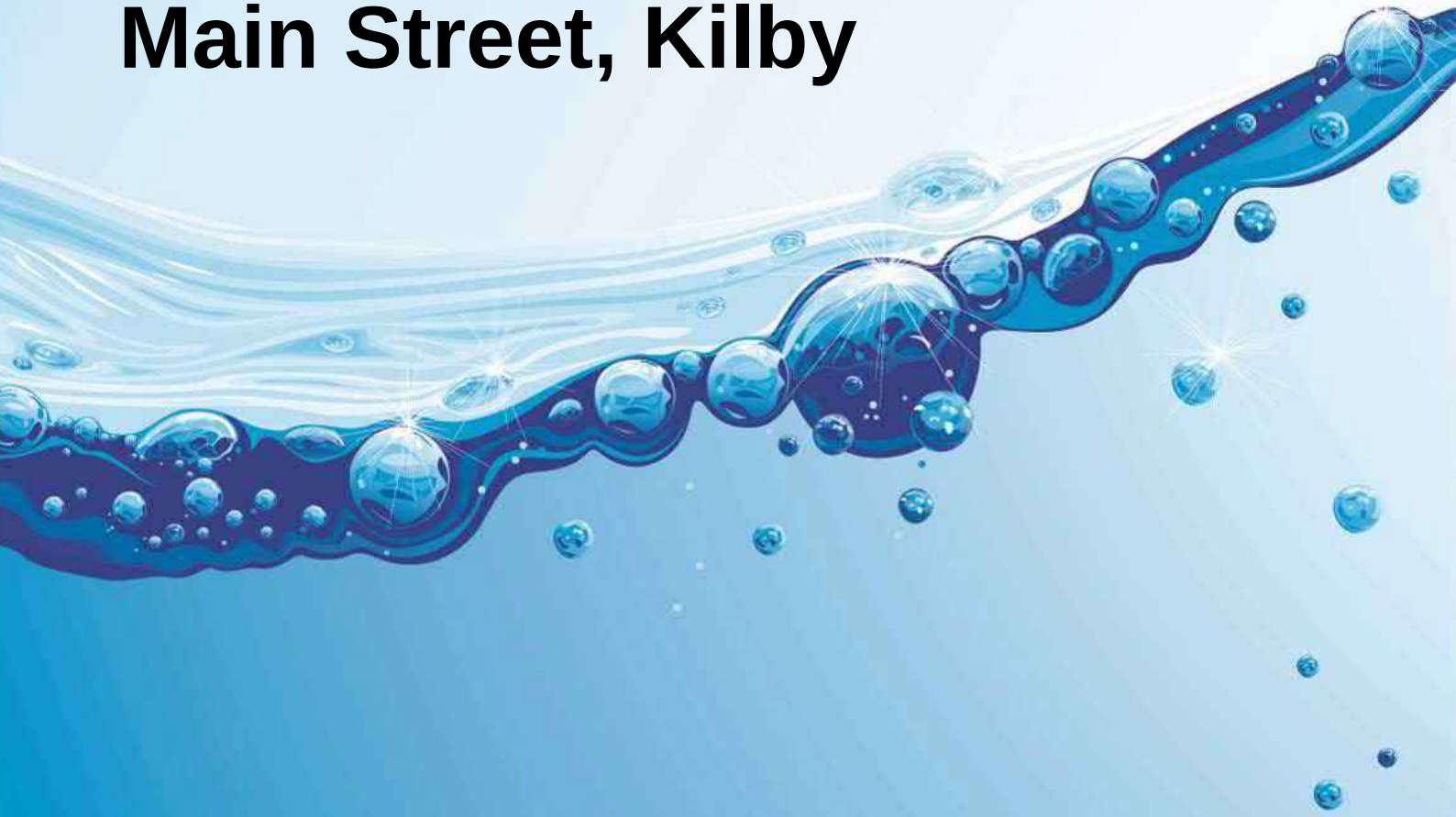
Leicestershire County Council

Main Street, Kilby



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

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AECOM: 2015-04-13

DETAILED FLOOD INVESTIGATION

Leicestershire County Council Investigation Reference:	**2016-INV-203**
Investigation Location:	**Main Street, Kilby**
Date of Flooding:	**27th August 2016**
Revision	**Final**

Prepared:	Alannah Bolton	Graduate Water Consultant	14/03/2019
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Approved:	Steve Edwards	Associate Director	14/03/2019
Leicestershire County Council Approved:	Mohamed Admani	Senior Engineer	16/04/2019

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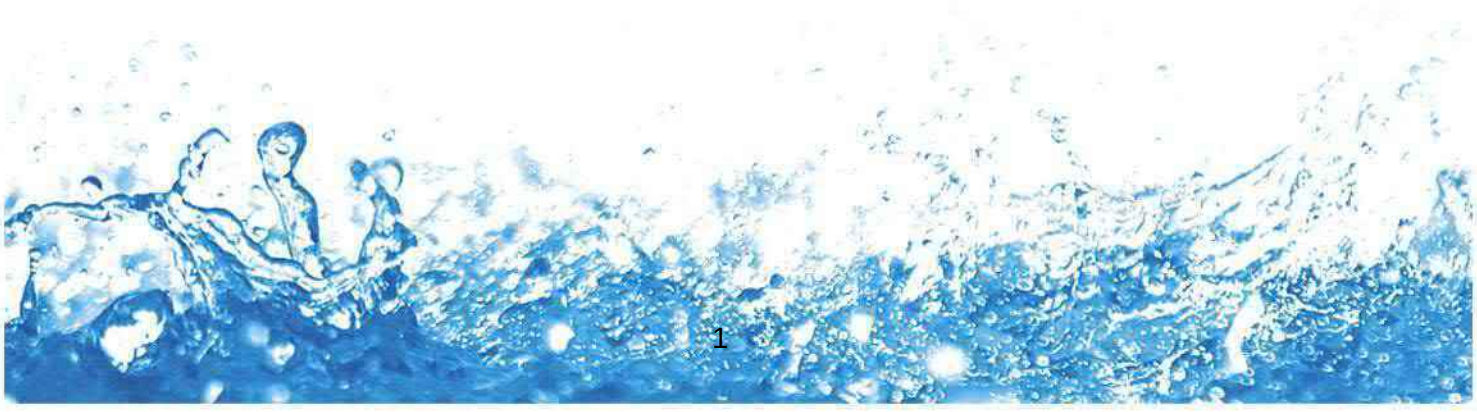


1. EXECUTIVE SUMMARY

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), Leicestershire County Council (LCC), must undertake a flood investigation in order to determine the relevant flood risk management authorities involved and which flood risk management 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 within Main Street, Kilby that occurred on the 27th of August 2016 as it was reported (via a Flood Reporting Form provided by Leicestershire County Council) that at least two residential dwellings were reported to have flooded internally, believed to be a result of highway drainage inundation.

1.2. CAUSE OF FLOODING

Over the course of the investigation it became clear that the flooding was caused by a period of intense rainfall that occurred within the catchment. The description of the flooding suggested that surface water was unable to drain into the highway drainage system because the capacity was exceeded due to a deceased animal obstructing the surface water outfall to the north in additional to a faulty flap valve at the same location. Subsequently, surface water ponded at a low point at the junction of Main Street and Spinney Road, resulting in the internal flooding of 2 residential dwellings.

1.3. MAIN FINDINGS

Anecdotal reports submitted through the Flood Reporting Form to Leicestershire County Council found that flooding at the junction of Main Street and Spinney Road in Kilby occurs on an annual basis.

The flooding to this area is initiated by intense rainfall. Ponding occurs on the highway where there is a natural low spot, which can be identified on the LiDAR[1] provided in Appendix B.

Spinney Road, as observed on site, has no formal highway drainage system significantly contributing to the volume of surface water runoff experienced during times of flood.

The local sewer system consists of a 300mm diameter surface water sewer draining the village of Kilby along Main Street, flowing from east to west and out-falling into the un-

[1] LiDAR shows the topography of an area and is derived using a laser to measure the distance between a survey aircraft and the ground surface, including buildings and other assets (above ground pipelines, highways, street furniture, power lines, railway tracks). This data is represented in a LiDAR Plan that shows the topography of the surveyed area.

