Leicester Road, Loughborough

Flood Report

To discuss the flood report contact the Flood Risk Management Team by e-mail: flooding@leics.gov.uk or phone 0116 305 0001

Limitations

The attached Report (the "Report") has been prepared by AECOM Infrastructure & Environment UK Limited ("AECOM") for the benefit of the Leicestershire County Council ("Client") in accordance with the agreement between AECOM and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations and conclusions contained in the Report (collectively, the "Information"):

- is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- represents AECOM's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- may be based on information provided to AECOM which has not been independently verified;
- has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- must be read as a whole and sections thereof should not be read out of such context;
- was prepared for the specific purposes described in the Report and the Agreement; and
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

AECOM shall be entitled to rely upon the accuracy and completeness of information that was provided to it and has no obligation to update such information. AECOM accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

AECOM agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but AECOM makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

Without in any way limiting the generality of the foregoing, any estimates or opinions regarding probable construction costs or construction schedule provided by AECOM represent AECOM's professional judgement in light of its experience and the knowledge and information available to it at the time of preparation. Since AECOM has no control over market or economic conditions, prices for construction labour, equipment or materials or bidding procedures, AECOM, its directors, officers and employees are not able to, nor do they, make any representations, warranties or guarantees whatsoever, whether express or implied, with respect to such estimates or opinions, or their variance from actual construction costs or schedules, and accept no responsibility for any loss or damage arising therefrom or in any way related thereto. Persons relying on such estimates or opinions do so at their own risk.

Except (1) as agreed to in writing by AECOM and Client; (2) as required by-law; or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals, the Report and the Information may be used and relied upon only by the Client.

AECOM accepts no responsibility, and denies any liability whatsoever, to parties other than the Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of AECOM to use and rely upon the Report and the Information. Any injury, loss or damages arising from improper use of the Report shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report and any use of the Report is subject to the terms hereof.

AECOM: 2015-04-13

DETAILED FLOOD INVESTIGATION

County Council Investigation Ref.:	**2016-INV-115**
Investigation:	**Leicester Road, Loughborough**
Date of Flooding:	**7th May 2016**
Revision	**Final**

Officer:	Stacey Johnson	Engineer, AECOM	14/03/2019
Checked:	Anupriya Prabhuswamy	Senior Engineer AECOM	14/03/2019
Approved:	Steve Edwards	Associate Director, AECOM	14/03/2019
Leicestershire County Council Approved	Mohamed Admani	Senior Engineer	16/04/2019

Report produced for Leicestershire County Council by AECOM
Royal Court
Basil Close
Chesterfield
S41 7SL

CONTENTS **PAGE NO.**

1. EXECUTIVE SUMMARY

1.1. 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) must undertake a flood investigation in order to determine the relevant flood risk management authorities involved and which actions have been (or should be) taken to mitigate future flood risk. Where an authority carries out a formal investigation, it must publish the results and notify the relevant risk management authorities.

It was deemed necessary to complete a formal investigation into the flooding incident on Leicester Road, Loughborough, on the 7th May 2016 as internal flooding of a residential dwelling on Leicester Road from an unknown source was reported to Leicestershire County Council (LCC), the LLFA, via a Flood Reporting Form. The Flood Reporting Form stated that one property is reported to have experienced water ingress into the ground floor of the property, driveway and the back garden.

1.2. CAUSE OF FLOODING

Over the course of the investigation, LCC discovered a separate branch of the highway drainage network just outside the flooded property which was found to be blocked. This is believed to be the primary cause of the flooding. Following this discovery, remedial works have since been carried out by the LCC.

1.3. MAIN FINDINGS

This investigation has determined that the most likely cause of the flooding experienced at a residential property on Leicester Road on 7th May 2016 was the result of a heavy rainfall event, the position of the property at a low point and the identification of a blockage in a portion of the highway drainage network adjacent to the property which took surface water away from the highway.

Since the existence of this branch of the highway drainage network was not known to LCC at the time of flooding incident, it had not been regularly maintained. However, remedial works have now been undertaken to remove the blockage.

2. INTRODUCTION

2.1. LEAD LOCAL FLOOD AUTHORITY INVESTIGATION

Section 19 of the FWMA states:

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers 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

2.2. FLOOD INVESTIGATION CRITERIA

A formal investigation will be carried out if one or more of the following occurs after a flooding event:

- Loss of life or serious injury
- Critical infrastructure flooded or nearly flooded from unknown or multiple sources
- Internal property flooding from unknown or multiple sources

In the following circumstances, discretion may be used to investigate a flooding incident:

- A number of properties have been flooded or nearly flooded
- Other infrastructure flooded
- Repeated instances
- Investigation requested
- Risk to health (foul water)
- Environmental or ecologically important site affected
- Depth/area/velocity of flooding a cause for concern

2.3. RISK MANAGEMENT AUTHORITIES

The following risk management authorities were identified as relevant to the flooding at Leicester Road:

- Leicestershire County Council – Local Highway Authority
- Leicestershire County Council – Lead Local Flood Authority
- Severn Trent Water Ltd.
- Environment Agency

2.4. FLOODING INCIDENT

It was deemed necessary to complete a formal investigation into the flooding incident within Leicester Road, Loughborough, on the 7th May 2016 as internal flooding of a residential dwelling on Leicester Road from an unknown source was reported to LCC, the LLFA, via a Flood Reporting Form.

3. SITE BACKGROUND

3.1. LOCATION

The site is located in the south east suburb of Loughborough, close to the junction of Leicester Road and Shelthorpe Road (Appendix A, Site Location Plan) located in the Charnwood Borough of Leicestershire County. The surrounding properties are detached and semi-detached 20th century houses. The road runs in a north-south direction in this location. The area affected by flooding lies in a low point, where land slopes downwards from south to north towards Grammar School Brook (running west-east at this point), and then again slopes down from the north to the south towards the brook. See Appendix F for the detailed elevation information. The general slope of the area is from southwest to northeast. The catchments of the surface water system are made up of medium and high density housing.

Surface water flood mapping from the Environment Agency (See Appendix D) suggests that ponding on Leicester Road and some flooding of gardens would be expected to occur in a 3.33% AEP[1] rainfall event. As this is the lowest return period storm modelled, it is also possible that this occurs in more frequent less severe storms (e.g. 10% AEP). During a 1% AEP event, the flooding in the garden increases and flooding is shown to occur across Leicester Road.

3.2. DRAINAGE SYSTEMS

A STW surface water sewer conveys water north along Leicester Road, where it is joined by another branch running east along Shelthorpe Road. The system then runs north east for a short distance below outfalling to Grammar School Brook.

In addition to the STW surface water network, a previously unknown highway drainage network was discovered by LCC adjacent to the flooded residential dwelling. This highway drainage network was found to be blocked with debris/rubble. It is not known how the network became blocked with rubble. The extent of the highway drainage network at this area is still unknown.

It has also been identified that gullies along Leicester Road adjacent to the flooded residential dwelling connect into this highway drainage network, discharging north into the Grammar School Brook separate to the STW network.

3.3. MAIN RIVER

Grammar School Brook flows in a generally north eastern direction, passing under the Grand Union Canal before joining Hermitage Brook. The Grammar School Brook is a Main River maintained by the Environment Agency.

The Environment Agency Risk of Flooding from Rivers and Sea Map[2] indicates that the affected residential dwelling is at a medium risk of flooding from Grammar School Brook.

[1] The Annual Exceedance Probability (AEP) refers to the probability of a flood event occurring in any one year. The probability is expressed as a percentage. For example if an event has a magnitude of a 1 in 100 year flood, it would be expressed as having a 1% Annual Exceedance Probability (AEP).
[2] Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=RiversOrSea

Medium risk means that each year this area has a chance of flooding of between 1% and 3.3%. This takes into account the effect of any flood defences in the area. These defences reduce but do not completely eliminate the chance of flooding as they can be overtopped, or fail.

4. FLOODING INCIDENT

4.1. PREVIOUS FLOODING INCIDENTS

Anecdotal reports suggest that water ponds on the highway regularly and has ended up within close proximity of the affected property on 7th May 2016 on a number of occasions.

Prior to the flooding event of 7th May 2016, LCC were aware of incidents of highway flooding however the gullies had been jetted and were fully functional. Following the flooding event on the 15th of October 2016, LCC confirm that issues were evident.

