Kent County Council

Flood Investigation Report

Location of Investigation: Snodland

Date of incident: 10 June 2019

This document has been prepared by Kent County Council Flood and Water Management Team as the Lead Local Flood Authority under Section 19 of the Flood and Water Management Act 2010, with the assistance of:

- Kent County Council
- Tonbridge and Malling Borough Council
- Kent Fire and Rescue Service

The findings in this report are based on the information available to KCC at the time of preparing the report. KCC expressly disclaim responsibility for any error in or omission from this report. KCC does not accept any liability for the use of this report or its contents by any third party.

This report can be found here where more information can be found about the requirements and trigger for a Section 19 investigation and the roles and responsibilities of Risk Management Authorities.

For further information or to provide comments, please contact us at flood@kent.gov.uk

Summary of event

On the 10th June 2019 heavy rainfall was experienced across the country. 31 flood warnings and 1 flood alert were issued by the Environment Agency across England, with some areas of Kent recording in excess of 100mm of rain in a 24-hour period. The average rainfall for June in Kent is 53 mm[1].

Very heavy rainfall occurred county wide, with areas such as West Kingsdown, Vigo, Snodland and Swanley particularly badly affected.

This report will focus on the Snodland area where around 20 properties are known to have been flooded by surface water, many of those were affected internally. The locations of the reported flood incidents are shown in Figure 1 and Table 1 provides a summary of the investigated flooding issues and known flood extent.