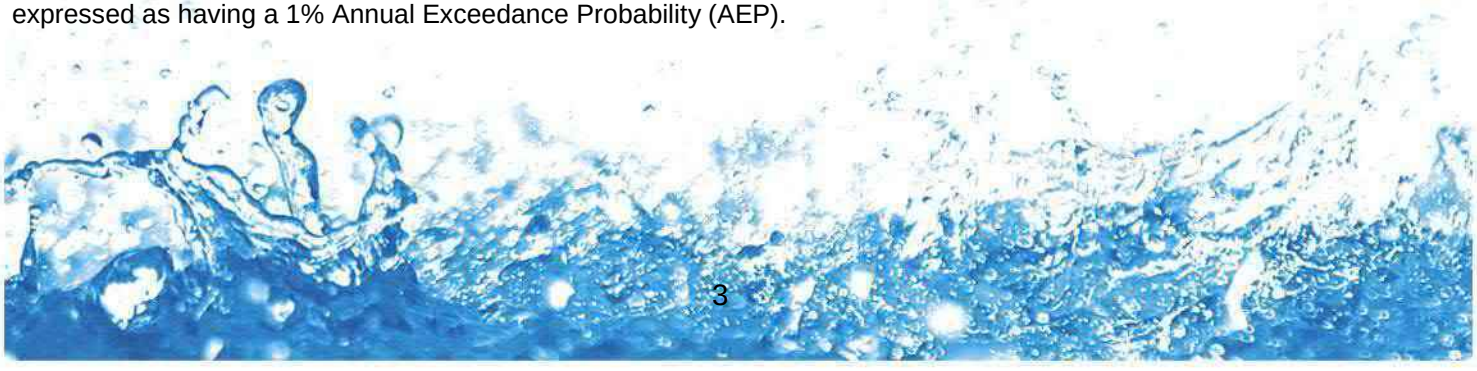
named watercourse. Parallel to this pipe flows a 225mm dia. combined sewer pipe. This pipe (which increases to a 375mm diameter Pipe downstream) continues below the watercourse to a treatment station. Anecdotal reports suggest the combined sewage overflow was engaged, leading to the addition of foul water to the flooding.

The hydrological analysis of the storm in question found it to have a 2% Annual Exceedance Probability[2] (1 in 50 year). Typical highway drainage networks are built to cope with a 3.33% AEP (1 in 30 year), identifying that this storm in particular was of a magnitude the drains were not designed to cope with.

At the time of the storm event in August 2016, LCC recorded reports of there being a significant obstruction (deceased animal) to the highway drainage of Kilby. A CCTV survey commissioned by LCC following the incident found the drains to be restricted due to siltation. LCC have also advised that the drainage network contained a malfunctioning flap valve which contributed to the flooding.

Therefore, for the event on the 27th of August 2016, it seems that the high volume of rainfall combined with the topography of the land, insufficient capacity, malfunctioning flap valve and the significant obstruction to drainage, resulted in the internal flooding of at least 2 dwellings.

[2] 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. INTRODUCTION

2.1. LEAD LOCAL FLOOD AUTHORITY INVESTIGATION

Section 19 of the Flood and Water Management Act (2010) 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

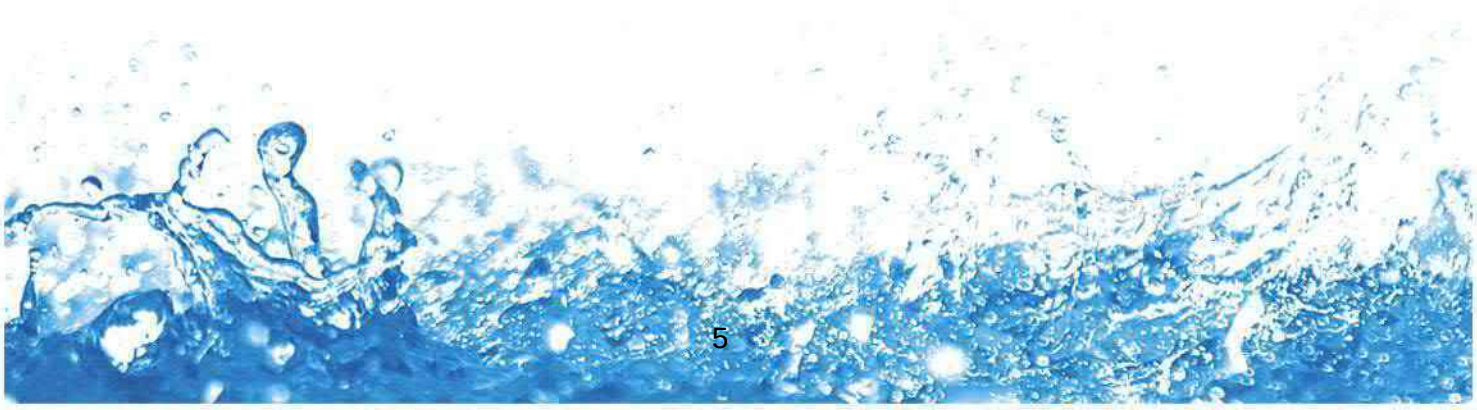
2.3. RISK MANAGEMENT AUTHORITIES

The following risk management authorities were identified as relevant to the flooding at Main Street, Kilby:

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

2.4. FLOODING INCIDENT

It was deemed necessary to complete a formal investigation into the flooding incident within Main Street, Kilby on the 27th of August 2016 as it was reported (via a Flood Reporting Form provided by LCC) that at least two residential dwellings were reported to have flooded internally.



3. SITE BACKGROUND

3.1. LOCATION

The village of Kilby lies in the most eastern portion of the Blaby District of Leicestershire. Kilby lies approximately 10 kilometres south-east of Leicester and approximately 3 kilometres south-east of Wigston (Appendix A).

The location of the flooding investigated is to the west of the village of Kilby at the road junction of Spinney Road and Main Street. The affected residential properties lie to the north and south of Main Street.

LiDAR data provided by LCC (found in Appendix B) identifies Main Street to slope east to west, with its lowest point being at the junction with Spinney Road. The junction is found to be on a similar level above ordnance datum to the watercourse south of the junction.

The junction of Main Street and Spinney Road is at risk from fluvial flooding. The source of potential fluvial flooding is a tributary of the Main River Sence, approximately 50m south-west of the junction. The Environment Agency Long Term Flood Risk Map, reproduced by LCC in Appendix F, identifies the junction to be located within Flood Zone 2 which has a 0.1% Annual Exceedance Probability (1 in 1000 year return period).

The likely catchment which drains to this junction consists of open farmland and the immediate residential area. The area of Kilby is predominantly rural.

3.2. DRAINAGE SYSTEMS

The Severn Trent Water (STW) drainage network shows both a combined and surface water sewer network running along Main Street, with pipe diameters of 225mm turning into 375mm and 300mm respectively. The surface water network outflows into a watercourse immediately north-west of the junction while the combined sewerage system takes both foul and surface water further north to be treated. The STW plan also shows a combined sewer overflow connection between the combined and surface water sewers close to the road junction. From the plan, it would suggest that, during storm events, excess water flows from the combined sewer to the surface water sewer. This should be investigated to confirm the connection arrangement between the sewers in case this could be contributing to the flooding problem.

Despite the presence of the public sewerage systems, residents reported a large volume of surface water runoff came from Main Street. A site visit data sheet is included in Appendix C. Anecdotal evidence obtained during a site visit suggests that surface water is not being removed from the road surface effectively, which may be due to a range of issues including blockages further down in the system (including the outfalls), an inadequate number of fully functioning road gullies to remove the water off the road, or undersized pipes.

Email correspondence from the LLFA suggests that during the flood event of 27th of August 2016 the surface water sewer outlet flap valve was not opening sufficiently. In addition to this, anecdotal reports suggest that the manhole located in the field between the watercourse and road junction began to discharge water, further revealing that the system may have surcharged.

