Hertfordshire County Council Flood Investigation Report Report

Travellers Lane, Hatfield
Hertfordshire

Travellers Lane in 2010
Aerial Photography © GeoPerspectives.co.uk

Hertfordshire

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Revision Schedule

Hertfordshire County Council
Travellers Lane Flood Investigation Report

August 2017
Revision 5

Rev	Date	Details	Author	Checked and Approved by
1	31/08/16	For internal FRM team consultation	James Lester, Flood Risk Management Project Officer	Andy Hardstaff Flood Risk Management Team Leader
2	01/09/2016	Draft for issue to Risk Management Authorities following comments from FRM team	James Lester, Flood Risk Management Project Officer	Ryan Thomas, Partnership and Scheme Development Officer
3	15/09/2016	Draft for issue to resident and Risk Management Authorities following comments from RMAs	James Lester, Flood Risk Management Project Officer	Andy Hardstaff Flood Risk Management Team Leader
4	27/07/2017	Draft following comments from RMA	Ryan Thomas, Partnership and Scheme Development Officer	Andy Hardstaff Flood Risk Management Team Leader
5	01/08/2017	Final	Ryan Thomas, Partnership and Scheme Development Officer	Andy Hardstaff Flood Risk Management Team Leader

Explanation of Acronyms

Acronym / Term	Explanation
FWMA 2010	**Flood and Water Management Act 2010** – Legislation that was developed and enacted as a result of the review in to the serious flooding in 2007. It brings new powers and duties to local authorities and other regulatory bodies.
HCC	**Hertfordshire County Council**
LDA 1991	**Land Drainage Act 1991** – Legislation that sets out a range of roles and responsibilities relating to flood risk management. It is also the legislation that gives powers to local authorities to manage flood risk and highlights the role of the landowner to manage watercourses on their land to maintain the flow of water.
LLFA	**Lead Local Flood Authority** – This is the role assigned to the unitary or county council for an area with a range of duties and powers to support the management of local flood risk.
RMAs	**Risk Management Authorities** – Bodies identified in the FWMA 2010 with roles and powers to manage flood risk. In Hertfordshire this includes the County Council, district councils, Highway Authority, Highways England, the Environment Agency, the Bedfordshire and River Ivel Internal Drainage Board, Thames Water and Anglian Water Services Limited..
Adopted Highway	The term has been used in this report to include all highways maintainable at public expense. This includes historic highways as well as those formally adopted through section 38 of the Highways Act 1980 and preceding powers.
Antecedent conditions	Antecedent conditions is a term used to describe the relative wetness or dryness of a catchment, which changes continuously and can have a very significant effect on the flows during wet weather. Antecedent moisture conditions are high when there has been a lot of recent rainfall and the ground is moist. Antecedent moisture conditions are low when there has been little rainfall and the ground becomes dry.
Attenuation	The processes of water retention on site slowly being released to a surface water/combined drain or watercourse.
Storage	An area or structure where surface water flows are retained.
Swale	Broad, shallow and vegetated channels which are designed to store or transport excess runoff water and remove pollutants**.**

Executive Summary

Travellers Lane has been affected by multiple flood events, which first started in December 2013. Flooding has been caused by two flooding mechanisms; overland surface water flooding and water surcharging from the foul water sewer network. There have also been incidents of flooding in the absence of rainfall, caused solely by obstructions to flow in the foul water sewer network along with a combination of both flood mechanisms. Flooding from the foul water network was recorded on a number occasions in 2016. There was internal flooding to properties caused by foul water surcharging from two private foul water manhole chambers located at the front of properties in Travellers Lane.

Hertfordshire County Council (HCC) in its role as Lead Local Flood Authority on becoming aware of a flooding issue arising from surface water flooding has the responsibility to begin an investigation. HCC instructed McCloy Consulting to identify the surface water flow paths, build a hydraulic computer model that replicates the reported flood events and to suggest alleviation options that could reduce the flood risk in the local area.

The main findings of the study are:

- There are two terraces of housing affected on Travellers Lane.
- Five of the thirteen properties identified as being at risk from flooding have reported internal flooding.
- Flooding occurred because of both overland surface water flow and the foul water sewer system surcharging. Witness accounts confirm flooding from manholes linked to the foul water sewer; from both the main sewer line manholes and also from sewer chambers which are in the front gardens of properties in Travellers Lane.
- A hydraulic computer model predicted flooding from the chambers in the gardens of properties but not from the main sewer manholes. The model is accepted as under predicting surcharge levels and flood volumes in relation to the foul water sewer system.
- The hydraulic model predicts that for the reported flood events the highway drainage system had sufficient capacity to accommodate surface runoff which enters the system through gully inlets. However, the model also indicates that not all surface runoff was collected by the gully inlets for the rainfall events considered (particularly the July 2015 rainfall event) due to the intensity of rainfall leading to runoff which exceeded the inlet capacity of the drainage system.

Following publication of the draft s19 report a public engagement meeting took place on 23 September 2016 with residents from the affected area. Presentations along with a question and answer session provided residents with information on investigations conducted by HCC and Thames Water Utilities Ltd (Thames Water). Questions raised about the sewer operations were passed on to Thames Water. Other questions directed to HCC were recorded; these have been answered and included in appendix 4.

1. Introduction

1.1 LLFA Investigation

Under Section 19 of the Flood and Water Management Act (FWMA) 2010 HCC as Lead Local Flood Authority (LLFA), on becoming aware of a flood in its area, must, to the extent that it considers it necessary or appropriate:

- Investigate the incident;
- Identify the Risk Management Authorities (RMAs) with relevant flood risk management functions;
- Establish if the relevant RMAs have responded to the flood event or are proposing to respond;
- Publish its findings; and
- Inform the relevant RMAs of its findings.

As defined under Section 6, subsection 13 of the FWMA 2010, an RMA has certain powers to manage, regulate, assess and mitigate flood risk. We have identified the following RMAs as part of this Section 19 flood investigation for Travellers Lane:

- HCC as LLFA
- Thames Water

The Travellers Lane flooding issue was first brought to HCC's attention following the floods which took place on 24 December 2013 and 7 February 2014 from which seven properties were reported to have flooded internally. One property was reported to have flooded internally on both dates. Subsequent flood events occurred on the 19 September 2014, 16 July 2015, 26 August 2015 and 23 June 2016.

Due to the severity of the flooding that took place during the winter of 2013/2014, it was determined that this flood incident met the criteria in Policy 2 of HCC's Local Flood Risk Management Strategy and HCC subsequently started an investigation.

1.2 Site Location

The investigation area is on Travellers Lane in South Hatfield. Please see figures 1 and 2, with a contributing surface water catchment as shown in figure 3.

