

FLOOD INVESTIGATION REPORT

Investigation Ref:	50
Location:	Cossington, Main Street
Date of Flooding:	1 st October 2019

STATUTORY CONTEXT

Section 19 of the Flood and Water Management Act 2010 (FWMA) states that, on becoming aware of a flood which meets certain predetermined criteria, the Lead Local Flood Authority (LLFA, the Council) must, to the extent it considers necessary or appropriate, undertake a flood investigation. This investigation should determine the relevant flood risk management authorities (RMAs) involved, their functions and whether the RMAs have exercised or propose to exercise those functions. The LLFA must publish the findings and notify the RMAs.

LEICESTERSHIRE'S FLOOD INVESTIGATION CRITERIA

Mandatory	
Loss of life or serious injury	<input type="checkbox"/>
Critical infrastructure flooded or nearly flooded from unknown or multiple sources	<input type="checkbox"/>
Internal property flooding from unknown or multiple sources	<input checked="" type="checkbox"/>
Discretionary	
A number of properties have been flooded or nearly flooded	<input type="checkbox"/>
Other infrastructure flooded	<input type="checkbox"/>
Repeated instances	<input type="checkbox"/>
Investigation requested	<input type="checkbox"/>
Risk to health (foul water)	<input type="checkbox"/>
Environmental or ecologically important site affected	<input type="checkbox"/>
Depth/area/velocity of flooding a cause for concern	<input type="checkbox"/>

SUMMARY OF IMPACTS AND FINDINGS

Source(s) of flooding

Ordinary Watercourse	Main River	Surface Water	Groundwater	Public Sewer	Canal	Land Drainage	Highway Drainage
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Impact (number)

Residential	Business	Other Buildings	Roads	Critical Infrastructure
9			1	

RISK MANAGEMENT AUTHORITIES (RMAs)

The following RMAs were identified as relevant to the flooding incident:

- Leicestershire County Council (LCC) – LLFA.
- Leicestershire County Council (LCC) – Local Highway Authority for the highway drainage system along Main Street.
- Charnwood Borough Council (CBC) – Land Drainage Authority and Local Planning Authority.

- Environment Agency (EA) – Governing body for strategic flood risk and for works on or within close proximity to the River Soar (Main River).
- Severn Trent Water Ltd (STW) – Statutory undertaker for public wastewater and freshwater assets along Main Street.

FINDINGS OF INVESTIGATION

1. DETAILS OF FLOOD EVENT

On the morning of the 1st October 2019, nine residential properties in Cossington village were internally flooded. A heavy rainfall¹ occurred the day before (approximately 18.6mm in 24 hours, with 15.6mm specifically falling over a 3-hour period) and on the morning of the event (a further 11.4mm, source: Wanlip rain gauge² – located approximately 1.5km south-west of Cossington). Prior to the event, catchments located within central England were subject to prolonged, and in some cases intense, rainfall resulting in heavily saturated catchments.