Visual inspection of Spinney Road during the site visit showed the only highway drainage to be a ditch along the northern minor arm, with significant vegetation growth. Whilst the ditch contains an outlet under the adjacent field, it was reported to have little effect on the drainage capability. As this falls within the catchment for Main Street, it is likely to have had a significant effect on the volume of water collecting at the junction.

Figure 1 Drainage ditch along minor northern arm of Spinney Road

Figure 2 Surface Water Outfall to unnamed brook

4. FLOODING INCIDENT

4.1. PREVIOUS FLOODING INCIDENTS

Anecdotal reports suggest that several residential dwellings on Main Street, Kilby have experienced internal flooding on in the past. Flooding typically occurs in summer, during intense rainfall events. As it is a recurring incident, the issue has been raised to the Parish Council and LCC as an ongoing matter of concern amongst the residents.

4.2. FLOOD INCIDENT

On Saturday the 27th of August 2016, a very intense rainfall event occurred across the area creating flash surface water runoff. Rainfall quantities from a nearby rainfall gauge (Fleckney) are illustrated in Figure 4 Location of rainfall gauge and site of flooding incident Surface water exceeded the capacity of the drainage systems, leading to excess surface water flowing down Main Street and Spinney Road. Water pooled at the junction of these two roads, making access and egress challenging for the local residents and eventually leading to the internal flooding of two residential dwellings. Anecdotal evidence reports that once the rainfall subsided, the floodwaters dissipated in approximately 30 minutes.

Although no flooding was reported to LCC by other residents in close proximity to the affected residents, surrounding houses were observed on site to be at the same level as the properties that experience internal flooding.

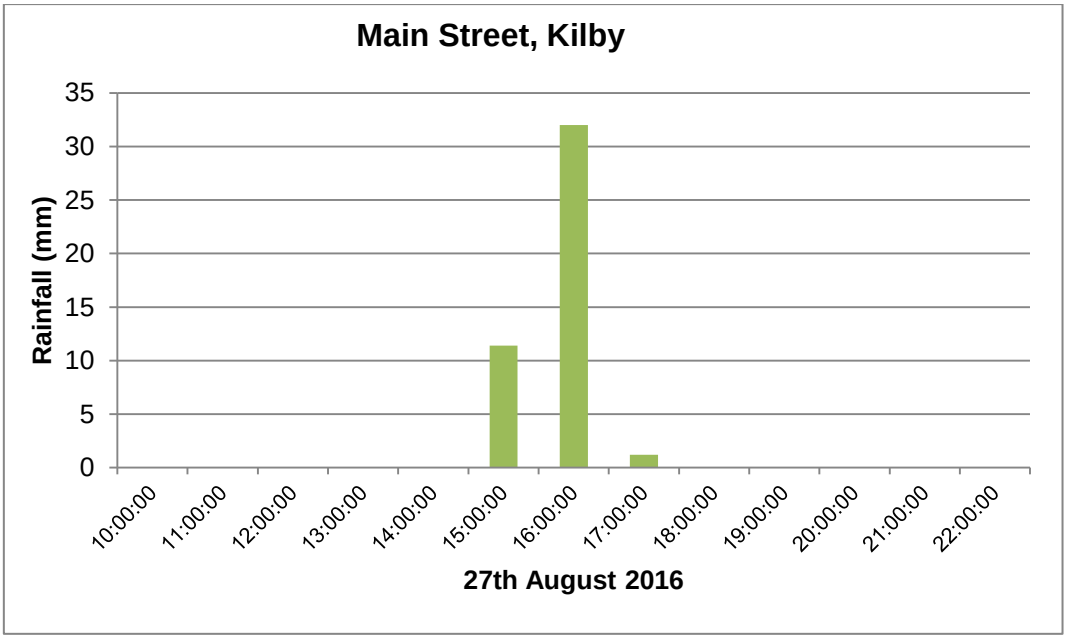


Figure 3 Rainfall data showing the rainfall event which resulted in flooding in Kilby

4.3. RAINFALL ANALYSIS

The Hydrological Summary produced by the Centre for Ecology and Hydrology[3] for August 2016 stated that much of the UK experienced a wetter August.

However it also stated that:

'Localised flash flooding occurred in the Midlands on the 27th.'

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. The rainfall gauge closest to Kilby is located at Fleckney as shown in Figure 4, located 4.1 km to the south-east.

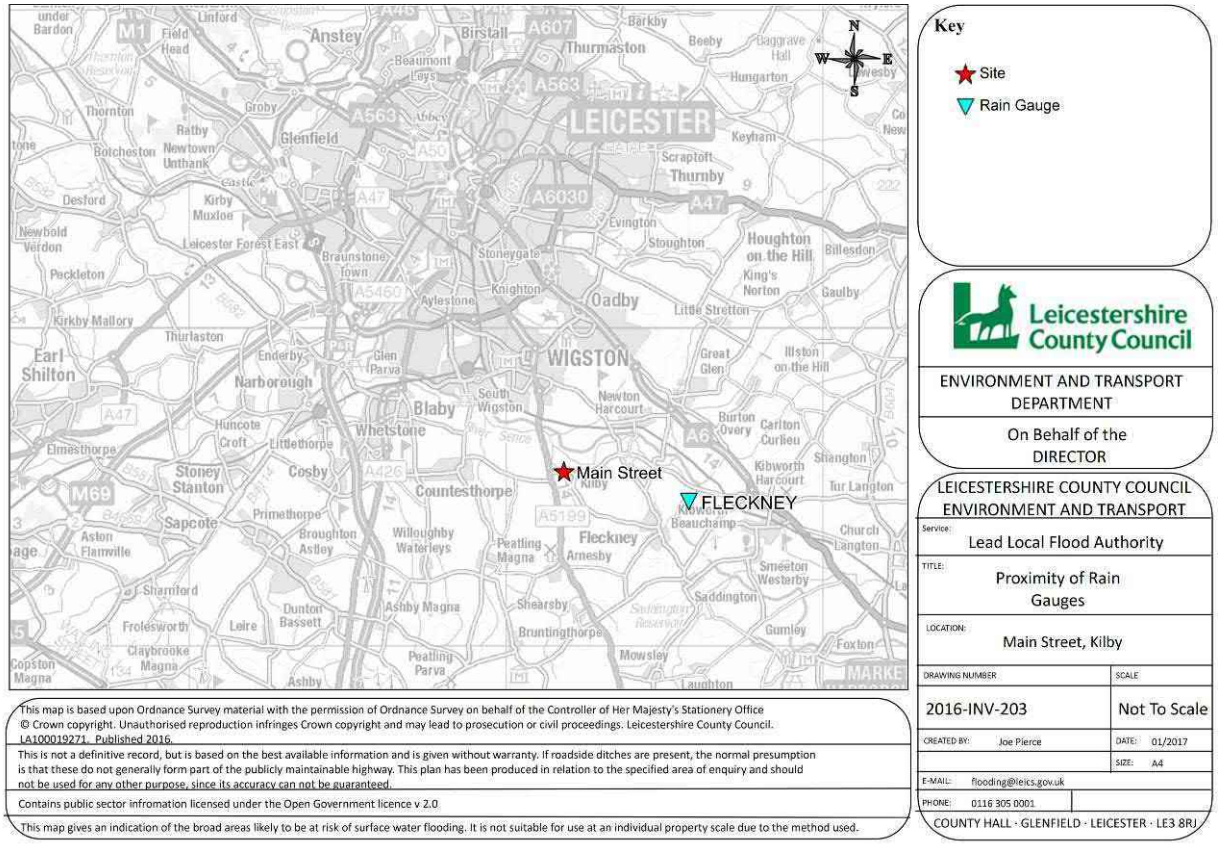


Figure 4 Location of rainfall gauge and site of flooding incident

Table 1 Rainfall gauge near the siteprovides a summary of the relevant Environment Agency rainfall gauges within the study area that were used for data analysis purposes. A Hydrology Technical Note describing the hydrological method used to undertake probability of occurrence analysis for the flooding incident has been provided in Appendix D.