[1] Source: https://www.southernwater.co.uk/water-for-life/regional-rainfall

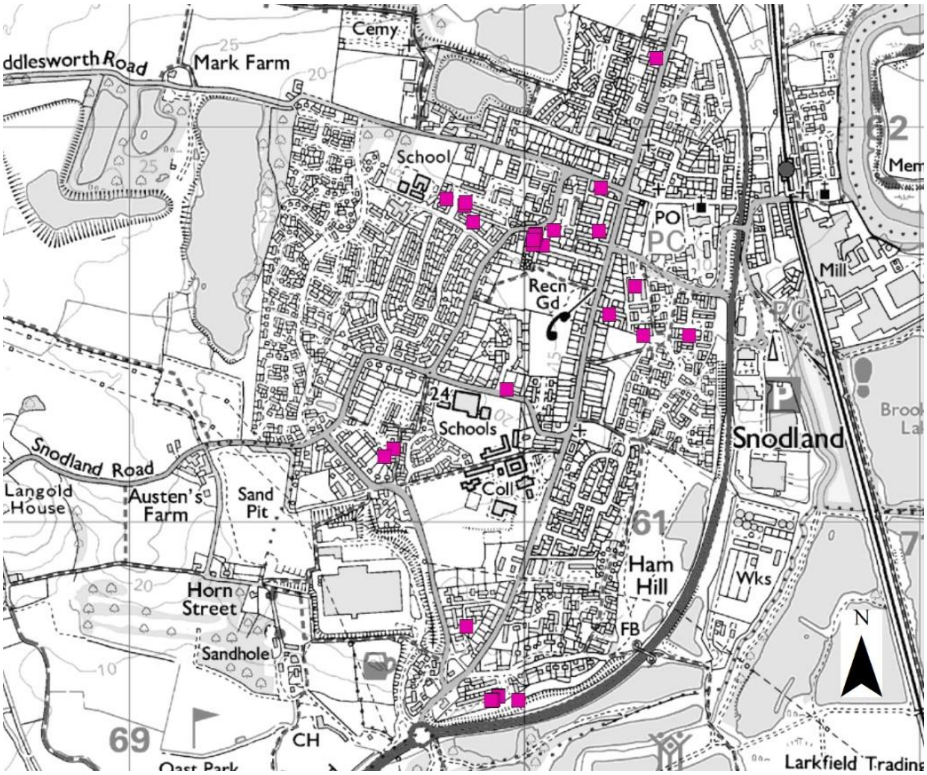

Figure 1 Location of Reported Flood incidents in Snodland

Table 1 Summary of the investigated flooding issues

Location	Details of flooding	Source of Report
Pout Road	Internal flooding to 2 properties	KCC
Saltings Road	Internal flooding to 2 properties, water was reported to have come from overflowing drain in Oxford Road and flowed into Saltings Road water reached a depth of 4 to 5 inches	KCC and TMBC
Recreation Avenue	Internal flooding to 9 properties	TMBC and KFRS
Lakeside	6 properties affected Damage to vehicles due to depth of water	TMBC, KFRS and KCC
Pridmore Road	3 properties affected	TMBC, KFRS and KCC
High Street	1 property affected – water reached property no confirmation that water entered property garden was flooded	KCC and TMBC
Holborough Road	1 internal flooding to property water reached around 10 inches	KFRS
St Katherine Lane	Internal Flooding to 1 property. Internal flooding at St Katherines School, 21 classrooms affected water reached a depth of 6 inches. School was closed for 2 days immediately after the flood.	KFRS
Roberts Road	Highway Flooding	KFRS
Birling Road	1 property affected	KFRS
Rectory Close	1 property affected	KFRS
Cooper Road	1 property internally flooded	KCC
Sortmill Road	Internal flooding to Retail Depot	KCC
Oxford Street	Highway flooding	KCC
Freelands Road	Highway flooding	KCC

Site Location, Topography and Flood Risk

Snodland is located north-west of Maidstone, situated close to the River Medway. The town sits at the base of the steep scarp slopes of the North Downs, small watercourses rise along the scarp slopes where the chalk gives way to gault clay and drain towards the Medway. Snodland predominantly sits over gault clay, however to the south at Ham Hill the lower elevation exposes Folkestone Beds Sandstone.