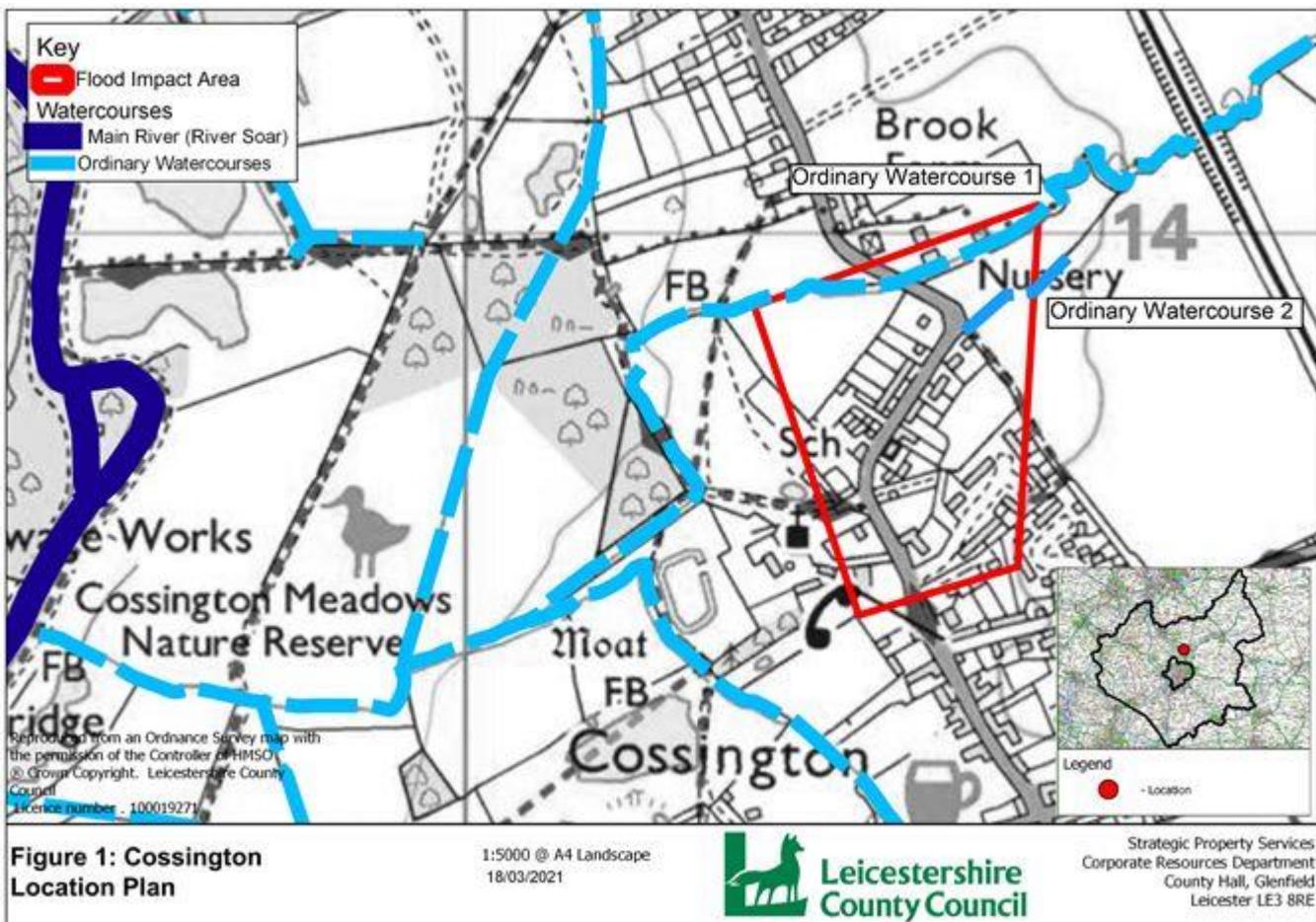
The rainfall event quickly overwhelmed the already saturated catchment, resulting in the ordinary watercourse to the north of the village breaching its banks. Flood water subsequently flowed directly onto the highway, due to the highway culvert acting as a bottleneck, and onto land to the south of the ordinary watercourse. Significant overland flows from adjacent fields also overwhelmed an unmarked ordinary watercourse (not available on any mapping available to the Council) located 80m south of the discussed ordinary watercourse. This water flowed onto Main Street, adding to the volume of flood water already on the highway, which then headed south towards the impacted residential properties. The volume of flood water subsequently overwhelmed the design capacity of the highway drainage network and breached the highway and residential property thresholds, resulting in the internal flooding of nine residential properties.

2. LOCATION AND SETTING

Cossington village is in Charnwood Borough (Figure 1) in the River Soar sub-catchment of the Humber River Basin District. The residential properties impacted during the 1st October 2019 flooding event are located to the north of Main Street, which is the main highway that runs through the centre of Cossington, south of where Ordinary Watercourse 1 is culverted beneath Main Street (Figure 1).

¹ https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/library-and-archive/library/publications/factsheets/factsheet_3-water-in-the-atmosphere.pdf