[3] Centre for Ecology and Hydrology. (2016). Accessed [Online]: http://nora.nerc.ac.uk/514505/1/HS_201608.pdf

Table 1 Rainfall gauge near the site

Name	Time series	Record start year	Record end year
Fleckney	Hourly	1985	2016

5. SUMMARY OF IMPACTS AND FINDINGS

5.1. IMPACTS

The flooding event on the 27th of August 2016 caused internal property flooding to two residential dwellings. 'Bow waves' from passing vehicles further exacerbated the flooding. Other properties undertook mitigation measures to prevent inundation of their properties. The local highway network was also impacted, resulting in disruption to the local community and to users of the highway network.

Due to the steep gradient of Spinney Road, the flow of water can create conditions that are potentially hazardous for vehicles. Anecdotal reports state that in previous instances, vehicles have lost control at the tight turn of the junction and caused considerable damage to a residential property, although whether this was solely caused by water on the road is unknown.

Residents reported that in previous events/incidents, floodwater would drain through the fields to the north-west, eventually making its way to the watercourse through three potential outfalls – one for overflow, one for surface run off from Main Street, and the other for rainwater collected in the drain along the northern minor arm of Spinney Road. As it is unclear which outfall coincides with which system, further investigation is required, potentially a CCTV survey of the system; especially as it was reported that one or more outfalls may have been blocked.

5.2. HIGHWAY DRAINS

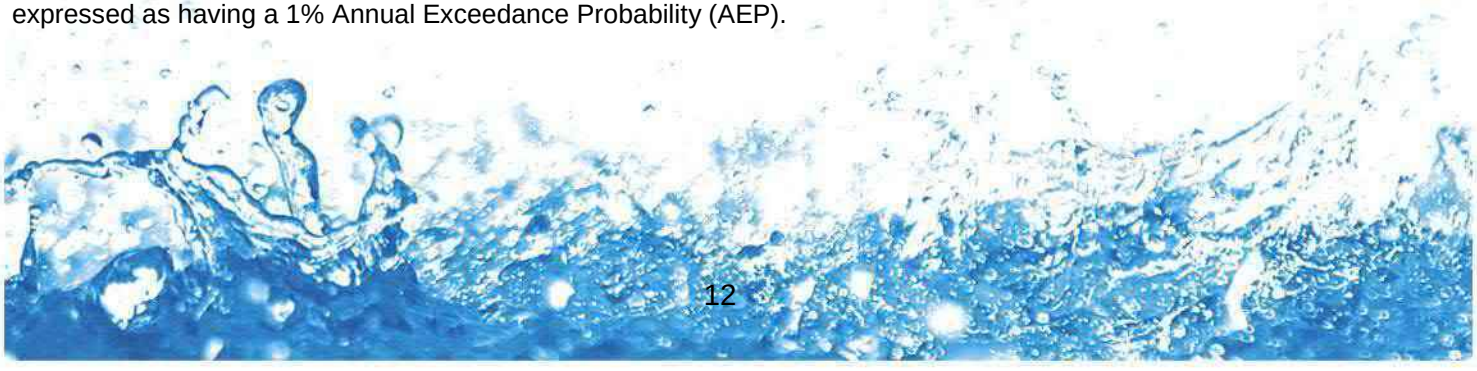
The highway drainage along Main Street consists of traditional highway gullies.

The hydrological analysis of the storm in question found it to have a 2% Annual Exceedance Probability[4] (1 in 50 year). Typical highway drainage networks are built to cope with a 3.33% AEP (1 in 30 year), identifying that this storm in particular was of a magnitude that would overwhelm the drains.

Correspondence with LCC shows that a CCTV survey was carried out following the flooding incident. Several gullies were reported to be restricted due to siltation, but the adjoining sewers were shown to be clear. This suggests that there was an issue with runoff collection and entry of the water into the storm water network due to a lack of highway gully maintenance. If correct, this would have contributed to the severity of the flooding that took place during the August 2016 event.

At the time of the storm event in question, LCC recorded reports of there being a significant obstruction (dead animal) to the highway drains on Main Street. This

[4] 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).



obstruction is believed to have been a contributing factor to the flooding in this location in August 2016.

5.3. PUBLIC SEWER

Main Street is served by a combined public sewer which takes both foul and surface water away for treatment. Anecdotal reports suggest the combined system overflowed into the highway drainage. It is thought that although this might be a contributing factor, it is not the direct cause of the flooding.

The surface water network serves the catchment provided by the highway drainage gullies, which was reported by LCC to be restricting discharge at the outfall to the watercourse by a malfunctioning flap valve. The magnitude of the August 2016 rainfall event would have overwhelmed the sewers, even if the outfall had been fully operational.

5.4. THE ORDINARY WATERCOURSE

There is an unnamed ordinary watercourse south of Main Street junction, a tributary of the River Sence. This watercourse crosses under Spinney Road and flows through the fields in a north-westerly direction.

Although this is the receiving waterbody for the surface water sewer, no issues with it were reported by residents. While flooding of the road and properties is shown on the Risk of Flooding From Rivers and Sea Map in Appendix E, this is predicted for a 0.1% AEP (1 in 1000 year) storm, which is much more severe than the August 2016 incident which was a >2% AEP (1 in 50 year) storm. This all suggests that the watercourse was not the cause of this flood incident.

5.5. EXTENT OF FLOODING

The surface water flooding shown on the Environment Agency Long Term Flood Risk Map for Surface Water in Appendix F at the flood location is consistent with what residents reported with regards to extent. However, the flooding appears to occur at a lower AEP than shown on the flood map.

The extent of flooding ties in well with the LiDAR mapping (Appendix B), which shows the topography of the area.

6. RESPONSIBILITIES

6.1. LEAD LOCAL FLOOD AUTHORITY (LEICESTERSHIRE COUNTY COUNCIL)

LCC has 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 Lead Local Flood Authority has a responsibility to investigate flood incidents under Section 19 of the Flood and Water Management Act (FWMA) 2010. Whilst the County Council 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 the County Council with the mandate or funding to tackle all identified causes of flooding.

The LLFA also has a responsibility to maintain a register of assets which have a significant effect on flooding, whether from surface runoff, groundwater or ordinary watercourses. This is detailed within Section 21 of the FWMA. The register must contain a record about each structure or feature, including the ownership and state of repair.

6.2. BLABY DISTRICT COUNCIL

Blaby District Council has powers under Section 14 of the LDA 1991 to undertake flood risk management works on ordinary watercourses (excluding Main Rivers), where deemed necessary. Under Section 20 of the LDA 1991, Blaby District Council has the powers to (by agreement of any person and at their expense) undertake drainage work which that person is entitled to carry out and maintain.

6.3. HIGHWAY AUTHORITY (LEICESTERSHIRE COUNTY COUNCIL)

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.

6.4. 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.

6.5. RIPARIAN LANDOWNERS OF WATERCOURSES

As detailed within the Environment Agency 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, to more permanent measures such as installing floodgates, raising electrical sockets and fitting non-return valves on pipes.

7. AGREED/ RECOMMENDED ACTIONS

There are a number of recommendations for various risk management authorities and individuals (riparian owners) that may reduce the impact of future similar events. These are outlined below.

7.1. SEVERN TRENT WATER

Severn Trent Water is to monitor and assess any areas of restriction or insufficient capacity within their system, upgrading them and refine the hydraulic model as appropriate. Routine maintenance activities will continue to ensure that the sewerage networks have good serviceability. In particular they should ensure that the flap valve at the outfall to the un-named watercourse about 50m northwest of the corner of Main Street with Spinney Road, should be routinely greased and checked.

7.2. LEAD LOCAL FLOOD AUTHORITY (LCC)

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

7.3. LOCAL HIGHWAY AUTHORITY (LEICESTERSHIRE COUNTY COUNCIL)

LCC is to continue to monitor and maintain their gullies and road drainage system, keeping them clear from obstruction so they can function at full capacity.