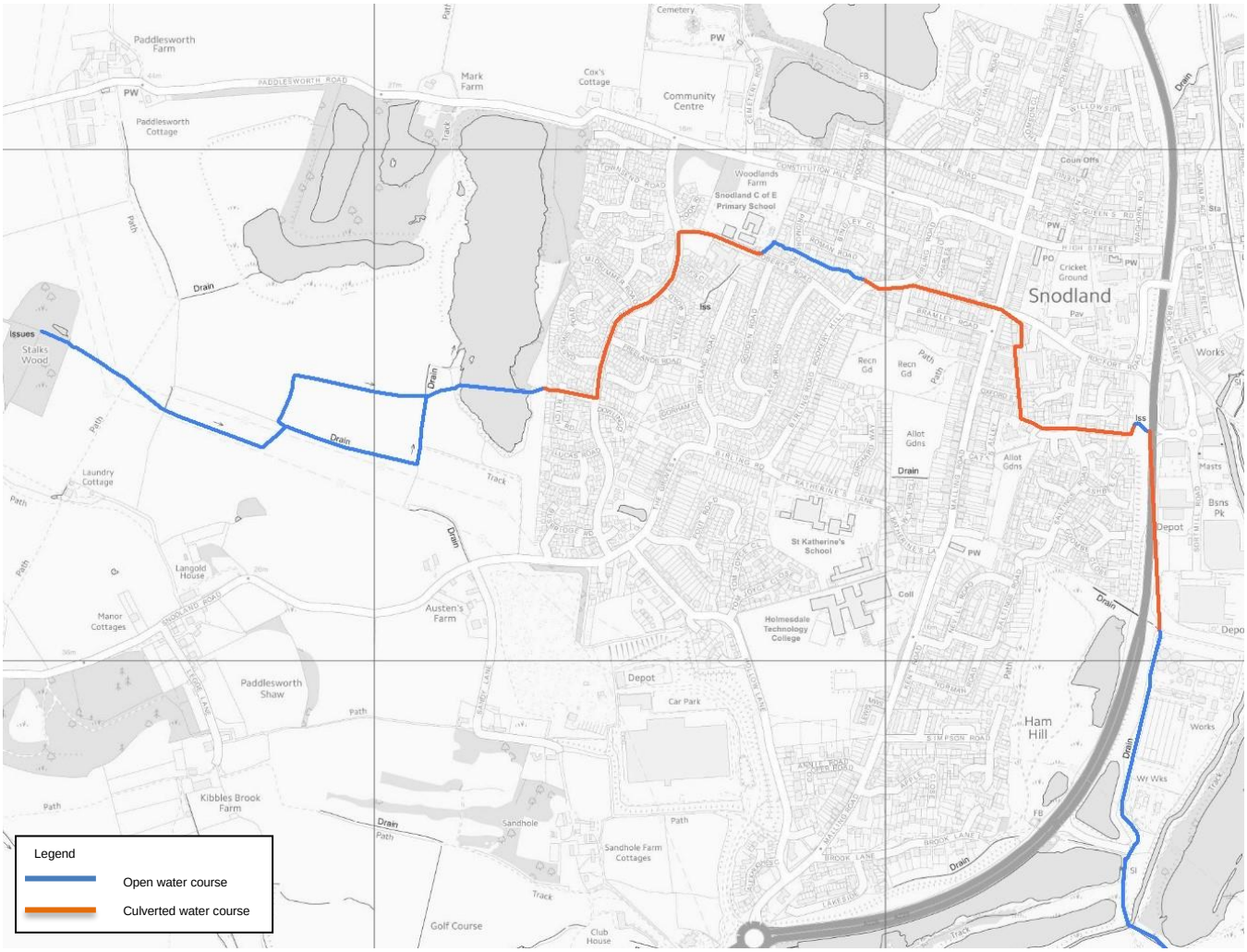

Figure 2 Location of the watercourse in Snodland

A small water course rises in Stalks Wood to the west of Snodland, the water course flows in an easterly direction and passes through the former quarry site on Paddlesworth Road forming a large online lake. The catchment upstream of the lake covers an area of 0.7km^2 and is predominantly arable farmland. The lake is owned by Tarmac Cement and Lime Ltd and forms part of the Paddlesworth Lake complex. The lake covers approximately 9 hectares with both the inlet and outlet located at the southern end of the lake.

As The watercourse leaves the lake via a small channel where it enters a culvert on TMBC owned open greenspace.

The culverted watercourse follows the road network underneath Ritch Road and St Benedict Road, before becoming open water at Roberts Road adjacent to Snodland C of E School, here the channel turns sharply to the east before passing under Pridmore Road. The open watercourse continues to run parallel to Roberts Road before entering a culvert at Birling Road.

Photo 1 Inlet to the culvert at Paddlesworth Lake (18/06/2019)

Photo 2 Inlet to the culvert at Birling Road (27/06/2019)

The culvert follows the route of Birling Road to the junction of Rectory Avenue and from here follows a straight line to the junction of Chapel Road and Malling Road. The culvert continues in an easterly direction along Rocfort Road before turning South to follow the route of the footpath which runs to the rear of Rectory Close and Saltings Road. After 200 meters the culvert turns east for a further 240 meters before becoming open water to the rear of properties on Saltings Road adjacent to the A228. At the A228 the watercourse enters a culvert and flows south becoming open ditch at the Ham Hill sewage works and finally joining the Leybourne Stream within the Country Park. The catchment area for this water course covers a total of 2.1km^2.

Photo 4 Security screen on outlet of pipe at Saltings Way (18/06/2019)

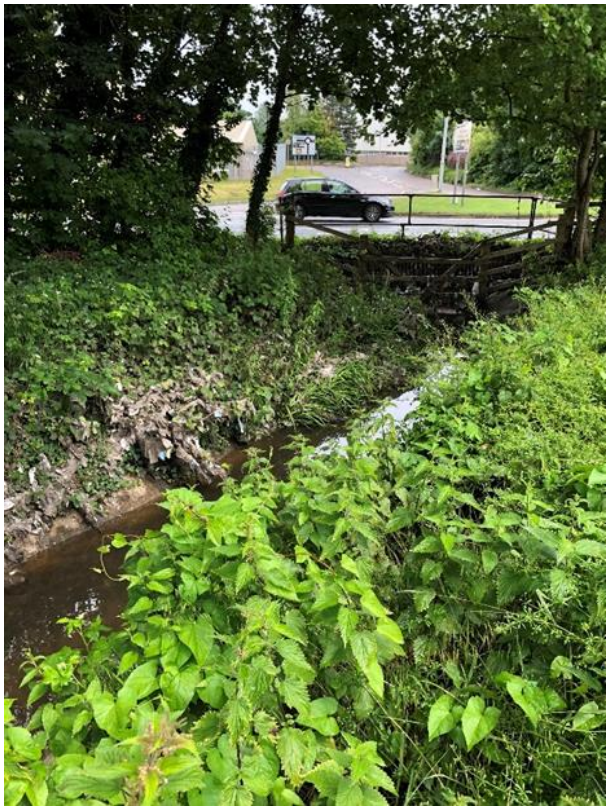

Photo 3 Open channel between Salting Road and the A228 (18/06/2019)

The Leybourne Stream flows from the south of Snodland, travelling on the eastern side of the A228, it travels through Leybourne Lakes country park. Turning north within the country park the stream travels adjacent to the eastern side of the sewage works and Sortmill Road industrial estate before turning east and passing underneath the railway line and joining the River Medway.

During rainfall events, water that is not captured by surface water drainage will follow the topography and naturally drain towards the watercourse. The updated Flood Map for Surface Water (uFMfSW) shown in Figure 3 is published on the Environment Agency website, it shows the areas around the watercourse are at high risk of surface water flooding, it should be noted that lakes and ponds are shown in dark blue on the map. The uFMfSW map follows the route of the watercourse and the locations of flooded properties correspond to this area.

