

Caterham Drive Flood Investigation Report – 7th June 2016

*Final Version
January 2017*

Prepared by: Sarah Betts
Graduate Water Consultant

Checked by: Amy Ruocco
Senior Water Consultant

Emily Craven
Associate

Approved by: Sarah Kelly
Regional Water Director

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Midpoint, Basingstoke, Hampshire, RG21 7PP, United Kingdom
Telephone: 01256 310 200 Website: <http://www.aecom.com>

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1 Introduction

1.1 The Flood Event

In June 2016 heavy localised rainfall led to severe surface water flooding in south London before the weather system moved north across the country. The London Borough of Croydon was particularly affected on 7th June resulting in localised deep, fast-flowing water which submerged/floated vehicles and entered properties at several locations. This flood investigation report will explore the factors leading to flooding on Caterham Drive, Coulsdon on the 7th June 2016.

1.2 Why has this flood been investigated?

Croydon Council is the Lead Local Flood Authority (LLFA) for the London Borough of Croydon and has a responsibility to record and report flood incidents, as detailed in Section 19 of Part 1 of the Flood and Water Management Act 2010 (FWMA)¹.

FLOOD AND WATER MANAGEMENT ACT 2010

Part 1: Flood and Coastal Erosion Management

19. Local authorities: investigations

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

- (a) which risk management authorities have relevant flood risk management functions, and
- (b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under (1) it must:

- (a) publish the results of its investigation
- (b) notify any relevant risk management authorities

Croydon Council has developed a Flood Investigation Protocol which outlines the process that will be followed to determine the need for an investigation (this is available on request).

The requirement for an investigation is determined on a case-by-case basis, considering factors such as the source and impact of the flooding event, e.g. the number and type of receptors (homes, businesses and critical infrastructure) affected by the flooding. The Protocol provides guidance to aid decision-making and threshold levels which are used as a guide to determine when an investigation should be carried out. However, it should be noted that the Flood Investigation Protocol remains under review. The key thresholds from the Protocol are listed in Table 1.1, along with details of how the thresholds were exceeded during the 7th June 2016 surface water flood event at Caterham Drive.

¹ Flood and Water Management Act (2010) <http://www.legislation.gov.uk/ukpga/2010/29/contents>

Table 1-1 Flood Investigation Protocol Threshold Exceedance for the 7th June 2016 Flood Event

Key thresholds	Threshold exceeded?
There has been a fatality or serious injury as a direct result of flooding.	There were no reports of fatalities or serious injuries as a result of the flood event
Depth greater than 0.10m over ground floor threshold of a residential property <i>or</i> more than 3 residential properties flooded.	Six properties were reported to have suffered internal flooding in excess of 0.10m. Flooding reached up to 900mm in some locations.
Flooding has prevented the operation of the critical infrastructure for more than 2 hours.	There is no critical infrastructure located on Caterham Drive.
More than 3 commercial properties been affected by flooding <i>or</i> the flooding is deemed to have caused significant economic disruption.	There were no reports of commercial properties flooded along Caterham Drive.
It is unclear which Risk Management Authority (RMA) is responsible <i>or</i> whether the appropriate duties have been carried out.	Some clarification is required on necessary actions to mitigate future flooding.
The weight of public interest justifies the need for investigation (to be decided internally after review).	Residents of Caterham Drive have experienced flooding and property damage on a number of occasions over the last 15-20 years.

1.3 Aims and Objectives

This report aims to meet the requirements of Section 19 of the Flood and Water Management Act (FWMA) as well as provide a useful reference for the effective future management of this source of flooding in Croydon through;

- Exploring flood related background information of the area,
- Providing details and mechanisms of the flooding incident,
- Identifying the responsibilities of Risk Management Authorities (RMAs) and the actions which were carried out,
- Identifying successful response measures and lessons learned, and
- Recommending the next steps.