4.2. FLOOD INCIDENT

On Wednesday 7th May 2016, intense rainfall fell over the area for a short duration between 18:00hrs. to 19:00hrs. Rainfall data from the nearest rainfall gauge that recorded that rainfall event (Mount St. Bernards, 8.8 km away) is shown in Figure 1. This is thought to have caused localised flash flooding which may have exceeded the design capacity of the drainage system of Leicester Road. The flooding situation on Leicester Road was further exacerbated by the unmapped highway drainage that was discovered during the course of this investigation. Flood water ponded on the highway and rose to a level sufficient to overtop the footpath and flow onto a residential dwelling which is located at a lower level relative to Leicester Road, down the driveway of the residential dwelling and ponded until it entered the ground floor via the front door and garage.

Anecdotal reports also suggested that those at the affected residential dwelling had created informal defences to guide water around the property into the back garden, in an attempt to prevent internal flooding. Reports suggested that these informal defences were successful in directing the majority of the floodwater to the back garden which is located at a lower level compared to the dwelling. However, after the event the water ponded in the low-lying back garden unable to either enter the sewer system or sufficiently infiltrate the underlying clayey soils. The floodwater therefore had to be manually moved by the residents and disposed of to the nearest highway gully at the front of the property.

Anecdotal reports suggest that the floodwaters in the highway receded roughly an hour after the rain stopped and the ponding in the garden remained for a day or more. This is likely to be due to the low levels of the residential gardens.

A video of the flooding incident provided to LCC also shows flood water entering the front gardens of the neighbouring properties.

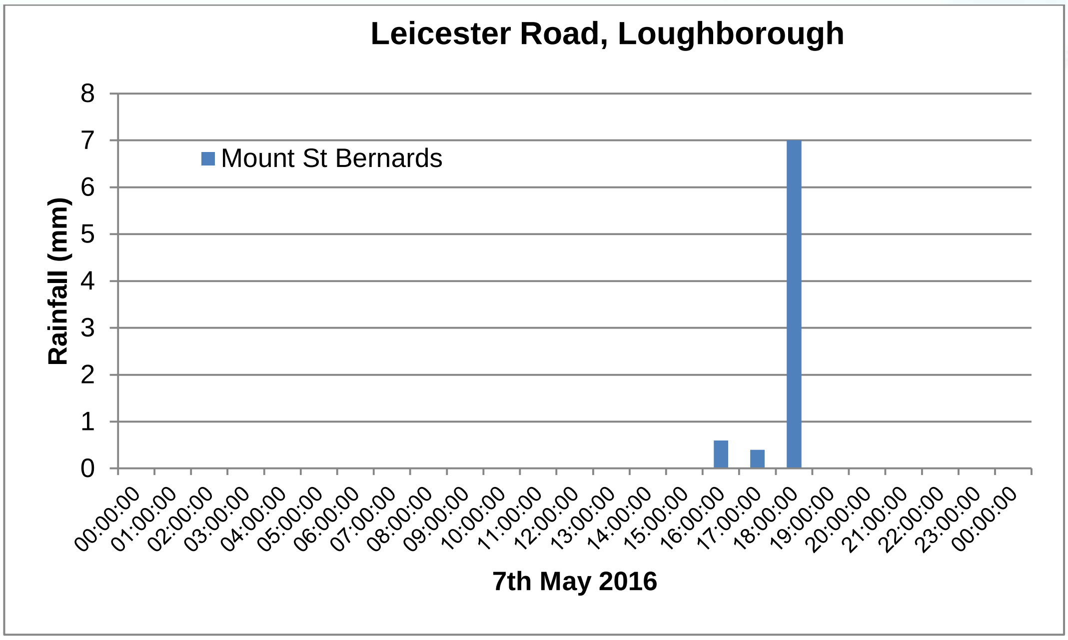


Figure 1 Rainfall data showing rainfall event which resulted in flooding on Leicester Road, Loughborough

4.3. RAINFALL ANALYSIS

The Hydrological Summary produced by the Centre for Ecology and Hydrology for May 2016 stated that:

"A westerly air flow meant that the cold, wet conditions at the end of April continued into the start of May. Easterly air flows bringing warm and sunny conditions were dominant from the 5th although were accompanied by localised rainfall…Localised heavy, thundery showers were common and triggered some surface water flooding…"

However it also stated that generally:

…"*May rainfall totals were around average at the national scale (102% of average for the UK as a whole), but notable contrasts were evident regionally… Much of southern England received more than 110% of average; the Thames and Anglian regions were particularly wet (133% and 132% of average, respectively)."*

Source: http://nora.nerc.ac.uk/513809/1/HS_201605.pdf

The maximum rainfall from the nearest rainfall gauge has been used to estimate the event rarity for the flood event using the Depth-Duration-Frequency (DDF) rainfall model.

Table 4-1 below provides a summary of the relevant Environment Agency rainfall gauge within the study area that was used for data analysis purposes i.e. Mount St Bernards. This rainfall gauge was chosen because it is located in close proximity to the flooding site (see Figure 2). The rainfall gauge at Burton-on-the-Wolds is located closest to the flood incident at Leicester Road in Loughborough. Analysis of rainfall data from the Burton-on-the-Wolds gauge indicates that the rainfall event was not recorded by the gauge on or around 7th May.

However the rainfall event on 7th May was recorded by the Mount St Bernards rainfall gauge, which is the next nearest gauge to the flooding incident. Therefore rainfall data from the Mount St Bernards gauge was used for data analysis purposes for this site.

Table 4-1 Rain gauge information

Name	Time series	Record start year	Record ending year
Mount St Bernards	Hourly	1985	2016

A Hydrology Technical Note that describes the hydrological method that was used to undertake probability of occurrence analysis for the flooding incident has been provided in Appendix E. The site specific technical note is provided in Appendix E-1.

An estimate using the hourly average rainfall depth, two hourly rainfall depth and 5 hourly rainfall depths, indicates that the flood incident at Leicester Road, Loughborough in May 2016 had an estimated event rarity of less than 2 years, or with more than a 50% Annual Exceedance Probability (AEP). However, it should be noted that the rainfall event was very localised and may not have been fully recorded by the nearby rain gauges.