The national surface water flooding provided by the Environment Agency on the gov.uk long term flood risk information map[2] indicates these areas to be at a medium to high risk of surface water flooding. Medium and high risk means that these areas have a chance of flooding of greater than 1% and 3.3% in any one year respectively.

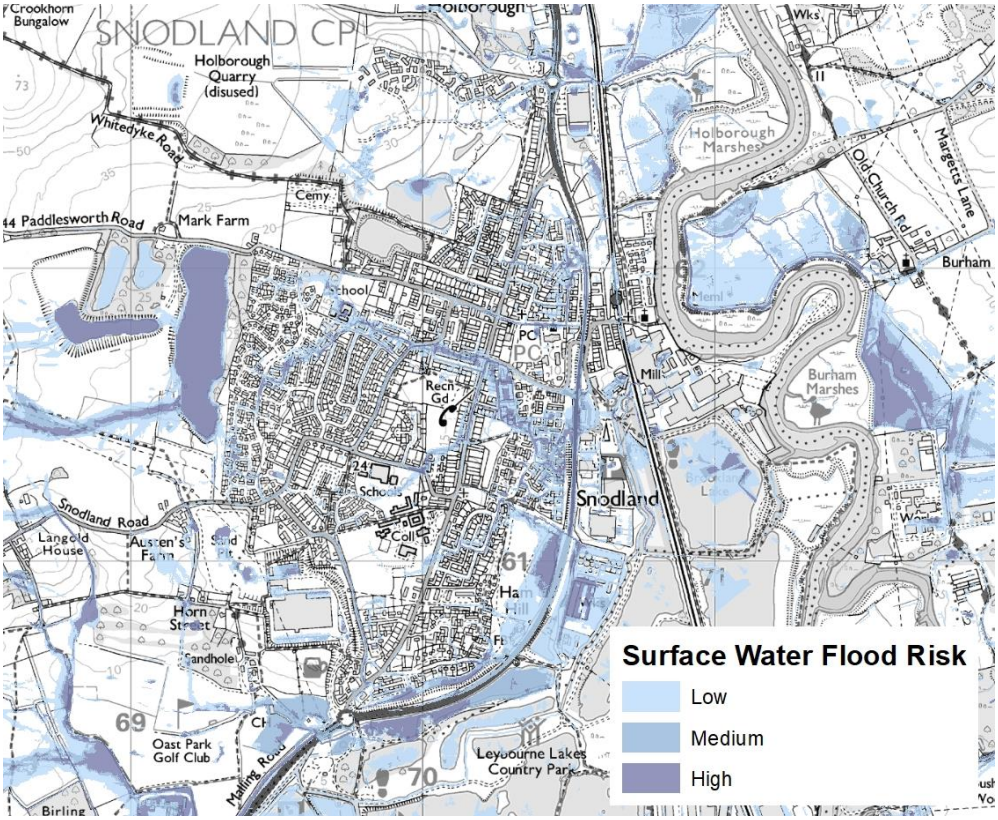

Figure 3 Environment Agency surface water flood map

Drainage System Details

Snodland is a densely built up area with a high percentage of impermeable surfaces, private drainage, roofs and highways. The town is drained by a combination of mechanisms, the older parts of the town drain to combined sewers, which carry both foul and surface water, and discharge at the sewage treatment works at Ham Hill near Snodland. Newer parts of the town are served by dedicated surface water sewers which discharge to a local watercourse.

The drainage in some parts of the town is based on soakaways, which collect surface water from a small area and allow it to infiltrate into the ground. Soakaways rely on the natural permeability of the underlying rock for the water to soak into. They are usually made by digging large manholes that are lined with perforated concrete rings or open jointed brickwork. The manhole provides storage for water as it seeps through the perforations in the chamber into the surrounding bedrock over a period of 24 to 48 hours, ready to accept a subsequent storm. Prolonged very heavy rainfall or multiple heavy rainfall events within a short period can overwhelm the storage available in these soakaways and result in surface water flooding occurring. Individual soakaways serve relatively small areas of between two and six road gullies.