1.4 Data Collection and Review

Data relating to the flood incident and emergency response has been requested from the following organisations for input into this investigation;

- Croydon Council,
- Surrey County Council (SCC),
- Environment Agency (EA),
- Thames Water Utilities Ltd (TWUL),
- London Fire Brigade, and,
- Metropolitan Police Service.

In addition to the requested data, a site visit was carried out at Caterham Drive and the surrounding area with LBC officers on 5th August 2016 to gather information on the local topography and drainage infrastructure as well as collate any information from local residents pertinent to the flood event and previous flooding events.

1.5 Duties and Responsibilities

1.5.1 Risk Management Authorities

Under the definition of Section 6(13) of the FWMA, the RMAs with responsibilities on this occasion were as follows:

- a) Lead Local Flood Authority – Croydon Council
- b) Environment Agency

c) Water Company – TWUL

d) Highway Authority – LBC

Additionally, emergency response roles were carried out by:

- London Fire Brigade
- Metropolitan Police Service
-

The legal duties of these organisations are summarised below.

1.5.1.1 London Borough of Croydon

As the LLFA, the FWMA 2010 requires that LBC lead the management of local flood risk from surface water, groundwater and ordinary watercourses within the Borough. Its duties include investigation of significant flood events (Table 1.1), maintaining a register of structure and features influencing flood risk and developing a Local Flood Risk Management Strategy (LFRMS) for Croydon.

The FWMA outlines that LLFAs have powers to designate structures and features that affect flooding in order to safeguard assets that are relied upon for flood risk management. Once a feature is designated, the owner must seek consent from the authority to alter, remove or replace it (FWMA Schedule 1, Section 1).

As the Highway Authority, the Highways Act 1980² requires that Croydon Council ensure that highways are drained of surface water and where necessary maintain all drainage systems. Highway Authorities are responsible for providing and managing highway drainage which may include provision of roadside drains and ditches, and must ensure that road projects do not increase flood risk.

The current Croydon Council gully cleansing programme stipulates that gullies are cleaned at least once a year throughout the borough. This increases to four times per year in Critical Drainage Areas. The gullies in Caterham Drive are scheduled to be cleaned four times per year.

Highway drainage has a capacity for highway surface water only; they are not designed to handle runoff from large storm events. Therefore during extreme flash floods the capacity is often exceeded. The Highways authority have the abilities to improve highway drainage, however they are under no obligation to do so.

Croydon Council is a Category 1 Responder under the Civil Contingencies Act 2004³ and therefore has a responsibility, along with other organisations for developing emergency plans, contingency plans and business continuity plans to help reduce, control or ease the effects of an emergency.

1.5.1.2 Surrey County Council

Surrey shares a boundary with the south of the Borough. SCC is LLFA for the County and therefore also has the duty under Section 19 of the FWMA 2010, to investigate a flood when it is considered necessary or appropriate to do so. They are also responsible for the maintenance of the highway drainage in the county as the Highway Authority.

1.5.1.3 Environment Agency

The Environment Agency has a responsibility to provide a strategic overview for all flooding sources and coastal erosion. The Environment Agency take a risk based approach to flood risk management and have a number of roles and responsibilities including as a statutory consultee on flood risk throughout the planning process and regulation of third party works on main rivers.

The FWMA outlines that the Environment Agency has powers to designate structures and features that affect flooding in order to safeguard assets that are relied upon for flood risk management. Once a feature is designated, the owner must seek consent from the authority to alter, remove or replace it (FWMA Schedule 1, Section 1). The Environment Agency is also a Category 1 Responder under the Civil Contingencies Act 2004.

1.5.1.4 Thames Water Utilities Limited

As an RMA under the FWMA, TWUL is responsible for managing the risks of flooding from the surface, foul and/or combined sewer system. This can be caused by blockages, asset failure or heavy rainfall overwhelming the system.