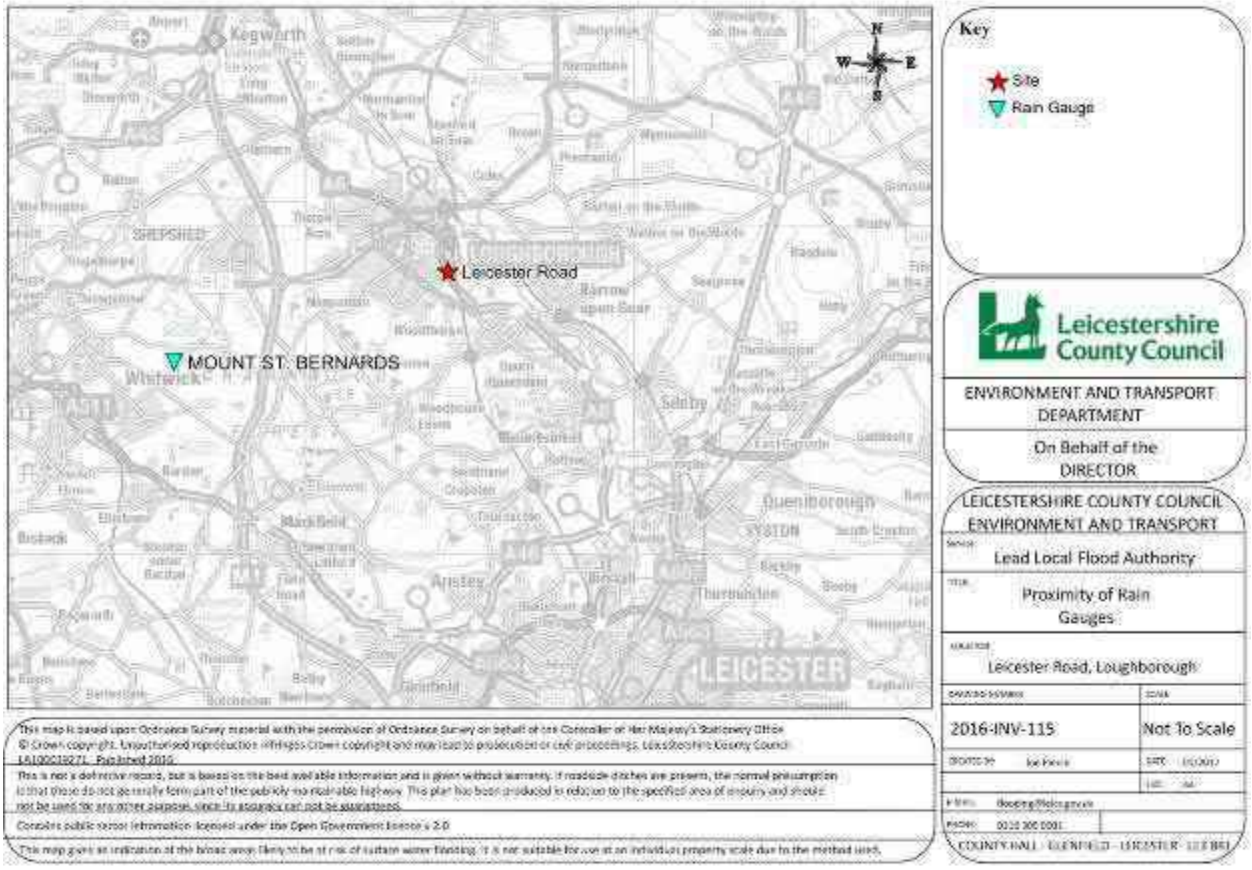


Figure 2 Location of the rainfall gauge and the flooding site location

5. SUMMARY OF IMPACTS AND FINDINGS

5.1. IMPACTS

The flooding event on the 7th May 2016 appears to replicate a pattern of previous highway flooding incidents that had been anecdotally reported to occur at Leicester Road. This event resulted in internal flooding to one residential dwelling, whereas according to anecdotal reports, actions taken by the residents have prevented repeat flooding in subsequent events. During the event in May 2016, water also flowed onto the grounds of the neighbouring property, but internal flooding of this property was not reported to LCC.

5.2. LOCAL TOPOGRAPHY

Topographic data (Appendix F) suggests that the residential property that was flooded is located below the level of Leicester Road. There is a low spot on the highway adjacent to the property (Figure 4) where a large volume of water from the surrounding catchment ponds during intense storm events if the capacity of the highway drainage network is either exceeded or reduced due to blockages.

Figure 3 Flooding of driveway at Leicester Road

Figure 4 Ponding of surface water on Leicester Road

Figure 5 Flooded back garden

The locality of the ponded water during the flooding incident of May 7th 2016 (see Figure 3 and Figure 4) suggests that an issue existed in the highway drainage during the flooding incident. Once the water overtopped the pavement, it cascaded into the nearby driveway and flowed into the low-lying back garden (see **Error! Reference source not found.**, **Error! Reference source not found.**, and **Error! Reference source not found.**).

5.3. HIGHWAY DRAINAGE

LCC discovered a separate branch of the highway drainage network just outside the flooded property which was blocked. Following this discovery, remedial works have since been carried out by LCC to clear the blockage. Maintenance to these gullies is on a reactive basis, and are not included in a regular maintenance regime.

Since this portion of the previously unknown highway drainage network was blocked, during periods of heavy rain, surface water was reported to pond on the highway and footway. This rose to a sufficient level to overtop the footway and flow down driveways into the residential properties, which are lower than the road level.

5.4. PUBLIC SEWER

STW plans show both a foul and a combined sewer line in addition to the STW surface water sewer running north along Leicester Road. These are shown to converge before heading east along a route parallel with Grammar School Brook. The change in direction occurs at a point roughly half way between the property and the brook. This system is independent of the highway surface water system.

There was no suggestion that the combined/foul sewer system contributed to the flood event.

5.5. MAIN RIVER

Anecdotal reports suggest that during recent flood events, the brook has been at a relatively low level and not near the top of bank. A series of photographs received from the Environment Agency shows Grammar School Brook beside the Army Reserve Centre on the date of the flooding. The images span from 18:00hrs on the 7th of May to 10:00hrs on the 8th of May and show that the brook did not overtop Leicester Road at any stage during this period of time. It is therefore not thought that the flooding issues were caused by capacity issues within Grammar School Brook.

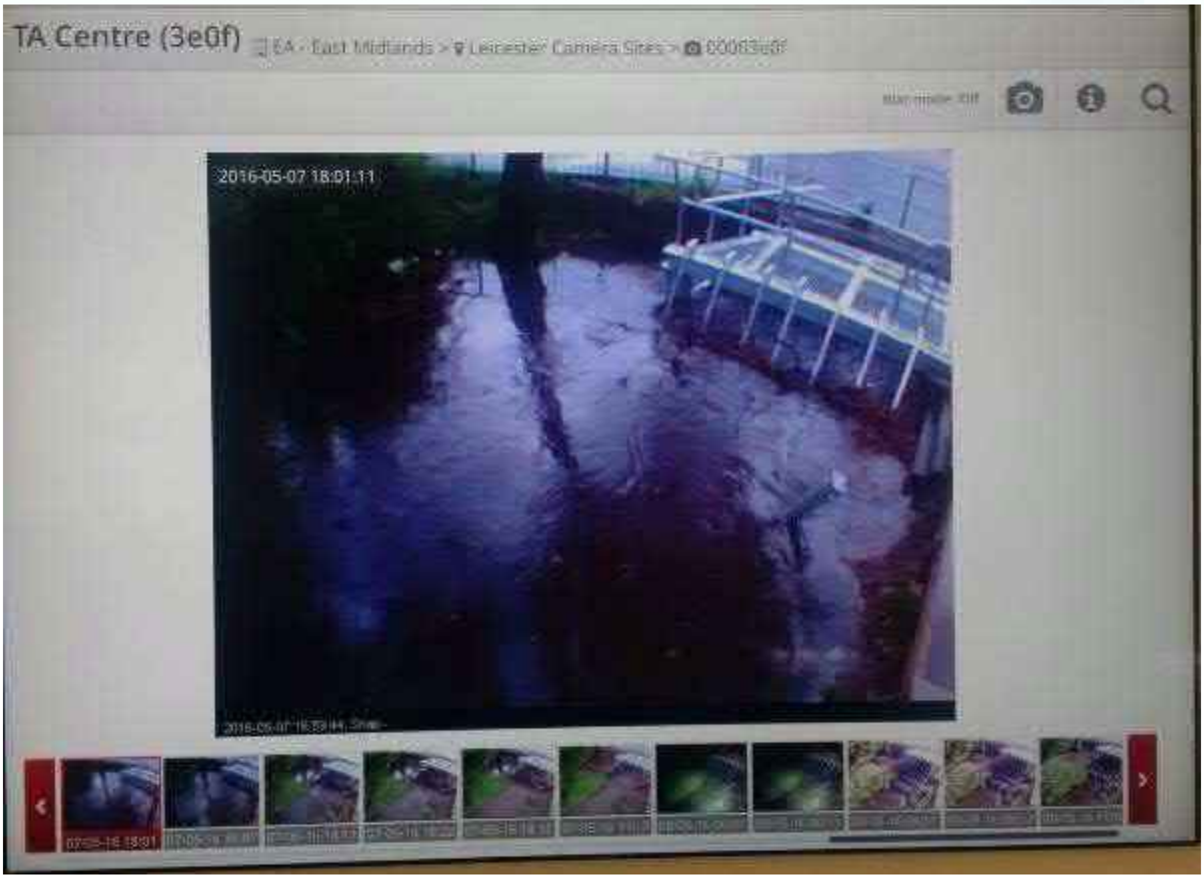


Figure 6 Photographs from the EA showing the level of Grammar School Brook on between May 7th and May 8th

5.6. EXTENT OF FLOODING

The extent of the reported flooding in Leicester Road is relatively small due to the road cross-section and kerb height. Water spills onto the affected property before it can spread to a wider extent. The flooding is therefore difficult to compare to the freely available flood maps from the Environment Data WMS Service (https://data.gov.uk)[3]. The maps suggest that minimal flooding occurs on Leicester Road with the significant ponding occurring in the rear garden of the property and neighbours.

The maps can be seen to support the residents' account by confirming that a local depression exists in Leicester Road and that surface water is likely to pond here. However, the mapping is not detailed enough to identify the issues that affect individual properties.

[3] The Environment Agency's Risk of Flooding from Surface Water Maps show areas where surface water would be expected to flow or pond.