[2] The flood warning information service long term flood risk maps are publicly accessible by visiting https://flood-warning-information.service.gov.uk/long-term-flood-risk/map

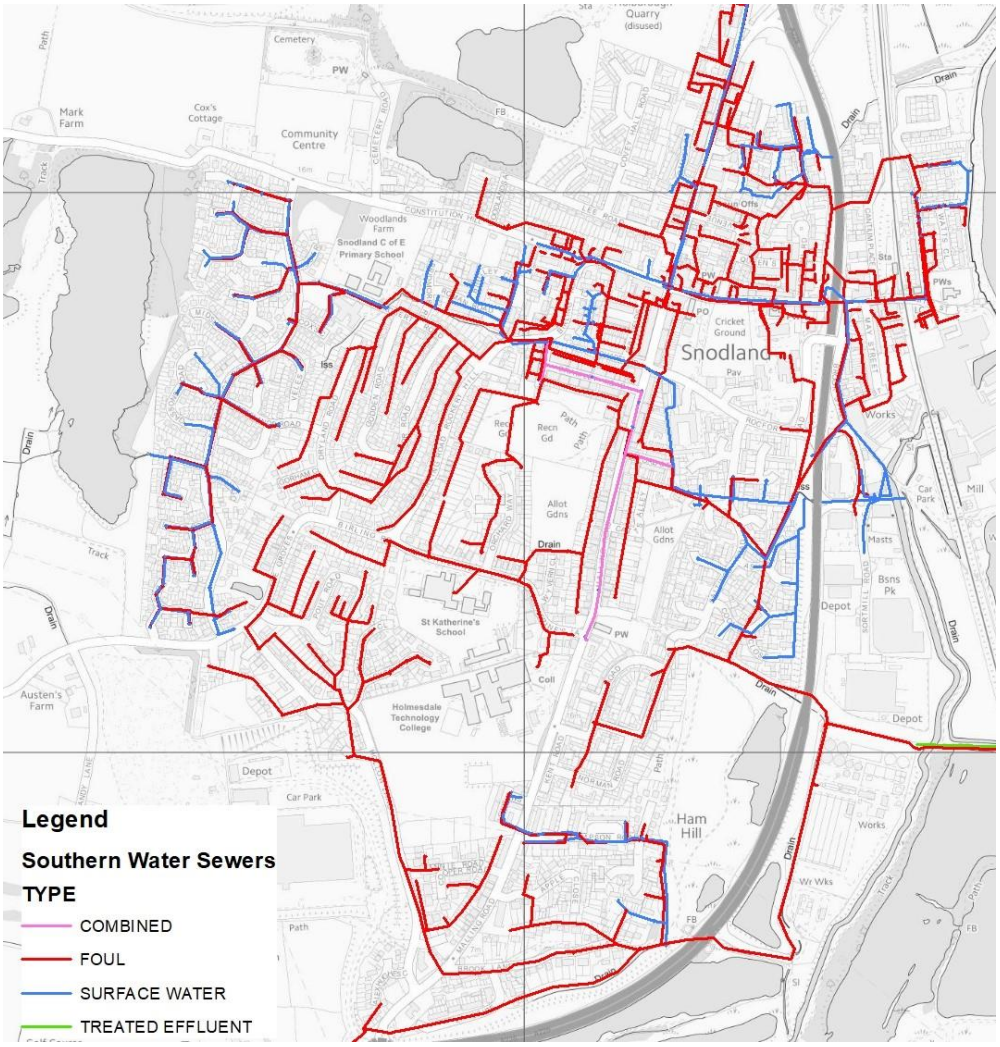

Figure 4. Southern Water public sewers within Snodland

The public sewers in Snodland are owned and maintained by Southern Water. The drainage assets on the public highway are owned and maintained by KCC as the Highway Authority, the highway generally drains to the public sewer network, in some areas it drains to soakaways or via dedicated highway sewers, which are owned by KCC. At Pout Road, St Katherines Lane, Roberts Road and Lakeside the highway run-off is managed by the highway drainage network.

The areas around St Benedicts Road including Freelands Road to the west, Pridmore Road, the High Street and Holborough Road to the north and Saltings Road and Rectory Close to the east are of more recent construction and have separate surface water and foul water drainage. The surface water sewers discharge to the culverted watercourse which is located underneath the highway.

The area around Malling Road including Recreational Avenue and Oxford Street is within the older area of the town and is drained almost exclusively by combined sewers.

At Lakeside the highway run-off is discharged via soakaways.

At Sortmill Road the highway is drained via private surface water drainage which discharges into the Leybourne Stream.

Modern sewerage in the UK is designed according to the standards set out in Sewers for Adoption guidance together with the sewerage undertaker's own supplementary design stations. Sewers for Adoption was first published in 1980 and sets out a design standard for sewers and drains of 1 in 30 years plus climate change, i.e. a new sewer system should be designed to contain a storm of 1 in 30 years return period, storms that exceed this intensity needn't be contained in the sewer system. Water companies that own the public sewer network can invest in the sewers according to their business plan, however this

investment is regulated by the water regulator, OfWat, and must be cost beneficial. Consequently, it is rare for improvement works on sewers to provide a capacity greater than the 1 in 30-year standard where the existing system does not already exceed this standard.