² <https://www.gaugemap.co.uk/>

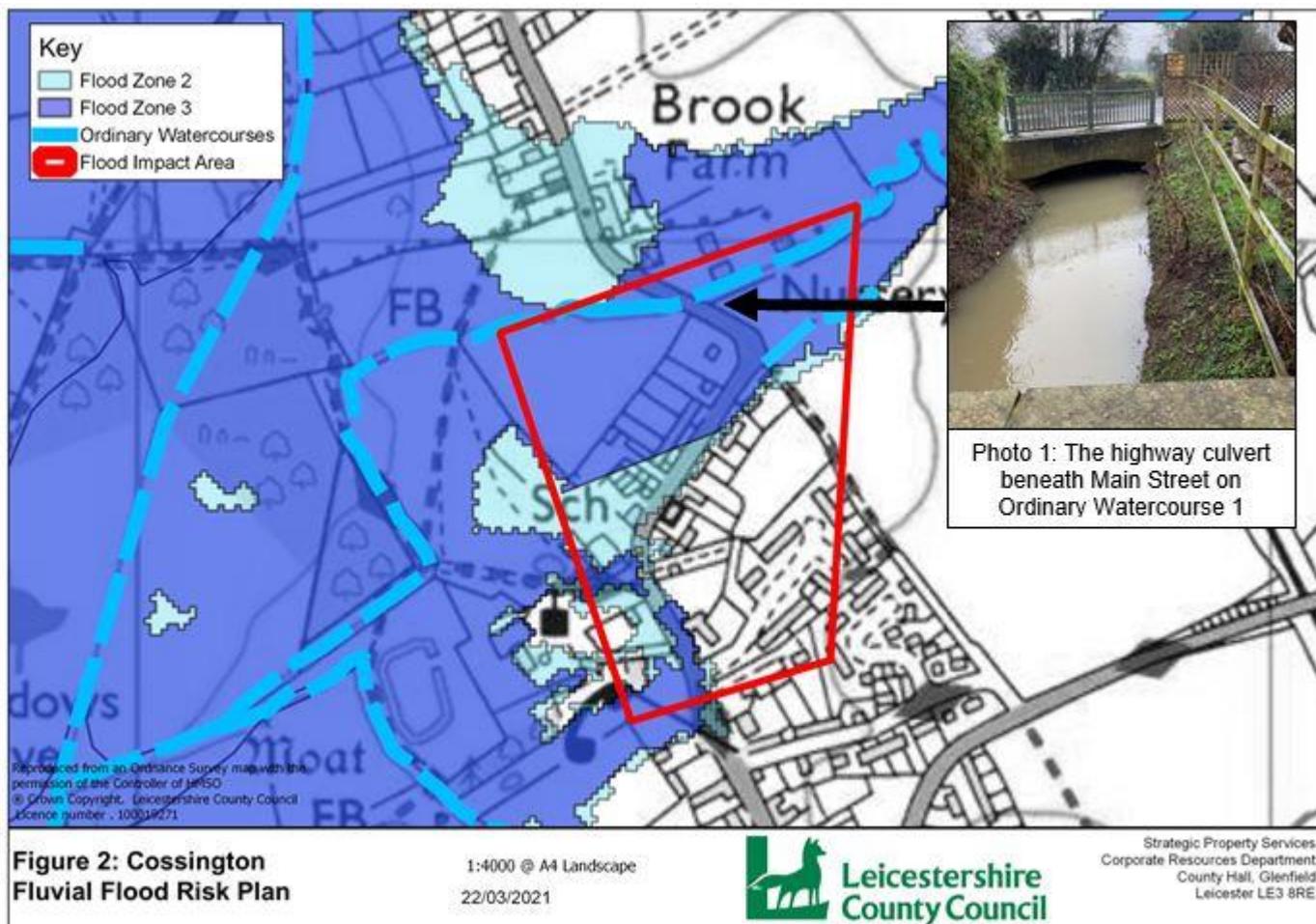


2.1 Ordinary Watercourses and Local Drainage Systems

There are two key Ordinary Watercourses that are located in close proximity to the impacted area of Cossington. Ordinary Watercourse 1 flows in a westerly direction through the north of the village and under Main Street (Photo 1). Ordinary Watercourse 1 eventually outfalls into the River Soar (Main River) approximately 1km west of Cossington. A large proportion of properties in Cossington are located within Flood Zones 2 and 3 of the River Soar (Figure 2). To the west of Main Street, Ordinary Watercourse 1 is located within the River Soar flood plain and so the watercourse is likely to be hydraulically sensitive to what is occurring in the River Soar (i.e. may react to anything that happens in the Main River).

Ordinary Watercourse 2 was found during a site visit following the flood event and was not initially displayed on any mapping available to the Council (Figure 1). Information regarding its source and connection with the ordinary watercourse network is therefore limited.

Main Street is served by a traditional highway drainage system, including highway storm water gullies which connect directly into the STW surface water system. The village is served by foul and surface water sewer networks, owned and maintained by STW. The surface water sewer system consists of a 150mm diameter pipe and flows in a southerly direction down Main Street discharging into Ordinary Watercourse 1 to the west of Cossington at ordnance survey National Grid Reference (OSNGR) Easting: 460072; Northing: 313570. The foul drainage network along Main Street (consisting of a 225mm diameter pipe) also flows in a southerly direction, before combining with another west flowing foul drainage system beneath the crossroads with an unnamed adjacent highway. This system then flows north into a pumping station system approximately 60m west of Main Street.