Figure 1 Hatfield, Hertfordshire

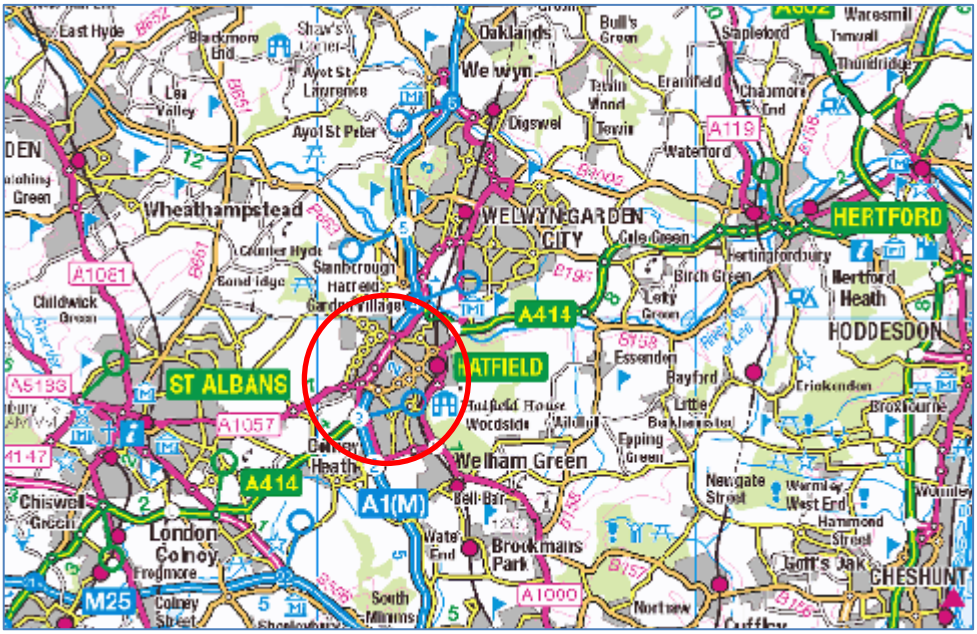


Figure 1: Location of Hatfield

Figure 2 Area of investigation in Hatfield

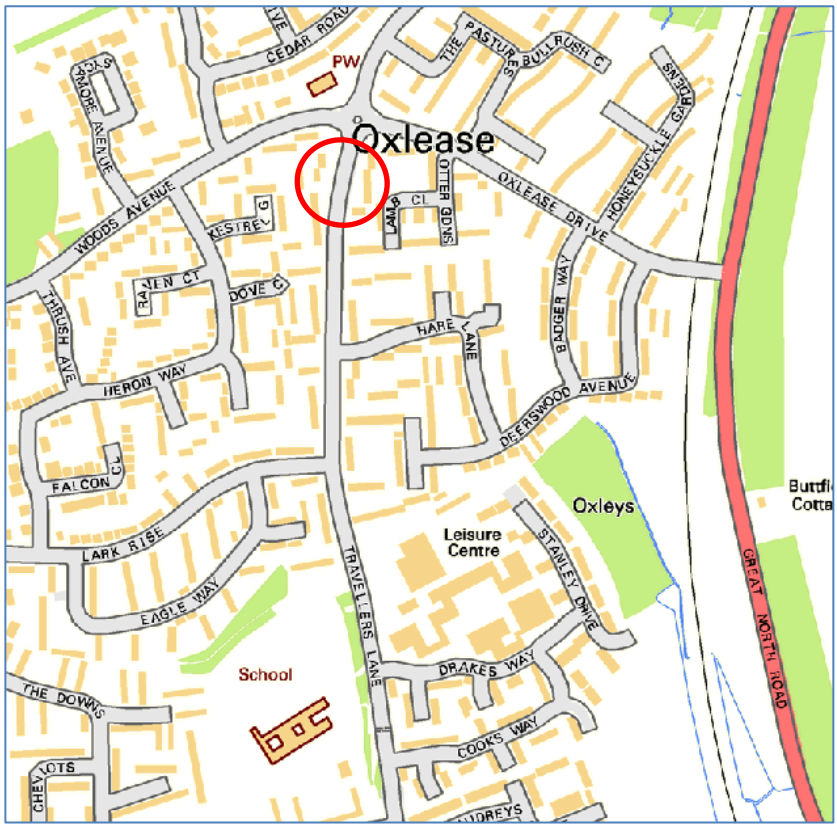


Figure 2: The area investigated

Figure 3 Catchment boundary

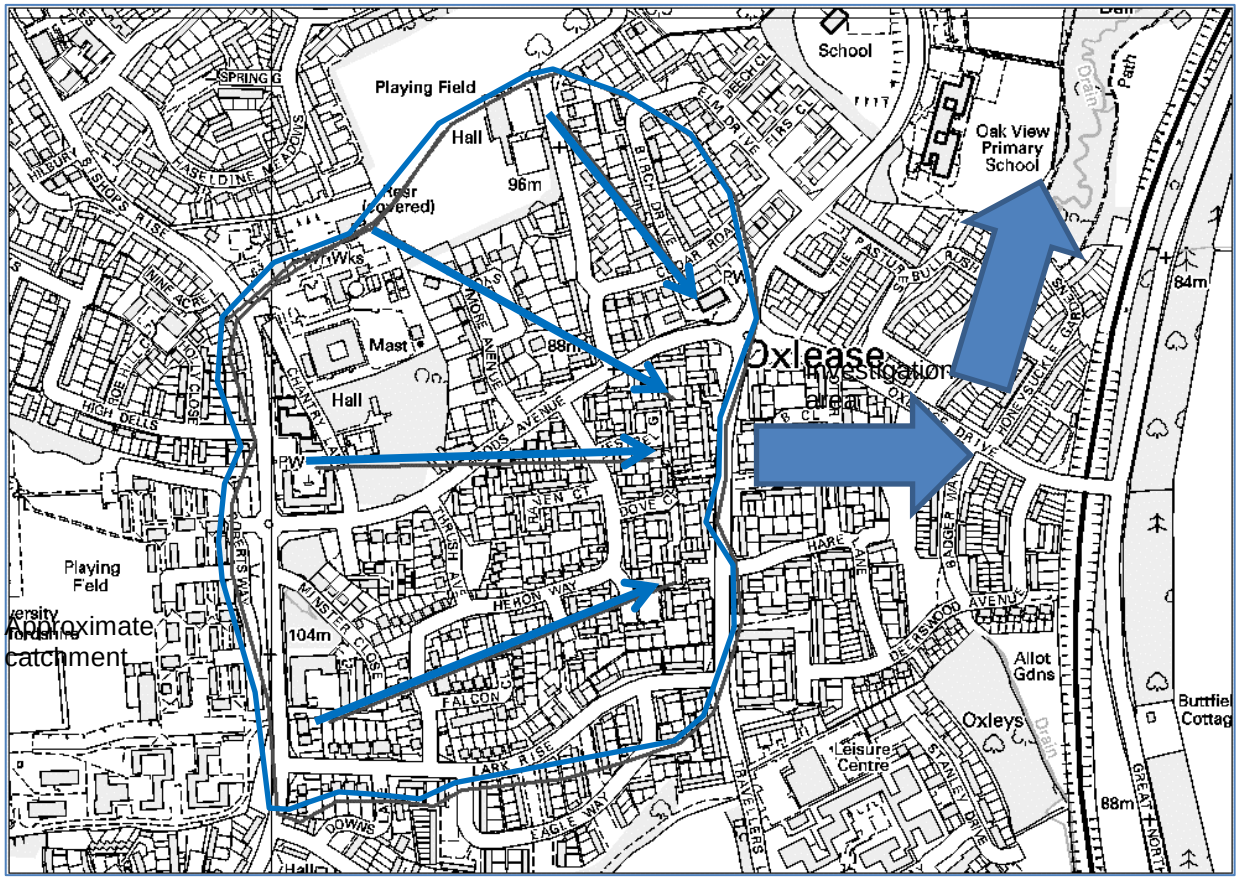


Figure 3: The area within which any rain that falls will flow towards Travellers Lane. The arrows represent approximate flow direction within the catchment. © Crown copyright and database rights 2017 Ordnance Survey 10.0019606

2. Background and History of flooding

2.1 Previous flood events

Flooding has been reported to HCC and recorded for the following dates. HCC as LLFA has only been recording flooding events from 2010.