6. RESPONSIBILITIES

6.1. HIGHWAY AUTHORITY (LCC)

LCC are defined as the local Highways Authority and has a duty to maintain the highway under Section 41 of the Highways Act (1980). The Highway Authority are responsible for maintain a safe a reliable local highway network. Refer to the Useful Links section of the report for further information on the Highways Act (1980).

6.2. LEAD LOCAL FLOOD AUTHORITY (LCC)

LCC have the overall responsibility for coordinating the management of local flood risk (namely ordinary watercourses, surface water and groundwater).

As stated within the introduction section, LCC as the LLFA has a responsibility to investigate flood incidents under Section 19 of the FWMA. Whilst LCC can suggest possible causes of flooding in Leicestershire and make recommendations to ensure flood risk is mitigated as far as possible, the FWMA does not provide LCC with the mandate or funding to tackle all identified causes of flooding.

6.3. ENVIRONMENT AGENCY

The Environment Agency has a strategic overview responsibility under the FWMA as well as permissive powers to carry out maintenance work on Main Rivers under Section 165 of the Water Resources Act (WRA). Main River means all watercourses shown on the statutory Main River maps held by the Environment Agency and the Department of Environment, Food and Rural Affairs, and can include any structure or appliance for controlling or regulating the flow of water into, in or out of the channel.

The Environment Agency has permissive powers to carry out works of maintenance and improvement on these rivers. These powers can be used to undertake works to reduce flood risk where landowners fail to undertake their responsibilities under the WRA.

The Environment Agency can undertake enforcement action where third party asset owners fail to maintain their property/land in appropriate condition. They may consider undertaking maintenance or repair of third party assets in order to safeguard the public interest and where other options are not appropriate.

The Environment Agency has provided a series of photographs of water level in Grammar School Brook during the flood event. It was found that the Grammar School Brook was not the cause of flooding of the residential property on Leicester Road on May 7th 2016.

6.4. WATER COMPANY (SEVERN TRENT WATER)

Water and sewerage companies are responsible for managing flood risks related to surface water, foul water and combined sewer systems. Public sewers are designed to protect properties from flood risk in normal wet weather conditions. In extreme weather conditions however there is a risk of these public sewers being overwhelmed, resulting in sewer flooding.

Following the 'Private Sewer Transfer' on 1st July 2011, water companies are now responsible for all pipes systems on private land that serve more than one curtilage and are connected to a public sewer. Under Section 94 of the Water Industry Act (1991) statutory sewerage undertakers have a duty to provide sewers for drainage of buildings and associated paved areas within property boundaries.

Water companies are responsible for all public sewers and lateral drains. Public sewers are a conduit (typically a pipe) assigned to a water and sewerage company that drains two or more properties; conveying foul, surface water, or combined sewerage to a positive outfall. Connection of other drainage sources to public sewers is discretionary, following an application to connect.

STW was consulted during this flood investigation. STW have indicated that there are known flooding issues in this area from the combined water sewerage system, and upon investigation it was concluded that this was not the cause of flooding of the residential dwelling on Leicester Road that occurred on May 7th, 2016.

6.5. RIPARIAN LANDOWNERS OF WATERCOURSES

As detailed within the EA document 'Living on the Edge', riparian landowners have certain rights and responsibilities, including the following:

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

The following link provides further information:
http://www.environment-agency.gov.uk/homeandleisure/floods/31626.aspx.

6.6. RESIDENTS AND TENNANTS

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.

Residents are urged to report all flooding incidents to both LLC and STW.

7. AGREED/RECOMMENDED ACTIONS

There are a number of agreed/recommended actions for various Risk Management Authorities and individuals (riparian owners) that may reduce the impact of future similar rainfall events. These are outlined below:

7.1. LOCAL HIGHWAY AUTHORITY (LCC)

LCC has agreed/completed the following actions:

1. Unblocked the identified highway drainage that had become blocked with rubble.
2. Installed multiple gullies to the local depression and adjacent to a bus stop on Leicester Road, in an attempt to further intercept highway run-off. These works were carried out in April and July of 2018.
3. Continue to monitor and maintain the gullies and highway drainage network as per the Council's agreed maintenance schedule.

7.2. SEVERN TRENT WATER

STW will continue to monitor the performance of their assets and provide remedial actions as appropriate. Routine maintenance activities will continue to ensure that the sewerage networks have good serviceability.

7.3. LEAD LOCAL FLOOD AUTHORITY (LCC)

The LLFA will continue to support the community to ensure that they are suitably supported and guided with regards to improving personal resilience as required.

7.4. RIPARIAN OWNERS

The owners responsible for the banks of Grammar School Brook should keep the watercourse clear of vegetation and debris. Based on observations from the site visit, it is recommended that debris, particularly a concrete slab located in the Grammar School Brook that is acting as a weir immediately downstream of the highway drainage and STW surface water outfalls should be removed to improve flow.

7.5. RESIDENTS AND TENANTS

Property Level Resilience measures could also be explored to be implemented in the area, if the blockage removal action and new gully installation undertaken above do not resolve the flooding to the property.

8. ACKNOWLEDGEMENTS:

A special mention of thanks should be given to all of those residents of Leicester Road who provided AECOM with knowledge and experience, which has been incorporated into this report and will help to contribute to future flood alleviation and resilience in those affected areas.

9. ABBREVIATIONS:

AEP	Annual Exceedance Probability
LCC	Leicestershire County Council
FIR	Flood Investigation Report
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act 1991
LLFA	Lead Local Flood Authority
WRA	Water Resources Act 1991
LiDAR	Light Detection and Ranging
STW	Severn Trent Water Ltd
FMfSW	Flood Map for Surface Water
RMAs	Risk Management Authorities

APPENDIX A

SITE LOCATION PLAN

This is not a definitive record, but is based on the best available information and is given without warranty. If roadside ditches are present, the normal presumption is that these do not generally form part of the publicly maintainable highway. This plan has been produced in relation to the specified area of enquiry and should not be used for any other purpose, since its accuracy can not be guaranteed.

This map gives an indication of the location of the site. It is not suitable for use at an individual property scale due to the method used.

Key

None.

Leicestershire County Council

ENVIRONMENT AND TRANSPORT DEPARTMENT

On Behalf of the DIRECTOR

LEICESTERSHIRE COUNTY COUNCIL ENVIRONMENT AND TRANSPORT

Service: Lead Local Flood Authority

TITLE: Site Location

LOCATION: Leicester Road Loughborough

DRAWING NUMBER	SCALE
2016-INV-115	Not To Scale
CREATED BY: Stacey Johnson	DATE: 05/01/2016
	SIZE: A4

E-MAIL: flooding@leics.gov.uk
PHONE: 0116 305 0001
COUNTY HALL · GLENFIELD · LEICESTER · LE3 8RJ

APPENDIX B

SITE VISIT NOTES

Leicestershire CC – Section 19 Reports
Site Visit Data Sheet

1. Detail of Area/Properties/People Affected						
Location/Ward Area:	Leicester Road, Loughborough					
Team:	NM & AP					
Property Type(s) at flood risk Incl. Number:	Residential:	Min. 3	Industrial:		Office:	
	Educational:		Religious:		Recreational:	
Other (e.g infrastructure)	Leicester Road					
Comments:	Stormwater ponds on Leicester Road before spilling over the pavement and onto adjoining property. The resident who returned the survey reported water entering the property and inundating the ground floor. This has happened twice in the last 6 months.					