3. SUMMARY OF EVIDENCE

3.1 Prior to Flood Event

The Council holds records of previous external and highway flooding in Cossington for 2007, 2008 and 2012. No previous formal flood investigation has been conducted due to the flood events occurring prior to the Council being designated as the LLFA, or the event not triggering a formal investigation due to there being no reports of internal flooding to residential or business properties.

CBC has established a Flood Plan (January 2019) for the borough which outlines flood warning zones and actions to take during and following a flood event. Cossington also has a voluntary flood warden volunteer who assists with liaising with the Council and the Resilience Partnership Duty Officer to discuss (potential) issues. However, the Council holds no records of contact with the voluntary flood warden during the flood event and so it is not known if any actions were taken prior to the event to support the community.

The summer of 2019 was exceptionally wet, with the Severn-Trent region experiencing the wettest June-October on record. Almost all the UK received above average rainfall, with regions of the East Midlands receiving more than 170% of average rainfall. Successive rainfall events during September 2019 resulted in catchments across central England being subject to prolonged, and in some cases intense, rainfall. This subsequently resulted in heavily saturated catchments across central England. On the 1st October 2019, persistent heavy rainfall fell across much of Leicestershire onto already saturated catchments adding to the already high volumes of surface water present in the catchment.

Parts of Cossington Village are situated within the River Soar Flood Risk Warning area. Although three of the nine residential properties which internally flooded during this event are within the River Soar Flood Risk Warning area, no flood warnings were raised prior to the flood event. This is due to River Soar levels not reaching the threshold to activate the flood warning at the time. As Ordinary Watercourse 1 is not categorised as Main River, there is no telemetry data available to raise a flood warning when there is increased flood risk from Ordinary Watercourse 1. The EA did not receive any fluvial flood reports from Cossington on the 1st October 2019 suggesting that the Main River did not contribute towards the flooding during this event.

3.2 Flood Event

The nature of the water was perceived as a 'tidal wave' down Main Street, with anecdotal reports indicating it originated from Ordinary Watercourse 1 overtopping its banks through the premises of a local business (Derry's Nursery). The water then used the highway as a conduit to flow southwards (Figure 1 and Photo 2). Overland surface water run-off was also described from the agricultural land to the east of Main Street and further south to the west of Main Street which added to the volume of flood water on the highway (later presented in Figure 3).