The local Highway Authority will also continue to monitor and maintain their gullies and highway drainage network as per the agreed maintenance schedule, keeping them clear from obstruction so they can remain operable.

7.4. RIPARIAN OWNERS

The property owners which have experienced flooding should ensure that the drainage systems within their property boundary are well maintained and kept clear of blockage.

Property owners should also consider exploring Property Level Resilience (PLR) measures to better defend their properties from flooding.

8. ACKNOWLEDGEMENTS:

A special mention of thanks should be given to all of those residents of Kilby who provided AECOM with knowledge and experience, which has been incorporated into this report and will help to contribute to future flood mitigation within the village of Kilby.

9. ABBREVIATIONS

AEP	Annual Exceedance Probability
LCC	Leicestershire County Council
NWDC	North West Leicestershire District Council
FIR	Flood Investigation Report
FWMA	Flood and Water Management Act 2010
LDA	Land Drainage Act 1991
LLFA	Lead Local Flood Authority
LiDAR	Light Detection and Ranging
STW	Severn Trent Water Ltd.
RMAs	Risk Management Authorities

APPENDIX A

SITE LOCATION PLAN

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

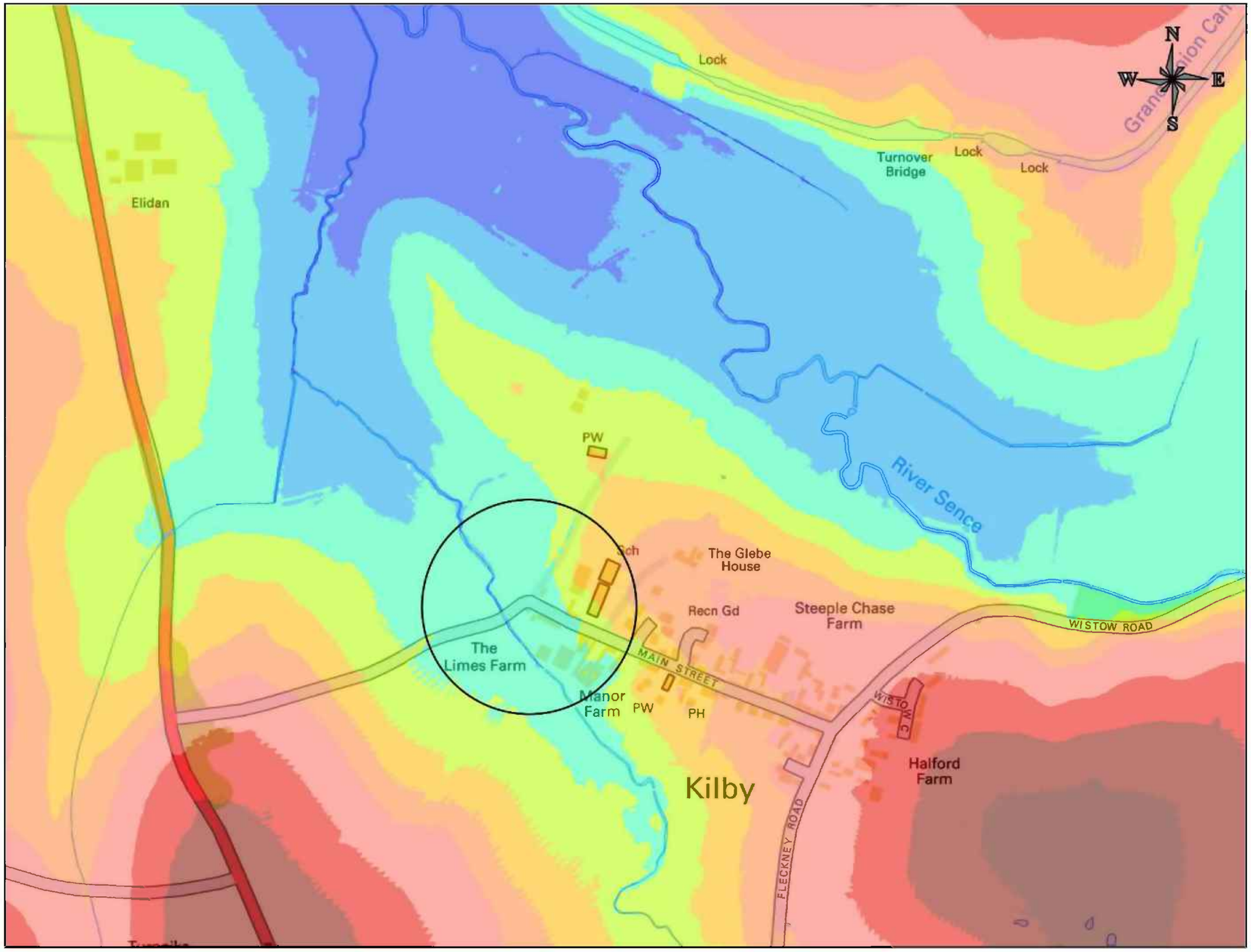
LOCATION: Main Street Kilby

DRAWING NUMBER	SCALE
2016-INV-203	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

LIDAR PLAN



Key

LiDAR Elevation mAOD (m)

67-71	98-102
71-75	102-107
75-77	
77-79	
79-81	
81-83	
83-85	
85-87	
87-91	
91-94	
94-98	

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: Main Street, Kilby

DRAWING NUMBER	SCALE
2016-INV-203	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 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 C
SITE VISIT NOTES

Leicestershire CC – Section 19 Reports
Site Visit Data Sheet

1. Detail of Area/Properties/People Affected						
Location/Ward Area:	Main Street, Kilby					
Team:	SE & SAJ					
Property Type(s) at flood risk Incl. Number:	Residential:	2+	Industrial:		Office:	
	Educational:		Religious:		Recreational:	
Other (e.g infrastructure)	Junction					
Comments:	Reports that ponding annually after similar storm events. Flood water gathers from all roads leading to this junction.					

2. Details of Flooding							
Flood damage incurred? :	Internal flooding experienced at Number 4.		Through doors:	Ponding in house number 3 & 4.			
			Through windows:				
			Through floors:				
			Through airbricks:				
			Through drainage:	Ponding in road			
Source of flooding (if known):	Main River	Other Water Course	Road	Overland	Public Sewer	Private Drain	Other e.g. blocked culvert, gully etc,
			Y	Y			Y
Comments (include estimate of flow path and sketch where possible):	The origin of the water is not clear, but is thought to be due to surface water from the storm. The junction seems to be the lowest point in the area, and as such water collects from all approaching roads to this point. Email correspondence supplied by the Council suggests that the road gully pots may be filled with silt, and the outlets may be obstructed by partially closed valves and a dead horse.						

Water Depth Inside property (m)	Unknown
Water Depth Outside property (m)	Unknown

Leicestershire CC – Section 19 Reports
Site Visit Data Sheet

3. Effects of Flooding											
Damage to Props. (residential and commercial/retail):	Internal flooding of (at least) house numbers 3 & 4, along with complete flooding of the road at the junction. Potential for vehicles to lose control in the junction following a tight turn. In the past cars have damaged the external wall of house number 4 – following which bollards have been installed.										
Damage to infrastructure:	No visible damage.										
Were/are properties Vacated?	No		If Yes, for how long?		If Yes, relocated to where?						
Utilities Affected?	Electricity		Water		Gas		Phone		Other		
Flood Report/Grant application Refs?	Unknown										
4. Existing Flood Defences											
Is there an existing defence? Type and details:	Neither properties have flood defences.										
Condition	N/A										
5. Potential Flood Alleviation Measures											
Proposed Measure(s) Details incl. length, height, Constructability/Access	Flood Wall										
	Flood Embankment										
	Upstream storage										
	Storm Water Drainage System	Possible improvements to system									
	Cleaning/Maintenance	Regular maintenance of the system									
	SUDS										
	PLP										
Location Details and sketch (Public or Private Property, Provide Details (e.g. river embankment, field, main road, residential street)	Public street; Main Street Road										
Further Comments											

Leicestershire CC – Section 19 Reports
Site Visit Data Sheet

Add further comments, details, sketches here:

Signature:

Name of Collator:	Date:	Time:
Stacey Johnson	29 /11 /2016	11.00 am

APPENDIX D

HYDROLOGY TECHNICAL NOTE

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

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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.

