January 2021, occurs in advance of these recommendations being implemented flooding may occur which could have been managed more effectively. Therefore, we advise that the following actions are taken with immediate effect to help flood preparedness:

- Construct a sump within the London Road area, potentially in the Waitrose car park adjacent to London Road, with suitable surrounding space for appropriate vehicle lay-up areas. The sump should be sized to allow inlet hoses of multiple pumps to be placed safely. Appropriate covers should be located over the sump, all of which should be constructed in accordance with industry standard guidance. Procedural agreement between LLFA and RMAs to be reached for location and mobilisation of temporary pumps.
- Discussions should be held with the Trust pursuant to establishment of an agreement or Memorandum of Understanding with CWaC, as LLFA, and the EA in their capacity as an RMA, in relation to agreed operating procedures for sluices and related assets to more effectively manage water levels for flood risk purposes on the Weaver Navigation.
- Individual property protection measures including flood doors should be installed on previously affected property where the method of ingress was over property thresholds, air bricks or pipework.

11. Contacts and Useful Links

Key Flooding Contact Details

The following gives guidance on whom to contact about various types of flooding.	
Always contact the emergency services first (999) if you or a family member is in immediate danger.	
Flooding from a Public Sewer	
United Utilities	Report sewer flooding 0345 6723 723 www.unitedutilities.com
Flooding from a Burst Water Mains	
United Utilities	Report a leak 0800 330033 www.unitedutilities.com
Flooding from the Public Highway, Drains or Ordinary Watercourses (Non-Main River)	
Cheshire West and Chester Council	<p>The Council is responsible for dealing with carriageway flooding and flooding from highway drains.</p> <p>Call us on 0300 123 7 036 if you see dangerous flooding on a road or the flood is putting homes at risk.</p> <p>If a gully is blocked but not causing dangerous flooding it will be cleansed as part of the routine cleansing programme.</p> <p>https://www.cheshirewestandchester.gov.uk/residents/contact-us/report-it/potholes-and-road-faults.aspx</p>
Flooding from a Main River	
Environment Agency	<p>General enquiries 03708 506 506 (Mon-Fri, 8am – 6pm)</p> <p>Incident hotline 0800 80 70 60 (24-hour service)</p> <p>Floodline 0345 988 1188 (24-hour service)</p> <p>General enquiries email enquiries@environment-agency.gov.uk</p>

Useful Web Resources

The following web links contain useful information about being prepared, understanding flood risk and reporting drainage issues to CWaC.	
Being Prepared	
Prepare for a flood and get help during and after:	www.gov.uk/prepare-for-a-flood/get-help-after-a-flood

Prepare a Checklist and Action Plan (National Flood Forum)	https://nationalfloodforum.org.uk/about-flooding/preparing/checklist-action-plan/
Make a personal flood plan:	www.gov.uk/government/publications/personal-flood-plan
Prepare your property for flooding:	www.gov.uk/government/uploads/system/uploads/attachment_data/file/451622/LIT_4284.pdf
Understanding Flood Risk and Flood Warnings	
Check current flood warnings and river levels:	www.gov.uk/check-if-youre-at-risk-of-flooding
Sign up for flood warnings:	www.gov.uk/sign-up-for-flood-warnings
Finding Utility Provider	
Find your water and sewerage company	http://ccwater.custhelp.com/app/answers/detail/a_id/418

Bibliography

1M DTM LiDAR Data, Main River Map, Flood Zone Definitions, Flood Risk Map, Surface Water Flood Risk Map – Environment Agency, Open Source, 2020.

Flood Defences Location Plan, Rain and River Gauge Data, Water Situation Report October 2019, Flooded Properties Location Plan- Environment Agency, 2019.

Soil Type Characteristics and Map - National Water Council, 1981.

Navigable Waterway Maps - Canal and River Trust, Open Source, 2020.

Surface Water Flood Map – Northwich Town Centre, Pumping Station Location Plan, Outfall Location Plan, Baron's Quay Pumping Station Arrangement, Dock Road Pumping Station Arrangement - United Utilities, 2020.

CWaC Highway Gully Location Plan – Cheshire West and Chester Council, 2020.

Waitrose Drainage Plans – Healey Consulting, 2013.

Monthly Rainfall across England and Wales, UKPP Radar Data – Met Office, 2019.

Rainfall totals 9am 24 Oct to 9am 27 Oct 2019, October Rainfall 2019 Report – Met Office, 2019.

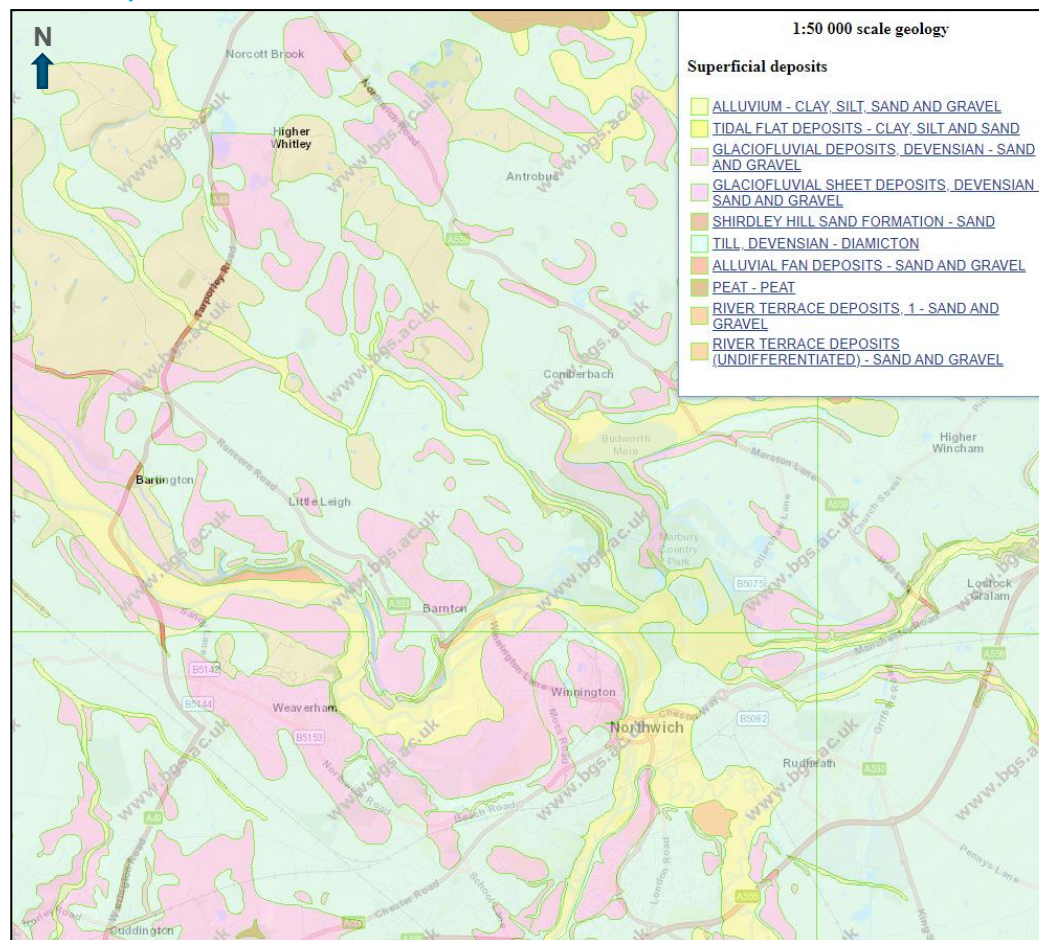
Groundwater levels data – Flood Assist, 2020.

Lower Weaver October 2019 Calibration Summary Final Report, September 2019. JBA Consulting on behalf of the Environment Agency by JBA Consulting.