- 24 December 2013
- 7 February 2014
- 19 September 2014
- 16 July 2015
- 26 August 2015
- 23 June 2016.

3. Assessment of the February 2014, July and August 2015 flood events

These flood events were chosen at the beginning of the investigation because they were known to involve contributions from surface water. Flooding that occurred on 23 June 2016 occurred after the investigation was commissioned and therefore is not discussed in detail in this report.

3.1 Observations

The observations from Travellers Lane were used as the basis for identifying the mechanisms causing flooding. There are three locations which are affected differently by flooding. These locations are identified in figure 4. Locations 1 and 2 are the front and rear of one row of terraced properties respectively and location 3 is the front area of another row of terraced properties.

- Locations 1 and 3 were observed to have been flooded at least in part by foul water surcharging from the main line sewer during each of the events in question.

- There is a foul water manhole in location 1, as shown on figure 4, that was reported to have surcharged on 26 August 2015 and another in location 3 which was reported to have surcharged on both the 7 February 2014 and 26 August 2015.

- There were no observations of foul water at the rear of properties in location 3.

- Location 2 was also flooded during each event with no observations of foul water. The maximum depth of flooding during the February 2014 and July 2015 events was approximately 130mm (5 inches).

Figure 4 Investigated flood areas

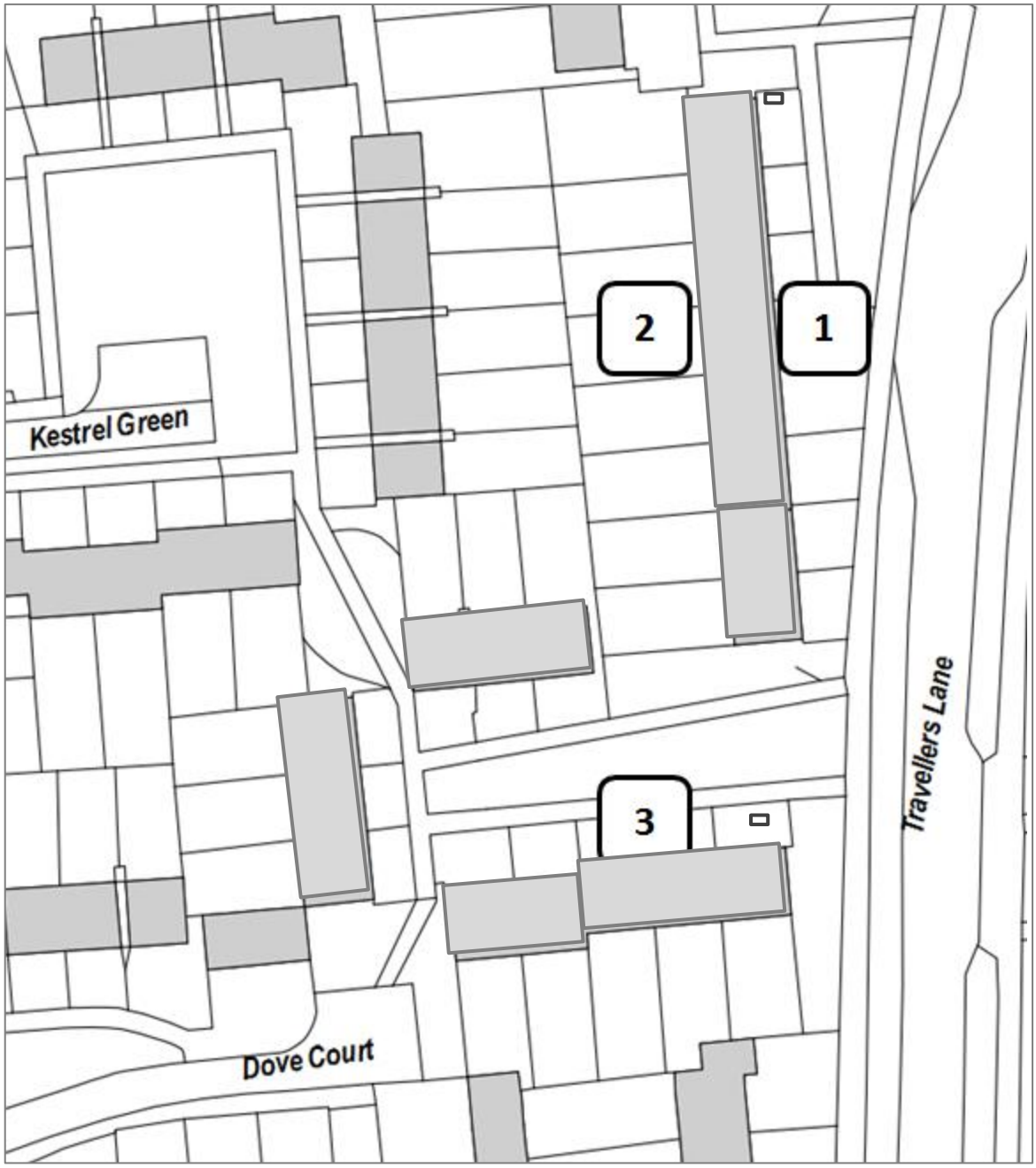


Figure 4: General locations affected by the investigated flood events
(Contains Ordnance Survey data © Crown copyright and database right 2017)