Highway drainage and soakaways are typically designed to manage a rainfall from a rainstorm with a 20% probability of occurring in any one year (a '1 in 5-year' event storm).

Rainfall Details

Rain Gauge	Ham Hill (Snodland) STW RG	
Rainfall	82.93mm	103.58mm
Time period	4.15 hours (17:15 – 21:30)	20 hours (01:30 - 21:30)
Annual Exceedance Probability	0.28%	0.70%
	1 in 352.7-year return period	1 in 142.1-year return period

Rainfall around the county is recorded by a series of rain gauges operated by the Environment Agency. These report the rainfall depth recorded over a 15-minute interval or a day. The data can be used with the Flood Estimation Handbook (FEH)[3] web service Event Rarity Calculator to assess the Annual Exceedance Probability (AEP) of the depth of rainfall that occurred. 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. This is also known as a '1 in 100 year' event.

Figure 5 shows the location of the rain gauges and Table 2 summarises the rainfall recorded at the Environment Agency rainfall gauge stations closest to the path of the storm on 10 June 2019.

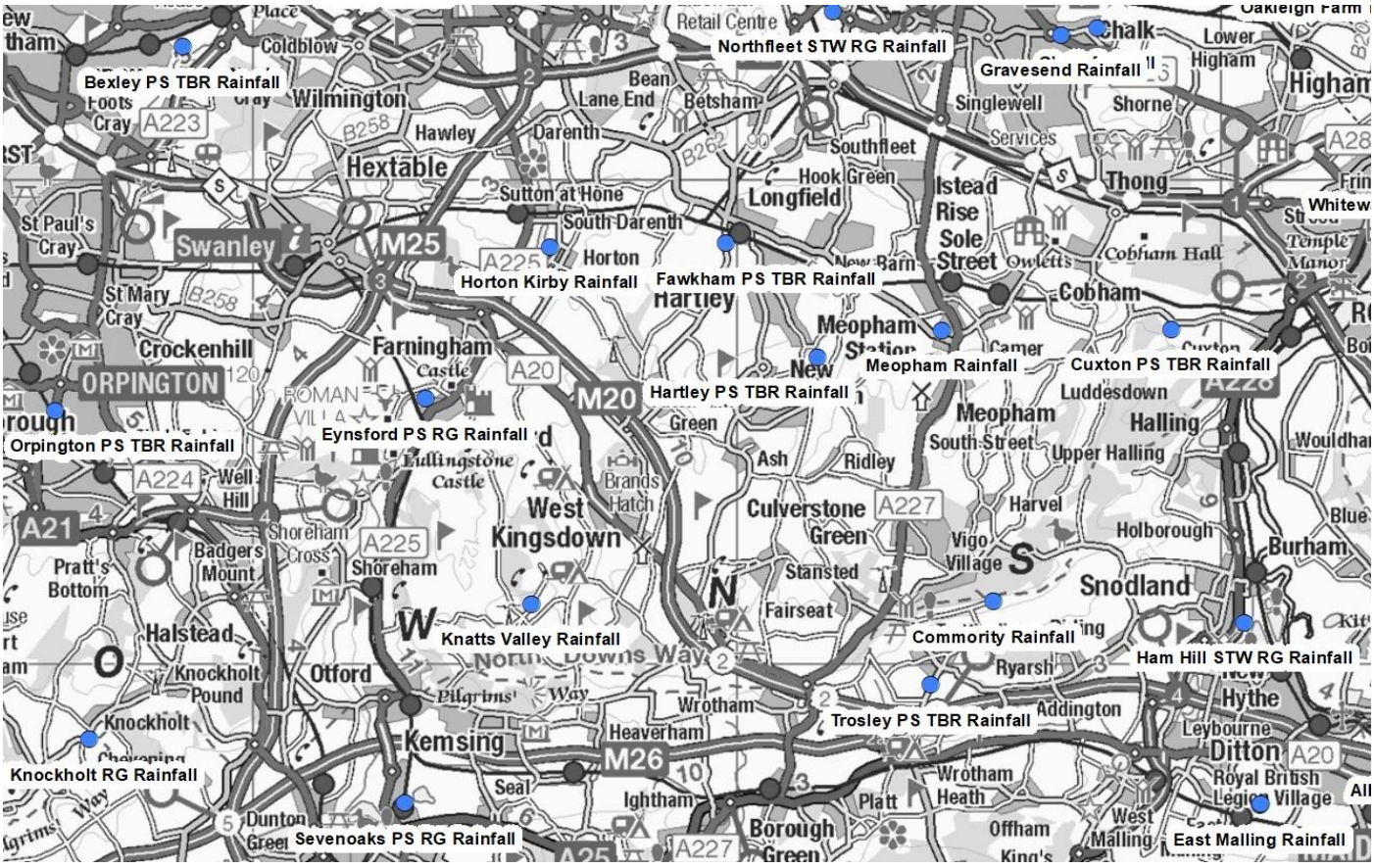

Figure 5 Location of rain gauge stations closest to the path of the storm.