Appendices

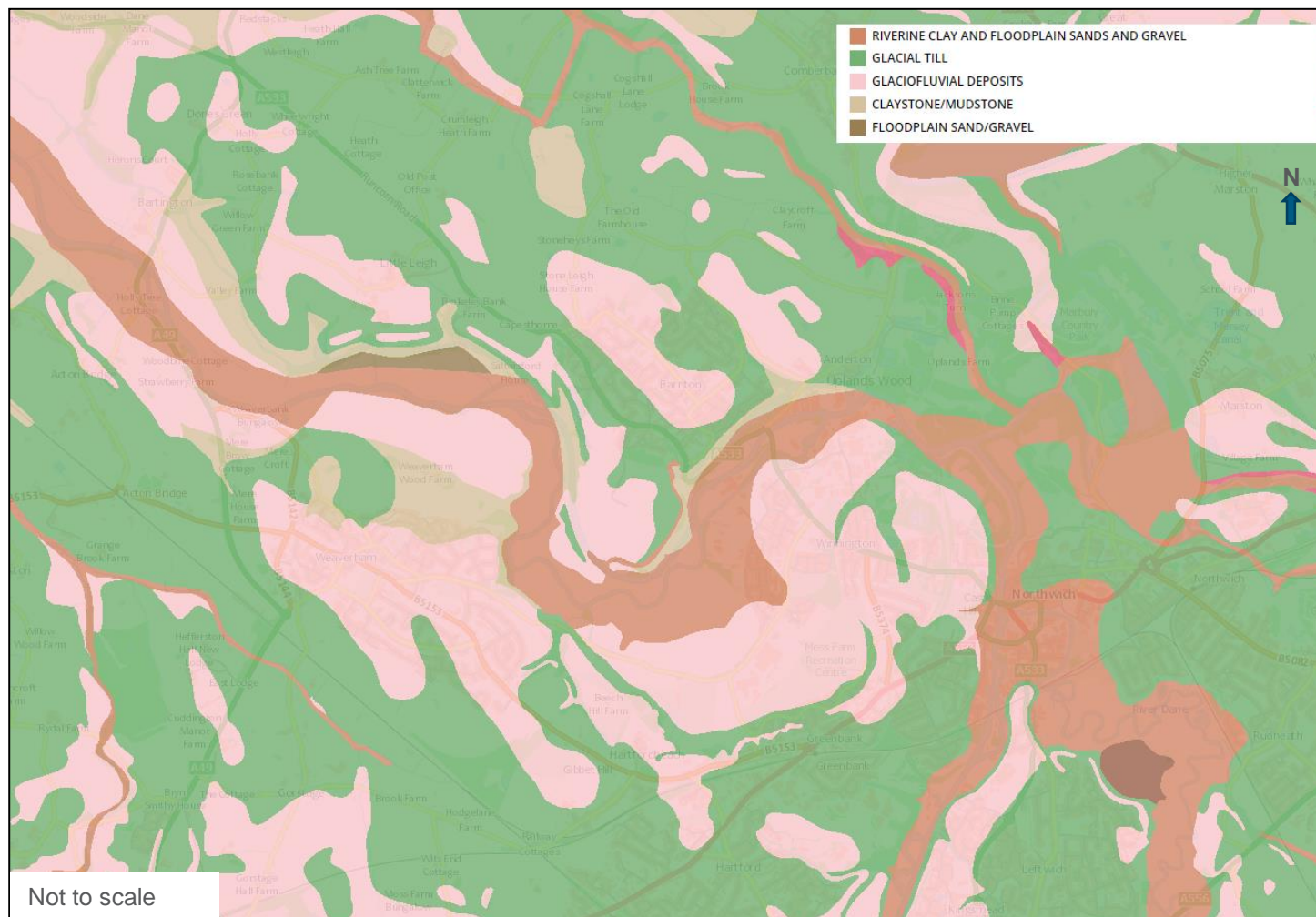
Appendix A. Geology and Soils Maps

A.1. Superficial Deposits Map



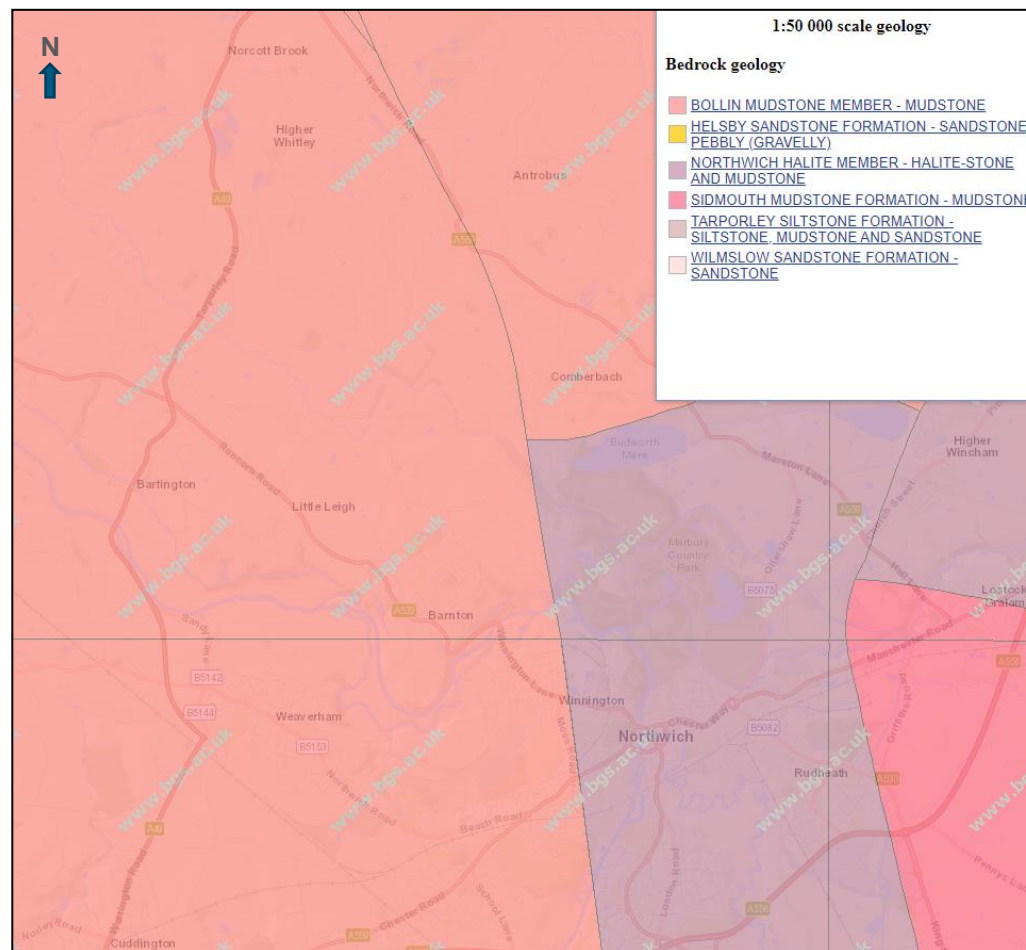
Source: GeoIndex Onshore Data Sources (www.bgs.co.uk)

A.2. Parent Material



Source: GeoIndex Onshore Data Sources (www.bgs.co.uk)

A.3. Bedrock Map



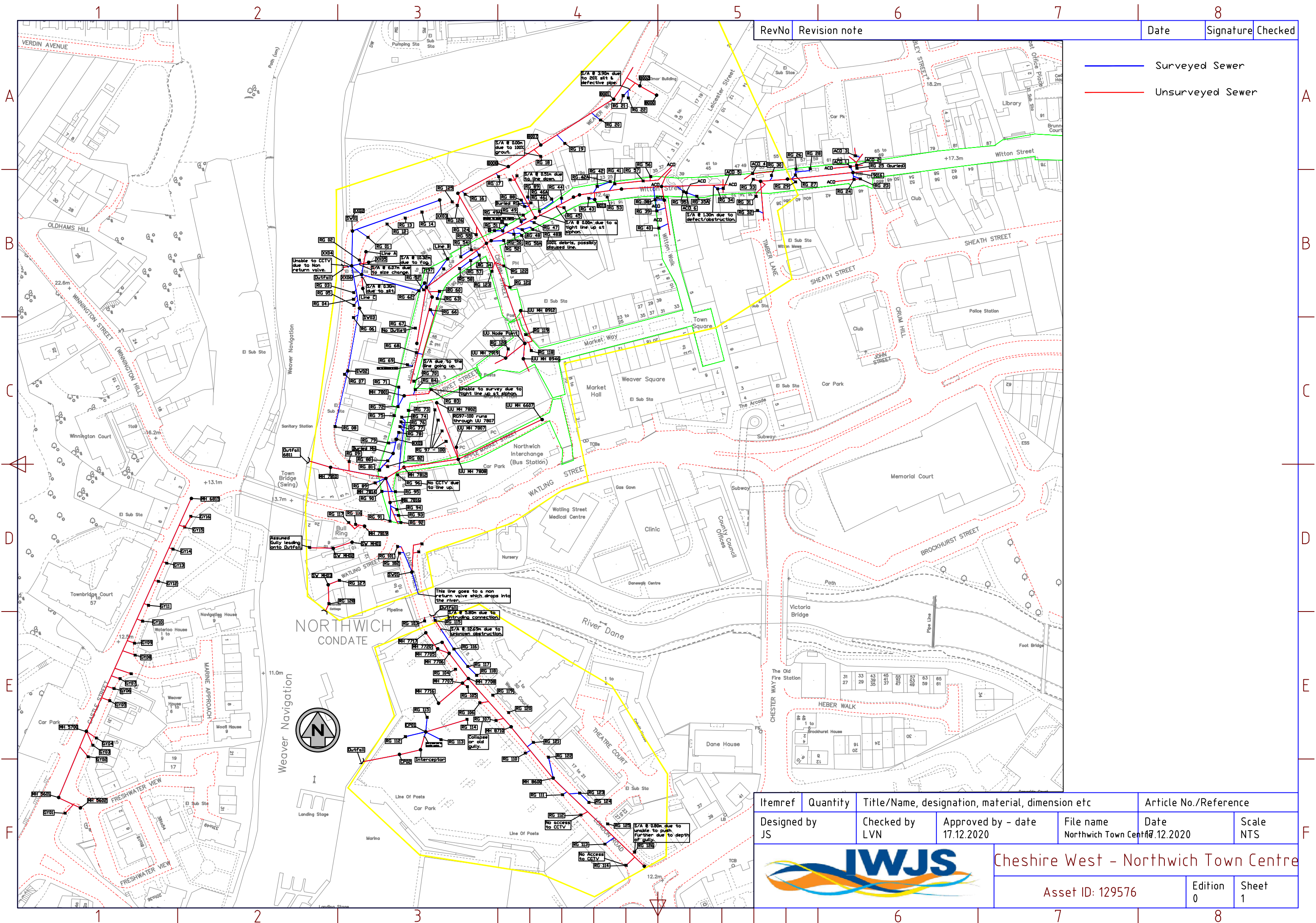
Source: GeoIndex Onshore Data Sources (www.bgs.co.uk)

