



Milton Keynes Council

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# FLOOD RISK INVESTIGATION

Stony Stratford Section 19 Report





Milton Keynes Council

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## Stony Stratford Section 19 Report

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# 1 INTRODUCTION

## 1.1 BACKGROUND

WSP UK Ltd (WSP) have been commissioned by the Milton Keynes Council (MKC) Flood and Water Management Team to investigate significant flooding in the village of Stony Stratford between the 23<sup>rd</sup>/24<sup>th</sup> December 2020.

A Section 19 flood investigation has been completed for Stony Stratford to investigate the flooding mechanisms, causes and sources of flooding that occurred.

## 1.2 RISK MANAGEMENT AUTHORITIES

Summary of Risk Management Authorities (RMA) and their responsibilities can be seen in Table 1-1.

**Table 1-1 – Risk Management Authorities relevant to this S19**

| Risk Management Authority             | Flood Risk Function   |
|---------------------------------------|---|
| Milton Keynes Council - LLFA          | <p>Lead Local Flood Authority (LLFA), responsible for undertaking an investigation of the 23<sup>rd</sup>/24<sup>th</sup> December flood event, ensuring co-operation between the Risk Management Authorities in this area and leading the development of emergency planning and recovery after the flood, particularly when the main source of flooding is surface water.</p> <p>Can carry out flood risk management works on minor watercourses (outside the IDB District);</p> <p>Works in partnership with other Risk Management Authorities to ensure risks are managed effectively.</p> |
| Anglian Water Services                | Responsible for ensuring the appropriate level of resilience to flooding and maintenance of the foul and surface water sewerage assets within the study area.   |
| Environment Agency                    | Manage the risk of flooding from main rivers, reservoirs, estuaries and the sea and responsible of developing long-term approaches to FCERM.  |
| Internal Drainage Board (IDB)         | <p>Responsible for managing water levels in low-lying areas as well as supervising land drainage and flood defences works on ordinary watercourses inside the Boards district.</p> <p>Act as Agent for Lead Local Flood Authority on Consenting and Enforcement matters.</p>  |
| Buckinghamshire Fire & Rescue Service | Local fire and rescue service responsible for attending to emergency events within Milton Keynes.   |
| Canal and River Trust                 | Canal and River Trust is responsible for 2,000 miles of navigable canals and rivers, together with bridges, tunnels, aqueducts,   |

|              |   |
|--------------|---|
|              | docks and reservoirs, along with museums and archive collections. The Milton Keynes trough pound is the nearest Canal and River Trusts waterway to Stony Stratford.   |
| Park's Trust | The Parks Trust owns and maintains approximately 2,500 hectares of land in Milton Keynes. They own a considerable amount of land within the valley floodplain of the River Great Ouse at Stony Stratford. They hold and operate this land in accordance with their purpose as a charity, which is to provide and maintain parks and green spaces for use by the public. |

It is considered that the above RMAs have exercised or are proposing to exercise those functions in response to the flood. The LLFA have exercised their flood risk management function by investigating reported incidents of flooding through the commissioning of this Section 19 Flood Investigation Report.

### 1.3 DATA COLLECTION

WSP has undertaken data collection activities with a variety of key stakeholders including the Environment Agency (EA), Anglian Water (AW), Milton Keynes Park's Trust, Canal & River Trust, the Internal Drainage Board (IDB), Buckinghamshire Fire & Rescue Service and MKC. This is being undertaken to obtain key data regarding the aforementioned flood events between the 23<sup>rd</sup>/24<sup>th</sup> December 2020, including but not limited to pre and post flood recovery actions, maintenance regimes and local flood risk issues associated with assets that may have contributed to the events.

Data obtained to date and further details regarding this can be seen in Table 1, Table 2 and Table 3 in Appendix A.

### 1.4 CONSULTATION WITH STAKEHOLDERS

The following key stakeholders have been consulted as they all have flood risk functions that are prevalent to the 23<sup>rd</sup>/24<sup>th</sup> December 2020 flooding event.

#### 1.4.1. ANGLIAN WATER SERVICES

AW provided information and datasets listed in Appendix A as well as verbal feedback within a call on 22<sup>nd</sup> June 2021. In the call the functioning and maintenance regimes of balancing lakes and river gauges were discussed (although with limited impacts within Stony Stratford), as well as the current studies that there are being undertaken to understand the capacity of their system in conjunction with the river catchment.

#### 1.4.2. ENVIRONMENT AGENCY

The EA's River Great Ouse catchment team have been consulted and have provided a spectrum of data including rainfall and river gauge data. A list of the information assessed from the EA can be found in Appendix A.

#### 1.4.3. INTERNAL DRAINAGE BOARD

The Buckingham and River Ouzel IDB have been consulted and further information on historical records of flooding as well as IDB assets have been provided. The IDB confirmed that no information of the study flood event was available. Further information of the data provided by the local IDB can be found in Appendix A.



#### **1.4.4. BUCKINGHAMSHIRE FIRE & RESCUE SERVICE**

The local fire rescue service (Buckinghamshire Fire and Rescue Service) have been consulted. Buckinghamshire Fire and Rescue Service provided the incidents attended by their crews between at the time of the December 2020 flood event. A list of the information provided can be found in Appendix A.

#### **1.4.5. CANAL AND RIVER TRUST**

The Canal and River Trust provided a letter where it was detailed the water level in the trough pound (canal pond bounded to the north by the Cosgrove Lock 21 at E 479491 N 242259, and to the south by the Fenny Stratford Lock 22 at E 488356 N 234371) on 23<sup>rd</sup> and 24<sup>th</sup> December 2020. During the flood event the water level in the pond was maintained at between 69mm and 170mm head over the control weir level set up at 71.68m AOD (normal water level is between -50mm and +150mm of the control weir crest). Further information can be found in Appendix A.

#### **1.4.6. PARKS TRUST**

The Park's Trust have been consulted. In this consultation Park Trust clarified their role within Milton Keynes mainly as a riparian owner maintaining riverside trees, other vegetation and habitats in accordance with good practice. It was also highlighted that they own and maintain a number of local estate sustainable urban drainage systems, in estates developed within the past 10 years. A list of the data provided by Parks Trust can be found in Appendix A.

#### **1.4.7. CONSULTATION WITH STAKEHOLDERS**

Community consultation held on Friday 6<sup>th</sup> August where key concerns from residents were outlined and taken into consideration for the preparation of this Section 19 Flood Investigation.

### **1.5 SITE VISIT**

A site visit was conducted on 7<sup>th</sup> June, On the day of the visit the weather was dry, hot and sunny. The days preceding the site visit the weather was generally dry.

The main aim of the site visit was to:

- Gain an understanding of this part of the catchment of the River Great Ouse within this location by identifying structures of the watercourse, flow paths and the setting of the watercourse in its catchment.
- Gain an understanding of the local areas by walking along streets where properties were reported to have flooded to understand the scale of flooding experienced during the 23<sup>rd</sup>/24<sup>th</sup> December 2020 and associated flooding mechanisms.
- Undertake liaison with the local residents regarding the aforementioned flood events.

The following key observations were noted:



**Figure 1-1** - Tombs Meadow Arches located on London Road (north of the High Street) partially blocked by debris.



**Figure 1-2** – Three arch bridge located further north on London Road, with one arch partially blocked by overgrown vegetation. Evidence of reduction in river flow capacity of the River Great Ouse.



**Figure 1-3** - Evidence of drop in elevation from London Road (north) to the High Street (south) that might encourage conveyance of surface water runoff to the High Street located in local low point.



**Figure 1-4** - Three culverts under Queen Eleanor Street. Evidence of at least two of the three culverts partially or totally blocked with debris and overgrown vegetation. Culverts potentially connected to River Ouse Valley Park.



**Figure 1-5** - Evidence of approximately 300mm culvert partially blocked with debris and vegetation. This culvert is connecting culverts in Figure 1-4 (culverts of significantly bigger dimensions and capacity) with the River Ouse Valley Park.



**Figure 1-6** - Evidence of blocked drain at Willow Lane and Prospect Road.

## 2 CONTEXT AND SETTING

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### 2.1 SUMMARY OF EVENT

As stated by the EA<sup>1</sup>, December 2020 was a very wet month with a total rainfall of 108mm (195% of the Long-Term Average (LTA) rainfall) across East Anglia. December 2020 was the second wettest December in this area since the record started in 1981. The consistently above average rainfall in the River Great Ouse catchment during October, November and December 2020 saturated the catchment and contributed to the flooding in Stony Stratford and surrounding areas during Christmas Eve of 2020.

The nearest river gauges are located in the River Great Ouse at Stony Stratford and further upstream at Passenham. It should be noted that the river level and flow data logged at the Stony Stratford gauge is communicated to the EA and linked to the flood warnings issues by the EA. The Passenham gauge recorded a maximum flow of 45.3m<sup>3</sup>/s on the 24<sup>th</sup> December, however the Stony Stratford gauge did not record the water levels from 14<sup>th</sup> December 2020 to 11<sup>th</sup> January 2021. This discontinuity in the river level data was caused by a communication issue with the gauge, resolved and reconnected on 11<sup>th</sup> January 2021. Water levels were taken however at the two upstream river gauges; Buckingham river gauge which recorded a peak over the night of the 23<sup>rd</sup> of December and into the 24<sup>th</sup> December, and Thornborough river gauge recording a peak water level at 10am on the 24<sup>th</sup> December. The River Great Ouse floodplain flooding impacted properties at the north end of the High Street, in Mill Lane, Prospect Road, Wolverton Mill and St Pauls Court.

The nearest rain gauge is Foxcote (E23657) located between Buckingham and Stony Stratford (approximately 8.9km south-west of Stony Stratford) recording an average rainfall for December 2020 of approximately 88.2mm. According to the Met Office<sup>2</sup> the average rainfall for Woburn climate station, the nearest climate station to Stony Stratford, was 57.3mm. Rainfall in Stony Stratford through December 2020 was 34% higher than the December average. The significantly above average rainfall in combination with the high-water levels from the river stressed highway drains, drainage ditches and the local sewer network exacerbating the flooding issues in this area.

Considering available data, 55 properties in Stony Stratford are reported to have been flooded by a combination of surface water runoff and fluvial flooding. 54 out of the total 55 properties were reported to be flooded internally with 1 property on Mill Lane reported to be flooded externally. The approximate locations of the reported flood incidents are shown in Appendix B.

Flood incident data from AW has not been provided at the time of writing this report.

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<sup>1</sup> [Environment Agency Fact Sheet December 2020 Flooding.](#)

<sup>2</sup> <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcpxfm7hf>



**Figure 2-1** – Drone footage showing flood extent at Stony Stratford High Street during the Christmas Eve flood event.

## 2.2 SITE LOCATION

Stony Stratford is located within the local authority of Milton Keynes, on the border of Northamptonshire and Buckinghamshire. The town lies along the Watling Street Roman Road and is surrounded to the south and north by the River Great Ouse. The town is situated 12km northeast from Buckingham, 9km southwest from Newport Pagnell and 83km northwest from London.

As shown in Figure 2-2 the High Street has always been a hub for the residents of Stony Stratford, as depicted from 1608<sup>3</sup>. A tributary of the Great River Ouse extended to the northeast where it met the northern extent of the High Street. It then flowed parallel to London Road, under one of the two three arched bridges located here and eventually re-joined the River Great Ouse in the north. This extension of the River Great Ouse, along with a tributary that also flowed parallel to London Road but on the eastern extent also re-joining the River Great Ouse to the north, have since been diverted.