2. Details of Flooding			
Flood damage incurred? :	Flooding of ground floor of property and surrounding gardens.	Through doors:	Front door and garage
		Through windows:	
		Through floors:	
		Through airbricks:	
		Through drainage:	

Source of flooding (if known):	Main River	Other Water Course	Road	Overland	Public Sewer	Private Drain	Other e.g. blocked culvert, gully etc,
			Y				

Comments (include estimate of flow path and sketch where possible):	During heavy rain, surface water from the highway is unable to enter the stormwater system where it is then conveyed 50 m to Grammar School Brook, a minor tributary of the River Soar. A puddle grows in the road until it overtops the pavement and flows onto the adjoining property. Flooding is made worst by vehicles passing the drive entrance too fast causing bow waves. During the most recent flooding on 7th May 2016, the resident reported that the level in the brook was low; however, the stormwater system was unable to keep the road clear. Severn Trent Water plans show the surface water sewer in Leicester Road is joined by a branch in Shelthorpe Road before outfalling to the brook. It is possible that this flow overwhelms the outlet, causing the sewer under Leicester Road to back up preventing effective drainage of the highway. The residents were renovating the property and used building supplies to deflect water away from the property, directing it to the rear garden. The water ponded in the garden and typically takes a significant time to dissipate.
Water Depth Inside property (m)	0.01-0.02
Water Depth Outside property (m)	0.05 next to property, 0.1 in garden

<table>
<tr><th colspan="11">3. Effects of Flooding</th></tr>
<tr><td>Damage to Props. (residential and commercial/retail):</td><td colspan="10">Water damage to floors and skirting in the property.</td></tr>
<tr><td>Damage to infrastructure:</td><td colspan="10">No visible damage to the road</td></tr>
<tr><td rowspan="2">Were/are properties Vacated?</td><td rowspan="2" colspan="2">No</td><td colspan="2">If Yes, for how long?</td><td colspan="6">If Yes, relocated to where?</td></tr>
<tr><td colspan="2"></td><td colspan="6"></td></tr>
<tr><td>Utilities Affected?</td><td>Electricity</td><td></td><td>Water</td><td></td><td>Gas</td><td></td><td>Phone</td><td></td><td>Other</td><td></td></tr>
<tr><td>Flood Report/Grant application Refs?</td><td colspan="10"></td></tr>
<tr><th colspan="11">4. Existing Flood Defences</th></tr>
<tr><td>Is there an existing defence? Type and details:</td><td colspan="10">None.</td></tr>
<tr><td>Condition</td><td colspan="10">N/A</td></tr>
</table>

<table>
<tr><th colspan="3">5. Potential Flood Alleviation Measures</th></tr>
<tr><td rowspan="7">Proposed Measure(s) Details incl. length, height, Constructability/Access</td><td>Flood Wall</td><td></td></tr>
<tr><td>Flood Embankment</td><td></td></tr>
<tr><td>Upstream storage</td><td></td></tr>
<tr><td>Storm Water Drainage System</td><td>Add an additional gully at the low point. Potential upgrade to the public sewer outlet into the brook</td></tr>
<tr><td>Cleaning/Maintenance</td><td>Regular Maintenance required</td></tr>
<tr><td>SUDS</td><td>Upstream storage if sewer overloaded</td></tr>
<tr><td>PLP</td><td></td></tr>
<tr><td>Location Details and sketch (Public or Private Property, Provide Details (e.g. river embankment, field, main road, residential street)</td><td colspan="2">A second road gully should be constructed adjoining the existing gully outside 206 Leicester Road or nearby e.g. outside No. 208. This would improve the capacity of the system to remove surface water from the highway providing there is spare capacity in the surface water sewer to convey it away to the brook. A check would need to be made with STW to see if their surface water sewer is surcharging/flooding during significant rainfall events. The flooding could be originating from the sewer being overloaded and flooding at the lowest point on the system which is the gully outside 206 Leicester Road.

It may be possible to upsize the outlet to the brook to allow a larger pipe downstream of the joining of the Shelthorpe and Leicester Road sewer branches. It may also be possible and preferable to introduce a second sewer outlet, effectively separating the Leicester Road and Shelthorpe branches.

An alternate adjustment to the stormwater system might be to create a new branch linking the road gully outside the property that returned the</td></tr>
</table>

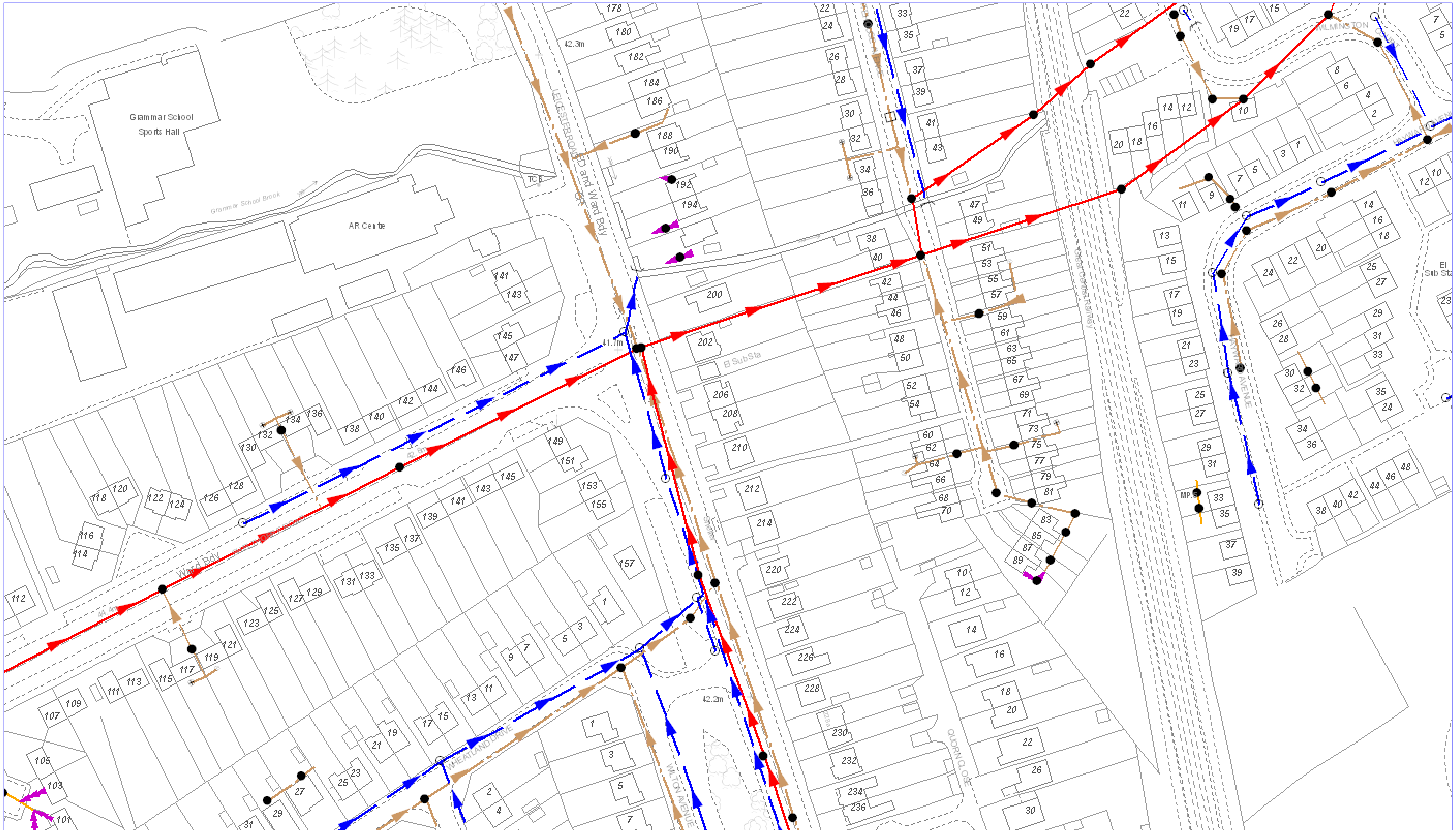
	questionnaire, to the brook directly. This would provide the ponded flow an alternate route to the brook. This option would require more works than adjustments to the outlet. Further benefit may be gained by developing some form of storage further upstream in the catchment feeding the Leicester Road branch. This could possibly take the form of tanks located in the green space between Wilton Avenue and Leicester Road. The stormwater drainage system should be maintained and cleared on a regular basis to provide the highest capacity at all times.
Further Comments	

Add further comments, details, sketches here:

Signature:

Name of Collator:	Date:	Time:
Nick Maynard	30/11/2016	10.30 am

APPENDIX C
SEVERN TRENT WATER PLAN



Public foul gravity
Pressurised foul
Public combined gravity
Pressurised combined
Public surface water gravity
Pressurised surface water
Section 104 sewers are shown in green
Private sewers are shown in magenta
All Non-Sewer Standard (NSS) Lateral Drains are shown in Orange
Abandoned sewer
Manhole - foul / combined
Lamphole
Overflow
Culverted watercourse
Manhole - surface water
Blind shaft
Outfall
Highway drain
Duct
Head node
Combined Lateral Drain (SS)
Foul Lateral Drain (SS)
Surface Water Lateral Drain (SS)
High voltage cable
Low voltage cable
Instrumentation

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

Sewer Record

O/S Map scale: Approx. 1:1250

Date of Issue: 03 01 2017

This map is centered upon OS Grid Ref:
x - 454322.0 y - 318656.0

Do not scale off this drawing

1. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of Severn Trent's assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.
2. The material contained in this drawing has been based upon the Ordnance Survey Map by SEVERN TRENT WATER Ltd. by permission of Ordnance Survey on behalf of the controller of her Majesty's Stationery Office. © Crown Copyright â€" SEVERN TRENT WATER Ltd. â€" **100018202**
3. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and no further copies should be made.