TWUL has a duty to provide and maintain a system of public sewers so that the areas for which they are responsible are effectually drained (Water Industry Act, 1991⁴). Since the late 1970s, and with the publication of Sewers for Adoption⁵ in

² Highways Act (1980) <http://www.legislation.gov.uk/ukpga/1980/66/contents>

³ Civil Contingencies Act (2004) <http://www.legislation.gov.uk/ukpga/2004/36/contents>

⁴ Water Industry Act (1991): <http://www.legislation.gov.uk/ukpga/1991/56>

⁵ *The Sewers for Adoption guide* was first issued in 1980 by WRc. Since then the document has become the standard for the design and construction of sewers to adoptable standards in England and Wales. It acts as a guide to assist developers in preparing their submission to a sewerage undertaker before they enter into an Adoption Agreement under Section 104 of the Water Industry Act 1991

1980, sewer systems have typically been designed and constructed to accommodate a rainfall event with a 1 in 30 probability of occurrence in any given year (3.3% Annual Exceedance Probability (AEP)) or less. Therefore, rainfall events with a probability greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. It should be noted however that in the area of Caterham Drive the sewer network is designed to manage foul flows only as surface water is managed through a network of soakaways in the highway.

TWUL is a Category 2 responder under the Civil Contingencies Act 2004 and therefore has the responsibility to co-operate and share information with Category 1 responders (e.g. LBC, EA) to inform multi-agency planning frameworks.

1.5.1.5 London Fire Brigade

The Fire Service is a Category 1 Responder under the Civil Contingencies Act 2004 and therefore has a responsibility, along with other organisations for developing emergency plans, contingency plans and business continuity plans to help reduce, control or ease the effects of an emergency.

1.5.1.6 Metropolitan Police

The Police are a Category 1 Responder under the Civil Contingencies Act 2004 and therefore has a responsibility, along with other organisations for developing emergency plans, contingency plans and business continuity plans to help reduce, control or ease the effects of an emergency.

1.5.2 Cooperation

All RMAs under the FWMA 2010 have a responsibility to cooperate and coordinate with regards to their flood risk management functions, including raising awareness of flood risk and the sharing of information. Landowners also have riparian responsibilities under the FWMA 2010 to maintain and undertake any necessary works on assets on their land (with relevant RMA consent) which could have a potential impact on flood risk.

1.5.3 Local Residents

Land owners and local residents are not RMAs; however residents who are aware that they are at risk of flooding should take action to ensure that they and their properties are protected. Residents should report flooding incidents or potential problems (such as blockages) to the LLFA or appropriate organisation if known.

2 Background

The London Borough of Croydon is located within Greater London, and is one of the largest London Boroughs. It is bounded to the north by the London Boroughs of Merton and Lambeth, to the east by the London Borough of Bromley, to the south by Surrey County Council and to the west by the London Borough of Sutton.

The north of the Borough is highly urbanised, although to the south and south east, the density of development begins to reduce and there is more park land and rural land. Coulsdon is located in the south west of the Borough and forms part of the North Downs with local topography characterised by steep slopes and dry valleys.

2.1 History of Surface Water Flooding in the London Borough of Croydon

Due to the topography and urbanised nature of the catchment, the London Borough of Croydon has high susceptibility to surface water flood events in certain locations.

The most significant surface water flood event on recent record occurred on the 20th July 2007, when intense periods of rainfall caused flash floods and the capacity of the existing drainage system to be exceeded in numerous locations across the Borough. Purley town centre experienced some of the worst flooding with significant flooding to properties and the local transport network.

More recently the Borough has experienced extensive flooding in the winter of 2013-14 due to prolonged heavy rainfall leading to exceptionally high levels of groundwater which resulted in extensive flooding in Kenley and Purley. In 2015 intense rainfall over 24 hours further resulted in deep surface water flooding in areas of Purley.

The Croydon Local Flood Risk Management Strategy (LFRMS)⁶ and Surface Water Management Plan (SWMP)⁷ identified the parts of Croydon which are particularly susceptible to surface water flooding, including Brighton Road through Purley up to Central Croydon and the A22 Godstone Road. Numerous records are held of historic flooding incidents in these low lying areas.