Appendix B. Asset Information of UU Outfalls

outfall Node Ref	Type of Outfall	Address	UU Investigation Findings	2021 Latest Update (From most recent cyclic inspections)
SJ 6573 6103	Surface Water	Yarwood Close, CW8 1ET	Unflapped	Flap valve installation scheduled
SJ 6573 5208	Surface Water	Navigation Road, CW8 1BE	Flap valve present	Vegetation at outfall but no problem noted
SJ 6573 6811	Surface Water	Bull Ring, High Street, CW9 5BU	Unflapped	Flap valve installation scheduled
SJ 6573 6818	Surface Water	Bull Ring, High Street, CW9 5BU-Under Tower	Unflapped	Flap valve installation scheduled
SJ 6573 6819	Surface Water	Rear of 2a High Street, CW9 5BT	Unflapped	Flap valve installation scheduled
SJ 6573 6703	Surface Water	Marine Approach, CW8 1GF	Unable to determine on latest inspection	Investigation and flap valve install scheduled
SJ 6573 6701	Manhole Chamber	Marine Approach	Sealed Manhole Chamber. Flow control in	N/A
SJ 6574 7200	Surface Water	Barons Quay, Leicester St, CW9 5LD	Unable to determine on latest inspection	Investigation and flap valve install scheduled
SJ 6573 7828	Surface Water	2 Watling Street, CW9 5EX	Flap valve present	Investigation scheduled
SJ 6673 0703	Surface Water	Rear of 34 Heber Walk, CW9 5JB	Unable to determine on latest inspection	Investigation and flap valve install scheduled
SJ 6673 1707	Surface Water	Whalley Road, CW9 5QB	Flap valve present	Debris removed on last inspection, flap valve operational
SJ 6673 1601	Surface Water	Rear of Daneside Court, Chester Way, CW9 5JA	Unable to determine on latest inspection	Investigation and flap valve install scheduled
SJ 6673 1501	Surface Water	Rear of 81 Drillfield Road, CW9 5HU	Unable to determine on latest inspection	Investigation and flap valve install scheduled
SJ 6673 1401	Surface Water	Water Street, CW9 5HP	Unable to determine on latest inspection	Investigation and flap valve install scheduled
SJ 6673 1405	Combined	Water Street, CW9 5HP	Manhole Chamber	No operational issues
SJ 6673 1407	CSO	Opp Water Street, CW9 5HP	Flap valve present	No operational issues
SJ 6573 9304	Surface Water	Waterbank Row, CW9 5UR	Flap valve present	No operational issues
SJ 6573 9300	Surface Water	Chapel Court, CW9 8AX	Flap valve present	No operational issues
SJ 6573 6805	CSO	Winnington Hill, CW8 1AQ	Flap valve present	No operational issues
SJ 6573 6600	CSO	Fresh Water View, CW8 1GE	Flap valve present	Some debris found but valve remained operational
SJ 6573 5210	CSO	Waterside House, Navigation Rd CW8 1DR	Flap valve present	Vegetation found but valve remained operational
SJ 6573 6204	CSO	Dock Road, Weir Street CSO, CW9 5HL	Flap valve present	Latest inspection outfall was submerged by river
SJ 6573 8700	CSO	Watling Street, CW9 5EX	Flap valve present	Debris removed and ensured valve was operational.
SJ 6573 9202	Surface Water	Vickers Way, CW9 8AT	Flap valve present	No operational issues
SJ 6673 2100	CSO	Carlton Road, CW9 5PG	Unflapped	Latest inspection outfall was submerged by river

Appendix C. CCTV Drainage Survey Schematic Plan

The full CCTV drainage survey report is available on request



Appendix D. Detailed Timeline

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
24/10/2019 12:00							
25/10/2019 12:00							
25/10/2019 19:30					Winnington sluices starts to open, reacting to increasing flow.		
25/10/2019 20:20					Hunts sluices starts to open, reacting to increasing flow.		
25/10/2019 20:40					Vale Royal starts to open reacting to increasing flow.		
25/10/2019 21:50					Dutton sluices start to open reacting to increasing flow.		
25/10/2019 22:00	Sandy Lane			Flood warning issued to Sandy Lane residents.			
26/10/2019 01:50	Dock Road PS	WW process high level alarm received for Dock Road PS.					
26/10/2019 04:45					Barnton sluice start to open reacting to increasing flow. High alarm raised at Winnington (10.33mAOD), acknowledged at 04:47.		
26/10/2019 05:15	Sandy Lane			Water continued to rise around Sandy Lane.			
26/10/2019 07:37						Alert	Weaver catchment including Nantwich, Frodsham, Crewe, Winsford and Northwich
26/10/2019 07:40						Alert	The River Dee Catchment in England from Whitchurch to Chester

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
24/10/2019 12:00	13.664	4.871	10.037	16.927						
25/10/2019 12:00	13.651	4.864	10.008	16.903						
25/10/2019 19:30	13.824	5.095	10.035	17.788	10.08	10.08	12.77	16.33		
25/10/2019 20:20										
25/10/2019 20:40										
25/10/2019 21:50										
25/10/2019 22:00	14.003	5.072	10.16	18.282						
26/10/2019 01:50										
26/10/2019 04:45	14.915	5.26	10.446	19.007						
26/10/2019 05:15	15.004	5.246	10.467	19.038	10.54	10.54	13.67	16.39		
26/10/2019 07:37										
26/10/2019 07:40										

CRT SCADA Data									
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
24/10/2019 12:00									
25/10/2019 12:00									
25/10/2019 19:30	19.2	0	88.1	0	0	30.7	0	0	7.89
25/10/2019 20:20									
25/10/2019 20:40									
25/10/2019 21:50									
25/10/2019 22:00									
26/10/2019 01:50									
26/10/2019 04:45									
26/10/2019 05:15	89.4	0	146.3	0	0	89.5	0	0	7.78
26/10/2019 07:37									
26/10/2019 07:40									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
26/10/2019 09:10					High high alarm raised at Winnington (10.48mAOD) acknowledged at 09:12.		
26/10/2019 09:30					Winnington sluices fully open. Barnton Sluice above water level and tracks level.		
26/10/2019 10:00			Phase 1 of flood defences mostly in place. One section open to allow foot traffic on the marina.		Saltersford sluice starts to open reacting to increase flow.		
26/10/2019 10:27						Alert	River Gowy catchment including areas around Frodsham
26/10/2019 10:30					Hayhurst level reached 10.95mAOD. From EA data this is when minor flooding is possible.		
26/10/2019 11:23						Warning	Weaver Navigation at Winsford
26/10/2019 12:00	Waitrose		Water started collecting on London Road south of Dane Bridge at Waitrose entrance.				
26/10/2019 13:30					Saltersford sluice fully open.		
26/10/2019 14:30	Waitrose		Dry side ponding in Waitrose car park. Ponding on London Road was severe, deep and spreading. River level readings was 1.61m at Hayhurst Bridge and 3.64m at Rudheath.				

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
26/10/2019 09:10										
26/10/2019 09:30	15.955	5.396	10.754	19.4						
26/10/2019 10:00	16.094	5.456	10.815	19.453						
26/10/2019 10:27										
26/10/2019 10:30	16.262	5.558	10.858	19.496	10.95	10.95	14.34	16.39	6.16	10.45
26/10/2019 11:23										
26/10/2019 12:00	16.638	5.824	10.919	19.643	11	11	14.57	16.39	7.83	10.31
26/10/2019 13:30	16.801	5.99	10.939	19.878	11	11	14.79	16.39	9.62	10.18
26/10/2019 14:30	16.855	6.034	10.99	20.059						

CRT SCADA Data									
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
26/10/2019 09:10									
26/10/2019 09:30									
26/10/2019 10:00									
26/10/2019 10:27									
26/10/2019 10:30	89.5	0	312.6	0	0	89.5	0	0	7.78
26/10/2019 11:23									
26/10/2019 12:00	89.5	0	357.9	0	0	150.8	0	0	7.91
26/10/2019 13:30	89.4	0	357.9	0	0	305.5	0	0	7.9
26/10/2019 14:30									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
26/10/2019 15:30						Warning	River Weaver at Anderton
26/10/2019 16:00			Water level started to rise in Marina and at Dane Bridge. EA advised marina residents to get out or stay put. Phase 1 closed completely.				
26/10/2019 17:00			EA Site Controller spoke to Flood Incident Duty Officer advising to contact UU to discuss their assets on site and get an Engineer to attend and confirm systems are operational. Further requested Police to escalate a call to UU for the same reason.		Vale Royal fully open, upstream level still at desired level but now starts to climb.		
26/10/2019 17:14					High alarm raised at Vale Royal (16.56mAOD), acknowledged at 17:15		
26/10/2019 17:30			Flood depths in Waitrose car park 0.5m higher than river level.				
26/10/2019 18:00	Lakeside Caravan Park			Water starting to get noticeably higher at the downstream end of the park – Caravan No. 35. Electric was lost for that caravan.			

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
26/10/2019 15:30	16.901	6.043	11.085	20.285						
26/10/2019 16:00	16.935	6.048	11.118	20.394						
26/10/2019 17:00	17.022	6.066	11.198	20.477						
26/10/2019 17:14										
26/10/2019 17:30	17.068	6.076	11.238	20.498						
26/10/2019 18:00	17.115	6.089	11.301	20.524	11	11	16	16.71	9.61	10.34

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
26/10/2019 15:30									
26/10/2019 16:00									
26/10/2019 17:00									
26/10/2019 17:14									
26/10/2019 17:30									
26/10/2019 18:00	151	0	358	0	0	367.4	0	0	7.83

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
26/10/2019 18:00	Sandy Lane			Water level couple inches below deck level - boats loosened as a precaution.			
26/10/2019 18:15	Waitrose		Significant ponding dry side Waitrose.				
26/10/2019 18:27					High high alarm raised at Vale Royal (16.785mAOD) acknowledged at 18:28.		
26/10/2019 18:30	Lakeside Caravan Park			Were informed all sluice gates were open.	Available sluices at Hunts Fully Open, upstream level still at desired level but now starts to climb.		
26/10/2019 19:00	Lakeside Caravan Park			Water reached lighting columns and tripped the electric for the park.	Level upstream of Vale Royal goes beyond the instruments current range 17.00mAOD.		
26/10/2019 19:05	Bullring		Seepage through flood wall at Bullring.				
26/10/2019 19:30			Phase 2 defences set up.				
26/10/2019 19:50					Available sluices at Dutton Fully Open, upstream level still at desired level but now starts to climb.		
26/10/2019 20:15	London Rd		London road flooded.				
26/10/2019 20:30	Weaver Court		Water 6m from line of barrier in car park. River Dane is 400mm from flowing out of bank.				
26/10/2019 21:00	Sandy Lane			Water over decking – Using wellies to go into the water to loosen the boats more.			