Photo 2: A section of Main Street which experienced flooding on 1st October 2019

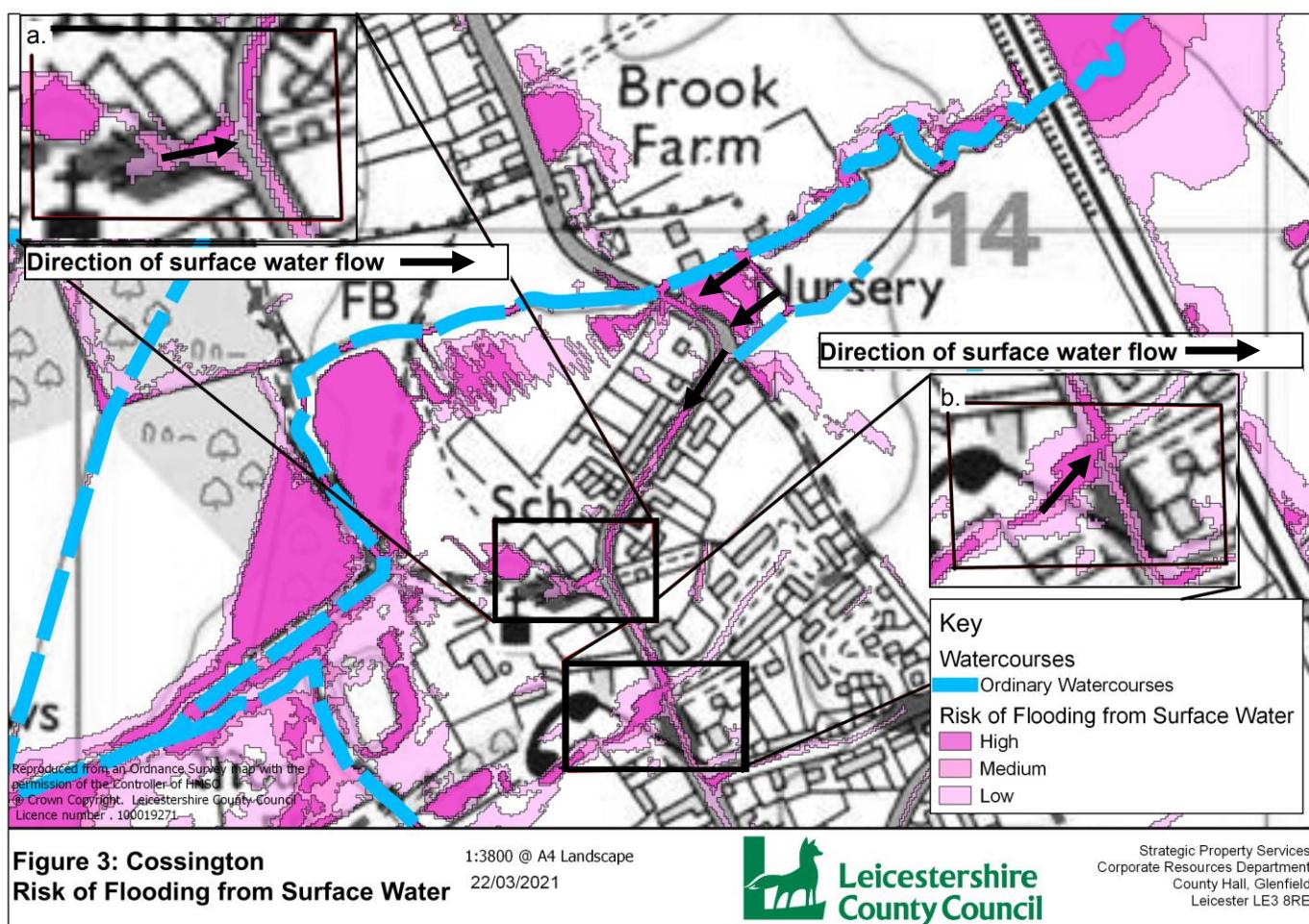
It was reported that external flooding impacted driveways, gardens, footpaths, and the local highway network, with some reports indicating that flood water reached knee deep levels. Flood water eventually started to enter nine residential properties via overtopping the highway kerb thresholds and because residential property thresholds were lower than the highway in some instances. Internal water levels were described as varying from 2-30cm depending on the location and gradient of the residential property.

Three residential properties also anecdotally reported that the local sewer network was surcharging along Main Street in addition to the above. During this investigation it has been identified that this was not the main source of flooding.

3.3 Post Flood Event

Following the flood event, CBC collected data, distributed sandbags and helped reassure the community. A community meeting was held in the village hall for residents which the Council, CBC and STW attended. The Council has also conducted a range of site visits and meetings and distributed additional questionnaires to gather further information on the nature and impacts of the event. The Council has reviewed and analysed all available data as part of this investigation.

Figure 3 illustrates the Risk of Flooding from Surface Water for the study area. This data was produced by the EA and is created using high-level modelling which replicates where water would fall during certain rainfall events³. Land height data available to the Council indicates that the gradient of the agricultural land to the east of Cossington is relatively steep and falls towards Cossington Village, indicating that the village is situated in a relatively low point. Main Street has a slight gradient heading south, supporting anecdotal reports of flood water flowing south down Main Street towards the impacted residential properties; the output of this modelling supports this. Figure 3 identifies specific areas within Cossington (areas 'a' and 'b') which experienced internal residential property due to location specific factors and additional overland surface water run off routes.



³ <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>

Anecdotal reports indicate that the main source of flooding was from Ordinary Watercourse 1 exceeding its capacity, with subsequent flood water flowing onto Main Street. The site visit conducted by the Council after the flood event identified that the highway culvert which conveys Ordinary Watercourse 1 beneath Main Street is situated within the cross-sectional profile of the watercourse (Photo 1). Therefore, to some extent the highway culvert will impede the flow of the watercourse during flood conditions and cause water to exceed the capacity of the watercourse. There is also a smaller access bridge located within the grounds of Derry's Nursery which will also create some restriction to flow during flood conditions (Photo 3). Water subsequently follows the height of the land through channels dug out along the southern banks of Ordinary Watercourse 1 (Photo 4). This supports the described and predicted route of flood water during the flood event (Figure 3). It is understood through liaison with the landowner that the channels dug in the banks of Ordinary Watercourse 1 have been there for over thirty years, but it is not known why they were installed. Further investigations into why these channels exist are required to better understand their possible influence on the 1st October 2019 flood event.