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<sup>3</sup> <https://www.mkheritage.org.uk/archive/mkm/stonystratford/images/History/Stony1680.html>



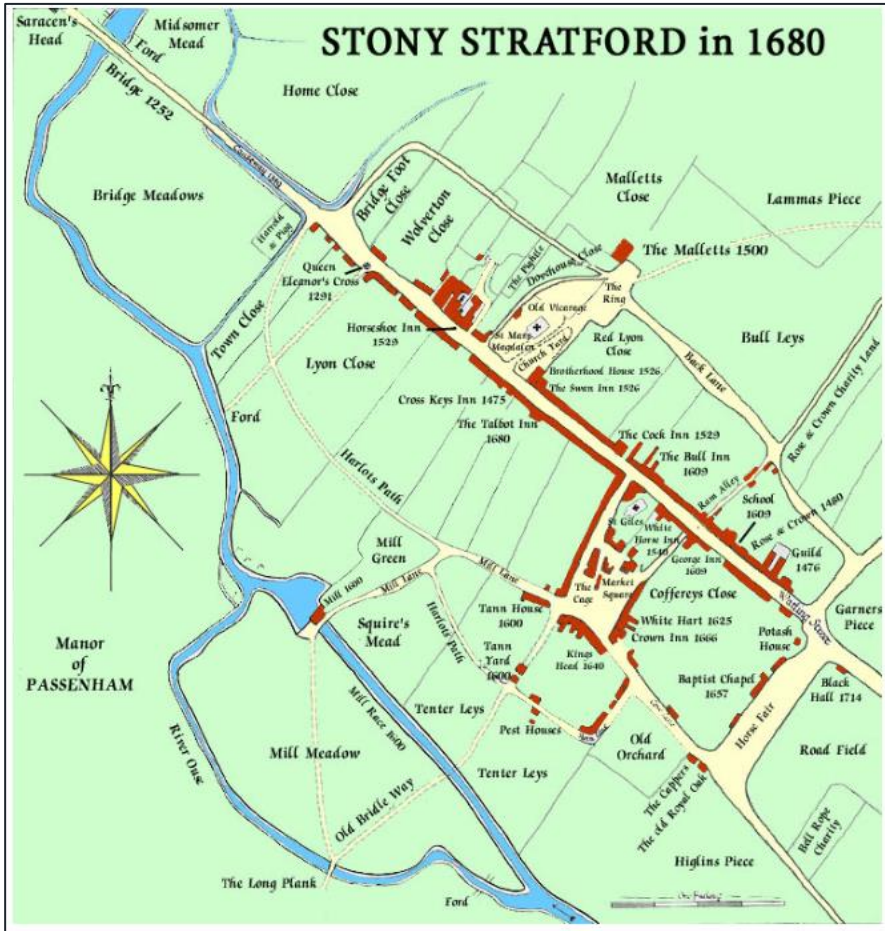


Figure 2-2 - Stony Stratford in 1680. Source: [Milton Keynes Heritage](https://www.miltonkeynesheritage.com/)

### 2.3 TOPOGRAPHY

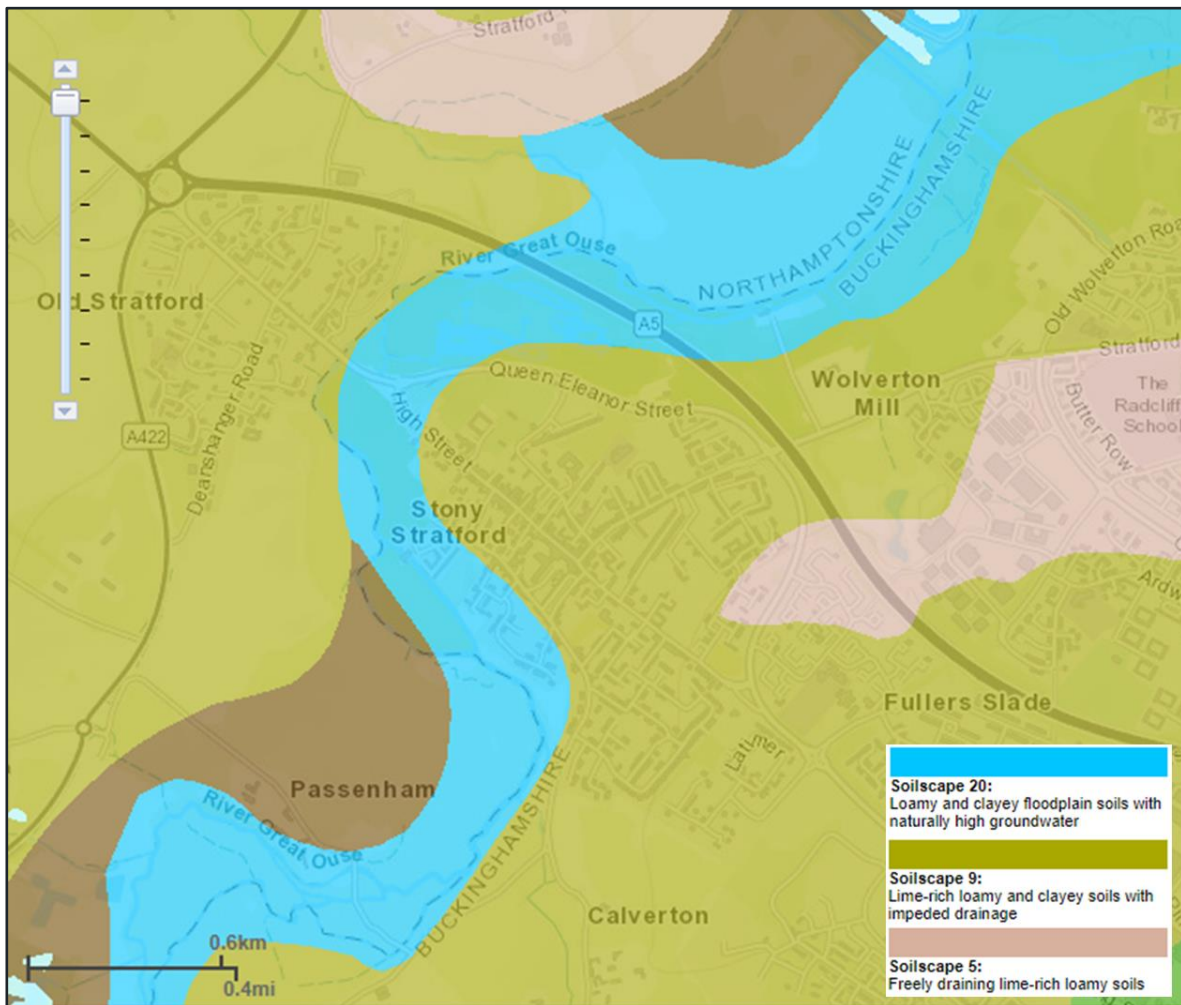
The topography of Stony Stratford is represented by higher elevations at Watling Street and lower elevations at the Ouse Valley Park, with elevations decreasing in a westerly orientation. The highest point is found in the Kiln Farm area with an elevation of approximately 95m AOD. From here, the elevation decreases to the town centre, which is surrounded by the River Great Ouse, with elevations of approximately 67m AOD in the north of the High Street.

### 2.4 GEOLOGY

The majority of the land within the study area is defined by the Cranfield Soil and AgriFood Institute (CSAI)<sup>4</sup> as Soilscape 9 as; “Lime-rich loamy and clayey soils with impeded drainage” and Soilscape 20 defined as “Loamy and clayey floodplain soils with naturally high groundwater”. Only a reduced section towards the east of Stony Stratford is classified as Soilscape 5, which is defined as “Freely

<sup>4</sup> Soil Types – Cranfield University, Source: <http://www.landis.org.uk/soilscapes/>, Last accessed: 27/07/2021

draining lime-rich loamy soils”. The area is also heavily urbanised with a high proportion of impermeable surfaces likely to increase runoff volumes.



**Figure 2-3 – Cranfield Soil and AgriFood map**

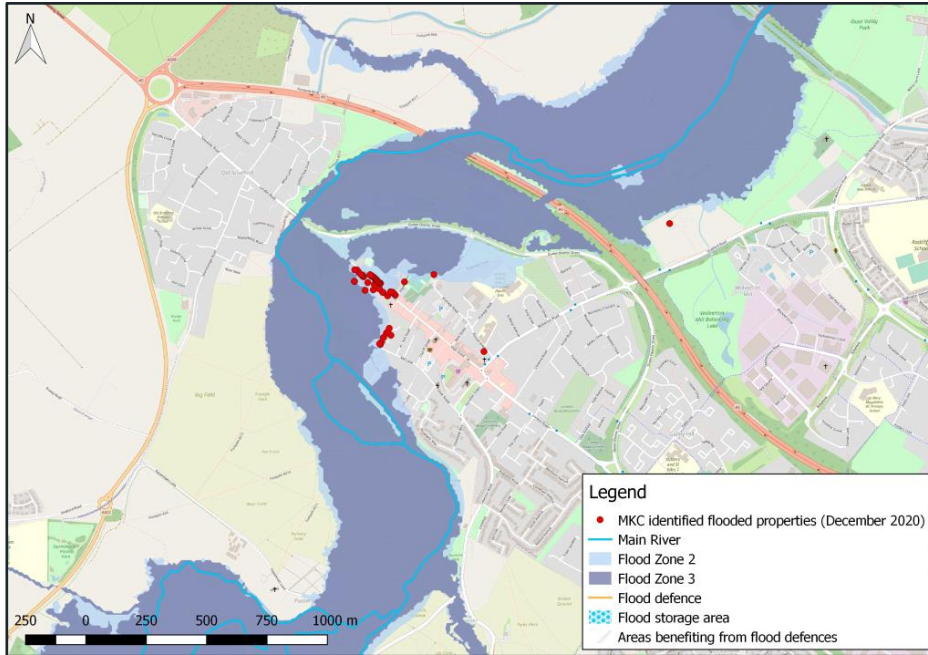
A review of the British Geological Survey (BGS)<sup>5</sup> maps indicate that the majority of the underlying soils of the town centre comprises of siltstone and mudstone (Lias Group) while the southern end of the town is built upon Oxford clay. The areas in the proximity of the River Great Ouse has resulted in a covering of alluvium, river terrace and head deposits.

<sup>5</sup> BGS Geology of Britain Viewer, Source: <https://mapapps.bgs.ac.uk/geologyofbritain3d/>, Last accessed: 27/07/2021

## 2.5 FLOOD RISK

### 2.5.1. FLUVIAL FLOOD RISK

Figure 2-4, included as well in Appendix C, shows an extract from the Environment Agency Flood Risk Map for Planning<sup>6</sup> which identifies that most of the properties reported as flooded in Mill Lane, High Street and Magdalend Close are within Flood Zone 2<sup>7</sup> classified at 'Medium Probability of Flooding' and Flood Zone 3<sup>8</sup> classified at 'High Probability of Flooding' properties at Prospect Road, Ostlers Lane and Fegan's court.



**Figure 2-4 - Environment Agency Flood Risk Map for Planning**

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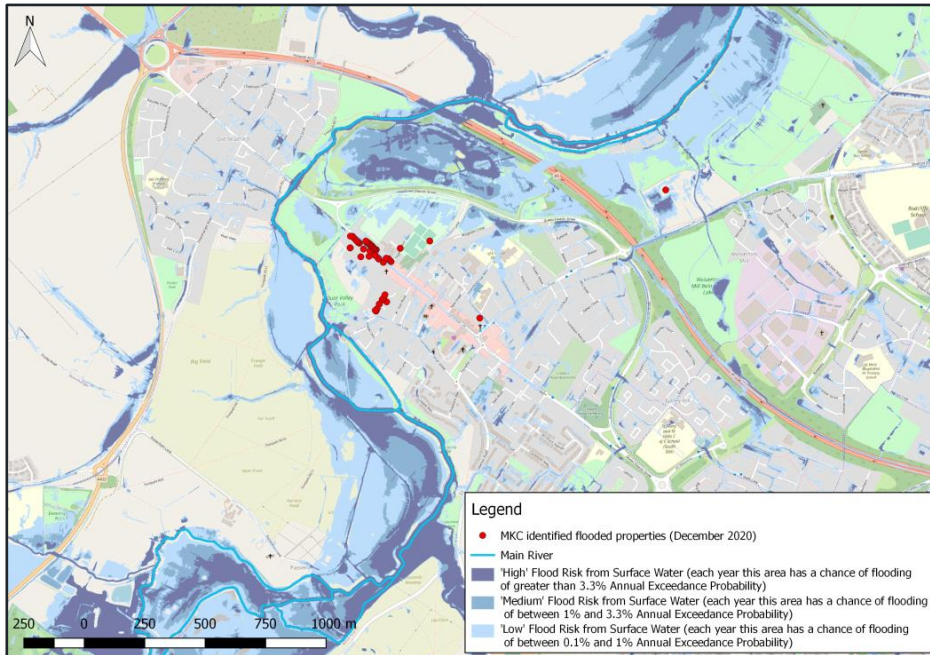
<sup>6</sup> EA Flood Risk Map for Planning. Source: <https://flood-map-for-planning.service.gov.uk/confirm-location?eastng=487583&northing=243709&placeOrPostcode=MK16%200EN>; Last accessed: 27/07/2021

<sup>7</sup> Flood Zone 2: Land having between a 1% and 0.1% annual probability of river (fluvial) flooding (between 1 in 100 return period and 1 in 1000 return period) in any given year; or land having between a 0.5% and 0.1% annual probability (between 1 in 200 return period and 1 in 1000 return period) of sea (tidal) flooding.