More specifically to this investigation, there have been previous flood events recorded in the vicinity of Caterham Drive and local residents have provided photographic evidence of flooding in 2007 and 2015.

2.2 Geology and Soils

The bedrock geology in the area is made up of Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation⁸. The Environment Agency Aquifer Designation map⁹ indicates that this is a 'Principal Bedrock' Aquifer, which designates rock with a high level of water storage that can support water supply and/or river base flow on a strategic scale. There are no overlying superficial deposits recorded on Caterham Drive. The soil overlying the bedrock along Caterham Drive is shallow, very acidic and peaty in character¹⁰.

2.3 Topography of Caterham Drive

The topographic map of the area shown in Figure 2-1 demonstrates that the natural topography of Caterham Drive promotes accumulation of surface water and directs surface water runoff along Caterham Drive from the southeast to the northwest as well as from the hills to the east and west. The properties flooded on 7th June 2016 are located in this topographic low where surface waters form prominent flow paths.

⁶ URS (2015) London Borough of Croydon Local Flood Risk Management Strategy

⁷ Capita URS (2011) London Borough of Croydon Surface Water Management Plan

⁸ <http://www.bgs.ac.uk/data/mapViewers/home.html>

⁹ Environment Agency. 2016. What's in Your Backyard? 'Aquifer Designation' maps. Available at http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683&y=355134&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=groundwater

¹⁰ <http://www.landis.org.uk/soilscapes/>

Figure 2-1 Topographic Map of Coulsdon¹¹

2.4 The Drainage System

The underlying chalk geology means that surface water drainage at this location discharges into soakaways. There are numerous soakaways along Caterham Drive which were identified during the site visit (05/08/16). Several soakaways local to the flooding had their condition assessed by Flowline; this is attached in Appendix B. The majority of these soakaways provide localised drainage for small clusters of road gullies. The efficiency of each soakaway will depend on the infiltration capacity of the ground and the soakaway design. Over time, soakaways can become silted/blocked and ongoing maintenance and debris clearing is required to maintain efficiency. A good soakaway needs to be able to discharge stored water quickly such that capacity is available to receive runoff from a subsequent storm.

¹¹ Available at: <http://en-gb.topographic-map.com/places/Coulsdon-9484214/> [Accessed 11th August 2016]

2.5 Modelled Flood Risk

Figure 2-2 Environment Agency flood map for Risk of Flooding from Surface Water¹²



Contains Environment Agency information © Environment Agency and database right

The RoFSW map gives an indication of the areas likely to be at risk of surface water flooding. The extents were produced from 2D models which were built using a national digital terrain model to represent the surface of the land, over which water can flow and pond. The RoFSW map improved on the previous surface water modelling by taking account of local models (where available) and information provided by the LLFAs. There are limitations with the surface water flood model, notably:

- The model does not represent flooding that occurs from overflowing watercourses, drainage systems or public sewers caused by catchment-wide rainfall events or river flow; and
- The model can only give an indication of flooding which could be caused by local rainfall.

The mapping provides four categories, as follows:

- Very low (a chance of flooding of less than 1 in 1000 (0.1%).)
- Low (a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%).)
- Medium (a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).)
- High (a chance of flooding of greater than 1 in 30 (3.3%).)

The Risk of Surface Water Flood Map illustrates a surface water flow path flowing in a north westerly direction, originating in the vicinity of Caterham-on-the-Hill flowing onto Caterham Drive. EA mapping identifies roads and properties within the vicinity of this flow path to be at risk of surface water flooding with an annual probability of greater than 3.3% ('High' 1 in 30 year return period). This is likely to be caused by urban runoff, with contributions from rural surfaces depending on the severity of the event and antecedent catchment conditions.