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
26/10/2019 18:00	17.115	6.089	11.301	20.524	11	11	16	16.71	9.61	10.34
26/10/2019 18:15	17.137	6.098	11.337	20.527						
26/10/2019 18:27										
26/10/2019 18:30	17.156	6.104	11.358	20.54						
26/10/2019 19:00	17.186	6.122	11.416	20.545						
26/10/2019 19:05										
26/10/2019 19:30	17.21	6.148	11.479	20.55	11	11	16	17	9.61	10.45
26/10/2019 19:50										
26/10/2019 20:15	17.232	6.197	11.55	20.548	11	11	16	17	9.61	10.5
26/10/2019 20:30	17.238	6.21	11.584	20.547						
26/10/2019 21:00	17.25	6.226	11.648	20.543	11	11	16	17	9.61	10.55

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
26/10/2019 18:00	151	0	358	0	0	367.4	0	0	7.83
26/10/2019 18:15									
26/10/2019 18:27									
26/10/2019 18:30									
26/10/2019 19:00									
26/10/2019 19:05									
26/10/2019 19:30	250.7	0	358.1	0	0	367.5	0	0	7.91
26/10/2019 19:50									
26/10/2019 20:15	358.6	0	358.1	0	0	367.5	0	0	7.95
26/10/2019 20:30									
26/10/2019 21:00	358.7	0	358.1	0	0	367.5	0	0	8.03

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
26/10/2019 21:00	Lakeside Caravan Park			Power back on after going to the substation to restart it. Stayed on for 1 hour before tripping again. Was rising roughly taking 2 foot of land every 10 minutes. Tracked using rocks at water level.			
26/10/2019 21:00	Waitrose		Phase 2 not completed in car park due to risk of submerged electrical boxes. Water level 0.6m - 0.7m in Waitrose car park. Marina entrance flood gate 1.2m.				
26/10/2019 21:17					High alarm raised at Dutton (7.95mAOD) acknowledged at 17:18.		
26/10/2019 21:43	Waitrose		Waitrose car park flooded.				
26/10/2019 22:16						Warning	River Weaver at Pickerings Bridge
26/10/2019 22:21						Warning	River Weaver at Acton Bridge and Weaverham
26/10/2019 22:21						Warning	Weaver Navigation at Sutton Dock
26/10/2019 22:36					High high alarm raised at Dutton (8.16mAOD) acknowledged at 22:27.		
26/10/2019 22:30	Lakeside Caravan Park			Still rising Water ingress to caravans.			
26/10/2019 22:34					Mains failure at Dutton.		

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
26/10/2019 21:00	17.25	6.226	11.648	20.543	11	11	16	17	9.61	10.55
26/10/2019 21:00	17.25	6.226	11.648	20.543	11	11	16	17	9.61	10.55
26/10/2019 21:17										
26/10/2019 21:43										
26/10/2019 22:16										
26/10/2019 22:21										
26/10/2019 22:21										
26/10/2019 22:36										
26/10/2019 22:30	17.274	6.344	11.8	20.528	11	11	16	17	9.61	10.65
26/10/2019 22:34										

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
26/10/2019 21:00	358.7	0	358.1	0	0	367.5	0	0	8.03
26/10/2019 21:00	358.7	0	358.1	0	0	367.5	0	0	8.03
26/10/2019 21:17									
26/10/2019 21:43									
26/10/2019 22:16									
26/10/2019 22:21									
26/10/2019 22:21									
26/10/2019 22:36									
26/10/2019 22:30	0	0	0	0	0	0	0	0	8.17
26/10/2019 22:34									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
26/10/2019 22:45			Water observed to be seeping rapidly. Water moves faster into the Bullring. River level at soffit of bridge beam.				
26/10/2019 23:15			Bridge deck overtops. Phase 2 in place.				
26/10/2019 23:30			Water bubbling up on building side of defence at Weaver Court and Waitrose car park drains, gulleys, tarmac and concrete.				
27/10/2019 01:08	Baron's Quay		Baron's quay dry side flooding (Odeon).				
27/10/2019 01:53	Bridge		Water still on bridge deck, 100mm.				
27/10/2019 02:00	Sandy Lane			Boats floating on to mooring. Flooding into property upstream.			
27/10/2019 02:45			Fire Brigade rescue 4 ladies from CareHome.				
27/10/2019 03:26			Evacuation of marina.				
27/10/2019 03:30	Sandy Lane			Observed peak height of water.			
27/10/2019 05:15					From EA Data Winnington Pound reaches maximum height of 12.28mAOD. Highest ever water level on EA records.		

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
26/10/2019 22:45	17.279	6.375	11.833	20.521						
26/10/2019 23:15	17.286	6.436	11.872	20.515	11	11	16	17	9.61	10.69
26/10/2019 23:30	17.291	6.471	11.904	20.506						
27/10/2019 01:08										
27/10/2019 01:53										
27/10/2019 02:00	17.315	6.601	12.106	20.416						
27/10/2019 02:45	17.318	6.608	12.118	20.376						
27/10/2019 03:26										
27/10/2019 03:30	17.318	6.616	12.151	20.34						
27/10/2019 05:15	17.292	6.625	12.151	20.254			16	17	9.61	10.89

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
26/10/2019 22:45									
26/10/2019 23:15	0	0	0	0	0	0	0	0	8.27
26/10/2019 23:30									
27/10/2019 01:08									
27/10/2019 01:53									
27/10/2019 02:00									
27/10/2019 02:45									
27/10/2019 03:26									
27/10/2019 03:30									
27/10/2019 05:15	0	0	0	0	0	0	0	0	8.52

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 06:51	Bullring PS	WW Network Non Infrastructure standby received high level alarm for Bull Ring PS. Dispatched to engineer- all pumps operational but high level remained, escalated to manager.					
27/10/2019 07:30					Mains returns to normal.		
27/10/2019 09:00	Waitrose	Ww Network Infrastructure standby were notified on the morning of Sunday 27th to investigate reports of foul flooding in the Waitrose car park on London Road. Estimate of 2 days provided, EA escalated for in day response.					
27/10/2019 09:00	Dock Road PS		EA representative - Dock Road PS quiet and not working, no UU staff.				
27/10/2019 09:44					Level upstream of Dutton reaches maximum level of 8.53mAOD.		
27/10/2019 10:50			Flood Incident Duty Officer contacted UU emergency number.				
27/10/2019 11:00	High St		Vision express, U Mobile High st flooding.				
27/10/2019 11:10			Contacted UU.				

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 06:51										
27/10/2019 07:30	17.224	6.633	12.053	20.133	11	11	16	17	9.61	10.87
27/10/2019 09:00	17.168	6.637	12.015	20.045	11	11	16	17	9.62	10.83
27/10/2019 09:00	17.168	6.637	12.015	20.045	11	11	16	17	9.62	10.83
27/10/2019 09:44										
27/10/2019 10:50										
27/10/2019 11:00	17.085	6.63	11.828	19.94						
27/10/2019 11:10										

CRT SCADA Data									
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 06:51									
27/10/2019 07:30	0	0	0	0	0	0	0	0	8.53
27/10/2019 09:00	358.7	0	356.3	0	0	366.9	21.8	0	8.53
27/10/2019 09:00	358.7	0	356.3	0	0	366.9	21.8	0	8.53
27/10/2019 09:44									
27/10/2019 10:50									
27/10/2019 11:00									
27/10/2019 11:10									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 11:20			Flood Incident Duty Officer escalated UU response via UU representatives.				
27/10/2019 12:00			One small section of the demountables were removed to allow gravity discharge from Waitrose car park due to the river level being lower than the water held in the car park. This combined with the use of a pump saw a decrease in water levels in Waitrose adjacent to the opening over the course of 3-4 hours. The majority of the car park and London Road was still under water after this time.				
27/10/2019 12:51			Water released from dry side to river.				
27/10/2019 12:53	Waitrose		Water behind defences still.				
27/10/2019 13:30			Flood Incident Duty Officer contacted UU engineer who said they would be on site within the hour.		Level upstream of Vale Royal comes back into instrument range and continues to drop.		
27/10/2019 14:00	Sandy Lane			Water starting to recede.			
27/10/2019 14:00	Waitrose		Water still behind defences.				

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 11:20										
27/10/2019 12:00										
27/10/2019 12:51										
27/10/2019 12:53										
27/10/2019 13:30	16.966	6.627	11.689	19.811	11	11	16	17	9.59	10.66
27/10/2019 14:00	16.938	6.606	11.663	19.786						
27/10/2019 14:00	16.938	6.606	11.663	19.786						

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 11:20									
27/10/2019 12:00									
27/10/2019 12:51									
27/10/2019 12:53									
27/10/2019 13:30	357.8	0	356.5	0	0	366.5	21.9	0	8.42
27/10/2019 14:00									
27/10/2019 14:00									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 14:40	Waitrose	<p>Network technician attended Waitrose car park at 14:40 and found the network to be surcharged down to the last in line pumping station, Dock Road. Technician believed no pumps were running due to the stagnant network, surcharged wells and lack of any noise from pumps. Arrived to find 4 premises to potentially have internally flooded - deep flood water meant that this was not fully investigated immediately. Discovering that Mh8615, Mh8618 and Mh7209 were surcharged, including the CSO Mh were surcharged, a process controller was called out to check on Dock Road PS. Witnessed Weaver Navigation in extremely high flow and no pollution visible.</p>					
27/10/2019 14:51			UU arrive on site.				
27/10/2019 15:00			At tactical command group, EA representative had contact with Joint UU duty manager.				