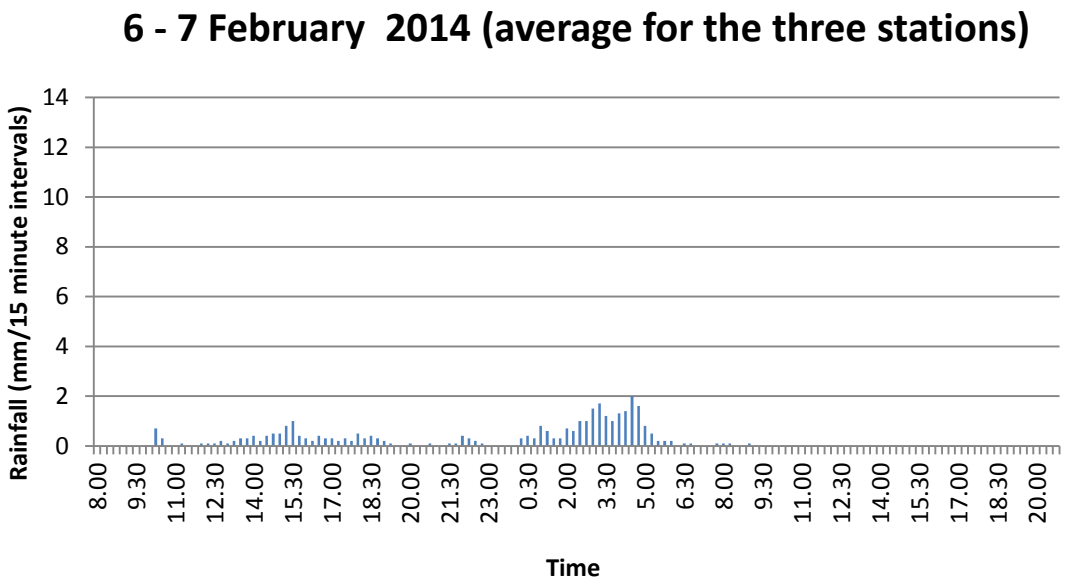
3.2 Rainfall and antecedent conditions

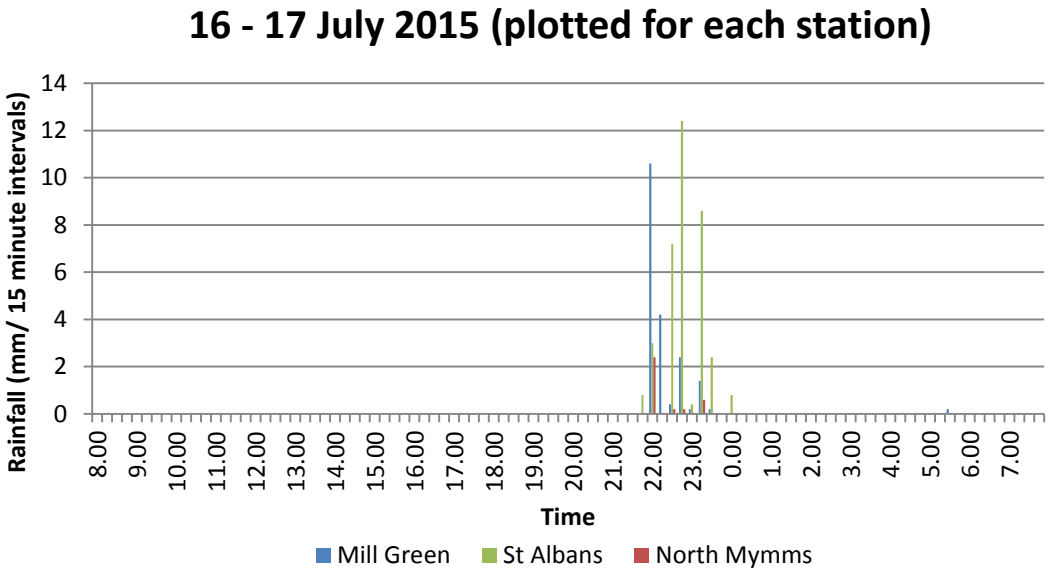
The levels of rainfall related to the flood events were estimated using data from weather stations in North Mymms, Mill Green and St Albans. For the location of these weather stations, see figure 8 in appendix 1.

Rainfall at the Travellers Lane catchment was assumed to be an average of what was recorded at these stations given that they are each a similar distance from the catchment. The measured rainfall is shown graphically in figure 5.

The rainfall on 16 July 2015 (see figure 5 (b)) as recorded at the local weather stations has been plotted for each station and not as an average to reflect the local variability of rainfall. Because of this variability, quantifying the amount of rain at Travellers Lane catchment cannot be determined exactly.

- 7 February 2014 – Heavy rain (50% probability of occurring in any given year) after three days of rain.
- 16 July 2015 – Heavy rain including a high intensity peak (1.7% probability of occurring in any given year)
- 26 August 2015 – Heavy rain (20% probability of occurring in any given year) following three days when rainfall occurred.





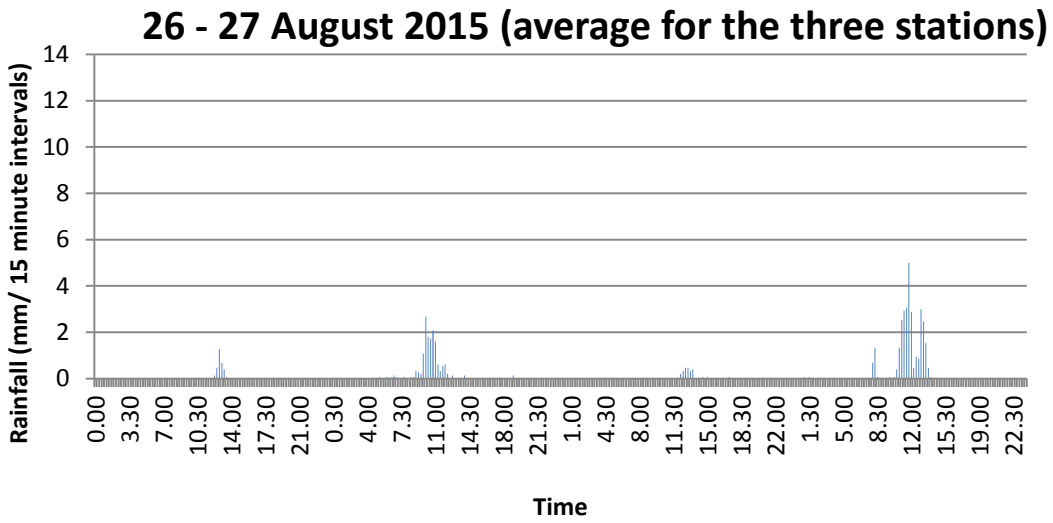


Figure 5: Rainfall preceding flood events

Surface water flooding occurred because of two distinct combinations of rainfall and antecedent conditions. The February 2014 and August 2015 floods were caused by heavy rainfall conditions preceded by wet weather which had caused the ground to become saturated. In contrast, the July 2015 flood was caused by intense rainfall, with a large volume of water falling in a short space of time.

3.3 Surface water runoff (pluvial)

The two areas where the flooding of dwellings occurred are localised low spots on the western side of Travellers Lane, at a break in gradient of the slope which drains in a broadly easterly direction from Bishops Rise towards the Great North Road. The properties in question lie on land between 130mm and 400mm lower than the road surface of Travellers Lane. This is significant because water that is not contained within the highway and overtops kerbs or dropped kerbs will flow down towards these lower lying properties. If there is a low threshold, for example a low step or airbricks, this further increases the risk of a flood inundating the property. The catchment is largely urban in character and the approximate area is 40 Ha. Approximately 22% of the catchment is confirmed as impermeable (road, paths and buildings). There will be some form of engineered drainage associated with much of these impermeable areas. Approximately 20% of the catchment is defined as roadside which may be grassed verge or surfaced pavement or parking areas. It is assumed that this area is permeable or will drain to the main carriageway.

Approximately half of the catchment is defined as “general surface” which will predominately be the gardens associated with houses, a proportion of which will be impermeable. This will include drives, patios, hard standings and pathways which may or may not be directly linked to drainage systems. Making an allowance for hard standings and based on visual analysis of the 2010 aerial photographs for the area, the working assumption is that approximately half of the catchment has some degree of permeability which will act to reduce the volume of surface runoff.

Surface water is expected to have reached location 2 (see fig. 4) having flowed down Briars Lane and overtopped the kerb on Woods Avenue. Location 3 is expected to have received significant flows from Kestrel Green and Dove Court.

3.4 Surface Water and Sewerage (Thames Water)

There are separate sewer networks serving the catchment. One will carry foul water and the other surface water. Thames Water is the responsible authority for both networks.

There are many ways that flooding originating from the foul water sewer network can occur, examples include:

1. Too much water in the sewer, causing water to surcharge from a low point in the network. This could be from a manhole outside or from internal downstairs toilets and sinks.
2. Rain entering the sewer, with the additional water surcharging in the same manner as point 1
3. A fault in the main sewer, such as a blockage, root penetration or a broken section of pipe, restricting the flow and causing water to back up behind it

Thames Water conducted a series of investigations of the sewer network following a series of flood event in 2015 and 2016. These flood events coincided with the surface water flooding events that are being investigated in this report. Thames Water identified sections of pipe where the capacity was severely restricted due to collapses in pipe and major root penetration. At the time of the high rainfall events, there was a series of hydraulic failures downstream from the Investigation site that restricted the flow capacity of the sewer. Due to the increased water levels in the foul network during the high rainfall events, it is highly likely that surface water is discharging into the foul water network somewhere upstream in the sewer catchment; however the source of this connection has not been located during this investigation. This could be from a series of private mis- connections overwhelming the foul water sewer network. Within the Travellers Lane site, we found that two front gardens drained to the foul water sewer. If this occurs multiple times in the catchment in can add a considerable volume of water to the foul water sewer.