¹² <https://flood-warning-information.service.gov.uk/long-term-flood-risk/>

Comparing the modelled flood risk with the recorded flood incidents on Caterham Drive reveals that the areas previously reported to have flooded are located within the area susceptible to surface water flooding as defined by the Environment Agency mapping. The properties which reported flooding during the 7th June 2016 event are located adjacent to 'high' risk flood areas as defined by the RoFSW mapping. The RoFSW map displays a large flow pathway stemming from Caterham on the Hill through to Caterham Drive, with several smaller flow pathways feeding onto it from The Glade, Coulsdon Common and the junction between Tauton Lane and Waddington Avenue.

2.6 Local Flood Risk Zone

The local area including Caterham Drive has been identified as a Local Flood Risk Zone (LFRZs) in Croydon Council's SWMP. A LFRZ is defined as "*a discrete area of flooding that affect houses, businesses or infrastructure*". Residents have reported previous flooding from surcharging foul sewers following heavy rainfall, combined with overland flow originating from steep slopes around Caterham Drive.

3 The Flood Event

3.1 Locations of Flooding

A diagram of the reported flood impacts and locations is attached in Appendix A.

On the 7th and 8th June 2016 TWUL received over 80 calls relating to flooding in the area around Caterham Drive. Four properties in the north of Caterham Drive and a further two in the south reported flooding to the council. It is likely that flooding of properties to the south of Caterham Drive was influenced by surface water runoff from Rydon's Lane, as shown in the photographs (Table 4 04). Surface waters then propagated northward down Caterham Drive following the road gradient and flooding properties at the end of the road adjacent to 'Dollypers Hill' (Appendix A). Information from the Metropolitan Police Service stated that bus drivers in the area had reported two foot of fast flowing water along Caterham Drive and traffic diversions were put in place. Table 3-1 summaries the reported records of property flooding held by Croydon Council and Appendix A highlights their location.

For confidentiality, the house numbers have not been disclosed in this report. Instead, letters A-F have been used for reference.

Table 3-1 Property flooding during 7th June 2016 (source: Croydon Council)

Properties	Reported Impacts
Properties A and B at the northern end of Caterham Drive	Complete ground floor and garden flooding, up to 1m in some areas.
Two properties C and D at the northern end of Caterham Drive, uphill of A and B	Complete garden flooding and partial ground floor flooding /damp creep
Properties E and F, at the southern end of Caterham Drive	Internal flooding, extent unknown. Resident has had to move out whilst the house dries out.

3.2 Weather Conditions and Rainfall

According to the Environment Agency Monthly Water Situation Report¹³, the South London catchment rainfall total for June 2016 was the wettest month on record for this area, since records began in 1981¹⁴. Kent and the South of London received 198% of the long-term average rainfall for June. The intense storm that caused the flooding at Caterham Drive occurred on 7th June 2016 between 12:30 and 15:30. A number of local weather stations recorded over a month's worth of rainfall during this period as summarised in Table 3-2.

The average total rainfall for June in the area is 53.4mm (recorded at Kenley Met Office climate station). Records from this flood event show that just under 1.5 times this monthly average rainfall fell on the area within 2 hours on 7th June 2016¹⁵. The highest recorded rainfall was recorded at the Caterham on the Hill weather station where 72.6mm of rainfall fell between 12:00 and 14:00.

The Environment Agency rain gauge at Purley Oaks (TBR Grid Reference: TQ 3213962248) approximately 4km north of Caterham Drive recorded a total of 11mm rainfall on the 7th June 2016, illustrating high local variation.