APPENDIX D

RISK OF FLOODING FROM SURFACE WATER (RoFSW) MAP

Location Map

N
W E
S

ENVIRONMENT AND TRANSPORT DEPARTMENT

ON BEHALF OF THE DIRECTOR

LEICESTERSHIRE COUNTY COUNCIL
ENVIRONMENT AND TRANSPORT

SERVICE: LEAD LOCAL FLOOD AUTHORITY

TITLE: updated Flood Map for Surface Water

LOCATION: LEICESTER ROAD

DRAWING NUMBER	SCALE
2016-INV-112	Not To Scale
CREATED BY: Edwin Knight	DATE: 27-10-2016
	SIZE: A4

E-MAIL: flooding@leics.gov.uk

PHONE: 0116 305 0001

COUNTY HALL · GLENFIELD · LEICESTER · LE3 8RJ

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

APPENDIX E

HYDROLOGICAL STUDY

Leicestershire Section 19 Flood Investigations

Hydrology Technical Note

Leicestershire County Council

Project Number: 60527961

January 2017

Quality information

Prepared by	Checked by	Approved by
Lucy Rushmer Senior Consultant	Helen Burton Senior Consultant	Katie Pearson Associate

Revision History

Revision	Revision date	Details	Authorized	Name	Position
V1	24/01/2017	Check	KP	Katie Pearson	Associate

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

Leicestershire County Council

Prepared by:

Lucy Rushmer
Senior Consultant
T: +44(0)113 391 6800
E: lucy.rushmer@aecom.com

AECOM
2 City Walk
Leeds
West Yorkshire
LS11 9AR

T: +44(0)113 3916800
aecom.com

Table of Contents

Figures

Tables

1. Introduction

AECOM have been commissioned by Leicestershire County Council (LCC) to deliver S19 flood investigations for 13 sites across Leicestershire which experienced property and road flooding during 2016. This Hydrology Technical Note describes the hydrological method that was used to undertake probability of occurrence analysis for each flooding incident / each location. Table 1-1 lists the location and date of each flooding incident investigated.

Table 1-1: Location and date of each flooding incident

Flooding location	Easting	Northing	Date of flooding
Wellsic Lane Rothley	458088	312541	09/03/2016
Highgate Road Sileby	460841	315409	10/06/2016
Dunton Road Broughton Astley	453689	291755	09/03/2016
Walnut Leys Cosby	454887	294791	19/04/2016
Leicester Road Loughborough	454322	318656	07/05/2016
Windsor Road Loughborough	451746	320322	15/06/2016
Abbey Close Shepshed	447417	318085	15/06/2016
Blackwood Coalville	444852	314380	08/07/2016
Bishopdale Coalville	442990	317308	15/06/2016
Burleigh Avenue Wigston	460188	299926	27/08/2016
Main Street Kilby	461822	295496	25/08/2016
Kilby Road Fleckney	464540	293631	10/03/2016
Lymetree Grove	431094	315422	13/14/15/06/2016

2. Data Collection

AECOM used available Environment Agency, LCC, and Metrological Office rainfall gauge data and publically available hydrological information to estimate the probability of occurrence of each flood event. Data was obtained from rainfall gauges as close to the study sites as possible, where available for the time period between 1st January 2016 and 1st December 2016, which is the time span during which all the flooding incidents occurred at the 13 locations across Leicestershire.

3. Rainfall Analysis Methodology

3.1 Observed Rainfall Data

The Environment Agency provided hourly and daily total rainfall data for 10 rainfall gauges across the study area. However, only six of these rainfall gauges were appropriate to use for data analysis purposes due to the time period of the available data. Figure 3.1 shows the location of rainfall gauges and flooding incidents.

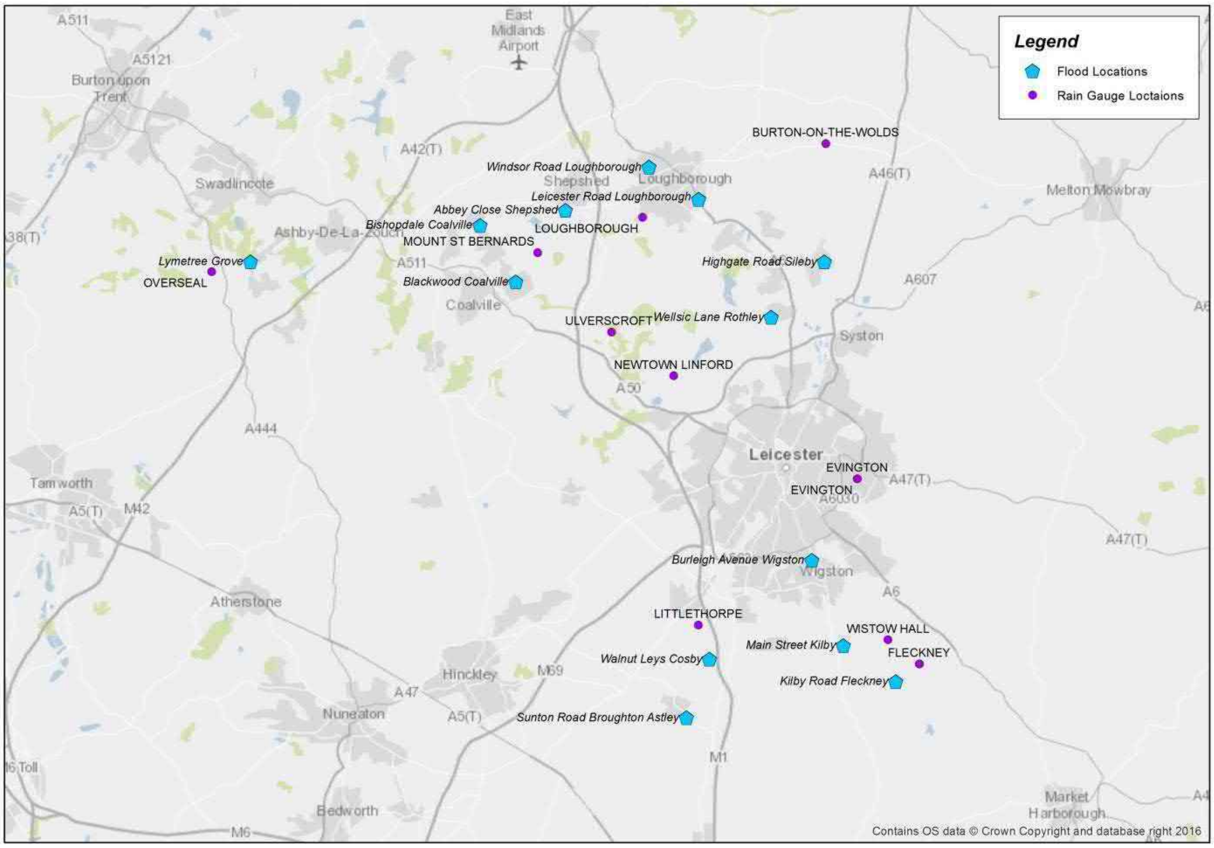


Figure 3-1: Location of flooding incidents and rainfall gauges

Observed rainfall data was analysed from relevant rainfall gauges and used to identify the key rainfall events during the time periods which are known to have caused localised flooding incidents at the 13 locations across Leicestershire.

The rainfall gauge closest to each flooding location was used for data analysis purposes. Where there was no obvious single gauge appropriate for the analysis and where a flooding location falls between two or more rainfall gauges, it is assumed that the rainfall total is an average from the nearest gauges. Table 3-1 indicates which rainfall gauges were used for each flooding location.

A distance weighting approach was considered for rainfall data analysis purposes. However, this was discounted because distance weighting approach is not appropriate for site specific flooding analysis, and is more commonly used for catchment hydrology.

The maximum rainfall depth was calculated for each rainfall event from the observed data, for a one hour, 2 hour and 5 hour storm duration.