<sup>8</sup> Flood Zone 3: land assessed as having a 1% or greater annual probability of fluvial flooding (1 in 100 return period or greater) in any given year or 0.5% or greater annual probability of sea flooding (1 in 200 return period or greater) in any year, not taking into consideration flood defences.

## 2.5.2. SURFACE WATER FLOOD RISK

The EA Long Term Flood Risk Map<sup>9</sup> shown in Figure 2-5 and within Appendix C identifies the properties reported as flooded in the High Street as being at ‘Medium Risk<sup>10</sup>’ and ‘High Risk<sup>11</sup>’ of flooding from surface water, with estimated water depths below 300mm immediately adjacent to the property, and 300-900mm in the street in front of the property. Properties flooded in Prospect Road are located in an area classified as ‘Low Risk<sup>12</sup>’ of flooding from surface water.



**Figure 2-5** – Environment Agency Long Term Flood Risk maps

## 2.5.3. GROUNDWATER FLOOD RISK

In regard to groundwater, the BGS Areas Susceptible to Groundwater Flooding map shown in Figure 2-6 identifies areas within Stony Stratford which are classified as having ‘Potential for groundwater flooding to occur at surface’ and ‘Potential for groundwater flooding of property situated below ground level’. This mapping provides an indication as to where there is the potential for groundwater flooding and should be considered alongside other sources of flooding.

High groundwater level conditions may not always lead to widespread groundwater flooding; however, they have the potential to exacerbate the risk of surface water flooding and flooding from

<sup>9</sup> EA Long term Flood Risk Map. Source: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?eastings=535641&northing=178954&map=SurfaceWater>; Last accessed: 27/07/2021

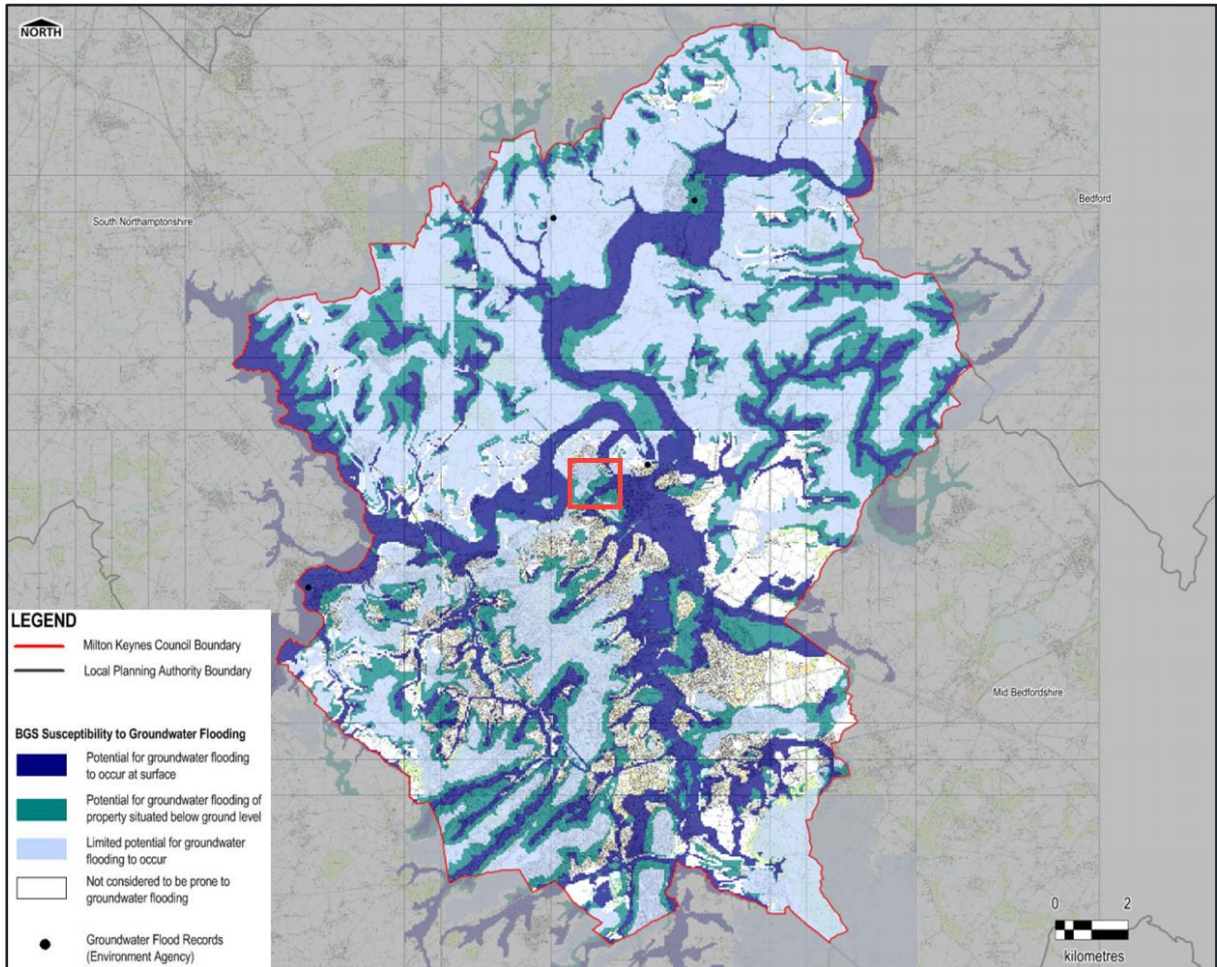
<sup>10</sup> Medium Risk: each year this area has a chance of flooding between 1% and 3.33%.

<sup>11</sup> High Risk: each year this area has a chance of flooding of greater than 3.33%.

<sup>12</sup> Low Risk: each year this area has a chance of flooding between 0.1% and 1%.

rivers by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer/groundwater interactions.

With reference to the National Hydrological Summary, rainfall was above average, which served to raise groundwater levels and saturate the catchment. High groundwater levels can cause seepage into the drainage network, therefore reducing its capacity. However, groundwater mapping in this area is uncertain and there may be disturbance to shallow natural soils and geology due to the area being largely urbanised.



**Figure 2-6 – Susceptibility to groundwater flooding.** Source: [Milton Keynes Council Local Flood Risk Management Strategy, AECOM 2016](#)

#### 2.5.4. DRAINAGE

The surface water drainage system within Stony Stratford is a separate system of public surface water and foul sewers owned and maintained by AW. Highway drainage, owned and maintained by MKC as the Highway Authority, generally consists of gullies connected to the public surface water and combined sewers. Appendix D at the end of the report shows the locations of the sewers within the problem understanding maps.

A call was held with AW the 22<sup>nd</sup> of June. During this call, they confirmed that they were not aware of any foul water incidents within the area at Stony Stratford during the 23<sup>rd</sup> / 24<sup>th</sup> December flood event.

The foul and surface water sewers in Stony Stratford are complex, with a number of sub-catchments and linkages between these sub-catchments. A high-level review of the drainage sewers indicates that sewers in the High Street are connected with the sewers running under Mill Lane which ultimately discharge in the River Great Ouse next to the Ouse Valley Park. This high-level analysis also indicates that sewers at London Road are connected with the sewer sub-catchment north of High Street which discharge north of Queen Eleanor Street at Stony Stratford Nature Reserve.

During the site visit, blocked gullies were observed at Willow Lane which could have been exacerbated surface water flooding in the area. However, it is unclear if the gullies became blocked after the event or the blockages were caused by the event itself. Therefore, a further study would be required if a greater understanding as to whether the condition and current capacity of the drainage network were a key factor in the flooding mechanisms at this location. Milton Keynes Highways reported that gullies were last cleaned in October 2017 and further maintenance is due in October 2021 based on the current cleansing cycle.

## 2.6 RECORDED FLOOD INCIDENTS

Stony Stratford has been liable to regular flooding from the River Great Ouse through the centuries. In November 1894 the flood waters reached from the Ouse to the High Street. The highest summer flood known was in June 1903 when the waters reached from Passenham to Cosgrove and from the Bridge to the High Street<sup>13</sup>. More recent historic flood events have been occurred in Stony Stratford prior to the event on the 24<sup>th</sup> December 2020. Stony Stratford flooded in March 1947 and 1998. The EA reported that flooding occurred to properties in Fegans Court, the High Street, Prospect Road, Temperance Terrace and Mill Lane during the Easter 1998 event. The IDB reported that for the 1947 flood event the flood levels near Willow Lane reached 65.47m AOD and flood levels downstream, just north of Wolverton Mill reached 63.93m AOD. In July 2007 Buckinghamshire experienced flooding originating from the River Great Ouse with the High Street in Stony Stratford impacted by this flood event.

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<sup>13</sup> Source: [Milton Keynes Heritage Archive](#). Last accessed: 3/8/2021

## 3 RAINFALL ANALYSIS

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### 3.1 RAIN GAUGE ANALYSIS

Figure 3-1 shows measurements from rain gauge Foxcote (E23657) which indicates a particularly wet month of December with persistent rain during the month. As stated by the EA<sup>1</sup> December 2020 was a very wet month with a total average of 108mm across East Anglia and it was the second wettest December in the River Great Ouse area since records began in 1981. Subsequently, the rainfall during the 23<sup>rd</sup> of December fell onto an already saturated catchment, exacerbating flooding issues. Tributaries of the River Great Ouse and upper parts of the catchment including that draining through Buckingham, responded very quickly leading to high river levels at Stony Stratford.

In addition, the EA<sup>1</sup> provided the Soil Moisture Deficit (SMD), which is the difference between the amount of water present in the soil and the amount of water the soil has the capacity to hold. This data shows that by the end of December the SMD was on average at 3mm across the East of England. This was 'below normal', whereby a low SMD means heavy rainfall is less likely to infiltrate the ground and more likely to run off into watercourses, indicating the impact of the intense rainfall experienced.

Reports received regarding the December flood event indicate that the flooding started on the night of the 23<sup>rd</sup> of December with homes reported as flooded on Temperance Terrace at 11pm. The closest rainfall gauge to Stony Stratford (Station E23657) located approximately at 8.9km, recorded 88.2mm of rainfall between 1<sup>st</sup> December and 31<sup>st</sup> December with a total of 29 mm rainfall recorded at the gauge on the 23<sup>rd</sup> and 24<sup>th</sup> December. Rainfall totals across south-east Britain (Figure 3-2) shows a relatively high intensity of rainfall in the northern section of the River Great Ouse catchment at Stony Stratford, over 23<sup>rd</sup> December and into 24<sup>th</sup> December.

Rainfall around the county is recorded by a series of rain gauges operated by the EA. These report the rainfall depth recorded over either a 15-minute interval or a day. To assess the rarity of the rainfall that fell, the Flood Estimation Handbook<sup>14</sup> (FEH) web service Event Rarity Calculator was used to assess the Annual Exceedance Probability (AEP). The AEP is the likelihood of rainfall of this depth or more falling in a year in that location. For instance, a rainfall event with an AEP of 1% means that rainfall of this depth or greater would only have a 1% chance of occurring in any one year in that location. This is also known as a '1 in 100 year' event. The Event Rarity Calculator assessed the recorded rainfall as a 1 in 2-year event. Although the magnitude of the rainfall event recorded in this gauge was not particularly significant, it must be highlighted that rainfall is not universal across a catchment and some areas may have experienced more significant rainfall or greater magnitudes. Also, the low SMD and high saturated catchment due to the persistent rain during the previous months intensified flooding at Stony Stratford.

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<sup>14</sup> FEH is the standard tool in the UK to estimate rainfall return periods. It is used by the Environment Agency and all professional hydrologists to estimate rainfall and rainfall return periods.