¹³ Environment Agency (2016) Monthly Water Situation Report [Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/536457/WSR_June2016.pdf (Accessed on 18/10/16)]

¹⁴ Met Office Climatic Data, Available At: <http://www.metoffice.gov.uk/public/weather/climate/gcpgvgqmw>

¹⁵ Available at: <http://www.metoffice.gov.uk/public/weather/observation/gcpgvgqmw> (Accessed 18/10/16)

Figure 3-1 Extract from the Environment Agency Monthly Water Situation Report: June 2016

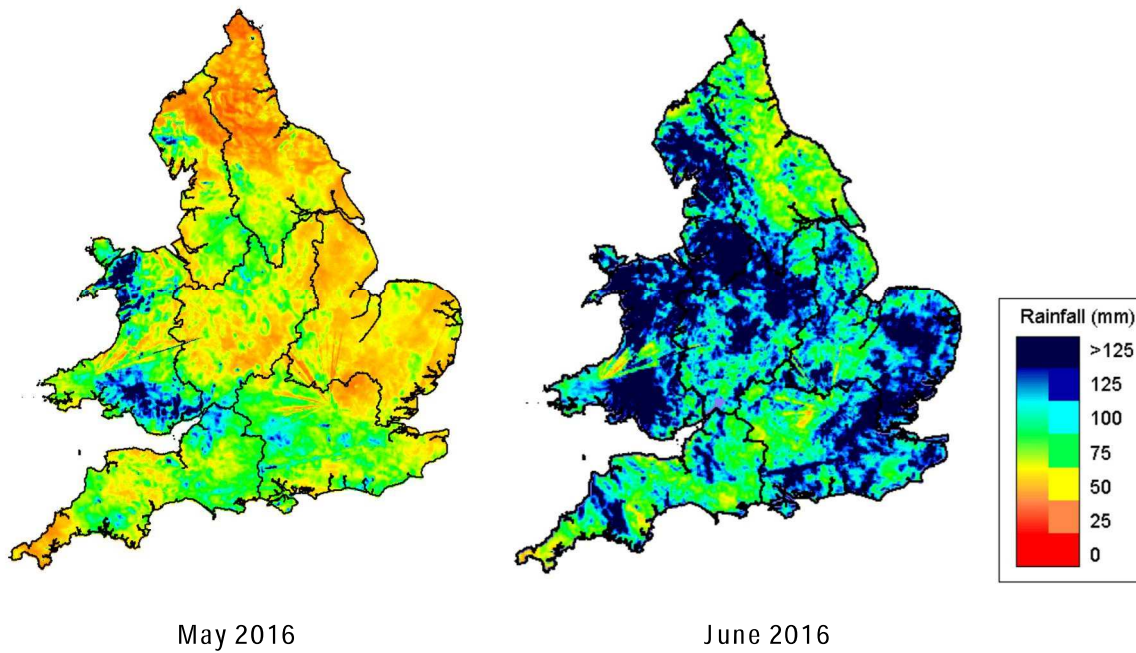


Table 3-2: Rainfall records for 7 June 2016 rainfall event

Weather Station	Location relative to Caterham Drive	Rainfall recorded	Notes
Kenley	Approx. 1.4km north of Caterham Drive	40mm in one hour	Rain gauge data collected by Met Office ¹⁶
Caterham Drive	Caterham Drive	40.9mm in 1 hour (12:55-13:55)	Local weather station ¹⁷
Caterham on the Hill	Approx. 1.8km south of Caterham Drive	72.6mm between 12:00-14:00	Local weather station ¹⁸
Purley Oaks	4km north of Caterham Drive	11 mm (daily total)	Environment Agency rain gauge

¹⁶ Available at: <http://www.metoffice.gov.uk/public/weather/observation/gcpgvqgmw> (Accessed 18/10/16)

¹⁷ <https://www.wunderground.com/personal-weather-station/dashboard?ID=IC0ULSD03#history/s20160607/e20160607/m/daily>

¹⁸ <https://www.wunderground.com/personal-weather-station/dashboard?ID=ISURREYC2>

3.3 Sources of Flooding

Rainfall on the 7th June 2016 caused significant surface water flooding in concentrated locations mainly in the south of the Borough and beyond in the catchment of the River Wandle. The reported sources of flooding at Caterham Drive were from surface water and sewer flood sources.