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 14:40										
27/10/2019 14:51										
27/10/2019 15:00										

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 14:40									
27/10/2019 14:51									
27/10/2019 15:00									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 15:30			EA representative contacted UU duty manager. Informed surface water management is by them. It was indicated there may be an issue with the pumping station.				
27/10/2019 16:00	Dock Road PS	Process standby called to Dock Road to assist network. 2 pumps were found to be operational. Found Pump 4 was not running on arrival. Pump restarted in manual whilst repairs were made to flooded ultrasonic level instrument.					
27/10/2019 17:00			UU engineer confirmed to site controller that the pumps weren't working. Showing no issues apart from a penstock issue. UU engineer focussed on the network infrastructure not process with regards to the last in lines.				
27/10/2019 17:47	Dock Road PS	Job raised by process site controller for further technical support.					
27/10/2019 18:01	Dock Road PS	3rd pump turned on in manual.					

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 15:30										
27/10/2019 16:00	16.813	6.502	11.474	19.684						
27/10/2019 17:00	16.713	6.447	11.416	19.628						
27/10/2019 17:47										
27/10/2019 18:01										

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 15:30									
27/10/2019 16:00									
27/10/2019 17:00									
27/10/2019 17:47									
27/10/2019 18:01									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 18:05	Waitrose	Network technician was informed that Dock Road was fully operational at 6.05pm and on site teams witnessed flood levels begin to drop at Waitrose car park.					
27/10/2019 18:10		By 18:10, process operatives managed to restore flow in the pump not passing flow forward.	Pumps advised as operational, they had malfunctioned and since been repaired.				
27/10/2019 19:00	Waitrose		One pump had malfunctioned and was repaired and turned on at 19:00. It was observed that within 30 mins, the area of inundation with water on London Road was reduced. The majority of the water was cleared by 21:00.				
27/10/2019 21:00	Waitrose		Water for the most part gone.				

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 18:05										
27/10/2019 18:10										
27/10/2019 19:00	16.455	6.33	11.263	19.516						
27/10/2019 21:00	16.201	6.216	11.068	19.413	11	11	16	16.53	9.6	10.27

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 18:05									
27/10/2019 18:10									
27/10/2019 19:00									
27/10/2019 21:00	359.1	0	357.4	0	0	367.4	22.3	0	7.82

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 23:00	Waitrose	<p>Levels remained high in wet well until approximately 11pm</p> <p>2x road sweepers sourced by UU at 19:30 and on site at 21:30, assisting in clearing blocked highways gullies that aided in receding flood water.</p> <p>Throughout this period the small drain towards the corner of the carpark continued to allow the ingress of river flow to continue flooding the car park.</p>					

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 23:00	15.966	6.123	10.904	19.328						

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 23:00									

						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
27/10/2019 23:16	Dock Road PS	Job closed down. Comments as follows: Pumped Wells down and cleaned heads and emptied junction boxes of water ingress. Monitored until healthy levels and watched auto working correctly. left working correctly. Process operatives job was closed at 23:15 but network operatives didn't leave London Road until approx 01:30 - 01:40 by the time the clean up around bridge was completed and signed paperworks for sweepers checked EA were happy etc.					
28/10/2019 00:00							

	River Level Gauge Data									
Date / Time	Dane (Rudheath) (mAOD)	Weaver (Pickerings Cut) *Data not available in mAOD - data in m	Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)	Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
27/10/2019 23:16										
28/10/2019 00:00	15.872	6.094	10.789	19.29	10.91	10.92	16	16.29	9.6	10.06

	CRT SCADA Data								
Date / Time	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
27/10/2019 23:16									
28/10/2019 00:00	234.3	0	352	0	0	367.6	0	0	7.63

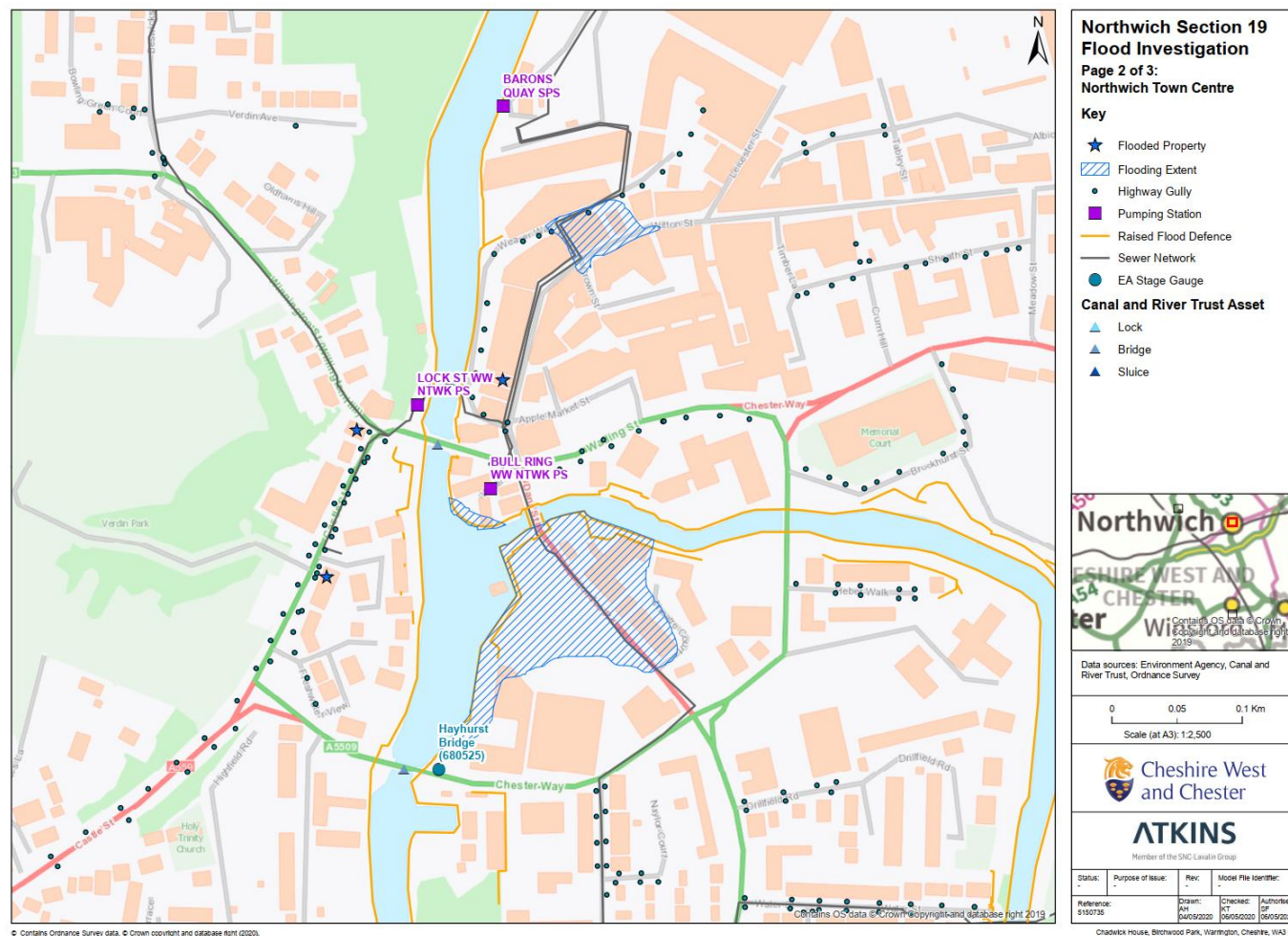
						Flood Warnings	
Date / Time	Flood Area	UU	EA	Residents and Property Owners	CRT	Alert/ Warning	Name
28/10/2019 01:40		Ww Network teams remained on site through to 1:40am on Monday 28th assisting the EA with clean up. During this time Cityflex suction was used to remove excess flood water. Following the suction, additional flooding continued to collect in the corner of the Waitrose carpark, this appeared to be coming from the Aeco drain and not UU assets.					
29/10/2019 00:15							
30/10/2019 00:00							
30/10/2019 23:45							

	River Level Gauge Data									
		Weaver (Pickerings Cut) *Data not available in mAOD - data in m			Hayhurst Swing Bridge Upstream River Level 1 mAOD (All Data) (Value)	Hayhurst Swing Bridge Upstream River Level 2 mAOD (All Data) (Value)	Vale Royal Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Vale Royal Sluice Upstream Controlling Level mAOD (All Data) (Value)	Saltersford Sluice Sluice 1 Position (Height AOD) mAOD (All Data) (Value)	Saltersford Sluice Upstream Controlling Level mAOD (All Data) (Value)
Date / Time	Dane (Rudheath) (mAOD)		Weaver (Hayhurst Bridge) (mAOD)	Weaver (Ashbrook) (mAOD)						
28/10/2019 01:40	15.655	5.937	10.647	19.217						
29/10/2019 00:15	14.616	5.038	10.066	18.53						
30/10/2019 00:00	14.102	4.901	10.081	17.999						
30/10/2019 23:45	13.883	4.983	10.06	17.694						