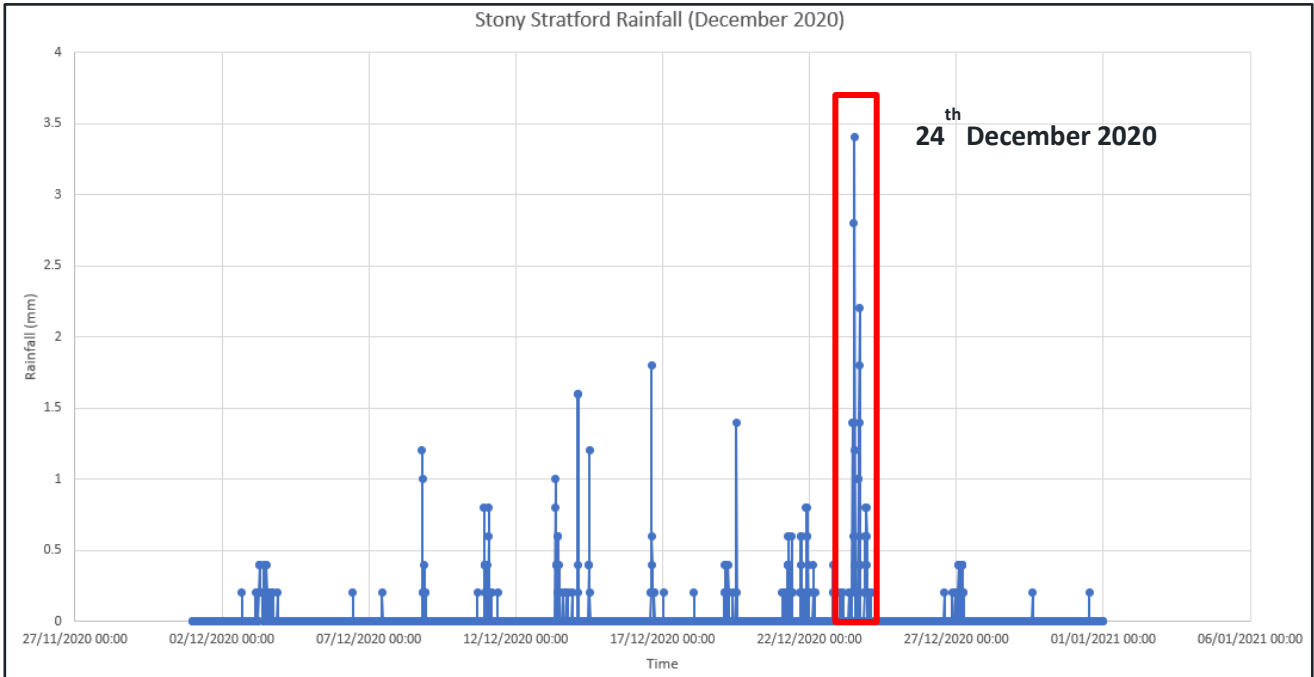


Figure 3-1 - 15min rainfall (mm) recorded at Foxcote E23657

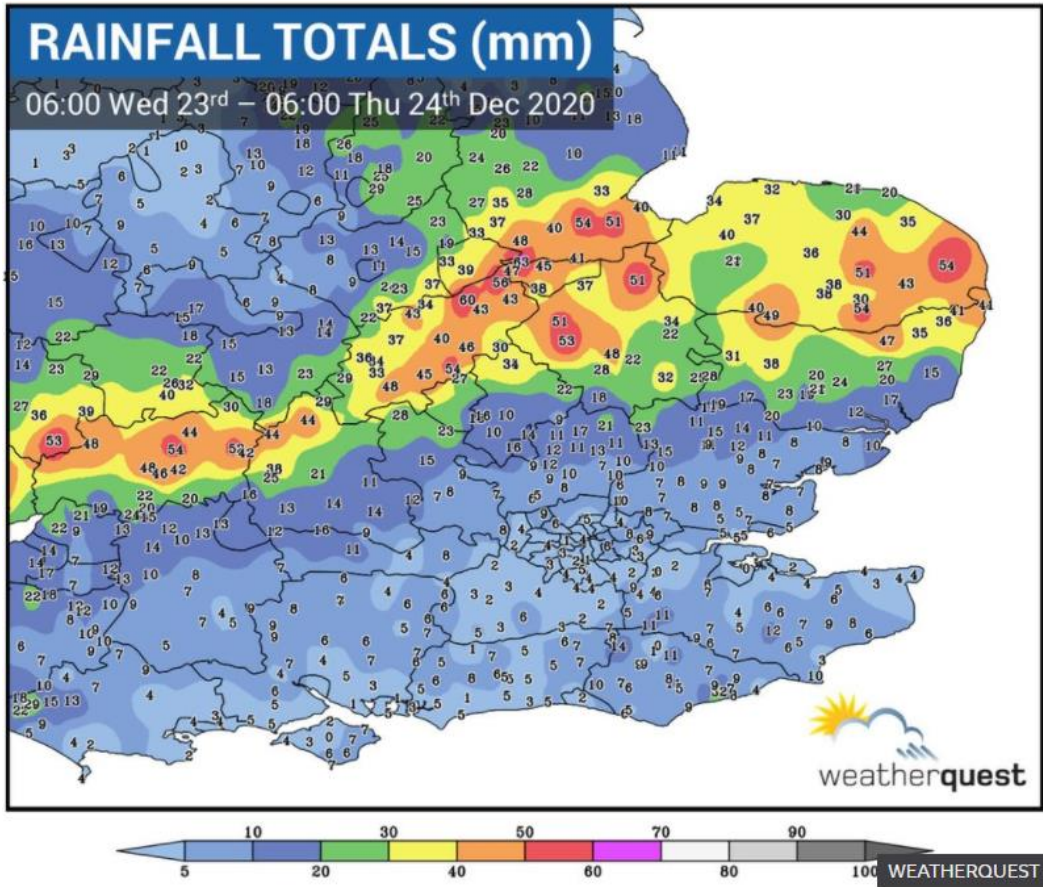


Figure 3-2 - Rainfall totals across south-east Britain. Source: Weatherquest services



## 3.2 RIVER GAUGE ANALYSIS

There are several river gauges along the River Great Ouse. Stony Stratford gauge is located within Stony Stratford next to the Mill Field (See Figure 3-3). The EA owns and maintains this gauge.

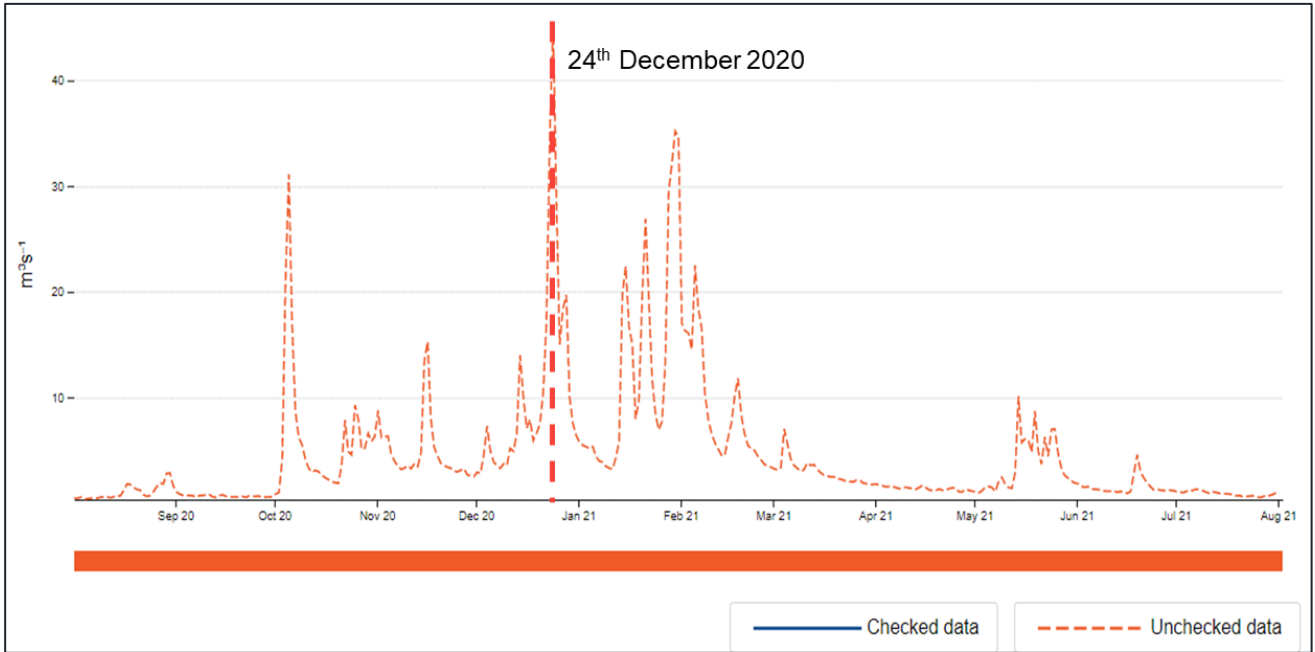


**Figure 3-3 - Location river gauges at Stony Stratford**

River gauge analysis has been based on gauging station data that has not been validated yet (data validated available until the 30<sup>th</sup> September 2020), which means that the outcomes from this analysis may change in future assessments.

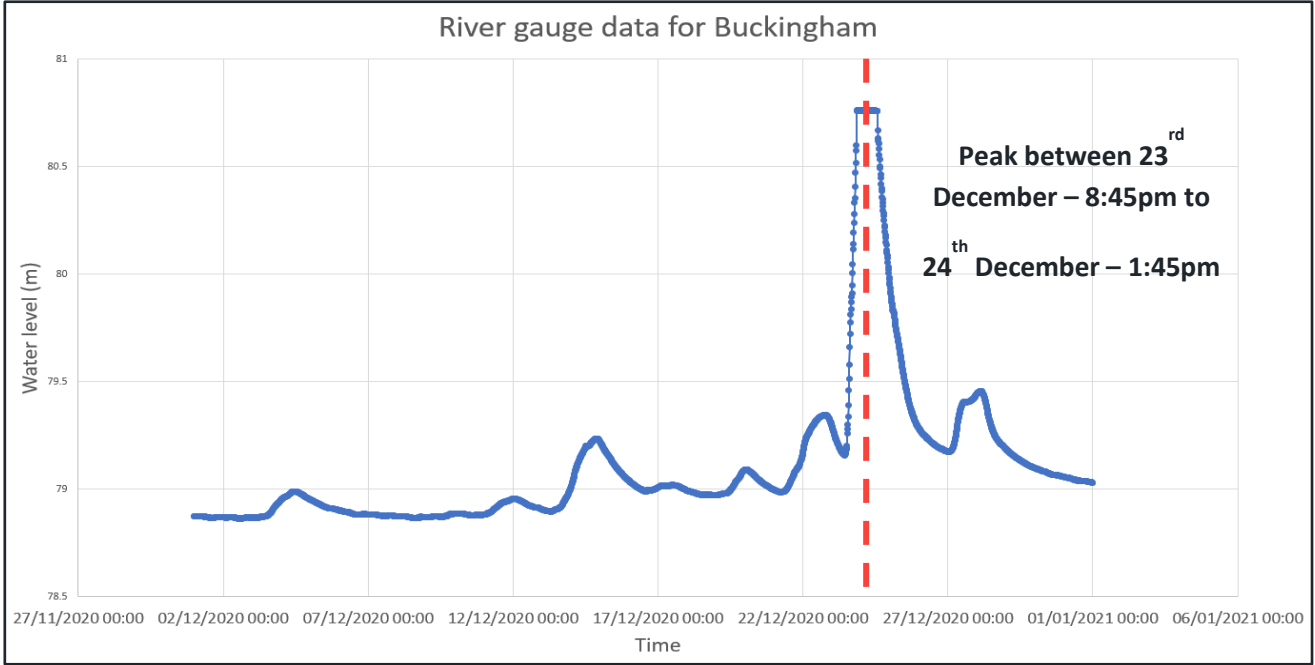
Data obtained from the National River Flow Archive (NRFA)<sup>15</sup> and the EA for the 23<sup>rd</sup> and 24<sup>th</sup> December 2020<sup>th</sup> at the Passenham Ultrasonic gauge at River Great Ouse is shown in Figure 3-4. This figure clearly indicating a steep rise in river flows, with a peak estimated above 45.3 m<sup>3</sup>/s on the 24<sup>th</sup> of December as a result of the heavy rainfall during the 23<sup>rd</sup> December on the River Great catchment Ouse upstream of Stoney Stratford.