3.3.1 Surface Water

In an intense rainfall event, surface water will rapidly form flow paths and accumulate in topographic lows. This happens naturally, but is exaggerated by the positioning of impermeable surfaces (especially roads) and piped drainage networks.

Figure 2-2 displays the Environment Agency's RoFSW map, which demonstrates a major flow pathway from Caterham on the Hill north to Caterham Drive via Coulsdon Common. Photographic and video evidence of the 7th June 2016 event provided by the council reveals surface water runoff flowing onto Caterham Drive from Rydon's Lane and Stites Hill Road (Table 4); providing evidence for the flow path identified on the Environment Agency RoFSW map. However, to confirm the source of this additional surface water further investigation and detailed modelling of the area is required.

3.3.2 Foul Water Sewer (TWUL)

The sewer network in the area is designed for foul water only. Surface water drains via a separate system of soakaways within the highway. TWUL carried out a survey following the flood and found there to be spare capacity in the foul network in this area (based on managing foul flows only).

Correspondence with TWUL confirmed that the foul sewer network is only designed to a 1 in 20 year event, however, when building new sewers TWUL looks to achieve a 1 in 30 standard to provide some additional headroom. Therefore any storm greater than the design standard of the sewer may overwhelm the system. Photographic evidence from the 7th June 2016 shows that the combined system surcharged on Caterham Drive. This suggests that surface water entered the combined system causing overcapacity. Surface water entry into the combined sewers may have been exaggerated by a combination of factors, including: additional permitted connections that have accumulated over the years and/or direct surface water ingress into the foul water piped network. The contribution of this source to the flooding on Caterham Drive will need to be confirmed through further investigation and modelling of the TWUL sewer network, including recent updates to the system.

3.3.3 Surface Water Drainage Network

The 7th June 2016 flood event highlighted that the current drainage network on Caterham Drive struggles to efficiently drain away surface water during heavy rainfall. This is evident from the surcharged highway drains (gully pots) and manholes (Table 4 01).

The evidence suggests capacity issues on Caterham Drive; however, the issue is likely to be more widespread associated with increasing demand and development of the infrastructure across the borough. Although for around the last 60 or so years, there have been separate sewers for foul wastewater and surface wastewater, the integrity of the system has been compromised by misconnections, whether deliberate or otherwise. This process occurs largely undetected making it impossible for authorities to monitor the volume of surface water that could enter the foul water drainage network during a rainfall event. Moreover, if these connections link with the foul sewer system, it can cause sewers to surpass their design capacity and surcharge during heavy storms, when floodwater can become contaminated with foul sewer water.

Furthermore there has been a growth in the paving of impermeable surfaces (e.g. Table 4 05) which increases the rate of runoff to low-lying areas, such as Caterham Drive. This could put pressure on the drainage and sewerage network in the affected areas, as they were not designed to receive such quantities of surface water in a short space of time.

Caterham Drive

On 7th June 2016, the surface water drainage and soakaway network was not able to effectively drain the large volume of rainwater which fell over a short time leading to the rapid onset of surface water flooding across roads and into surrounding properties. The deepest flooding was experienced in property A and B where the water level was reported to be approximately 900mm. This was sufficient to reach the threshold level of the properties and inundate the ground floor. Furthermore, the foul sewer was observed to surcharge by residents who photographed lifted manhole covers (Table 4 01). This indicates that significant surface water flows were able to enter the foul sewer.

A CCTV survey of the pipe network provided by LBC's contractor Flowline (Appendix B) has analysed the drainage infrastructure on Caterham Drive and reported factors that could have increased flood risk during the storm event:

- Gullies 9 and 10 were blocked. These are located opposite properties A and B, which experienced severe flooding, and,
- Gullies 4 and 10 were suspected to have collapsed outlet pipes (Table 4 03).

The gullies in Caterham Drive are scheduled to be inspected / cleaned four times a year as part of Croydon Council's cyclical gully cleansing programme. The records held by Croydon Council show that the gullies were last inspected/cleaned on 20th May 2016 prior to the flooding incident and no defects were identified with any of the gullies. Therefore, the blockages and collapsed pipes identified by the CCTV survey may have been as a consequence of the flooding.