Table 3-1: Rainfall gauges used for each flooding location

Flooding location	Rainfall gauge(s) used	Date of flooding	Maximum rainfall in different duration events (mm)		
			1hr	2hr	5hr
Wellsic Lane Rothley	Burton-on-the-Wolds, Evington	09/03/2016	4.40	8.10	16.80
Highgate Road Sileby	Burton-on-the-Wolds, Evington	10/06/2016	6.40	4.50	18.10
Dunton Road Broughton Astley	Littlethorpe	09/03/2016	5.00	8.40	16.80
Walnut Leys Cosby	Littlethorpe	19/04/2016	5.00	8.40	16.80
Leicester Road Loughborough	Mount St Bernards	07/05/2016	7.00	7.40	8.00
Windsor Road Loughborough	Burton-on-the-Wolds, Mount St Bernards	15/06/2016	17.40	25.30	30.90
Abbey Close Shepshed	Mount St Bernards	15/06/2016	25.40	40.20	49.80
Blackwood Coalville	Mount St Bernards	08/07/2016	8.80	14.4	17.20
Bishopdale Coalville	Mount St Bernards	15/06/2016	25.40	40.20	49.20
Burleigh Avenue Wigston	Littlethorpe, Evington, Fleckney	27/08/2016	22.40	31.67	33.27
Main Street Kilby	Fleckney	25/08/2016	2.60	3.60	3.80
Kilby Road Fleckney	Fleckney	10/03/2016	5.60	9.60	18.40
Lymetree Grove	Overseal	13/14/15/06/2016	14.60	-	-

3.2 Event Rarity

The maximum rainfall depth for these three event durations was then used to estimate the event rarity for each rainfall event using the Depth-Duration-Frequency (DDF) rainfall model. DDF curves describe rainfall depth as a function of duration for given return periods (probabilities) at specified locations within the UK and can be reproduced using the Flood Estimation Handbook (FEH) CD-ROM 3[1].

For each of the 13 locations, the DDF curve was plotted for each return period, ranging from 2 -100 years, for rainfall events up to a 10 hour duration. The maximum observed rainfall depths were plotted against these DDF curves for the three durations analysed to determine the return period of each rainfall event. This analysis allowed the estimation of probability as, for example, less than a 2 year return period event or between a 5 and 10 year return period event, depending on where the observed rainfall depth plotted compared to the DDF curves. Figure 3-2 shows an example of how the three observed rainfall maximums where plotted against the DDF rainfall curves to assess the probability of occurrence.

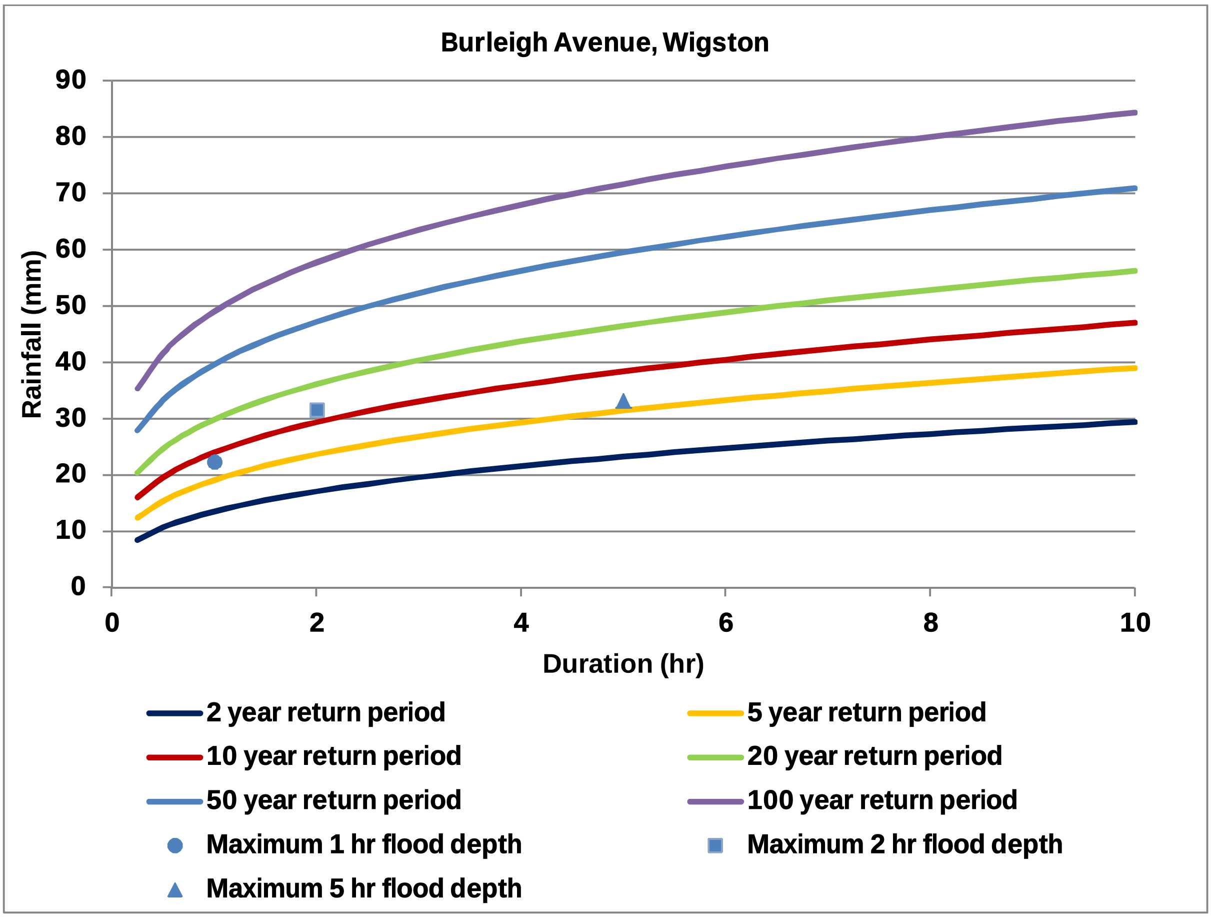


Figure 3-2: Example of rainfall maximums for different durations plotted against DDF rainfall curves to assess probability of occurrence

To verify the above analysis, the 'event rarity' function in the DDF rainfall model was also used to estimate a more specific (e.g. a 3.4 year) return period for each rainfall event. However, it is not considered appropriate to report these more specific return period estimates in the S19 reports as it would provide a false level of confidence in the rainfall analysis which is unrealistic, given the limitations below. It is considered more appropriate to report in terms of less than a 2 year return period event or between a 5 and 10 year etc. Figure 3-3 shows an example of the event rarity function in the DDF rainfall model in the FEH CD ROM 3.