Photo 3: The access bridge opposite the highway culvert from Main Street (photo taken in April 2019, from Google Maps)



Photo 4: Ordinary Watercourse 1 facing east from the access bridge indicating the channels dug on the banks of the watercourse (photo taken in January 2021)

Prior to the flood event, Ordinary Watercourse 2 was not visible on any mapping available to the Council and was found following a site visit after the flood event (Figure 1 and Photo 5). Figure 3 presents a surface water flow path across agricultural land to the east of Main Street towards Ordinary Watercourse 2. This predicted flow path closely matches the anecdotally reported route of flood water during the flood event. The site visit indicated that a possible source of Ordinary Watercourse 2 is from a small pond in the adjacent agricultural field (Photo 6).



Photo 5: A section of the Ordinary Watercourse 2 facing east (photo taken during site visit in January 2021)



Photo 6: Pond located to the north east of Ordinary Watercourse 2 which is the likely source of the watercourse (photo taken during site visit in January 2021)

A submerged rock faced headwall was identified for Ordinary Watercourse 2, but it has not been identified where this watercourse connects too. Given the sheer volume of water that fell on the already saturated catchment, it is likely that the amount of flood water exceeded the capacity of Ordinary Watercourse 2. The flood water would therefore have flowed onto Main Street, due to the topography of the land, and subsequently increased the volume of flood water on the highway. Further investigations into the source and connections of Ordinary Watercourse 2 are required to better understand its possible influence on the 1st October 2019 flood event.

On the 1st October 2019, the Council had received a large volume of flood reports from across the county, and available resources for responding to incidences relating to the highway would have been stretched. Anecdotally it was reported that bow waves worsened the impacts on Main Street during the flood event, with reports detailing concerns from the local community regarding vehicles passing along Main Street. Following the initial report, flood boards were requested for Main Street however the Council holds no record of any road closure in Cossington. Road closures by the Council would be dependent on the depth of water on the highway during the event, and therefore this suggests that the depth of water had not reached this depth threshold or that the water level had subsided by the time the Council were able to attend. Main Street is considered a key highway route within the local area with a high volume of vehicles passing through on a daily basis, this would have therefore exacerbated the number of bow waves as road users attempted to pass through flood water. The local highway network around Cossington would have also been impacted by the flood event due to the flat nature of the catchment. Road diversions may have therefore further increased the volume of traffic along Main Street.

Partially blocked gullies with leaves and debris and surcharging public sewers were also anecdotally reported as subsequently raising the water levels on the highway. The Council conducted site visits to clear the highway gullies following the flood event, with a follow up survey conducted of the highway drainage in August 2020. The survey identified some maintenance works were required, thus likely increasing the volume of water that would have been present on Main Street. The Council subsequently conducted the maintenance works and also installed three additional highway gullies on Main Street, approximately 60m south of Ordinary Watercourse 1, in an attempt to provide extra opportunities to remove water from the highway during flood events.

As there was no flood warning issued for the River Soar flood warning area, the river levels of the River Soar during the event would not have been enough to significantly decrease the discharge rate of Ordinary Watercourse 1. This indicates that the Main River did not play a significant part in the flood event. Land height data shows that Ordinary Watercourse 1's profile is relatively flat downstream of Main Street, signifying that the flow rate of Ordinary Watercourse 1 is relatively slow within the River Soar floodplain. During peak flow, this flat topography would have contributed towards an increase in the volume of water in Ordinary Watercourse 1. The interactions between the ordinary watercourses, the River Soar and overland surface water flows are based off evaluating available data. To better understand the hydraulic nature of the event, further investigation would be required to understand the interaction between all possible sources.

During site visits conducted by the Council it was identified that the highway thresholds adjacent to three of the impacted residential properties were relatively low (identified as area 'a' on Figure 3). The thresholds would therefore have been easily compromised by the high volume and velocity of the flood water on Main Street. Overland surface water flows from agricultural fields to the west of the impacted residential properties in area 'a' were also anecdotally reported, which is supported by a surface water flow route in Figure 3. This would have subsequently increased the volume of flood water heading towards these residential properties.

It has also been identified that an impacted residential property in area 'b' on Figure 3 has a significantly low property threshold, with steps down to the front door. This would have been quickly compromised by the flood water along Main Street.