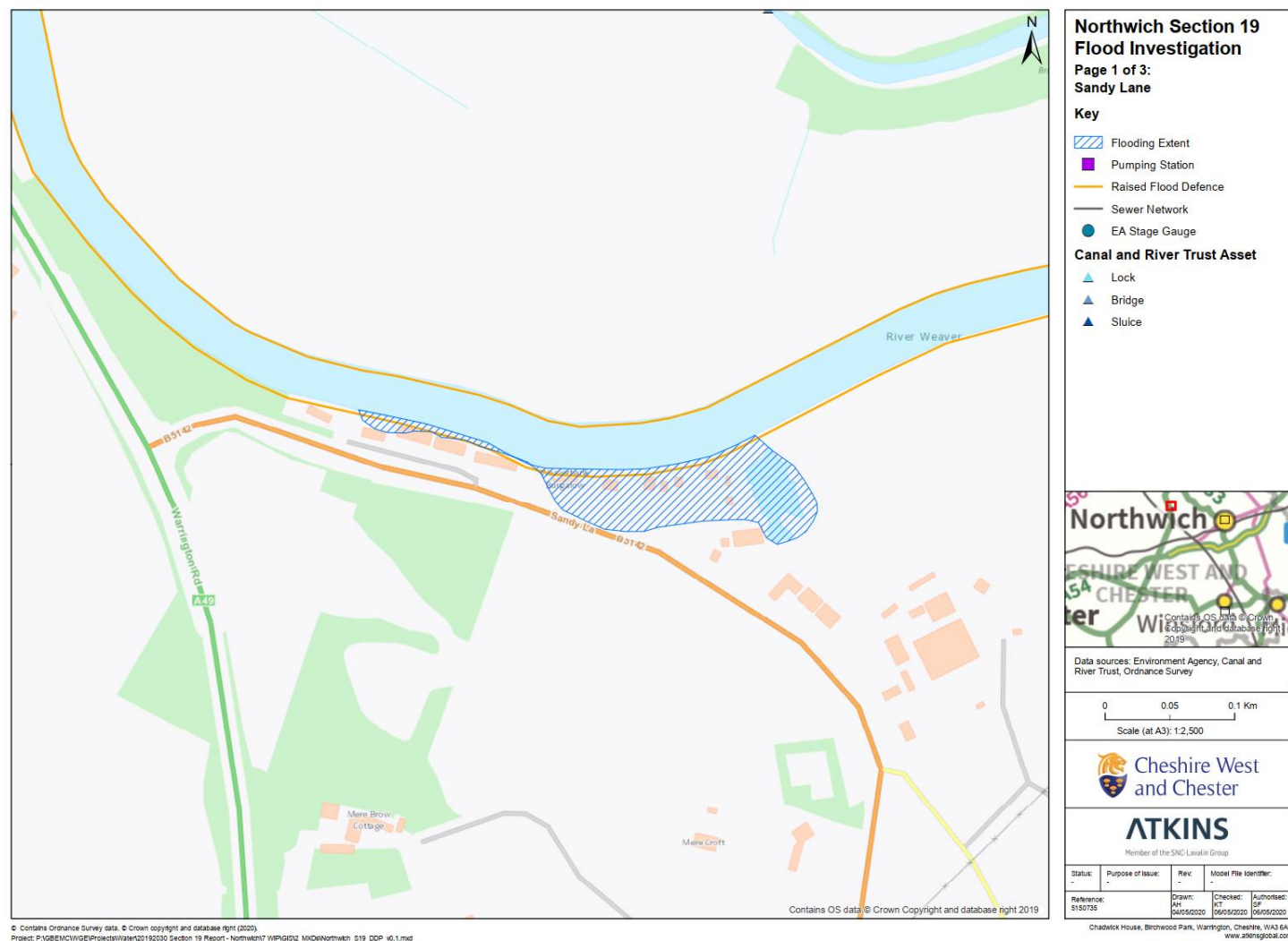
	CRT SCADA Data								
	Dutton Sluice Sluice 1 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 2 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 3 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 4 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 5 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 6 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 7 Open Height cm (All Data) (Value)	Dutton Sluice Sluice 8 Open Height cm (All Data) (Value)	Dutton Sluice Average River Level mAOD (All Data) (Value)
Date / Time									
28/10/2019 01:40									
29/10/2019 00:15									
30/10/2019 00:00									
30/10/2019 23:45									

Appendix E. Flood Outline Maps

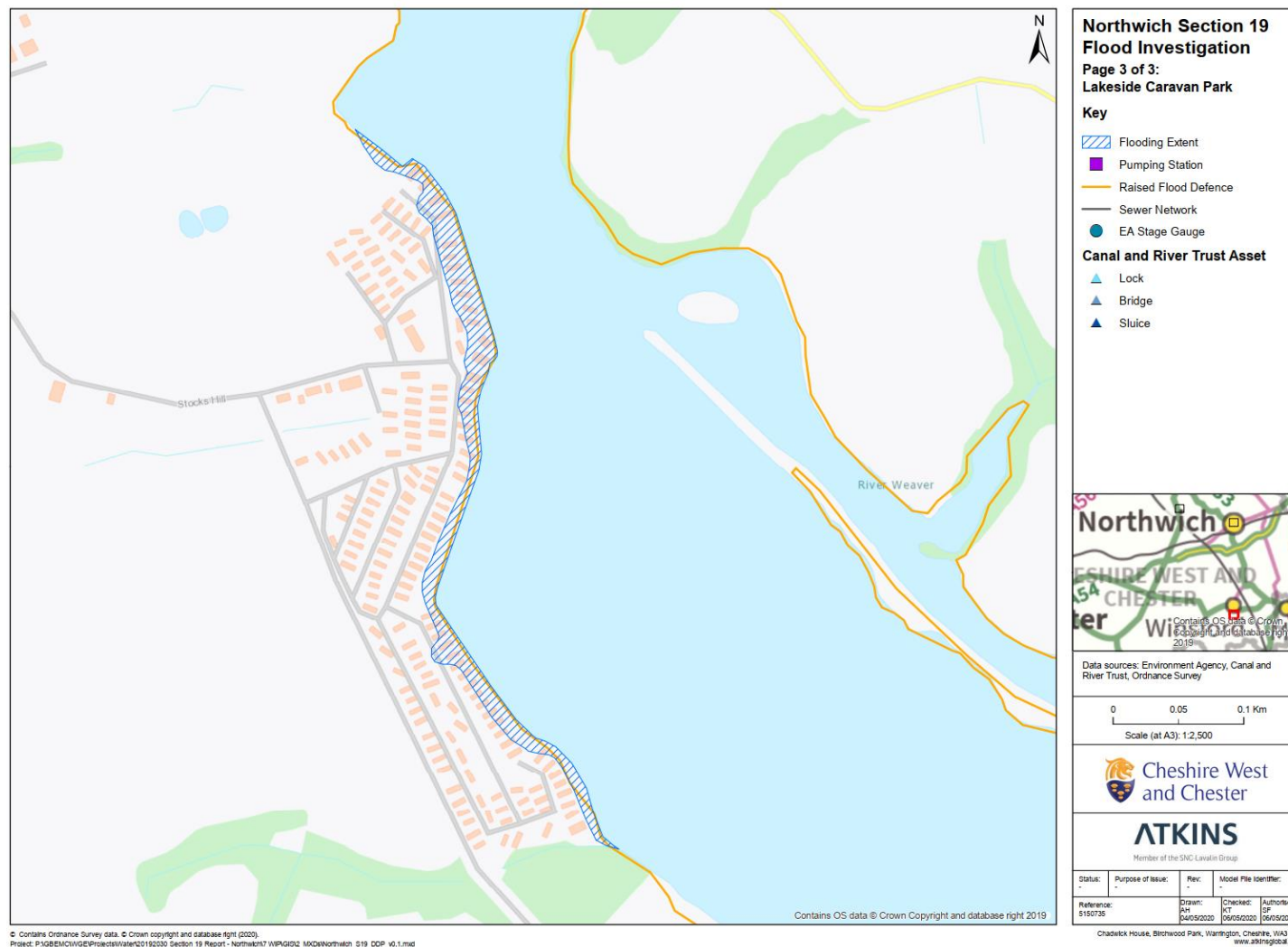
E.1. Flood Outline Map - Northwich Town Centre (Refer Appendix B for surveyed gully locations)



E.2. Flood Outline Map - Sandy Lane Acton Bridge Area



E.3. Flood Outline Map - Lakeside Caravan Park Winsford Area




Appendix F. Summary of Evidence

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Appendix F – Summary of Evidence – London Road

London Road			
Question	Answer	Evidence	Conclusion
Fluvial Flooding			
1. Was the river level higher than the ground level at the time of onset of flooding? Was the river level higher than level where flooding was observed?	No	The river level at the onset of flooding was 10.919mAOD. Highest river level 12.151mAOD. Ground level where flooding observed 11.00mAOD - 12.07mAOD. Photos of ponding on London Road.	The river level was lower than ground levels at the onset of flooding and therefore not the direct cause by out of bank or backflow. However, increased water levels may have influenced the ability for drainage assets to discharge freely.
2. Was there connectivity from river to the location of observed flooding?			
a) Through flood defence	No	The threshold for Phase 1 (1.42m or 10.754mAOD at Hayhurst Bridge) closure was reached at 9:30 26/10/19. Phase 1 was mostly closed by 10:00 (river level at 10.815mAOD by this point), however was not completely closed (one section of demountable defences was left open to allow Marina foot traffic. This opening had a threshold level of 11.5mAOD). Phase 1 was completely closed at 16:00 26/10/2019. At this time the river level was 11.118mAOD. The threshold for Phase 2 (2.22m or 11.55mAOD) was reached at 20:15 26/10/2019. Phase 2 defences were in place ahead of that at 19:30 26/10/2019. River level at this point was 11.479mAOD.	The demountable barriers were in place before the river level reached the threshold levels and therefore river water through the flood defence did not contribute to flooding.