Thames Water also established that a rising main pumps into the Travellers Lane main line sewer, immediately downstream of the site (at the junction of Lark Rise and Travelers Lane). This does not cause flooding directly, however if the rising main discharged at the same time as the flow in the sewer was greater than standard diurnal flow patterns; a combination effect with the obstructions identified downstream could exacerbate the flooding. Thames Water feel that with the obstructions removed the risk of flooding will be reduced.

3.5 Causes of flooding

In the investigated instances, surface water accumulated either as a result of high volumes of runoff from heavy rainfall on saturated ground conditions, or very intense rainfall. The storm which led to the flooding in February 2014 was not unusually heavy in itself but the context in which it fell was exceptional.

The winter of 2013/14 was one of the wettest on record and the weeks leading up to the 7 and 14 February were characterised by heavy storms crossing the Atlantic at approximately four day intervals. This was on top of ground that had been saturated or

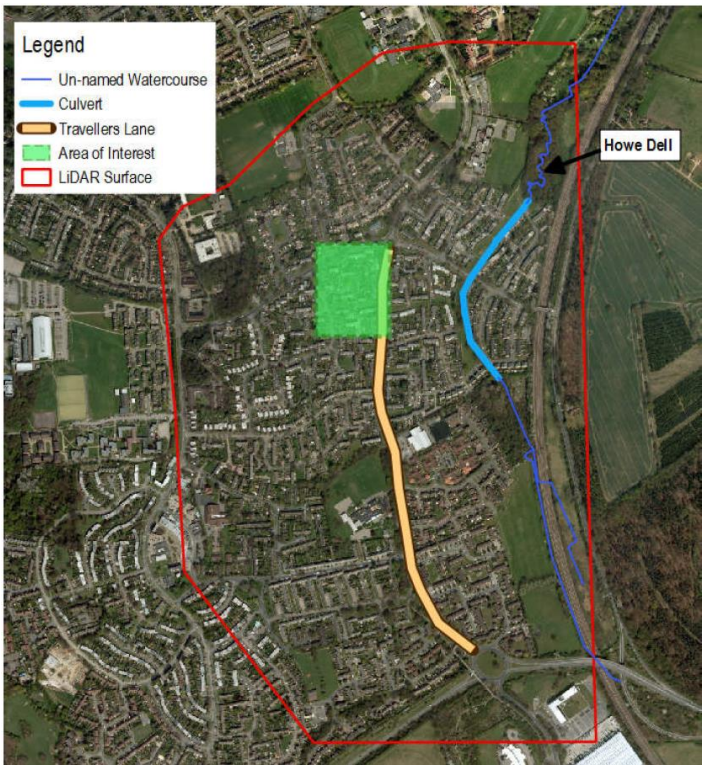
close to saturation for many weeks. No permeability tests have been carried out in the catchment but the assumption is that permeability would generally be low as the catchment is characterised by clay soils. Clay is not very absorbent, limiting the amount of water able to infiltrate into the ground. Therefore it is likely that the levels of saturation were a significant contributory factor to the flood event.

Due to the difficulties in understanding the surface water flooding mechanisms, a detailed hydraulic flood model was commissioned from a consultant. A flood model consists of multiple data sets, including:

- Topographical information, such as LiDAR (land heights)
- Underground sewer networks
- Rainfall data.

An Integrated Urban Drainage (IUD) model was built for the Travellers Lane drainage catchment, using Innovyze ICM software. This model was extended to a point where the catchment (surface runoff and piped surface water drainage) enters an open watercourse (see Figure 6).The foul sewer system is represented within the IUD model using hydraulic model data provided by Thames Water. The surface water sewer system and gully locations which serve the highway areas are based upon GIS data provided by HCC. The contributing hydrological catchment has been determined based on GIS analysis of a LiDAR based terrain model, augmented by drainage and infrastructure information. There is an unnamed watercourse significantly downslope of the affected properties. There are no other known influences in the catchment.

Figure 6: Surface Water Modelled Hydrological Catchment



The model has produced flood extent maps with likely flood depths depending on differing rainfall events and saturated levels. An example of the model results (the run for the flooding on 7 February 2014) is included within Appendix 3. The model helps in understanding the probability and severity of flood risk which will be used to assess the feasibility of any mitigation work.

The model results indicate that the three separate rows of houses in Travellers Lane flood from different flow paths and drainage networks. A detailed summary is listed next to the row of houses, see Figure 8. Overland flow occurs at both Kestrel Grange and Dove Court and from the north of the affected properties (from Woods Avenue).

The model also evaluated the surface water sewer network, as well as the highway gully network. The model found that both networks were close to full capacity; however the surface water sewer had sufficient capacity to accommodate surface run off collected by the highway gully network. The model predicts that not all surface runoff was collected by the highway gully network for the rainfall events considered, in particular the July 2015 rainfall event. Gully inlets have a finite capacity and where this is exceeded surface runoff will not enter the surface water sewer that will cause surface water flooding.

Map (Contains Ordnance Survey data © Crown copyright and database right 2015)	Location / Description	Comments
	Location **1**	In all events, surface water flow contributes to the flood extent at this location. A flow path is predicted originating from Briars Lane to the North. Surveyed pipe network along front of properties is shown to have capacity in the February 2014 event, while surcharge occurs at manholes in both the July and August 2015 event. Flood extent and depth at this location is greatest for the July 2015 event, this correlates with the highest surcharge levels in the pipe network for all events. Reports from latest flood event in August note flooding from manholes in front of the property, which correlate with the outputs of the model.
	Location **2**	Surface water flow contributes to flood extent at this location, with areas draining to a low point from the area to the east and north of the properties. A large flow path is predicted within the model from Briars Lane to the north, overtopping the kerb on Woods Avenue and flowing towards the rear of properties. Pipe network is surcharged in February 2014 event, without flooding of the manholes being represented by the model. In both 2015 events the hydraulic model represents flooding manholes to the rear of the properties, contributing to flood depths and extents at this location. Flood extent and depth at this location is again greatest for the July 2015 event, with surcharge levels in the sewer network highest for this event.
	Location **3**	Surface water flow contributes to flood levels at this point, with notable surface water flow paths from Dove Court and Kestrel Grange. In all cases, the pipe network to the front of the properties appears to have sufficient capacity within the immediate sewer network. In the 2015 events, capacity within the receiving network is close to capacity, in the main sewer line running parallel to Travellers Lane. Flood depths and extents are greatest for the July 2015 event.

Figure 7: Flood mechanisms for Travellers Lane

4. Responsible authorities and landowners

Part of the role of HCC as the LLFA in accordance with s19 of the FWMA 2010 is to identify the risk management authorities (RMA) that have flood risk management functions relevant to the flooding at Travellers Lane. Those RMAs and their relevant powers and functions are set out below.

4.1 Hertfordshire County Council as Lead Local Flood Authority

HCC as the LLFA for Hertfordshire has fulfilled its responsibility to carry out a Flood Investigation under Section 19 of the FWMA 2010, to;

1. Identify the relevant RMAs and;
2. Establish if those authorities intend to utilise their own powers and to what extent. The actions that the relevant RMAs have agreed to take are set out in Section 6.