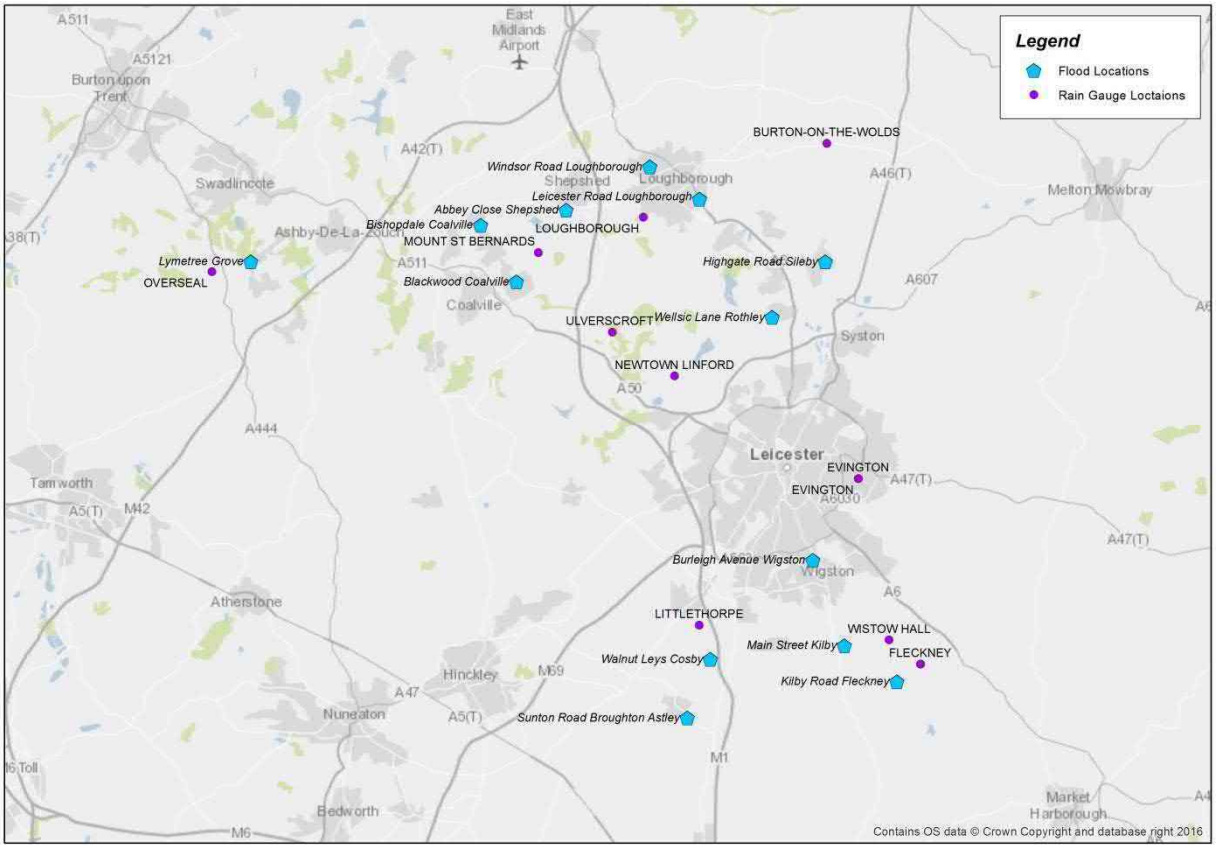

Figure 3-1: Location of flooding incidents and rainfall gauges

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.

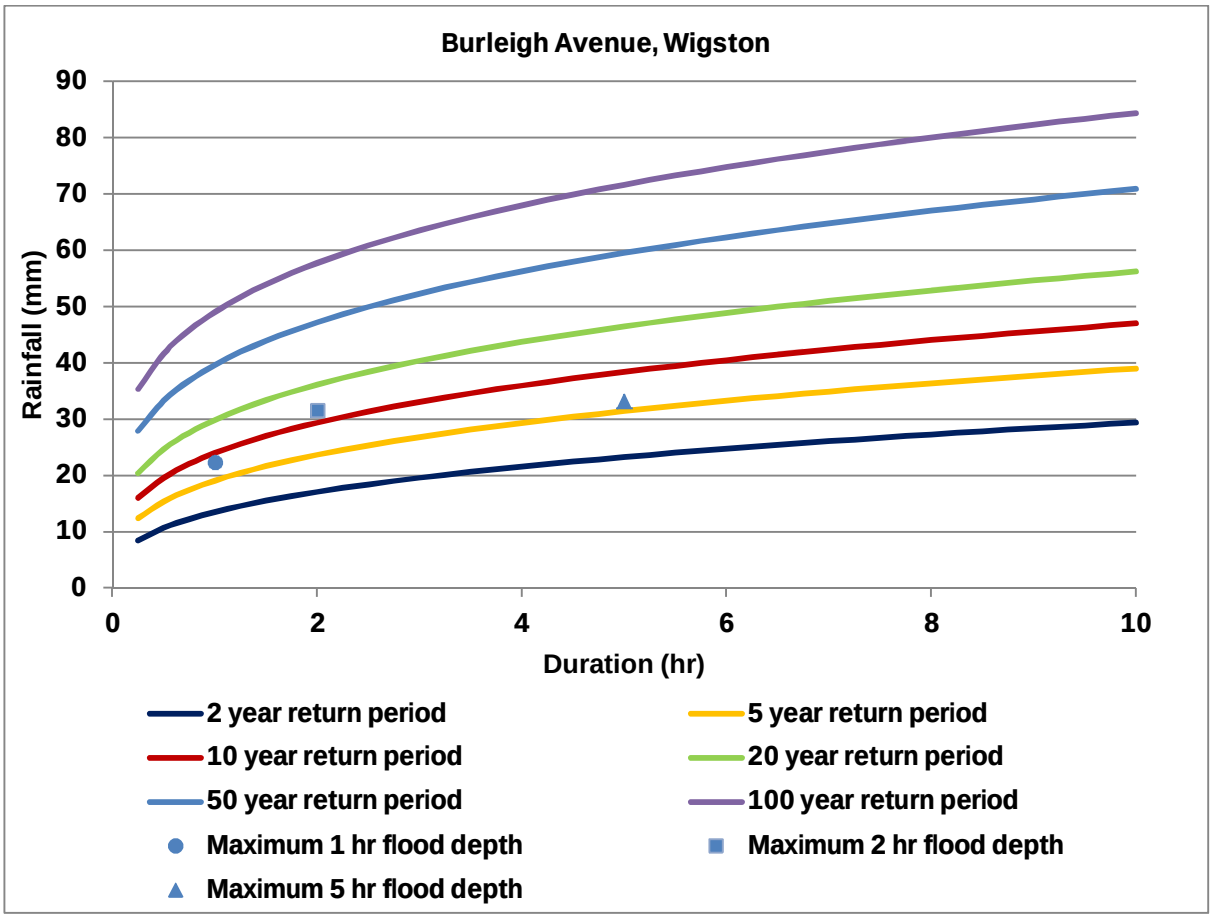

Figure 3-2: Example of rainfall maximums for different durations plotted against DDF rainfall curves to assess probability of occurrence