[1]Flood Estimation Handbook, 1999, Institute of Hydrology

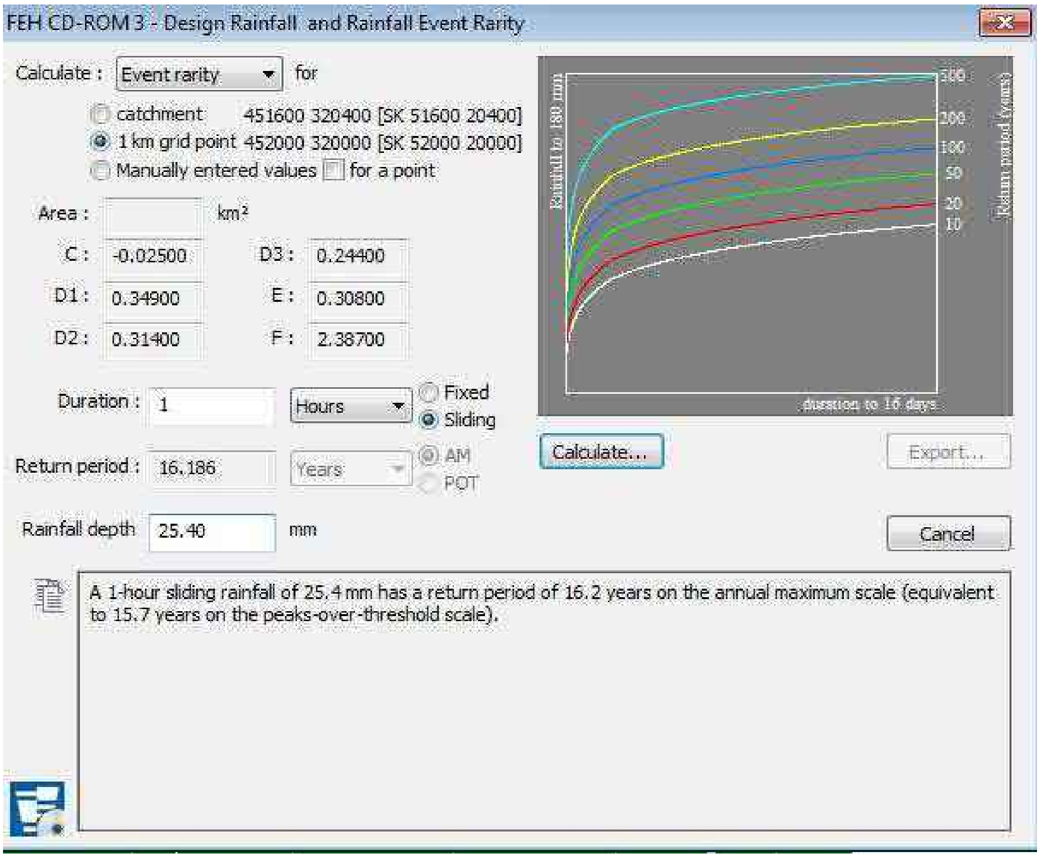


Figure 3-3: Example of the 'event rarity' function in the DDF rainfall model in FEH CD ROM 3

3.3 Limitations

There are some limitations associated with the hydrological methodology which should be considered when reviewing the S19 reports.

These flooding incidents were commonly associated with localised rainfall events which caused localised surface water flooding. Localised rainfall events are commonly characterised by intense fast moving rainfall. Although there is good coverage of rainfall gauges across the entire study area, it is possible that in some cases, the rainfall gauges used in this analysis did not record some of the key rainfall events if the rainfall did not fall directly over the gauge.

The Environment Agency provided hourly and daily total rainfall data for 10 rainfall gauges across the study area. However, only six of these rainfall gauges were appropriate to use for data analysis purposes due to the time period of the available data. Analysis of hourly rainfall data does mean that any particularly intense sub-hourly rainfall bursts are not considered in this analysis. It would have been more accurate to analyse 15 minute data as this would have helped to pinpoint the peak of the rainfall event more specifically. However, the Environment Agency could only provide hourly data within an appropriate timeframe to undertake analysis for this project.

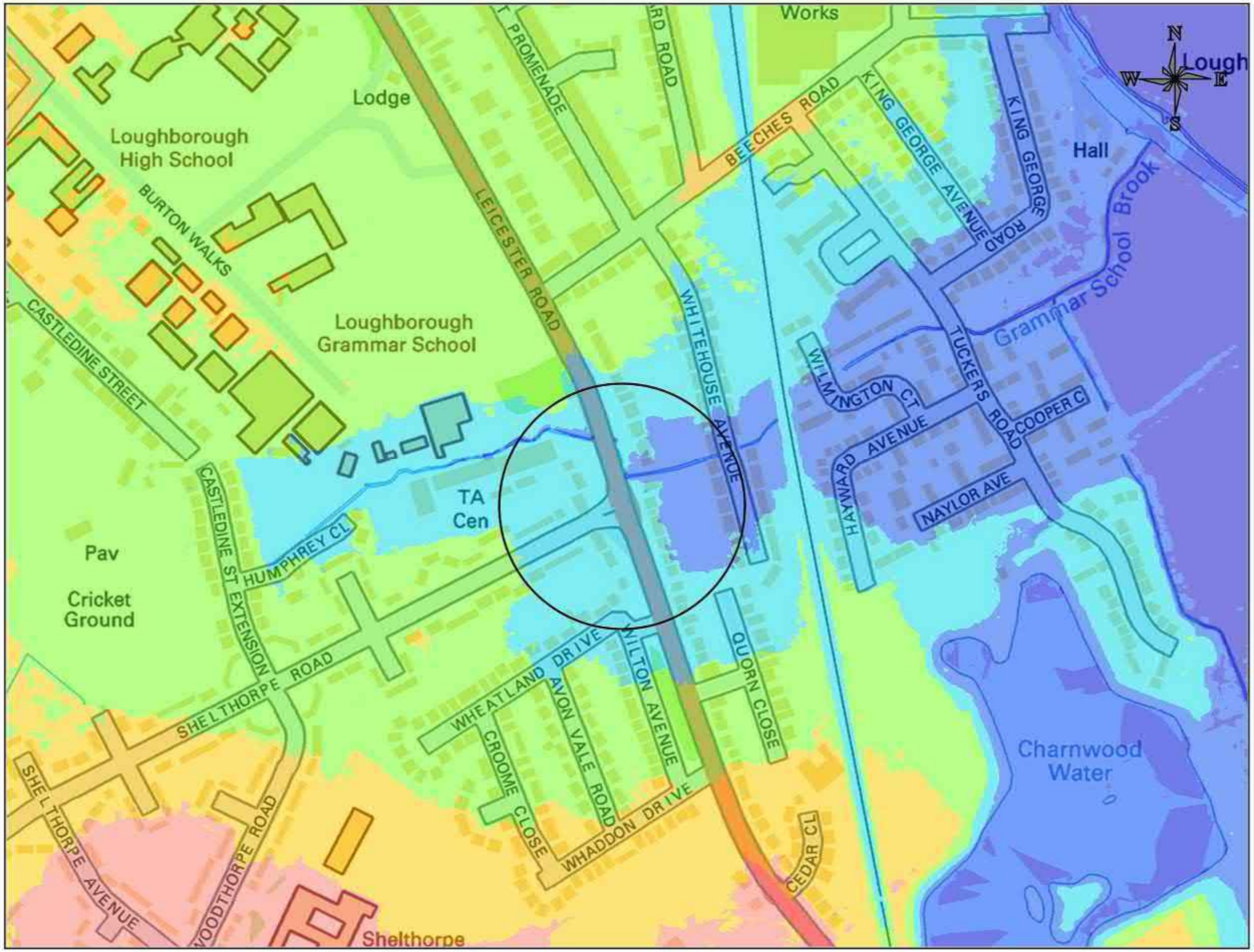
Where more than one rainfall gauge was used for data analysis purposes, averaging the maximum rainfall from more than one gauge has its limitations. The spatial distribution of rainfall varies across an area, especially during intense and fast moving rainfall events that caused these flooding incidents, such that the maximum rainfall may have occurred at one gauge and not others. However the area weighting method is not considered to be appropriate for site specific hydrology so this is the most appropriate option available. The averaging method chosen may have under-estimated maximum rainfall totals in some locations / some events.

4. Conclusion

Observed rainfall data was used to estimate the event rarity of known flooding incidents at 13 locations across Leicestershire. DDF modelling from FEH CD ROM 3 was used to obtain predicted rainfall depths at different durations. Rainfall depths from observed events were plotted against these predicted rainfall depths to estimate the event rarity of historic rainfall events.

APPENDIX F

LIDAR MAPPING



Key

LiDAR Elevation (mOAD)

35-37	51-53
37-39	53-55
39-41	
41-43	
43-45	
45-47	
47-49	
49-51	

Leicestershire County Council

ENVIRONMENT AND TRANSPORT DEPARTMENT

On Behalf of the DIRECTOR

LEICESTERSHIRE COUNTY COUNCIL ENVIRONMENT AND TRANSPORT

Service: Lead Local Flood Authority

TITLE: LiDAR Mapping

LOCATION: Leicester Road, Loughborough

DRAWING NUMBER	SCALE
2016-INV-115	Not To Scale
CREATED BY: Joe Pierce	DATE: 01/2017
	SIZE: A4

E-MAIL: flooding@leics.gov.uk

PHONE: 0116 305 0001

COUNTY HALL · GLENFIELD · LEICESTER · LE3 8RJ

This is not a definitive record, but is based on the best available information and is given without warranty. If roadside ditches are present, the normal presumption is that these do not generally form part of the publicly maintainable highway. This plan has been produced in relation to the specified area of enquiry and should not be used for any other purpose, since its accuracy can not be guaranteed.

This map gives an indication of the broad areas likely to be at risk of surface water flooding. It is not suitable for use at an individual property scale due to the method used.

STATUS OF THIS REPORT AND 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"[1]. 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 at Section 1.4 of the body of this report. The flood risk management functions which the Risk Management Authorities are proposing are described at Section 6 of 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.

---

[1] *As defined by Section 6(13) of FWMA*