In order to achieve the responsibilities under Section 19, HCC as LLFA must first establish the cause and impacts of the flooding and then, where possible, identify actions to reduce flood risk.

HCC as the LLFA for Hertfordshire has powers to carry out flood risk management works, in accordance with the Local Flood Risk Management Strategy for Hertfordshire, for flooding from surface runoff and ground water.

4.2 Hertfordshire County Council as the Highway Authority

HCC are the responsible authority to maintain and manage adopted highways including associated drainage infrastructure such as gullies, drainage pipes, and soakaways etc. which have been provided for the sole purpose of draining the public highway.

Travellers Lane and surrounding highways are highway maintainable at public expense and is impacted by the flooding.

HCC as the Highway Authority have powers to manage water falling on the public highway under the Highways Act 1980, however where this water originates from third party land and not from runoff from the highway these powers are limited.

HCC as the Highway Authority is required, as far as is reasonably practicable, to keep highways open and usable by the public.

In extreme flood events the majority of excess surface water will eventually flow onto the highway as roads act as manmade conduits for such water.

HCC as the highway authority has fulfilled its responsibilities of maintaining the highway drainage network.

4.3 Thames Water

Thames Water manages the public surface water and foul water sewer networks; it therefore has been identified as a relevant RMA.

Surcharging from manhole chambers associated with the public sewer system has contributed to and has been the sole cause for internal property flooding at Travellers Lane.

Thames Water manages flooding from their network in line with their business plan approved by OfWAT.

Since the Section 19 Investigation started, Thames Water has rectified three separate pipe defects that they have identified as being the cause of flooding from their network during the low rainfall return periods. They have also installed sewer alarms to a small number of properties to help warn residents that they may be at risk from imminent flooding from the foul water sewer situated at the front of their gardens.

5. Conclusions, potential mitigation options and recommendations

5.1 Conclusion

The Travellers Lane area has been the victim of separate flood events with different flood mechanisms. This investigation is limited to the surface water flood events, however through the completion of this investigation, discussions with Thames Water to about their sewer network has taken place.

The model has identified that the area is at risk from a series of different overland flow paths. The drainage infrastructure may have the capacity to accommodate increased flows; however there is a delay for water to discharge effectively into the correct network.

5.2 Potential mitigation options

The area which is the subject of this investigation has been flooded separately by both water surcharging from the foul sewer and surface runoff.

HCC (the LLFA) only has discretionary power to manage the risk of flooding from surface water runoff. Thames Water alone has the authority to alter the foul water sewer and to manage the flood risk associated with it. Before any mitigation actions can be considered, a feasibility study must be conducted to judge whether an action would be beneficial and cost effective. Any options proposed in future studies will be for surface water runoff only. However there may be an additional benefit in terms of protection from flooding from the foul sewer through capturing surface water that would have entered the foul water sewer.

Any proposed recommendations below will require detailed pre-feasibility studies to ensure that any flood risks are not passed on to other properties.

This investigation recommends the following options to be considered for feasibility:

5.21 Flood Conveyance Swale for Surface Water

Considering the existing layout of houses, there might be an opportunity to use the pathways, existing road and green corridors to collect and convey away flows whenever the capacities of the existing conventional surface water drainage systems are exceeded. Runoff would be deflected by a shallow swale away from properties. A swale is a flat based wide channel with shallow side slopes.

McCloy Consulting explored if this idea was feasible by adding a concept swale to the hydraulic model. The following was applied to produce a theoretical swale:

- Paths lowered from Dove Court and Kestrel Grange to provide flow conveyance to flood conveyance green corridor (this will create a wide shallow swale).
- Construction of walls to deflect exceedance flows from current flow paths to conveyance corridor and protect properties downslope.

- Construct a green corridor (wide shallow swale) through existing green space from the front of 40 - 48 Travellers Lane to Howe Dell.
- Provide additional drainage to collect flows from front and rear of 12-26 Travellers Lane.
- Provide road crossings (pipes) at Travellers lane and Oxlease Drive.
- Construct raised kerb and profiling of the road at Woods Avenue to convey flows from north of the catchment.
- Construct a drop kerb at Travellers Lane & Oxlease Drive to convey flows to west of the catchment.

Figure 8 identifies the location of the proposed Swale.

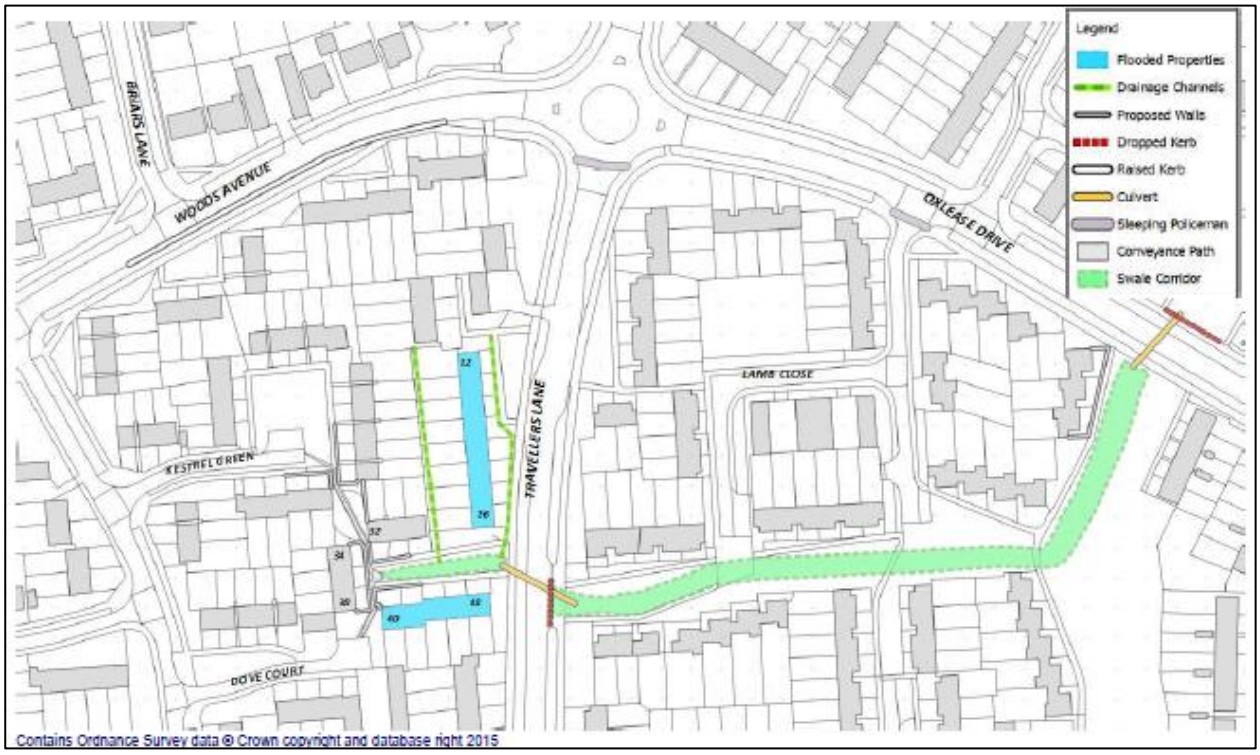


Figure 8:Proposed Swale

The model results indicate that the Swale option, which would create a flood conveyance corridor, could collect and convey surface water, greatly reducing the risk of internal flooding to a number of properties in Travellers Lane. The option intercepts the main contributing flows to these locations. The encouraging results justify that further modelling should be progressed to pre-feasibility stage.