<sup>15</sup> NRFA data are quality controlled before archival and release. Near real-time data are from the [Environment Agency's Hydrology API](#) and consist of checked and un-checked data. More information, including on quality flags for near real-time data is available in the [API documentation](#).

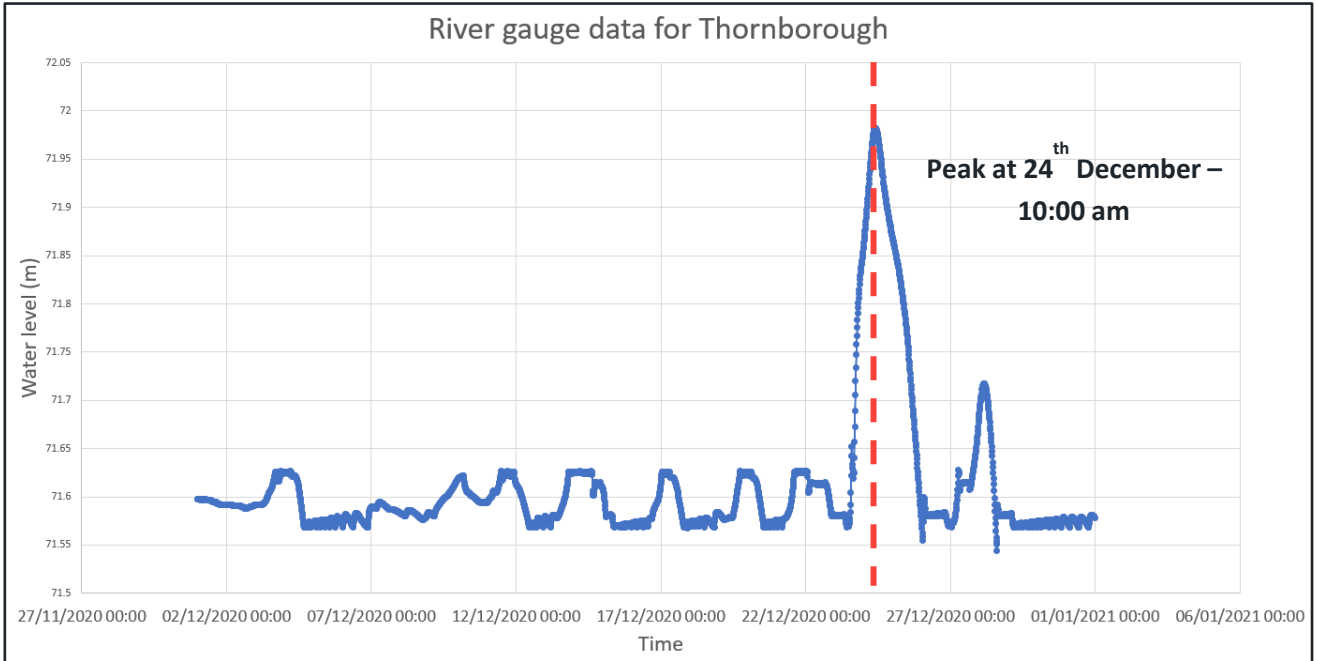


**Figure 3-4** – Gauged daily flow at Passenham Ultrasonic gauge at River Great Ouse. **Source:** National River Flow Archive (NRFA)

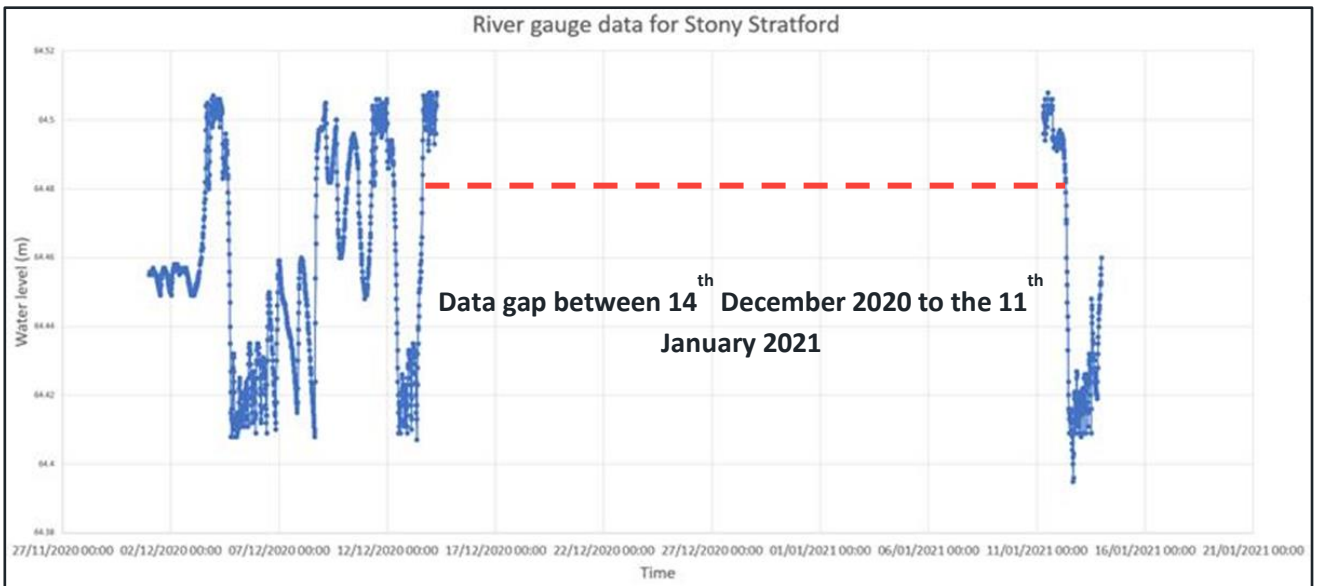
A study of the river flows has been undertaken for the River Great Ouse between Buckingham and Stony Stratford, by analysing river levels on Buckingham gauge, Thornborough gauge and Stony Stratford gauge, as shown in the figures below.



**Figure 3-5** - River levels at Buckingham gauge



**Figure 3-6 - River levels at Thornborough gauge**



**Figure 3-7 - River levels at Stony Stratford gauge**

Figure 3-5 shows the river levels at the Buckingham gauge which is located within the upstream reach of the catchment. The water levels peaked at this gauge from 23<sup>rd</sup> December – 8:45pm to 24<sup>th</sup> December – 1:45pm, indicating high water levels overnight of the 23<sup>rd</sup> December. Figure 3-6 shows river levels at the Thornborough gauge which is located further downstream of the River Great Ouse, between Buckingham and Stony Stratford. The water levels peaked here on the 24<sup>th</sup> December at 10.00am. This indicates the high-water levels in Buckingham overnight of the 23<sup>rd</sup> December propagated downstream to Thornborough where high water levels were present by the morning of the 24<sup>th</sup> December. Figure 3-7 shows river levels at the Stony Stratford gauge (location indicated in the Figure 3-3), for which there is a data gap between 14<sup>th</sup> December 2020 and 11<sup>th</sup> January 2021.



This discontinuity in the river level data was caused by a communication issue with the gauge, resolved and reconnected on 11<sup>th</sup> January 2021.

## 4 FLOODING DESCRIPTION AND MECHANISM

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The flood event that occurred during the 24<sup>th</sup> December was the result of intense rainfall in the upper catchment of the River Great Ouse during the 23<sup>rd</sup> December over an already saturated catchment due to a wet month of December. This led to a quick response of the watercourses and high-water levels within the River Great Ouse. As stated by the EA<sup>1</sup> the Soil Moisture Deficit (SMD), which is the difference between the amount of water present in the soil and the amount of water the soil has the capacity to hold, was on average at 3mm across the East of England at the end of December. This was 'below normal', whereby a low SMD means heavy rainfall is less likely to infiltrate the ground and more likely to run off into watercourses, indicating the impact of the intense rainfall experienced.

A total of 55 properties were reported to have flooded (1 externally and 54 internally) as a result of a combination of river and surface water flooding during the December flood event. Communication with local residents affected by the flood incident indicated that the River Great Ouse quickly increased, causing floodplain flooding and inundating first the back gardens of the properties, then flowing through their properties and continue flooding the north section of the High Street and surrounded properties. The poor conditions observed during the site visit on the 7<sup>th</sup> June 2020 of the culverts underneath Queen Eleanor Street connecting the floodplain of the River Great Ouse could have contributed to the severity of the flooding in the High Street. Figure A in Appendix D indicates the extent of the flooding showing how the river levels inundated the Ouse Valley Park reaching the properties in Prospect Road, High Street and St. Pauls Court.

The surface water drainage network which drains the area with the highest number of properties affected, includes an urban area of approximately 0.48km<sup>2</sup> and the properties on the High Street directly discharge on to the surface of the High Street, as is typical of this age of property. The High Street surface water sewer network owned by AW drains to the watercourse between the overflow culverts at the top of the High Street and the culverts under Queen Eleanor Street. It should be noted that this watercourse was historically Barley Mow Stream. It is considered that there may be benefit for considering the potential for the reinstatement of the Barley Mow Stream as an overflow route.

The surface water network associated with Mill Lane, Prospect Road, St Pauls Court and Wolverton Mill drains to the River Great Ouse. The high levels in the River Great Ouse during the 23<sup>rd</sup> and 24<sup>th</sup> December, submerged the outfall, impeding the discharge of surface water collected in the drainage system and potentially exacerbating the flooding at the High Street. Figure B in Appendix D shows the northern section of the High Street, which has a lower elevation, resulting in surface water flowing towards this section of the road.

A number of road gullies in this area were observed to be silted up during the site visit on the 7<sup>th</sup> June 2021 (Refer to Figure C in Appendix D). Even in optimum condition during very heavy rainfall, these gullies would only collect a small proportion of the surface water runoff from the roads, resulting in surface water flowing to lower points along the road. It is possible that the siltation observed within the gullies could have resulted from or been exacerbated during the rainfall event on 23<sup>rd</sup> December 2020 when silt and debris were washed off from the road and surrounding areas.

The local fire brigade attended the flood event. However, Buckinghamshire Fire and Rescue Service were unable to pump water out from the flooded properties as there was nowhere for the surplus

water to go. The police also attended the event and put a road closure in place for the High Street as a result of the flooding.

The Canal and River Trust have advised that for the Milton Keynes trough pound (bounded to the north by the Cosgrove Lock 21 and to the south by the Fenny Stratford Lock 22) on 23<sup>rd</sup> and 24<sup>th</sup> December 2020 the water level in the pound was maintained at between 69mm and 170mm head over the control weir (Fixed Weir V6 weir at E 482813 N 241025). Normal water level is between -50mm and +150mm of the control weir crest, i.e., 71.18m AOD and 73.18m AOD. Although the water level on the 23<sup>rd</sup> and 24<sup>th</sup> December was above normal this was still held within the pound without producing any uncontrolled overtopping.

It should be noted that although the 1998 flood event is often used as a benchmark by which other floods are measured and compared for the River Great Ouse, this was classified as a summer flood event which is characterised by dry summer months experiencing a sudden intense rainfall compared to the December 2020 flood event which was characterised as a winter flood event experiencing rainfall over a prolonged period of time. The 1998 flood event was estimated as a 1 in 125-year event<sup>16</sup>. Table 4-1 shows the peak flood level comparison between the 1998 flood event and the December 2020 flood event indicating the highest ever water levels were recorded in this location during the December 2020. It should be noted that the peak level of 65.37m AOD for the December 2020 flood event was an estimation provided by the EA since the Stony Stratford gauge did not record measurements during the flood event

**Table 4-1 – 1998 and 2020 flood level comparison**

| Flood Event | Peak Level (Stony Stratford gauging station) |
|-------------|--|
| 2020        | 65.37 m AOD*                                 |
| 1998        | 64.98 m AOD                                  |

\* Estimated peak based on level to level correlations of previous flood events from Passenham gauge.

<sup>16</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/295146/geh\\_o0807bnaz-e-e.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/295146/geh_o0807bnaz-e-e.pdf)

## 5 FLOOD RESPONSE

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Buckinghamshire Fire and Rescue Service with the help of Milton Keynes Council provided sandbags in the morning of Christmas Eve to several properties in the High Street that were impacted by the flooding in Stony Stratford during the night of the 23<sup>rd</sup> December.