Appendix F – Summary of Evidence – London Road

		<p>The level at which the river would overtop Dane Bridge and spill onto London Road is 11.86mAOD.</p> <p>River level did not reach top of defence level and there was no evidence of overtopping. No leakage was reported.</p>	
b) Unflapped or inoperable flow control on outfalls	Yes	<p>Outfalls 21 - 24 identified on the outfall map and schedule had flap valves in what appears to be working order. There is no record of flap valve performance during the event at these locations.</p> <p>Outfalls 25 -27 identified on the outfall map have flap valves which are private, however there have been reports of debris build up nearby and flap valve 26 was reported to be seized open following the event. This outfall is 300mm in diameter and thought to belong to the Weaver and Theatre Court development.</p>	<p>If flap 26 was seized open during the flood event, based on the river hydrograph and an assumed lowest cover level of 11.4mAOD, there would have been some backflow through the system.</p> <p>Based on a 300mm diameter, it is likely that this would have been a small contributing factor to the flooding on London Road.</p> 
Surface Water Flooding			
3. Was water able to drain via gravity to river from the area where the flooding was observed?	No	<p>River levels compared against the invert levels of outfalls in this area, indicate that operating flap valves would have been river locked.</p>	<p>Water would have backed up and contributed to surface water flooding.</p>

Appendix F – Summary of Evidence – London Road

4. Are there drainage assets in the area where the flooding was observed?	Yes		
5. Were they operating properly and at full capacity?			
a) Combined sewers (UU)	No	<p>Sewage is pumped up from Baron's Quay Pumping Station just over Dane Bridge, where it changes to a combined surface runoff and sewage gravity flow sewer flowing to Dock Road Pumping Station, which then pumps this forward to Northwich WasteWater Treatment Works. Dock Road Pumping Station has 4 sewage transfer pumps with a total pass forward flow capacity of 510L/s. Each pump can deliver 187L/s. Until 18:25 27/10/2019, only 2 pumps were operating passing forward 374L/s, at which point an operator manually activated a third pump increasing the pass forward flow to the maximum 510L/s. This was a lost capacity of 126L/s from the beginning of the event until 18:25 27/10/2019. As the ground levels along the gravity combined sewer from Dane Bridge to Dock Road Pumping Station are lowest at London Road where flooding occurred, any residual flows within the system unable to pass forward would have collected at this location.</p> <p>The overflow outfall to river at Dock Road Pumping Station invert level is 10.16mAOD</p>	<p>It is probable that some of the surface water flooding observed in this area occurred due to surcharge of the combined sewer from the reduced capacity at Dock Road pumping station. Whilst it is not possible to confirm the exact impact of this, it is reasonable to conclude that the 136L/s shortfall in pumped flow would have had significant impact to the low-lying London Road.</p> <p>London Road is the lowest point on the route of the combined drain from Dane Bridge, along London Road, to the Dock Road Pumping Station.</p>

		which was river locked by 22:00 25/10/2019.	
b) Highway drainage (CWaC)	No	<p>The drainage survey identifies a section of drain which discharges to the River Dane under Dane Bridge. It is uncertain whether this has a flap valve present, structural defects and intrusions are present on this section. This drain would have backed up during the event and contributed to the flood water</p> <p>(Section Inspection - 13/12/2020 - RG115RG115X, Page 357 of CCTV Drainage Report)</p>	<p>If this outfall was not flapped during the flood event, based on the river hydrograph and an assumed lowest cover level of 11.4mAOD, there would have been some backflow through the system.</p> <p>If this outfall is flapped, water would not be able to drain through the system due to high river levels.</p>
c) Private	Unknown	<p>Unknown condition of 3 private drains (Outfalls 25,26,27) which originate from Weaver Court and Theatre Court. Reported to have flap valves albeit one is identified as jammed.</p> <p>Waitrose drainage outfalls (3 no. no. 21 - 23 have outfall levels of 10.2mAOD) were river locked from 22:45 25/10/2020 until 28/10/2020 20:45 during which</p>	<p>A proportion of the surface water flooding observed is likely to have been a result of the 25mm of rainfall that fell during the period when the surface water drains were unable to discharge to the river due to the outfalls being river locked.</p>


Appendix F – Summary of Evidence – London Road

		approximately 25mm of rainfall fell. Chamber cover levels on the dry side as low as 11.10mAOD.	
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Appendix F – Summary of Evidence – Bull Ring

Bull Ring			
Question	Answer	Evidence	Conclusion
Fluvial Flooding			
1. Was the river level higher than the ground level at the time of onset of flooding?	Yes	First observation noted of Bullring flooding at 19:05 26/10/2019 river level at 11.479mAOD. Lowest ground level in the Bullring 10.36mAOD.	
2. Was there connectivity from river to the location of observed flooding?			
a) Through flood defence	Yes	The threshold for Phase 2 (2.22m or 11.55mAOD) was reached at 20:15 26/10/2019. Phase 2 defences were in place by 19:30 26/10/2019. River level at this point was 11.479mAOD. The level at which the river would overtop Dane Bridge and spill onto London Road is 11.86mAOD. The top of flood defence was 13.165mAOD and the highest river level was 12.051 therefore it did not overtop. A small amount of seepage was observed during the flood event through the flood defence wall close to the pipe bridge near Dane Bridge.	This could have contributed to flooding. EA pumps deployed to overpump this small volume of water back to river.
b) Unflapped outfalls	Yes	Outfalls 7, 8, 9 and 11 identified on the outfall map all have flap valves or a flow control Wastop in what appears to be working order. The UU surface water drain (UU Ref. 6819) labelled 10 on the sketch does not have a	A small amount of water would have back flowed through outlet no. 10.

Appendix F – Summary of Evidence – Bull Ring

		flap valve. There could have been some inflow from this outfall.		
Surface Water Flooding				
3. Was water able to drain from the area where the flooding was observed?	No	<p>Reports indicate the water was not able to drain and had to be pumped away.</p> <p>Invert of drain down valves range from 10.53 – 10.92mAOD, meaning these were river locked from 12:00 26/10/2019 to 22:00 27/10/2019.</p>	Surface water would have backed up within the gravity drainage system and spilt out above ground.	
4. Are there drainage assets in the area where the flooding was observed?	Yes			
Were they operating properly and at full capacity?				
a) Combined sewers (UU)		The Bull Ring pumping station was working throughout the event pumping 10 l/s to High Street. Operational peak maintained throughout but high levels within the system observed by engineer.	We are unable to conclude conclusively, from the information available, whether the capacity of the Bull Ring pumping station was sufficient. The fact that significant flooding still occurred at the Bull Ring suggests that a higher capacity would have reduced flooding but this flooding could have been associated with surface or highway systems rather than the combined system.	

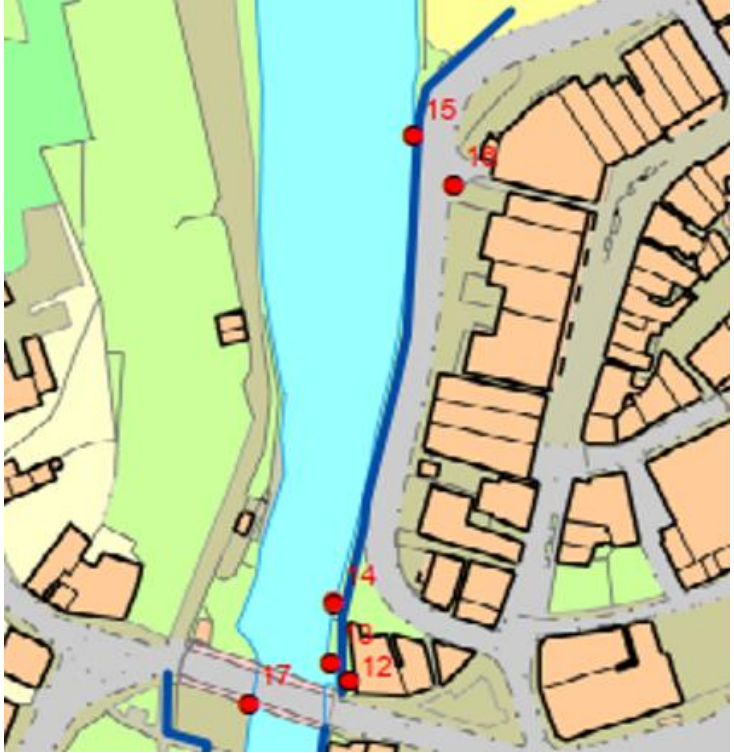
Appendix F – Summary of Evidence – Bull Ring

b) Highway drainage (CWaC)		<p>Two highway drains run down Watling Street. Both discharged to the River Weaver and had working non return valves.</p> <p>The CCTV drainage survey identified that one of these drains was reported to be filled with debris, no issues were reported on the second.</p>	<p>Once the flap valves were river locked surface water would have backed up within the system and contributed to surface water flooding.</p> 
c) Private	Yes	A single private drain discharges to the River Weaver from a private courtyard.	This may have led to back flow or backing up within the Bullring area.

Appendix F – Summary of Evidence – Weaver Way and High Street

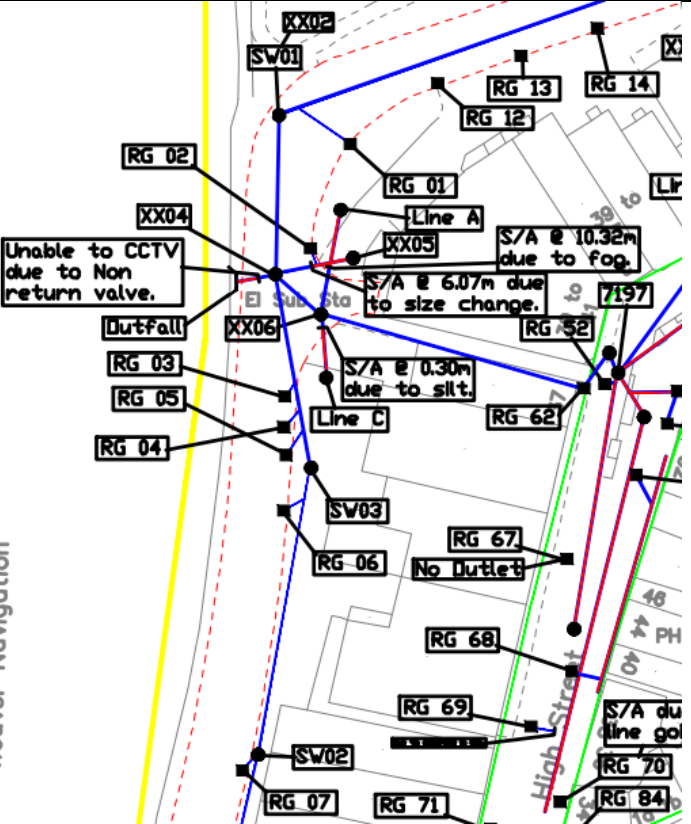
Weaver Way and High St			
Question	Answer	Evidence	Conclusion
Fluvial Flooding			
1. Was the river level higher than the ground level at the time of onset of flooding?	Yes	First reports of flooding 01:08 27/10/2019, river level at 12.005mAOD. Ground level where flooding observed 11.28mAOD. High St levels flooding observed from 11.94 – 12.65mAOD. Maximum river level 12.151m 03:30 on 27/10/19.	River levels in the Weaver would likely have influenced flooding on Weaver Way but unlikely to have affected High Street flooding.
2. Was there connectivity from river to the location of observed flooding?			
a) Through flood defence	No	The threshold for Phase 1 (1.42m or 10.754mAOD) closure was reached at 9:30 26/10/2019. Phase 1 was closed in this section by 10:00 (10.815mAOD).	No overtopping of the flood defence or the threshold prior to their installation