5.22 Improving Property Resilience

Due to the localised and complex nature of the flooding in this area, increasing the flood resilience of individual houses should be considered as an option. Measures such as removable flood gates and flood resistant doors allow water to pool around property and drain away naturally. Passive measures are preferable to manual measures which would require residents to put them in place during or before heavy rain.

The ‘Homeowners Guide to Flood Resilience’ illustrates the variety of ways in which a home can be protected through the fitting of various products and installations. The

document can be downloaded at;

http://www.knowyourfloodrisk.co.uk/pdf/protection-guide.pdf

Figure 9 indicates the number of properties where water levels would need to be considered when choosing the correct Property Level Protection.

Design Rainfall Event	5%-AEP	3.3%-AEP	1%-AEP
Number of Affected Properties	13	13	13
Of which flood depth of up to 0.6 m	6	5	3
Of which flood depth 0.6 - 0.9 m	7	4	3
Of which flood depth greater than 0.9m	-	4	7

Figure 9: Property Level Protection Applicability

Property resilience can only be effective against limited flood heights. If a level is greater than 600mm, it could put pressure on the structural integrity of the building due to the force of water acting against it. It is recommended that a full detailed survey is undertaken at each property using the modelled flood heights to help inform the most effective and appropriate resilience option

It should be noted that property level protection may not completely stop the entry of flood water and may only serve to delay the time of entry. Currently Property Level resilience is not funded by HCC; it is the responsibility of the property owner to protect their property with these resilience measures.

It also should be noted that both the swale and Property Level Protection options may require installation together in order to mitigate against the risks of flooding. A more detailed feasibility assessment should consider this issue.

5.23 Additional drainage in Travellers Lane

The model has identified that the Thames Water surface water sewer has additional capacity that isn't being utilised due to the location of the gullys currently in the highway. As flooding isn't due to the highway infrastructure and no repeat nuisance flooding has been reported, it is reasonable to assume that the current number of gullies in the locality is sufficient for draining the Highway. Therefore any additional drainage would need to be in the form of land drainage assets, which could be situated on the Highway or other strategic points to capture additional water from overland flow paths.
For this option to be taken forward, detailed modelling would be required in order to confirm that no flood risk is passed on downstream of the Travellers Lane site, as well as accurately determining the discharge rate required from the proposed drainage asset. There will also be a need to acquire consent from the responsible bodies, such as Thames Water, appropriate landowners and Hertfordshire County Council as the Highway Authority.

6. Next Steps and Actions

6.1 Lead Local Flood Authority

The following are agreed actions to be undertaken by HCC in its capacity as LLFA;

1. Hold a meeting with Thames Water who have been identified as a key Risk Management Authority for this area.
   Update actioned 12/09/2016

2. Make this draft report available to residents of Travellers Lane
   Update actioned 15/09/2016

3. Hold a public meeting for residents at Travellers Lane, currently programmed for 19 September 2016 **Update actioned 19/09/2016**

4. Record comments from both the community, Risk Management Authority and Key Stakeholders and produce a Final Report **Update actioned 19/01/2017**

5. To distribute final copies of the report to all relevant Risk Management Authorities and other appropriate parties.

6. Investigate the feasibility of the three options for managing flood risk in the investigation area.

7. Disclaimer

This report has been prepared as part of Hertfordshire County Council's responsibilities under the Flood and Water Management Act 2010. It is intended to provide context and information to support the delivery of the local flood risk management strategy and should not be used for any other purpose.

The findings of the report are based on a subjective assessment of the information available by those undertaking the investigation and therefore may not include all relevant information. As such it should not be considered as a definitive assessment of all factors that may have triggered or contributed to the flood event. HCC expressly disclaims responsibility for any error in, or omission from, this report arising from or in connection with any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the time of preparation and HCC expressly disclaim responsibility for any error in, or omission from, this report arising from or in connection with those opinions, conclusions and any recommendations.

HCC does not accept any liability for the use of this report or its contents by any third party.

Appendix 1

Rainfall data provided by the Environment Agency from climate stations at St Albans, Mill Green and North Mymms.

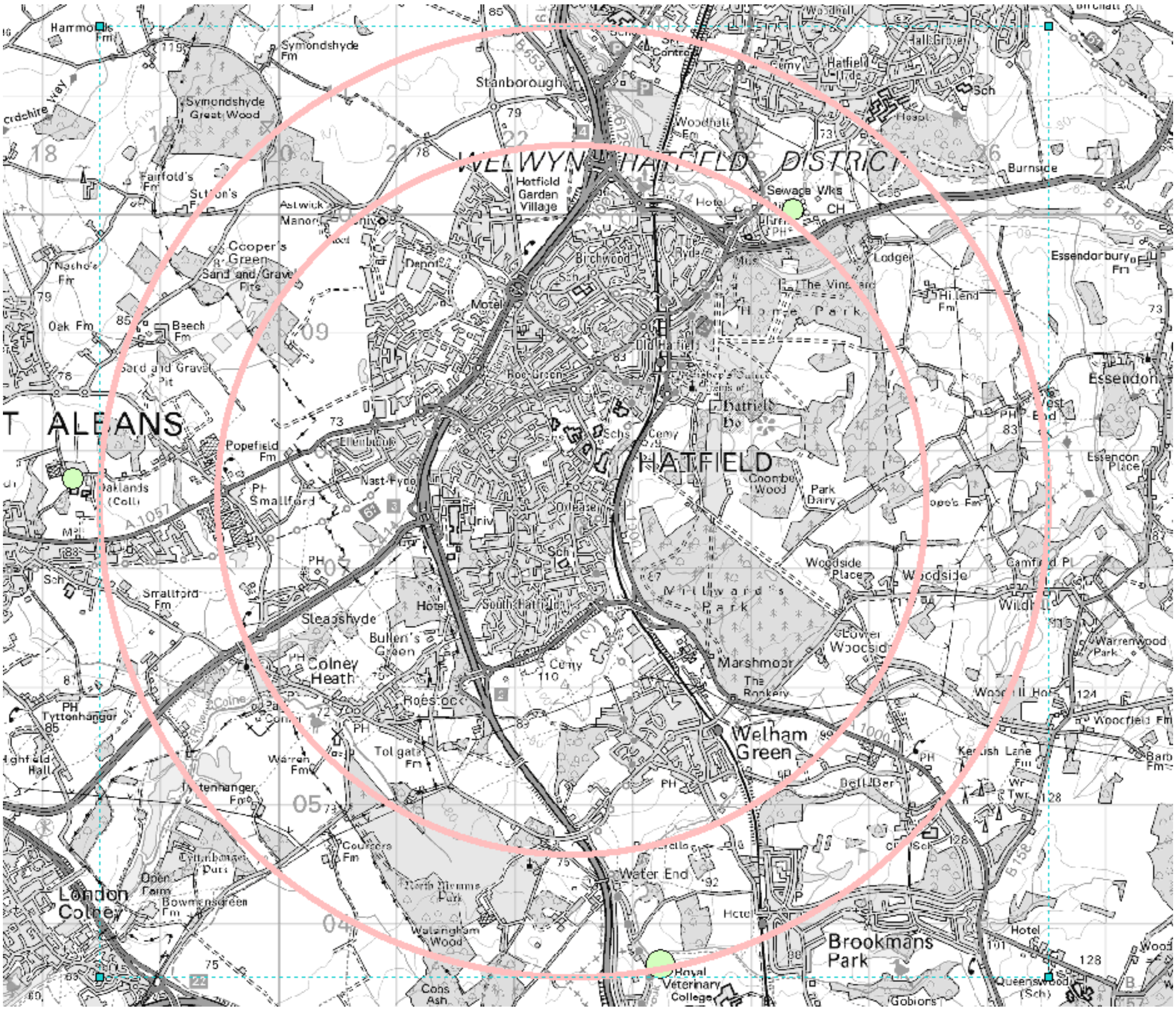


Figure 10: **Rain gauges as used to predict rainfall identified by the green dot.**