AW maintained 'full-incident' mode 24/7 over 12 weeks, from 23<sup>rd</sup> December 2020 to 12<sup>th</sup> March 2021. This response from AW to the flood events over 23<sup>rd</sup> and 24<sup>th</sup> December 2020 included 400 dedicated technicians and 500 volunteer shifts. Approximately 120 tankers were deployed to prioritise tankering water from pumping stations in order to help local residents. AW logged unprecedented volumes of contacts from concerned local residents; 30,000 jobs were raised and 80,000 incoming calls were received. AW undertook meetings with the regional MP's and local authority representatives and leading Technical Coordinating Groups (TCG) Flood Cells, as well as working closely with the EA to agree temporary local enforcement positions.

The EA issued a flood warning at 11:50am on 24<sup>th</sup> December for the low-lying River Great Ouse at Stony Stratford indicating "flooding is expected, take action to protect yourself and your property".

EA Operational staff were undertaking patrols of the Great Ouse, to checking and operating the assets and structure. The EA, along with other Category 1 and Category 2 responders, were involved in the Thames Valley Local Resilience Forum (LRF) multi-agency command and control groups that were co-ordinating the flood response effort.

## 6 CONCLUSIONS AND FURTHER WORK

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### 6.1 MAIN FINDINGS

The flood incident that occurred during the 24<sup>th</sup> December was the result of intense rainfall in the upper catchment of the River Great Ouse during the 23<sup>rd</sup> December. The rain fell on to an unusually saturated catchment, as reported by the EA, which likely lead to more surface water runoff than would be expected if the catchment was dry and groundwater was at normal levels. The quick response of the watercourses and high-water levels in the River Great Ouse increased the vulnerability of this area historically at high risk of fluvial flooding.

Although intense rainfall was recorded in some locations surrounding Milton Keynes such as Brackley which recorded 53mm on December 23<sup>rd</sup> as highlighted by the EA<sup>1</sup>, the nearest rainfall gauge from Stony Stratford only recorded 29mm of rainfall over 23<sup>rd</sup> and 24<sup>th</sup> December equating to a storm event of 1 in 2 years. Rainfall is not universal across a catchment and some areas may have experienced more significant rainfall or greater magnitudes. In this case, a localised strong rainfall event was not the trigger of the flood event at this location, but the extraordinary wet conditions of the River Great Ouse catchment.

It is understood that high water levels of the River Great Ouse caused flooding in the southern and northern area of the High Street and the High Street itself at Stony Stratford. The overgrowth vegetation and raised land adjacent to the culverts underneath Queen Eleanor Street impeded fluvial flows getting into the Stony Stratford Nature reserve, this may have adversely impacted the flooding in the High Street.

Highways drains and the sewer network are not designed to manage fluvial flows. Therefore, it is suspected that highway drains and the local surface water sewer network were also unable to cope with the volume of rainfall plus fluvial flows from the River Great Ouse resulting in ponding within the High Street.

This Section 19 Flood Investigation has identified that the following factors may have also contributed to flooding:

- Further investigation of maintenance and performance of surface water attenuation systems in the more recent developments should be undertaken to ensure they are performing as designed.
- Below optimum maintenance of Highway Authority or AWS assets has potentially increased the extent of surface water ponding in the affected areas and resulted in additional flooding to local properties with a low threshold. However, it cannot be confirmed at this stage and further analysis is required to understand current capacity of surface water sewer network.

### 6.2 RECOMMENDATIONS AND FURTHER WORK

Recommendations and further work are suggested for the following key stakeholders.

#### 6.2.1. RECOMMENDATIONS FOR COMMUNITIES AND RESIDENTS

- Production of a comprehensive community flood plan.
- Prepare Household Emergency Plans for the vulnerable properties in the area.



- Collaboration with Milton Keynes Council regarding any highways maintenance via the Report It Tool <sup>17</sup>.
- Work with the Community Flood Group, Emergency Planning Team, EA and other flood management authorities to improve flood resilience in this location.

### **6.2.2. RECOMMENDATIONS FOR MKC AS THE LEAD LOCAL FLOOD AUTHORITY**

- Support the community in the preparation of a Community Flood Plan, alongside the EA and other flood risk management authorities.
- Facilitate collaboration between key stakeholders to enhance current understanding of flood risk and flood mitigation measures at Stony Stratford, in order to determine any potential improvement opportunities and constraints.
- Assess the potential for enhancement of the culverts underneath Queen Eleanor Street to increase connectivity between floodplains.
- Continue to front and improve multi-agency co-operative working with Stony Stratford Flood Action Group (FLAG) regarding flood risk in the area.

### **6.2.3. RECOMMENDATIONS FOR THE ENVIRONMENT AGENCY**

- Support the community in the preparation of a Community Flood Plan, alongside MKC and other flood risk management authorities.
- Investigate and consider further improvements to maintenance, especially around London Bridge Road to increase discharge capacity of River Great Ouse at this location.
- Enhance the maintenance regime of the river gauges located within and upstream of Stony Stratford.
- Consider as part of the Great Ouse Strategic Flood Risk Intervention Study integrated hydraulic modelling that includes all sources of inflows including canal overflows to gain a better understanding of the sources of flooding that contributed to the flood event.
- Explore with MKC potential reinstatement of the overflow channel (historically Barley Mow Stream) for the Great River Ouse, associated with Stony Stratford.
- Explore with MKC the potential for Stony Stratford to be included as a project for a flood alleviation scheme.
- Develop an enhanced understanding of the hydrological catchment of the River Great Ouse and historical catchment changes to further analyse the impacts on Stony Stratford.

### **6.2.4. RECOMMENDATIONS FOR ANGLIAN WATER**

- Where funding and resources are available, develop a proactive maintenance plan for this catchment instead of reactive maintenance activities.

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<sup>17</sup> <https://www.milton-keynes.gov.uk/pay-report-apply/report-it>



- Develop further hydraulic studies to determine any potential capacity issues within the surface sewer system.
- Undertake CCTV survey in critical areas to identify potential blockages or defects in the surface sewer network.

# Appendix A

## APPENDIX A





MKC S19 Stony Stratford

| Dataset   | Owner              | Received? | Date       | Comments   |
|---|--------------------|-----------|------------|--|
| 15 minute Rainfall data   | Environment Agency | Y         | 22/07/2021 |  |
| River flow data   | Environment Agency | Y         | 22/07/2021 |  |
| River gauge data  | Environment Agency | Y         | 22/07/2021 |  |
| Any additional gauging station data for gauges within the Borough of Milton Keynes owned by the Environment Agency for last 10 to 15 years including the following gauges outside of Milton Keynes; River Tove at Cappenham Bridge and the River Great Ouse at Thornborough | Environment Agency | Y         | 22/07/2021 | Received river gauge data for stations surrounding Milton Keynes                         |
| Operation and maintenance regimes for the gauging stations  | Environment Agency | N         |            |  |
| Any information and data regarding the magnitude of the following flooding events occurring across the borough of Milton Keynes; 4th October 2020, 24th December 2020, 15th January 2021 and 30th January 2021  | Environment Agency | N         |            |  |
| The location and information regarding the EA flood alleviation schemes   | Environment Agency | Y         | 22/07/2021 |  |
| GIS shapefiles of any supplementary modelling that is not currently represented on the Flood Maps available online  | Environment Agency | N         |            |  |
| A copy of Chapter 11 of the Ouzel Flood Scheme document (1987)  | Environment Agency | N         |            | They do not hold a copy of this  |
| Catchment changes within Milton Keynes  | Environment Agency | N         |            |  |
| List of the hydraulic capacities of all structures upstream of the confluence of the river Ouzel and the river Ouse at Newport Pagnell  | Environment Agency | N         |            |  |
| Information pertaining to the balancing lakes associated with Milton Keynes   | Environment Agency | Y         | 10/08/2021 | 210810 105745 - Naomi Chatfield-Smith - FW EAn 2021 216430 - EA Data - Final response to |
| Gauging station locations   | Environment Agency | Y         | 07/06/2021 |  |
| Winter 20-21 Flooded Properties Working Spreadsheet EXTERNAL.xlsx   | Environment Agency | Y         | 07/06/2021 |  |
| Water Situation Reports for Partners  | Environment Agency | Y         | 07/06/2021 |  |
| Any supplementary modelling   | Environment Agency | Y         | 22/07/2021 | Products 5, 6 and 7  |
| Asset register  | Environment Agency | N         |            |  |
| Functional floodplain   | Environment Agency | N         |            |  |
| Stony Stratford community briefing May 2021 (1).pdf   | Environment Agency | Y         | 14/05/2021 |  |
| MK Assets (GIS files)   | Environment Agency | Y         | 22/07/2021 |  |
| MK operating procedures MKY-04-001.pdf  | Environment Agency | Y         | 22/07/2021 |  |
| Recorded Flood Event Outlines 216430 (Stony Stratford).pdf  | Environment Agency | Y         | 22/07/2021 |  |
| 2020 10 23 October Flooding Letter EA - FINAL.PDF   | Environment Agency | Y         | 19/04/2021 |  |
| 8433-1 2020 11 12 Reply.pdf   | Environment Agency | Y         | 19/04/2021 |  |
| Clip Map Layers (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Detailed River Network (GIS files)  | Environment Agency | Y         | 22/06/2021 |  |
| Flood Alert Areas (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Flood Map For Planning (Rivers and Sea) (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Flood Risk Areas (GIS files)  | Environment Agency | Y         | 22/06/2021 |  |
| Flood Warning Areas (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Flood_Storage_Areas (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Flood_Zone_2 (GIS files)  | Environment Agency | Y         | 22/06/2021 |  |
| Groundwater Vulnerability (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Historic Flood Map (GIS files)  | Environment Agency | Y         | 22/06/2021 |  |
| Indicative Flood Risk Areas (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Indicative_Flood_Risk Areas_PDF   | Environment Agency | Y         | 22/06/2021 |  |
| NRD (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| RFCC_Boundaries (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Risk of Flooding from Surface Water (Basic) (GIS files)   | Environment Agency | Y         | 22/06/2021 |  |
| Spatial_Flood_Defences (GIS files)  | Environment Agency | Y         | 22/06/2021 |  |
| Statutory Main River Map (GIS files)  | Environment Agency | Y         | 22/06/2021 |  |
| Water Situation Summaries   | Environment Agency | Y         | 22/06/2021 |  |
| Milton Keynes Lakes Operation (Sept 2004).pdf   | Environment Agency | Y         | 10/08/2021 |  |
| Master map  | MKC                | N         |            |  |
| Administrative areas  | MKC                | N         |            |  |
| IDB area  | MKC                | Y         | 22/06/2021 |  |
| Anglian water management area   | MKC                | N         |            |  |
| Areas Susceptible to Groundwater Flooding   | MKC                | N         |            |  |
| Location MKC flood defences/flood alleviation schemes   | MKC                | N         |            |  |
| Drainage Asset register & condition (including information on railway culvert referenced in SFRA)   | MKC                | N         |            |  |
| MKC Highways - flood Events   | MKC                | N         |            |  |
| Natural Flood Management (NFM) work summary   | MKC                | N         |            |  |
| Number and locations of property affected during flood event  | MKC                | Y         | 19/03/2021 |  |
| Any photos that were provided by local residents and confirmation if these can be used in the report.   | MKC                | Y         | 01/03/2021 |  |