Appendix F – Summary of Evidence – Weaver Way and High Street

b) Unflapped outfalls	Yes	<p>2 CWaC outfalls identified, both reported to have non-return valves between the upstream MH and the outfall (refer CCTV drainage Survey).</p> <p>1 UU surface water drain outfalls through this section, this has a flap valve (UU Ref 6811).</p>	<p>Potential for back flow through the UU surface water drain from the river and backing up of the CWaC highway drains.</p> 
Surface Water Flooding			
3. Was water able to drain from the area where the flooding was observed?	No	<p>Photos of ponding on Weaver Way and High Street.</p> <p>River levels within the Weaver would have caused the flap valves to river lock.</p>	<p>Consequence would have been some surface water ponding on Weaver Way.</p>
4. Are there drainage assets in the area	Yes		

Appendix F – Summary of Evidence – Weaver Way and High Street

where the flooding was observed?			
Were they operating properly and at full capacity?			
a) Combined sewers (UU)	Yes	<p>It is understood that the combined system worked as permitted, flowing via gravity to the Baron's Quay pumping station before being pumped to Dock Road.</p> <p>The river overflow with an invert of 9.69mAOD was river locked throughout the 26/10/2019 to 27/10/2019.</p>	Given the size of the catchment and the fact that the section of High Street flooded has localised low ground levels it is likely that any capacity issues within the combined sewer drainage system would have contributed to flooding on High Street.

<p>b) Highway drainage (CWaC)</p>		<p>Highway drainage flows to the Weaver via a flow control (Section Inspection - 01/12/2020 - XX04X)</p> <p>Evidence of fat, grease deposits and silts resulting in reduced capacity (Section Inspection - 02/12/2020 - XX05X, Section Inspection - 02/12/2020 - XX06X of CCTV Drainage Report)</p>	 <p>Fat and grease deposits would have reduced capacity of the drain to drain surface water from the area during the event, before the outfall flap valve was river locked.</p> <p>After the river level rose and the flap valve was unable to open and release the surface water, the highway drainage system would have backed up which would have contributed to surface water spilling from the lowest level gullies.</p>
<p>c) Private</p>	<p>Unknown</p>	<p>Unknown</p>	

Appendix F – Summary of Evidence – Castle Street

Castle St			
Question	Answer	Evidence	Conclusion
Fluvial Flooding			
1. Was the river level higher than the ground level at the time of onset of flooding?	No	First reports of flooding 19:30 26/10/2019 river level at 11.479mAOD. Ground levels in this area are 12.81mAOD and over.	Water levels on the River Weaver did not cause flooding here.
2. Was there connectivity from river to the location of observed flooding?			
a) Through flood defence	N/A		
b) Unflapped outfalls	N/A		
Surface Water Flooding			
3. Was water able to drain from the area where the flooding was observed?	No	Reports of basement flooding that was not able to drain starting at 19:30 26/10/2019.	
4. Are there drainage assets in the area where the flooding was observed?	Yes		
Were they operating properly and at full capacity?			
a) Combined sewers (UU)	Yes	A UU combined sewer runs from south to north on Castle Street to discharge to the Lock Street pumping station. Two CSOs, records show that the Winnington Hill CSO did not spill during the event. No monitoring records are available to confirm whether the Castle Street CSO spilled to the river.	Inconclusive as to whether this contributed. Winnington Hill CSO did not spill and therefore highly unlikely to have contributed to flooding. Inconclusive for Castle Street CSO, and therefore unknown whether Castle Street drain would have been surcharged resulting in flooding.

Appendix F – Summary of Evidence – Castle Street

b) Surface water drains (UU)	Yes	3 surface water drains flow directly to the River Weaver. The drain from Winnington Street (UU Ref. 6811) does not have a flap valve. The drain at Freshwater View (UU Ref. 6600) does have a flap valve and it is unknown whether the drain at Marine Approach (UU Ref. 6703) has a flap valve.	<p>Whilst it is feasible that any non-return valves, or unflapped outlets, could have been river locked causing the system to back up, this is considered unlikely to have caused the flooding of the cellar at the Relish Tandoori.</p> <p>It is feasible that water could have backed up in the Winnington Street drain which may have contributed to flooding at Mosshaselhurst Solicitors.</p>
c) Highway drainage (CWaC)	Yes	No information available which covers the highway drainage system at this location: the condition, levels or outfall location	Inconclusive as to whether this contributed. Potential contributor to both affected properties.
d) Private	Unknown	unknown	

Appendix F – Summary of Evidence – Sandy Lane, Acton Bridge

Sandy Lane, Acton Bridge			
Question	Answer	Evidence	Conclusion
Fluvial Flooding			
1. Was the river level higher than level where flooding was observed?	Yes	Reports from residents on site that water rose to approximately 8mAOD. The peak water level upstream of Dutton Sluices was 8.53mAOD.	
2. Was there connectivity from river to the location of observed flooding?			
a) Through flood defence	N/A	No flood defences present	
b) Unflapped outfalls	N/A	None noted	
c) Overland	Yes	<p>The source of flooding was fluvial as noted by several residents in the area.</p> <p>Questions were raised by the residents with regard the operation of the CRT sluice gates during the event. These have been investigated below.</p> <p>SCADA data and operator logs included below indicate that all five sluice gates in the Winnington Pound (3 at Winnington, 1 at Barnton and 1 at Saltersford) reacted to the water level at Hayhurst bridge and were all fully opened by:</p> <ul style="list-style-type: none"> • Barnton and Winnington Sluices open 09.30 on the 26/10/2019. • Saltersford Sluices fully open 13:30 on 26/10/2019. <p>Dutton sluices has 8 gates. All enabled gates (gates 1, 3 and 6) were open by 20:00 26/10/2019. The remaining 5 gates were closed. A mains failure occurred at 22:34 pm on 26/10/2019, the three open gates remained open.</p>	Fluvial flooding occurred at these properties. The water level was held up as a result of 5 gates remaining closed at Dutton Sluices. If all 8 gates had been opened there may still have been artificially raised water levels upstream but these would have been significantly lower than those observed during the event.

Appendix F – Summary of Evidence – Sandy Lane, Acton Bridge

		<p>A boat was observed breached across open gate 3 which would have constrained flow further. A photograph shows this. The photo shows clearly only 3 gates open.</p> <p>Peak water levels of 8.5m were reached at 02:55 on the morning of the 27/10/19.</p> <p>Concerns were also raised of instrumentation accuracy at Dutton Sluices when comparing water levels there to water levels at their properties on Sandy Lane.</p> <p>Multiple sources indicate that a CRT lock keeper observed high water levels on the morning of 27/10/2019 and opened the paddles on the Dutton lock. This action reduced water levels. It may be coincidental, but water levels showed signs of reducing at approx. 11:00am on the 27/10/2019.</p> <p>The Environment Agency's 'Lower Weaver October 2019 Calibration Summary Report' concludes that the '3 Gates Open' scenario within the hydraulic model provides a 'good general fit' with the observed water levels, wrack marks and flood property information. The level data suggests optimal fit for events between 5% and 2% Annual Exceedance Probability (AEP), or between 1 in 20 and 1 in 50-year flood event, which is broadly in line with river level analysis of the event and not for an extreme event.</p>	
Surface Water Flooding			
3. Was water able to drain from the area where the flooding was observed?	Yes		

Appendix F – Summary of Evidence – Lakeside Caravan Park

Lakeside Caravan Park, Winsford			
Question	Answer	Evidence	Conclusion
Fluvial Flooding			
1. Was the river level higher than level where flooding was observed?	Yes	Reports from residents on site that water quickly rose out of bank and flooded the caravans alongside the Bottom Flash	Out of bank flow caused by high water levels on the River Weaver.
2. Was there connectivity from river to the location of observed flooding?			
a) Through flood defence	N/A	No flood defences present	
b) Unflapped outfalls	N/A	None noted	
c) Overland	Yes	<p>The source of flooding was fluvial as noted by the park manager.</p> <p>Increased development in the area of the caravan park may have led to an increase of runoff which locally increased river levels at this location.</p> <p>The sluice gates downstream at Vale Royal were all opened and responded to river levels as shown in the operators logs and via the SCADA data.</p> <p>The caravans that flooded are in flood zone 3. Zone 3 is land that has a 1 in 100 or greater probability of flooding.</p> <p>Historical dredging was mentioned as a past solution at Bottom Flash in Winsford,</p>	Fluvial flooding occurred at these properties

Appendix F – Summary of Evidence – Lakeside Caravan Park

		however no records of this were available. Typically, dredging is not a preferred method of flood risk reduction due to the impact on the water environment and ecology, lack of evidence of its efficacy and long-term potential for reducing flood risk. However, that is not to say it should be discounted here. The EA and LLFA should advise what is possible to support the Caravan Park, similarly to Acton Bridge.	
Surface Water Flooding			
3. Was water able to drain from the area where the flooding was observed?	Yes		