It is understood that at the time of the flood event, STW were conducting a flood alleviation project to help reduce flooding from the public sewers. This included installing an additional storage tank and new storm water overflow pumps. The storage tank was operating during the flood event; however, the storm overflows were not yet complete. Therefore, the infrastructure did not offer the intended protection from flooding. However even if the scheme was completed, the sheer volume of flood water on the highway would have entered the sewer networks and caused local issues even if the storm overflows were complete and fully functioning due to the sewer systems not being designed for the volume of water.

Anecdotal reports described how this flood event differed to any other as the flood water was perceived as flowing towards Cossington Village like a 'tidal wave'. Land height data presents that the land to the east of Main Street has relatively steep topography, which could have facilitated a high velocity flow of water within Ordinary Watercourse 1. The Council has been in contact with Network Rail who has confirmed that the culvert upstream of Ordinary Watercourse 1 beneath the railway is inspected annually for blockages or restrictions. Maintenance works to remove vegetation in Ordinary Watercourse 1 were last completed in January 2020 following a visual inspection. There has been no firm evidence linked to the 'tidal wave' description in anecdotal reports, however it could be linked to numerous factors which would be explored with further investigation into the hydraulic nature of the flood event.

The Council received anecdotal reports of excessive vegetation within Ordinary Watercourse 1 adjacent to the highway culvert on Main Street during a September 2020 flood event. It is not known to what extent this section of Ordinary Watercourse 1 was vegetated during the 1st October 2019 flood event. Although any excessive vegetation within Ordinary Watercourse 1 would not have caused it to breach its banks, it may have contributed towards the extent of localised flooding in close proximity to Ordinary Watercourse 1 due to the additional vegetation slowing the flow downstream.

4. EXPLANATION OF FINDINGS

The result of the combination of factors described below resulted in the ingress of storm flood water to nine residential properties on Main Street and the external flooding of four residential properties on 1st October 2019:

- The whole of Leicestershire had experienced higher than average rainfall in the preceding months, meaning the land surrounding the village was saturated.
- The intense rainfall event and saturated ground conditions resulted in Ordinary Watercourse 1 reaching peak flow and exceeding its capacity, with flood water overflowing directly onto Main Street due to the highway culvert acting as a bottleneck and the watercourse banks being lower than the highway.
- Overland surface water ran off the saturated agricultural field to the east of Cossington towards Main Street. It is also likely that Ordinary Watercourse 2 was overwhelmed and added additional water to the highway.
- The accumulation of flood water on Main Street combined to flow south down the highway.
- The volume of flood water on Main Street overwhelmed the local highway drainage network, increasing the volume of flood water on the highway which reached such depths that it breached residential property thresholds.

Other more localised and specific factors are likely to have influenced the severity and impact of the flood water. Whilst these factors may have made a difference to the volume and peak flood levels, at the time of writing this report, there is no firm evidence that these factors would have independently caused any of the internal flooding experienced by this event. These factors include:

- Following the flood event, the highway drainage network was identified as requiring maintenance works. The condition of the highway drainage network during the event would have therefore increased the volume of flood water on the highway. Further investigations following the flood event indicated some restrictions within the STW drainage network which would have reduced the capacity of the highway drainage system to discharge. However, given the volume of flood water that fell during the event, the impact of this is considered negligible.
- The threshold levels of the highway in area 'a' were relatively low and so would have been quickly compromised during the flood event.
- The residential property threshold discussed in area 'b' would have been quickly compromised due to the front of the residential property being at a lower level than the highway.
- Bow waves from cars passing through Main Street were reported to increase water ingress to the front of residential properties. Main Street is considered a key route within the local highway network, and so the volume of cars passing over the highway may have exacerbated the impacts. As the local highway network was widely impacted, highway users may have diverted towards Cossington which may have also further increased the volume of traffic passing through Main Street.
- Excessive vegetation within Ordinary Watercourse 1 could have contributed to the localised flooding due to the vegetation slowing the flow of the watercourse. Given the volume of flood water that fell during the event, the impact of this is considered negligible.
- It was anecdotally reported that six of the impacted residential properties did not have any awareness of previous flooding to their residential properties. By considering the limited awareness and the speed of the flood water, it can be presumed that there may have been limited personal preparation for the flood, thus exacerbating its impacts.