## MKC S19 Stony Stratford

| Dataset  | Owner         | Received? | Date       | Comments  |
|--|---------------|-----------|------------|---|
| Activities that were completed before, during or after – including clean-up activities and removal of blockages etc.   | MKC           | N         |            |   |
| Are there any activities that should have been undertaken in advance of the event, such as installation of property flood gates.   | MKC           | N         |            |   |
| Consultation undertaken with other RMA's.  | MKC           | N         |            |   |
| Any known data gaps that may be a risk for completion of the S19 report or ability to draw conclusions.  | MKC           | N         |            |   |
| Fire brigade data  | MKC           | N         |            |   |
| Landscaping  | MKC           | N         |            |   |
| Email from Chris Brookes (Start-Up Research Limited) regarding Stony Stratford Section 19 Report Queries   | MKC           | Y         | 28/04/2021 |   |
| Flood Report Stony Stratford Town Council 19th January 2021_AP Response.pdf  | MKC           | Y         | 19/03/2021 |   |
| Great Ouse December 2020 summary.pdf   | MKC           | Y         | 19/03/2021 |   |
| Milton Keynes Drainage Study - Vol 3 Modelling.pdf   | MKC           | Y         | 29/03/2021 |   |
| Balancing Lakes locations and areas  | MKC           | Y         | 19/04/2021 |   |
| Balancing Lakes Activation Emails  | MKC           | Y         | 24/06/2021 |   |
| FEH2013 Return period 24122020 for 491679-253579.pdf   | MKC           | Y         | 15/06/2021 |   |
| MAP Rain - Gauging Station E21493.pdf  | MKC           | Y         | 15/06/2021 |   |
| MAP Rain - Gauging Station E22088.pdf  | MKC           | Y         | 15/06/2021 |   |
| MAP Rain - Gauging Station E60701.pdf  | MKC           | Y         | 15/06/2021 |   |
| Copy of Stony Stratford 10th March.xlsx  | MKC           | Y         | 19/03/2021 |   |
| Flood Log emails   | MKC           | Y         | 24/06/2021 |   |
| Flood Triggers emails  | MKC           | Y         | 24/06/2021 |   |
| Stony Stratford emails   | MKC           | Y         | 24/06/2021 |   |
| Stony Stratford Town Council emails  | MKC           | Y         | 24/06/2021 |   |
| Boundary Map (GIS files)   | MKC           | Y         | 22/06/2021 |   |
| Flood Data 2016 (GIS files)  | MKC           | Y         | 22/06/2021 |   |
| Flood Data 2018 (GIS files)  | MKC           | Y         | 22/06/2021 |   |
| MKC Lakes (GIS files)  | MKC           | Y         | 22/06/2021 |   |
| Highways (MKC sourced) (GIS files)   | MKC           | Y         | 22/06/2021 |   |
| Landscaping (MKC sourced) (GIS files)  | MKC           | Y         | 22/06/2021 |   |
| Parks Trust (MKC sourced) (GIS files)  | MKC           | Y         | 22/06/2021 |   |
| MKC watercourses (GIS files)   | MKC           | Y         | 22/06/2021 |   |
| Scrutiny Meeting files   | MKC           | Y         | 06/08/2021 |   |
| KarbonTech Report Card Prospect Road Vehicle Over.pdf  | MKC Highways  | Y         | 12/08/2021 |   |
| KarbonTech Report Cards Prospect Road.pdf  | MKC Highways  | Y         | 12/08/2021 |   |
|  |               |           |            |   |
| DG5 register   | Anglian Water | N         |            |   |
| Information on Anglian Water balancing lakes   | Anglian Water | Y         | 22/06/2021 | Covered in Wet Weather Incident - increased data sharing-20210622_083906-Meeting Recording.mp4. |
| Information on Anglian Water pumping stations  | Anglian Water | Y         | 22/06/2021 | Covered in Wet Weather Incident - increased data sharing-20210622_083906-Meeting Recording.mp4. |
| All rain gauging station data for gauges within the Borough of Milton Keynes owned by the Anglian Water for last 10 to 15 years  | Anglian Water | N         |            |   |
| Historic flooding records  | Anglian Water | N         |            |   |
| Any information and data regarding the magnitude of the following flooding events occurring across the borough of Milton Keynes; 4th October 2020, 24th December 2020, 15th January 2021 and 30th January 2021 | Anglian Water | Y         | 22/06/2021 | Covered in Wet Weather Incident - increased data sharing-20210622_083906-Meeting Recording.mp4. |
| Local flood risk issues associated with assets   | Anglian Water | Y         | 22/06/2021 | Covered in Wet Weather Incident - increased data sharing-20210622_083906-Meeting Recording.mp4. |
| Wet Weather Incident - increased data sharing email  | Anglian Water | Y         | 15/05/2021 |   |
| Wet Weather Incident - increased data sharing-20210622_083906-Meeting Recording.mp4  | Anglian Water | Y         | 22/06/2021 |   |
| Audio files between AW and local community (audio_only.m4a and zoom_0.mp4)   | Anglian Water | Y         | 06/08/2021 |   |
| AW_WW_EXPORT_MK (GIS files)  | Anglian Water | Y         | 22/06/2021 |   |
| ouzel fds.pdf  | Anglian Water | Y         | 10/08/2021 |   |
|  |               |           |            |   |
| Role of the Parks Trust in Milton Keynes   | Park Trust    | Y         | 20/04/2021 |   |
| Pre and post flood recovery actions and maintenance regimes across Milton Keynes   | Park Trust    | Y         | 20/04/2021 |   |
| Information on flood defences  | Park Trust    | Y         | 20/04/2021 |   |
| Milton Keynes Balancing Lakes  | Park Trust    | Y         | 20/04/2021 |   |
| Parks_Trust_Land_Stony_Stratford.JPG   | Park Trust    | Y         | 20/04/2021 |   |
| Sustainable Urban Drainage Systems managed by The Parks Trust in Milton Keynes.docx  | Park Trust    | Y         | 20/04/2021 |   |
| 1979_Chartered Municipal Engineer Journal_MK Balancing Lakes.pdf   | Park Trust    | Y         | 20/04/2021 |   |
| 2003_Environment Agency Operation of Willen and Caldecotte Lakes.pdf   | Park Trust    | Y         | 20/04/2021 |   |

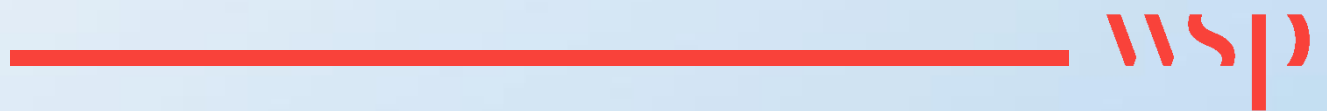


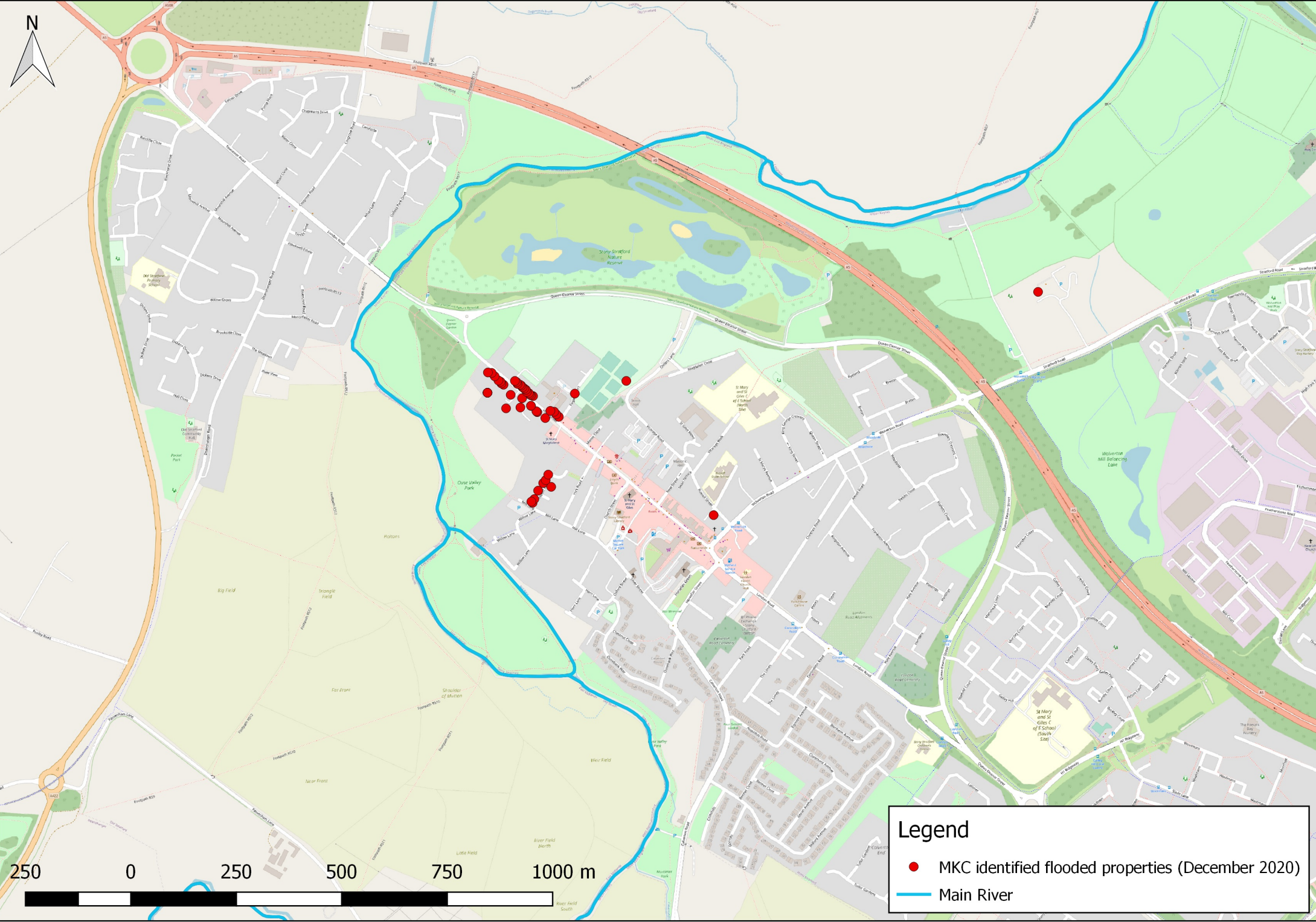
MKC S19 Stony Stratford

| Dataset  | Owner               | Received? | Date       | Comments   |
|--|---------------------|-----------|------------|--|
| Any information regarding water levels and operation of the structures during the 23rd/24th December 2020 as well as 15th January 2021   | Canal & River Trust | Y         | 06/05/2021 | General info on the water levels and operation of the structures |
| Any relevant information and data regarding the following flooding events occurring across the borough of Milton Keynes; 4th October 2020, 24th December 2020, 15th January 2021 and 30th January 2021 | Canal & River Trust | N         |            | They do not have this data                                       |
| Any information on overtopping and/or breach events during the 23rd/24th December 2020 as well as 15th January 2021  | Canal & River Trust | Y         | 06/05/2021 |  |
| Historic flooding records  | Canal & River Trust | N         |            |  |
| Historical overtopping and/or breach events  | Canal & River Trust | Y         | 06/05/2021 |  |
| Records of management and maintenance of the canal and its structures within the three study areas   | Canal & River Trust | Y         | 06/05/2021 |  |
| Bridges, canal centreline, outfall discharge points (GIS files)  | Canal & River Trust | Y         | 22/06/2021 |  |
| Shapefile GIS layer of the watercourses associated with Stony Stratford and IDB districts  | IDB                 | Y         | 04/05/2021 |  |
| Historic flooding records  | IDB                 | Y         | 04/05/2021 |  |
| Any relevant information and data regarding the following flooding events occurring across the borough of Milton Keynes; 4th October 2020, 24th December 2020, 15th January 2021 and 30th January 2021 | IDB                 | N         |            | They do not have this data                                       |
| Records of the Board's Asset management System for the assets located within the above study areas   | IDB                 | N         |            |  |
| IDB Shapefiles   | IDB                 | Y         | 22/06/2021 |  |
| IDB Watercourses   | IDB                 | Y         | 22/06/2021 |  |
| MK Flooding incidents attended Jan 2020 - Mar 2021.xlsx  | Fire Brigade        | Y         | 06/07/2021 |  |
| Historic flooding records  | Fire Brigade        | N         |            |  |