[3] The Flood Estimation Handbook (FEH), with its subsequent updates and FEH Software, provides the industry-standard methods for assessing flood risk in the UK. It offers guidance on the estimation of rainfall and river flood frequency and development site runoff rates across the UK.

Table 2. Rainfall levels recorded at Environment Agency Rain Gauge station on 10 June 2019.

Rain Gauge	Rainfall	Time Period
Bexley	22.62mm	Daily total
Hartley	70.96mm	01:30 – 22:30
Orpington	94.80mm	01:45 – 23:45
Commority	122.5mm	Daily total
Fawkham	48.60mm	02:00 – 22:45
Sevenoaks	43.86mm	01:45 – 21:15
Eynsford	96.16mm	02:00 – 23:15
Snodland	103.58mm	01:45 – 21:30
Trosley	75.40mm	01:15 – 22:00

The storm tracked broadly from the east to the west across the north downs, this is shown by the high levels of rainfall measured at Ham Hill, Commority, Eynsford and Orpington. Rainguges to the north and south of this path, Hartely and Trosley respectively, show lower, but still relatively high levels of rainfall. The rain gauges at Fawkham and Sevenoaks which lie further to the north and south respectively show further lower rainfall levels.

The nearest rain gauge to Snodland is located at Ham Hill. It recorded a total daily rainfall of 103.58mm on 10th June 2019 from 01:45 until 21:30. Given the consistency of this gauge with the others in the path of the storm this rainfall is considered to be representative of the rainfall experienced at Snodland

Whilst it rained continuously throughout the day, the heaviest rainfall was experienced from 17:15 until 21:30 with a total of 82.93mm of rainfall during that period.

Flood description

The earliest report of flooding was received from Covey Hall Road at 20:28 after approximately 44mm of rainfall had fallen. The caller reported a blocked drain causing flooding to the road and external flooding to the property. KFRS responded to a report of flooding on Holborough Road at 20:56. More widespread flooding occurred after 21:30 following an additional 42mm of rain which fell over a one-hour period.

As the intensity of the rainfall increased significant overland flows from the built areas began to drain towards the culverted watercourse and collect within the topographical low points. Recreational Avenue, Rectory Lane and Saltings Road suffered deep surface water flooding as the volume of water collected at a faster rate than the drainage system could discharge it.

Photo 5 Flooding at Rectory Lane (Source: Downs Mail)

KCC Highways provided an emergency response at Pout Road with the out of hours officer attending to clear gullies by number 61 and gullies were jetted on Pridmore Road to allow water to drain away.

Residents reported flooding on St Katherines Lane, where surface water came from the school playing field and flowed onto the highway. Overland flow from the playing field entered the school buildings affecting 18 classrooms, the intensity of the rainfall resulted in sections of the flat roof collapsing and the private rising main surcharged within the main building causing extensive damage to the property. Surface water from the school grounds flowed onto St Katherines Lane where KFRS responded to internal flooding at one property where water had reached a depth of 6inches.

At Lakeside surface water flooding collected at the topographical low point, flooding the highway and entering property. KCC Highways deployed a tanker to assist with controlling the flood water as it had nowhere to disperse.

At Sortmill Road it was reported that the during the storm the river level in the Leybourne Stream rose preventing the surface water system from discharging. Water collected at the topographical low points, causing flooding to the depot.

Flooding mechanism

The flooding on 10th June 2019 was the result of prolonged rainfall throughout the day followed by an intensive period of heavy rainfall which fell on saturated ground.

The online lake to the west of Snodland will have provided some attenuation of the upper catchment of the stream. However, as there is no monitoring of the levels in the lake, it is difficult to determine how the lake responded to the rainfall during the event and to what degree the outfall from the lake increased.

The urban area of Snodland with its high percentage of impermeable areas will have been a significant factor in the flooding, run-off from roofs, hard-standing and the highways will have increased the overland flow-pathways which naturally drains towards the culverted watercourse. The excessive rainfall which exceeded the capacity of the drainage, meant that water was not able to enter the surface sewer network fast enough and accumulated in the topographical low points affecting Pridmore Road, Robert Road, Birling Road, Recreational Avenue, Rectory Close Oxford Street and Saltings Road .