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

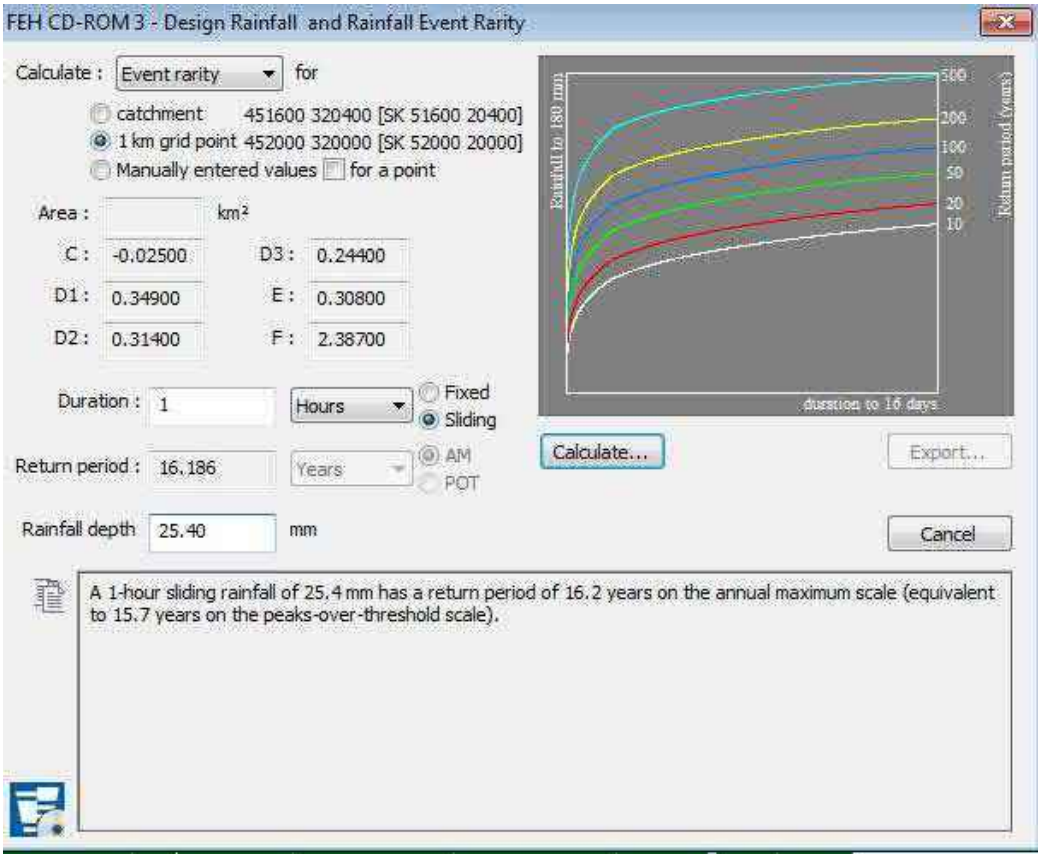

Figure 3-3: Example of the 'event rarity' function in the DDF rainfall model in FEH CD ROM 3

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.

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APPENDIX D-1

SITE SPECIFIC HYDROLOGICAL STUDY

APPENDIX D-1
SITE SPECIFIC HYDROLOGY

DDF curves describe rainfall depth as a function of duration for given return periods at specified locations within the UK and can be reproduced using the Flood Estimation Handbook (FEH) CD-ROM.

The DDF model for the Kilby catchment has been reproduced in Figure 4-3. The DDF model demonstrates that the 1 hour, 2 hour and 5 hour rainfall profiles over the Kilby catchment had an equivalent return period of between 20 and 50 years, i.e. between a 5% and 2% Annual Exceedance Probability (AEP). This was therefore a significant event.

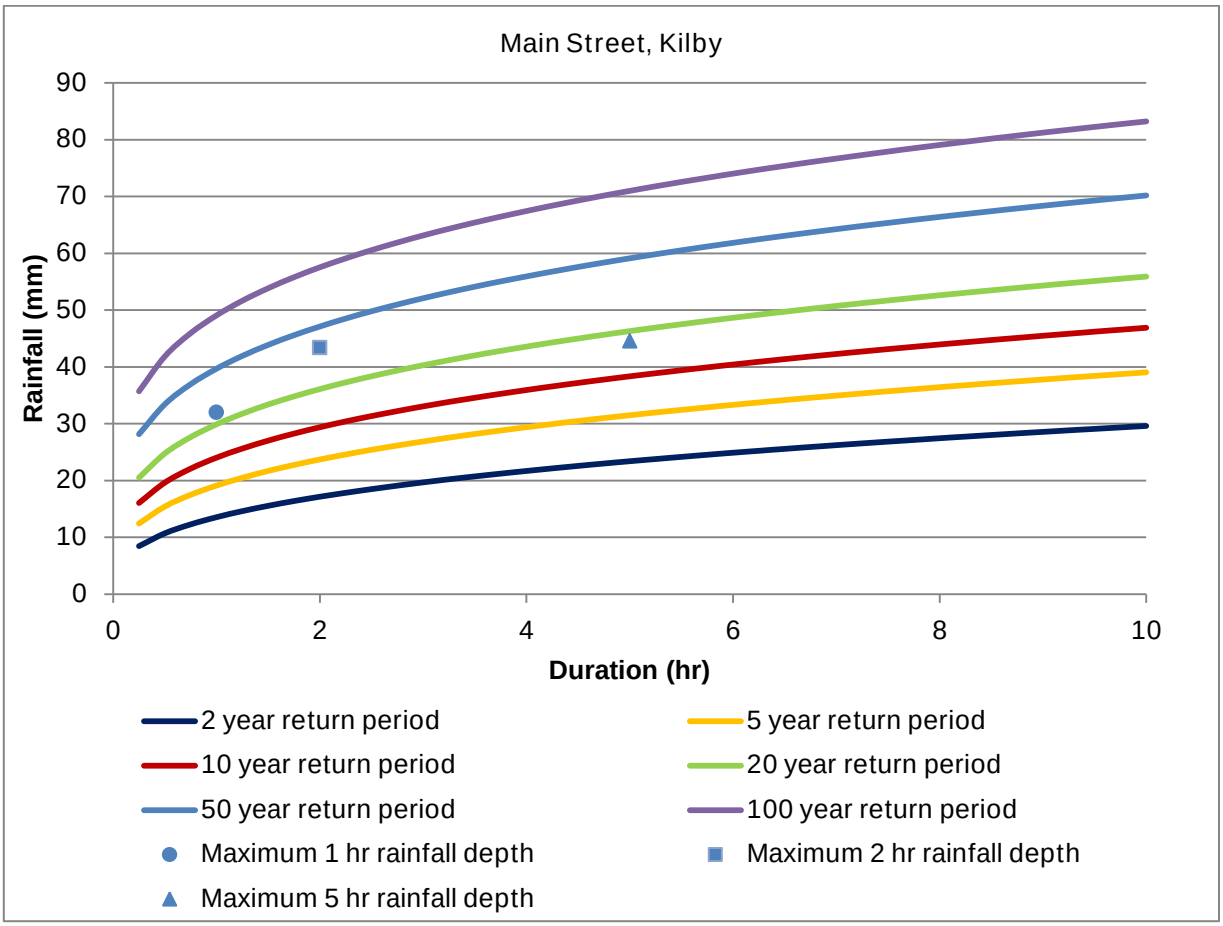
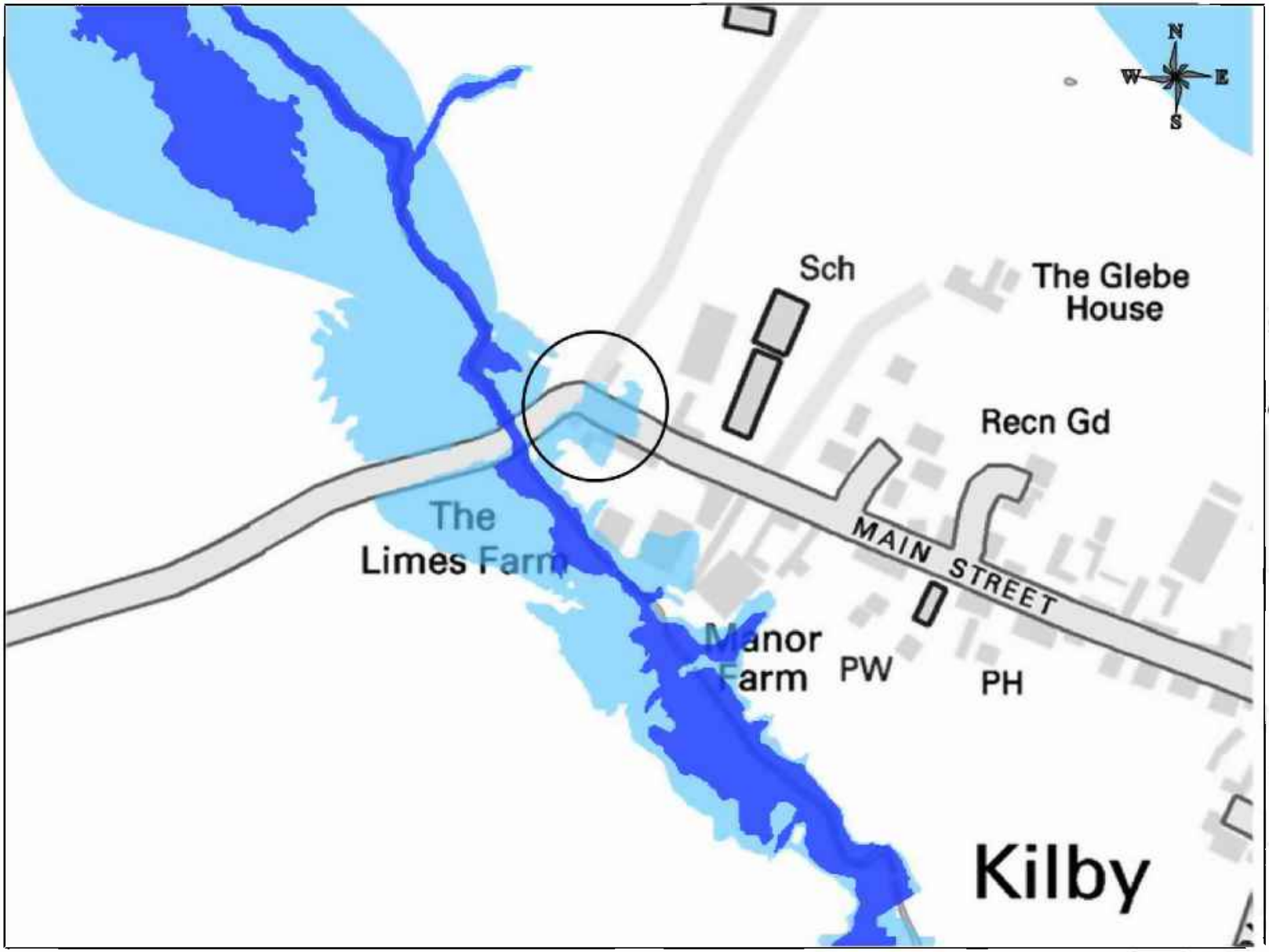