# Appendix B

**APPENDIX B**





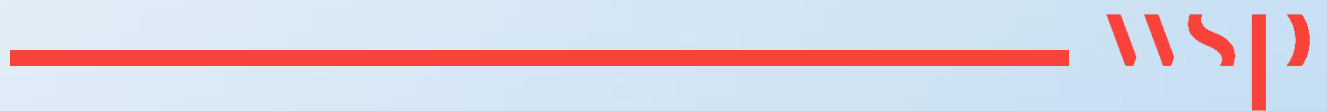
**Legend**

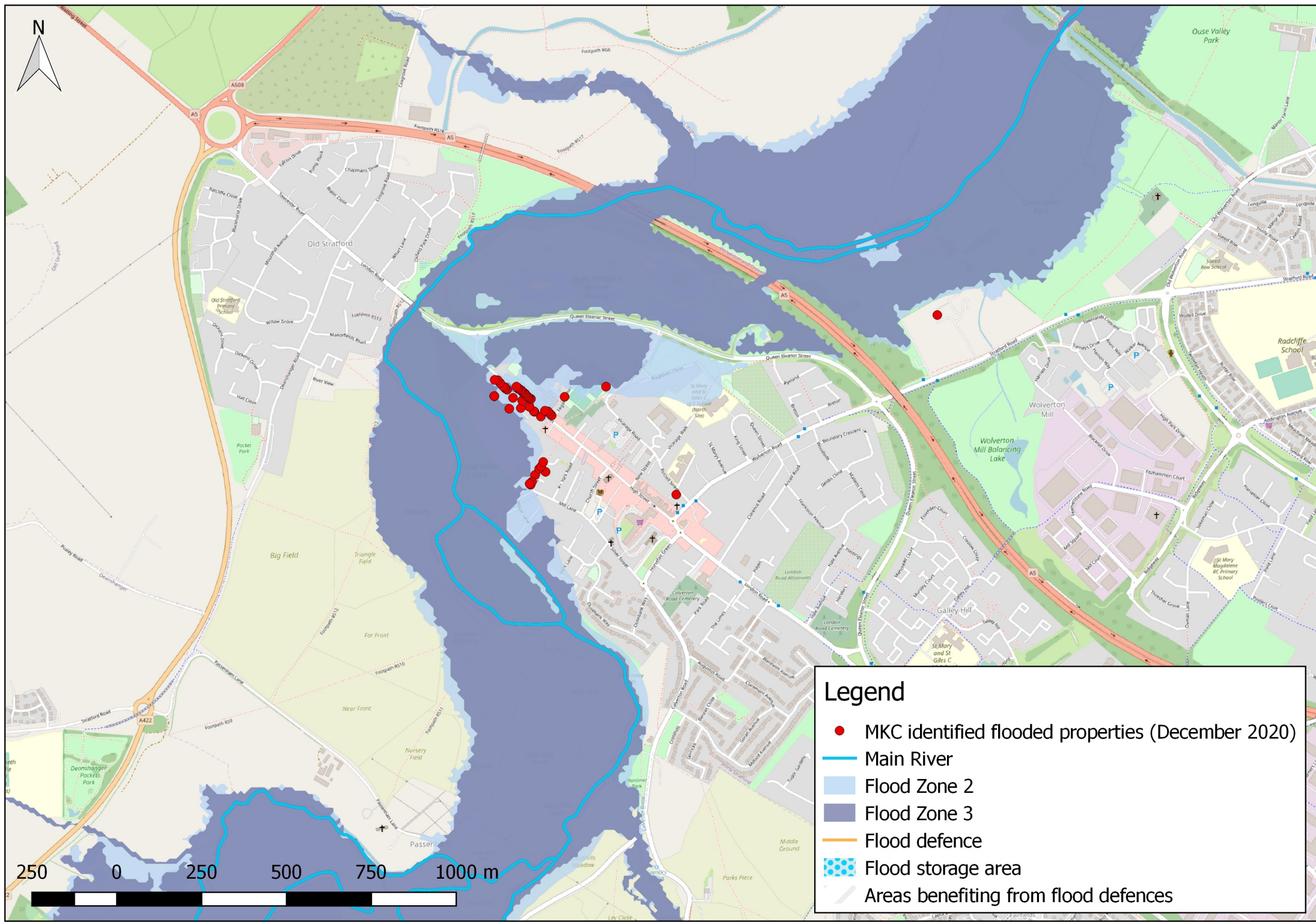
- MKC identified flooded properties (December 2020)
- Main River



# Appendix C

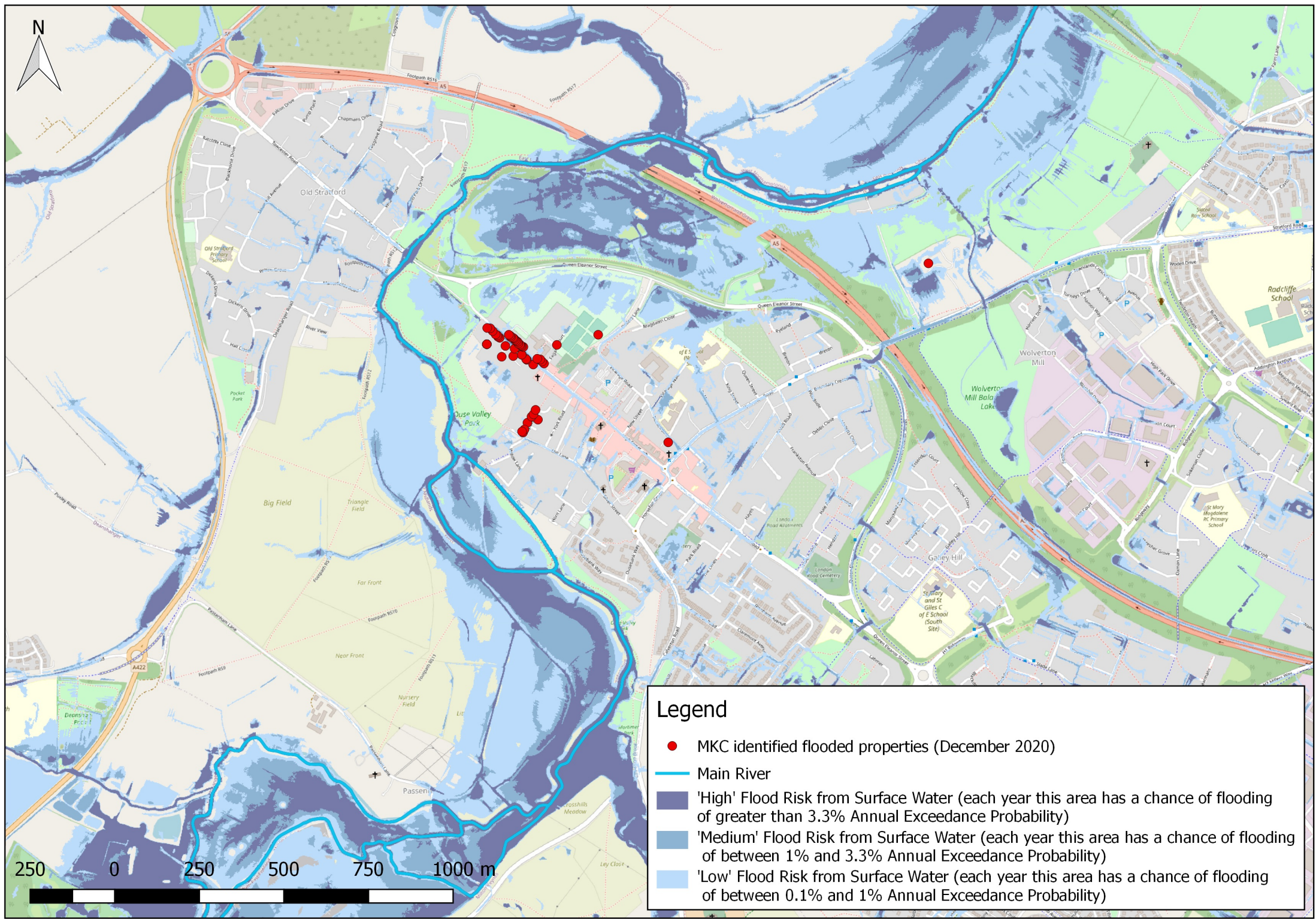
## APPENDIX C





### Legend

- MKC identified flooded properties (December 2020)
- Main River
- Flood Zone 2
- Flood Zone 3
- Flood defence
- Flood storage area
- Areas benefiting from flood defences



### Legend

- MKC identified flooded properties (December 2020)
- Main River
- 'High' Flood Risk from Surface Water (each year this area has a chance of flooding of greater than 3.3% Annual Exceedance Probability)
- 'Medium' Flood Risk from Surface Water (each year this area has a chance of flooding of between 1% and 3.3% Annual Exceedance Probability)
- 'Low' Flood Risk from Surface Water (each year this area has a chance of flooding of between 0.1% and 1% Annual Exceedance Probability)

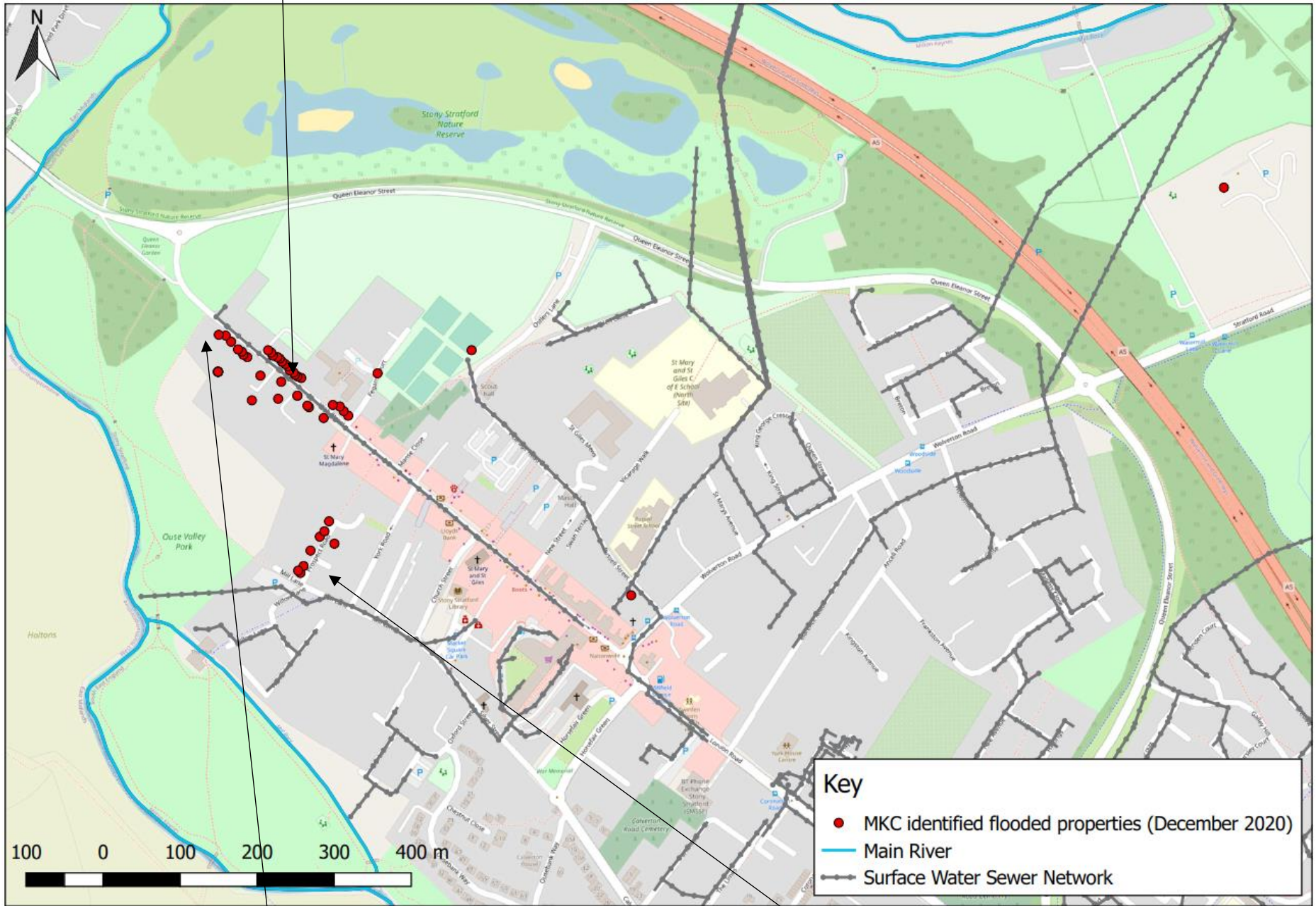
# Appendix D

**APPENDIX D**





Flood extent at the High Street during the night of the 23<sup>rd</sup> December 2020



Drone footage showing flood extent at Stony Stratford High Street during the Christmas Eve flood event.



Blocked drain at Prospect Road which had the potential to exacerbate flooding during a storm event.



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