At St Katherines Lane surface water drained from the roofs, carparks and playing fields of the school grounds and caused flooding within the school buildings. The privately owned rising main (pumped sewer pipe) surcharged lifting the manhole cover within the building, mostly likely as a result of the sewer becoming inundated with surface water. Overland flows from the school combined with surface water from the highway and collected at the topographical low point overwhelming the highway drainage on St Katherine Lane.

At Pout Road and Lakeside surface water is drained by highway authority soakaways, which were quickly overwhelmed by the heavy rainfall. However, anecdotal evidence provided by residents reported that drainage in Brook Lane was blocked and contributed to the flooding in Lakeside.

The private drainage network at Sortmill was cleaned on 24/05 prior to the flood event. Anecdotal reports from the private drainage engineer attending the flooded depot suggest that river levels in the Leybourne Stream were high preventing the drainage from discharging to the stream. However, the Environment Agency received no reports of fluvial flooding within the Snodland or Leybourne area on the 10 June.

Flood Response

A CCTV survey of the stream culvert was completed between Ritch Road and the outfall of the stream at Saltings Road. The survey identified no significant defects and once the rainfall had ceased the water began to drain away, indicating that the drainage system is operational, but was overwhelmed by the volume of rainfall during the event.

After the incident recovery activities included the cleansing of gullies at Freelands Road, Pout Road, Roberts Road, St Katherines Lane, Recreation Avenue Holborough Road, Saltings Road and Covey Hall Road.

On St Katherines Lane 3 of the 18 gullies were found to be full and on Recreational Avenue 1 of the 4 gullies was found to be full. On the High Street all six gullies were cleansed with no issues found. On Pridmore Road the whole road was cleansed including the stream culvert. However, the blocked drainage does not appear to be a significant contributor to the flooding.

A full CCTV survey of St Katherines Lane is still outstanding, however the partially completed survey has found there to be a complete blockage within one section of the highway drainage system along with numerous smaller defects.

At Lakeside, following attendance by a tanker to clear flood water, all the gullies were cleansed. CCTV survey of the soakaways at Lakeside found all the soakaways holding water at the time of inspection. Investigations have found that groundwater ingress has reduced their capacity to hold water. One of these soakaways was also found to have a foul misconnection from a private property. Highway soakaways are designed only to take surface water from the highway. CCTV surveys of the drainage within Brook Lane located a damaged pipe which was repaired in May 2020, however some further work is required in other parts of the road which has been delayed due to the Covid-19 pandemic.

Conclusions and Future Actions

A heavy rainstorm of a 1 in 142-year return period occurred in Snodland on the 10 June, including an intensive period of rainfall in the evening of a 1 in 352-year event, which led to the extensive flooding.

The prolonged rainfall caused significant overland flows from the urban catchment which resulted in flooding as water drained towards the culverted watercourse. Deep surface water occurred at the topographical low points above the culverted watercourse, as the volume of water was unable to discharge quickly enough through the surface water sewer into the watercourse resulting in flooding to properties in the vicinity. Storms of this severity are likely to overwhelm drainage which is not designed for rainfall of this intensity. Flood water drained away once rainfall had ceased indicating that the drainage systems are in operational order.

In locations away from the watercourse, surface water collected at the local low points causing flooding to properties. In these areas the highway drainage became overwhelmed as it is not generally designed to accommodate storms of this severity and it is unlikely improvements could prevent a similar flood if this rainfall was experienced again.

Following investigations into the structural condition of the soakaways at Lakeside KCC Highways are commissioning consultant engineers to review options to resolve the groundwater ingress into the soakaways.

At St Katherines Lane the outstanding surveys are due to be completed and any work will be actioned by KCC Highways in due course, however the Covid-19 lockdown has delayed the ability to progress works.

KCC's Flood and Water Management Team will commission a consultant to carry out an assessment of the surface water contribution from the upstream catchment and lake to better understand if there are options which could be identified to mitigate the risk from intensive storm events. This will be more detailed than the currently available surface water flood map, which are a high-level overview of risk for an area.

It should be noted that improvements must be cost-beneficial (i.e. is the costs of delivering them must be outweighed by the benefits they provide). Any improvements made are unlikely to completely eliminate the risk of surface water flooding - all measures can be overwhelmed by an event of sufficient extremity. Even if the standard of protection is increased in the future, it is unlikely that flooding in a similar event could feasibly be prevented.