In December 2020, one residential property reported internal flooding along Main Street, with an additional two residential properties reporting external flooding. The anecdotal reports state that the flooding was due to the drainage systems along Main Street becoming overwhelmed, resulting in flood water on the highway. The Council responded and closed Main Street to reduce the impact of bow waves and subsequently investigated the drainage network. It was concluded that the highway gullies had sufficient capacity, indicating that an issue within the STW surface water system. At the time of writing this report, STW is investigating the issue and remedial works are planned.

RECOMMENDATIONS / ACTIONS

Leicestershire County Council (LLFA) has agreed / undertaken the following actions:

- To continue to coordinate the actions of the RMAs and feedback to the community.
- Engaged with the riparian landowners to make them aware of their riparian responsibilities.
- Attended a community meeting following the flood event for the impacted residents.
- To investigate the appropriateness of a catchment study for the community to gain a greater understanding of the hydraulic nature of the event and the factors which contributed towards the flooding for subject to other priorities and identifying/securing funding. This should include the consideration of the appropriateness of a flow gauge for the community.
- To issue guidance notes to all affected residents to help those affected improve their resilience to flooding.

Leicestershire County Council (Local Highway Authority) has agreed/undertaken the following actions:

- In August 2020, investigative works were completed into the condition of the highway drainage system and the required maintenance works were completed.
- Installed additional gullies along Main Street near Derry's Nursery, completed ditch clearance and conducted remedial works south of Main Street at the junction with Syston Road.
- To work with all RMAs to understand the flooding mechanisms and identify ways to help mitigate future flooding.

STW has agreed/undertaken the following actions:

- To work with all RMAs to understand the flooding mechanisms and identify ways to help mitigate future flooding.
- Attended a community meeting following the flood event for the impacted residents.
- To raise investigation works to the public sewer network and depending on the outcomes of these investigations, complete remedial works if required.

CBC has agreed/undertaken the following actions:

- Collected data, distributed sandbags and helped reassure the community following the flood event.
- Attended a community meeting following the flood event for the impacted residents.
- To review the appropriateness of working with the Resilience Partnership to update the response plans in light of the findings of this Formal Flood Investigation Report.

Parish Council/Community Members

Local residents and tenants who are aware that they are at risk of flooding should take action to ensure that they and their properties are protected. Community resilience is important in providing information and support to each other if flooding is anticipated. Actions taken can include; signing up to Flood Warning Direct (if available), nominating a community flood warden, producing a community flood plan, implementing property level protection and moving valuable items to higher ground. More permanent measures are also possible such as; installing floodgates, raising electrical sockets, and fitting non-return valves on pipes.

DISCLAIMER

This report has been prepared pursuant to the Council's statutory responsibility, under the FWMA, to investigate flood incidents in its area. The statutory duty to investigate is not absolute or exhaustive. Under Section 19 of FWMA, the Council's statutory responsibility is limited to conducting investigations only to the extent the Council deems it necessary.

Where the Council deems it necessary to conduct an investigation, it is required to address two questions under 19(1) of the FWMA. Firstly, the Council is required to identify relevant "Risk Management Authorities"⁴. Secondly the Council is required to investigate whether the Risk Management Authorities have exercised, or are proposing to exercise, flood risk management functions set out under Section 4 of FWMA.

The relevant flood risk management authorities identified by the Council are defined in this report. The flood risk management functions which the Risk Management Authorities are proposing are also described in the body of this report.

Beyond discharging the specific statutory responsibilities under Section 19(1) of FWMA, the intended purpose of this report is solely as a resource to assist Risk Management Authorities and stakeholders to better understand the relevant flooding incident and to mitigate risks going forward.

Although the Council has commented upon contextual issues related to the flood event, it is not the purpose of this report to determine any private rights arising from the flood event.

Nor is the purpose of this report to reach conclusions as to whether any Risk Management Authority or other stakeholder (e.g. private land owners, public bodies or government agencies) has breached any duty of care (whether statutory or common law) that they may have held.

The Council has, in good faith, sought to locate and collate relevant primary and secondary evidence to prepare this report. However, the Council accepts no responsibility for assumptions or statements made on the basis of evidence which incomplete, inaccurate or both. As such, this report should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event.

The Council expressly disclaims responsibility for any error, omission or negligent misstatement in this report to the fullest extent permissible in law. Further the Council does not accept any liability for the use of this report or its contents by any third party. Where any party wishes to assert any rights or cause of action related to the flooding event they are requested to rely on their own investigations.

⁴ As defined by Section 6(13) of FWMA