Appendix 2

Catchment topography for Travellers Lane catchment

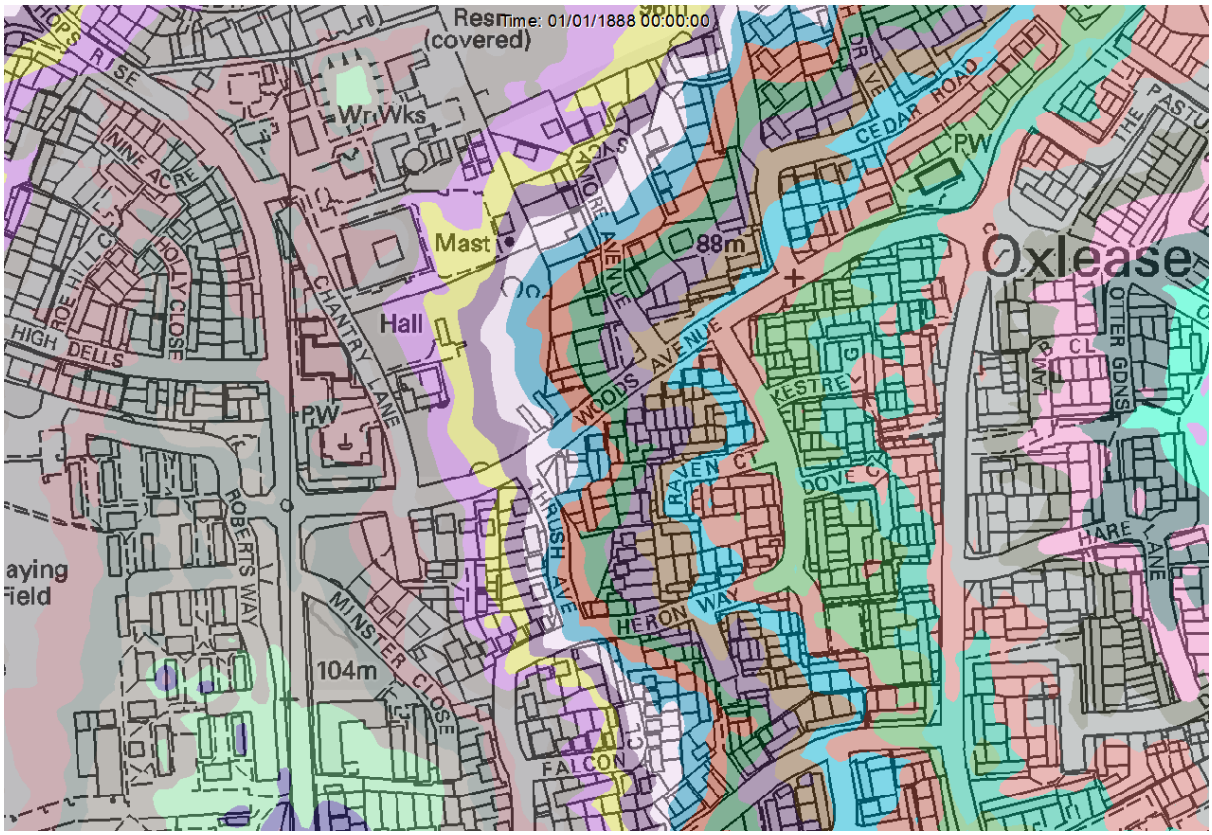


Figure 11: Land elevation in the area of the investigation.

Appendix 3

Notes taken by HCC at the Community Meeting 23 September 2016.

Members of the project team, along with a representative from Thames Water attended a public engagement meeting at Oxlease House, Travellers Lane on the evening of 23 September 2016. All residents within the study area were invited to attend the meeting and a presentation with question and answers session took place.

The Field Operations Specialist, representing Thames Water, provided an update of their own investigations, which concluded that root penetration downstream of Travellers Lane was restricting the flow capacity of the sewer. The works to rectify this problem had been completed before the meeting with additional works confirmed to be completed after the meeting. Further questions were posed to Thames Water at the end of the meeting which were passed directly to Thames Water to respond to residents. They are detailed below in section 7.1.

7.1 Questions for Thames Water

Resident Question 1: Customer Care experience. This included being put on hold for significant periods of time before getting through to an advisor for then to be told the issue had been fixed. The “fix” may have resulted in blockages being cleared but the underlying cause still remained. There were also issues of talking to staff with no local knowledge of the area

Resident Question 2: Residents do not believe that the flooding would be resolved from fixing the section of pipe identified in the presentation

Resident Question 3: Residents do not understand why it is their houses at risk of flooding if the problem identified for the cause of the flooding is much further downstream

Resident Question 3: Clarity of the Thames Water sewer network in the vicinity, particularly connections from the University of Hertfordshire campus which includes both the Surface and Foul Water discharge locations

Resident Question 4: Confirmation of the structural integrity of the sewer network near the University of Hertfordshire Campus at Bishops Rise due to type of road traffic during the construction phase

Council Response: All questions were sent via email on 21 September 2016 to Thames Water. We expect Thames Water to reply directly to residents

7.2 Presentation of Section 19 Investigation

McCloy Consulting discussed the methodology and results of the hydraulic model, which are detailed in this report. After the presentation, HCC recorded a number of questions from residents and made a commitment to find out the answers. Below are the questions sent via letter to all residents 26 September 2016 and the answers we are now able to provide.

7.2 Questions for Herts Highways

Resident Question 5: Confirmation of the gully clean programme for Travellers Lane, Dove Court and Kestrel Green

Council Response: The gullies are now on the vulnerable gullies list. This therefore means that they are attempted to be cleaned every six months when possible

Resident Question 6: Confirmation of all gullies in the vicinity of Travellers Lane that have been cleaned and when they were last completed

Council Response: The last recorded attempt to clean the gullies was 26 August 2016. We are unable to give specific details of the clean for each gully, however due to a parked car only one gully was inaccessible and another required further works.

Resident Question 7: Discussion about gullies that are prone to silting up due to nearby vegetation.

Council Response: If residents want to report a fault on the highway this can be done via the HCC website and the highway contractor will review the report.

7.3 Questions for the Lead Local Flood Authority

Resident Question 8: Confirmation that the surface water from the University building at Bishop's Rise is not contributing to the overland flooding experienced at Travellers Lane.

Council Response: After reviewing the topographical data, any surface water runoff would not drain towards Travellers Lane; instead draining towards A1(M), which is west of the university campus. After discussions with Thames Water, they have confirmed that the surface water draining from the site is connected to a surface water sewer in Bishops Rise, which flows north -west and not in the direction of Travellers Lane.

Appendix 4

Travelers Lane modelled outputs for the 7 February flood event