Figure 1: DDF model for Main Street, Kilby

APPENDIX E

RISK OF FLOODING FROM RIVERS AND SEA MAP



Key

Flood Zone 3

1% AEP (1 in 100)

Flood Zone 2

0.1% AEP (1 in 1000)

Leicestershire County Council

ENVIRONMENT AND TRANSPORT DEPARTMENT

On Behalf of the DIRECTOR

LEICESTERSHIRE COUNTY COUNCIL
ENVIRONMENT AND TRANSPORT

Service: Lead Local Flood Authority

TITLE: Flood Zones 2 & 3

LOCATION: Main Street Kilby

DRAWING NUMBER	SCALE
2016-INV-203	Not To Scale
CREATED BY: Stacey Johnson	DATE: 05/01/2016
	SIZE: A4

E-MAIL: flooding@leics.gov.uk

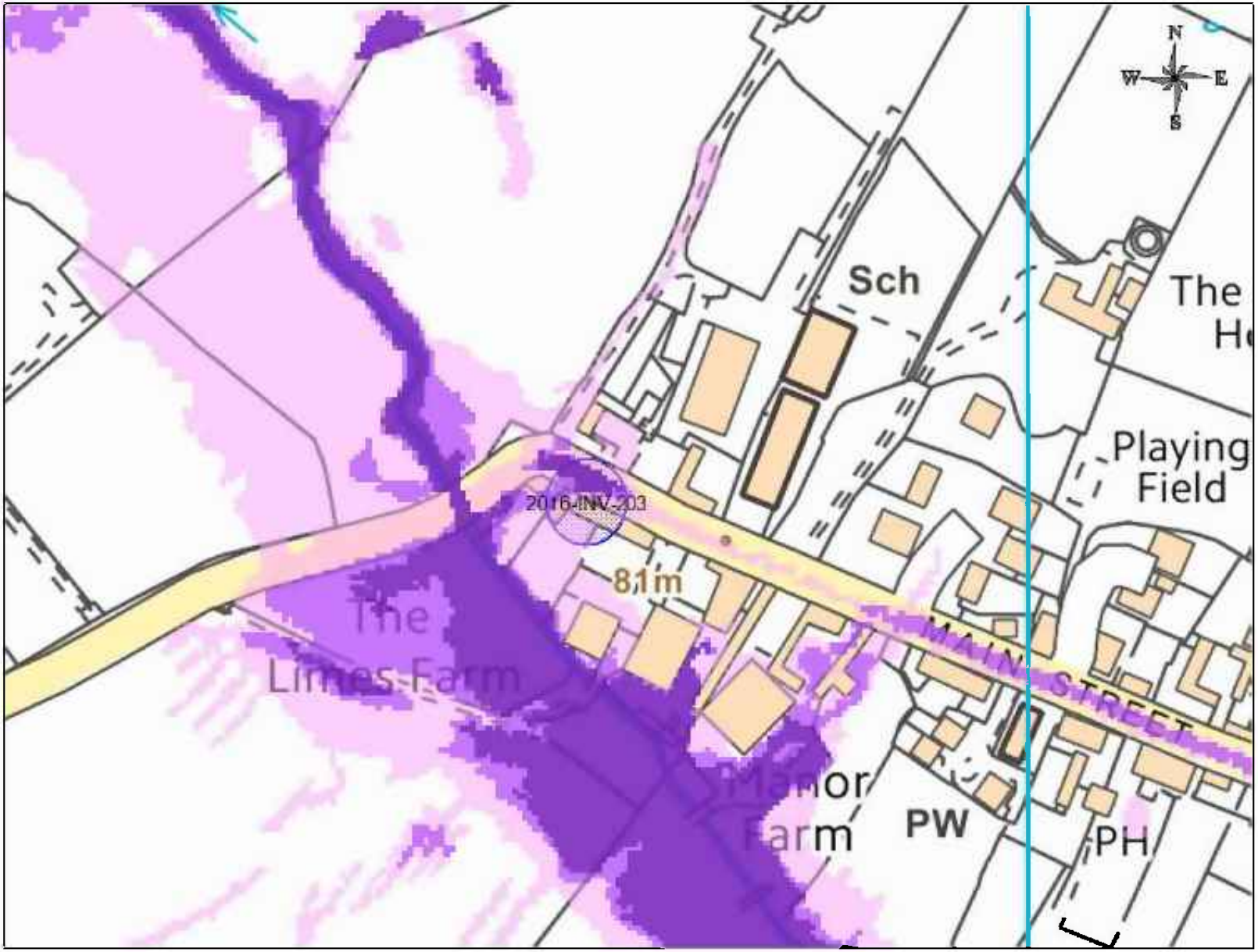
PHONE: 0116 305 0001

COUNTY HALL · GLENFIELD · LEICESTER · LE3 8RJ

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 F

ENVIRONMENT AGENCY LONG TERM FLOOD RISK MAPPING TO SHOW SURFACE WATER FLOOD RISK



Location Map

updated Flood Map for Surface Water

- 3.33 % AEP (1 in 30 Years)
- 1% AEP (1 in 100 Years)
- 0.1% AEP (1 in 1000 Years)

Site Location

- Site boundary

source_protection_zones_50k Legend

- Region

Leicestershire County Council

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: MAIN STREET

DRAWING NUMBER	SCALE
2016-INV-203	Not To Scale
CREATED BY: Chris Cant	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.