Blockage and collapse of gullies hinders the ability of the water to drain into a system and continue its route downstream. This could have contributed to the build-up of floodwater on the road surface; however, given the scale of the flood event the contribution would be minimal. Even with the gullies fully functioning, it is likely that flooding would still have occurred due to the volume and intensity of the rainfall during the 2-hour peak rainfall period. Following the flooding on the 7th June 2016, Flowline inspected/cleaned the pipe network to ensure they were clear and removed any blockages in the gullies. The soakaway system was tested and reported to be running adequately.


Caterham on the Hill

Coulsdon Common is located south of Caterham Drive; the Surface Water Management Study for Caterham on the Hill states *"The main storm drain (from Coulsdon Common) terminates in a soakaway located on the south-eastern edge of the Common. Over the last year this soakaway has surcharged on numerous occasions following heavy rainfall. The pressure of the water lifts the manhole cover allowing the water to then flow down the grass verge and onto Stites Hill Road, flooding the road. There is a drainage ditch which then conveys the water through Rydon's wood and out onto Caterham Drive"* (See Appendix A, Soakaway A).

The constraint at this soakaway may have contributed to the severity of the flooding downstream on Caterham Drive.

Table 4 Photographic evidence of flooding on Caterham Drive (source: Croydon Council)

ID	Photograph	Description
01		Surcharging manhole on Caterham Drive
02		Ground at end of road was dug out to allow surface water to continue its route into the neighbouring woodland known as 'Dollypers Hill'

ID	Photograph	Description
03		<p>Damage to the carriageway around a manhole cover on Caterham Drive</p>
04		<p>Video footage of surface water runoff from Rydon's Lane onto Caterham Drive</p>
05		<p>Pathway leading onto Caterham Drive was recently tarmaced adding to the area of impermeable surface. The debris visible on the path was deposited during the 7th June 2016 flood</p>
06		<p>Evidence of surface water flowing onto Stites Hill Road, adjacent to City of London Park</p>

4 Risk Management Authority, Emergency and Other Response

4.1 RMA Response

Tables 4-1 to Table 4-5 summarise the actions carried out by the respective RMAs. This is based largely on information provided by Croydon Council, TWUL and correspondence with local residents.

The main RMAs involved in the emergency and post-event response were Croydon Council and TWUL.

Table 4-1 Croydon Council Response

Croydon Council Response
<p>Immediate Response (7 and 8 June 2016)</p> <ul style="list-style-type: none"> Following receipt of calls and emails from residents reporting flooding in the Coulsdon area the Croydon Council Technical Support Team immediately deployed the gully cleansing crew (Kier) to assist by removing standing water and clearing nearby gullies that may be blocked. <ul style="list-style-type: none"> Due to the volume of demand, the gully cleansing crew was unable to reach Caterham Drive until 8th June at 13:25. When Croydon Council contractors arrived at Caterham Drive, Lanes for Drains (TWUL contractor) was already present as the flooding was believed to be related to TWUL drainage assets. Therefore, the LBC contractor left shortly without taking further action. On 8th June, once floodwaters had subsided Croydon Council were contacted by a resident of Caterham Drive to provide a sweeper to clear up debris and gully sucker to clean out roadside gullies. Sandbags were delivered to affected residents of Caterham Drive. <p>Ongoing Actions</p> <ul style="list-style-type: none"> Croydon Council Officers and Local Ward Councillors have met with affected residents of Caterham Drive and taken eye witness accounts of the flooding and damage and recorded any historical events experienced by the residents. Consultant appointed to carry out a flood investigation under Section 19 of the FWMA 2010 Croydon Council has inspected/cleaned and carried out CCTV survey on affected gullies, soakaways and connecting pipes in Caterham Drive (Appendix B). Remedial works were carried out where defects were identified; this included two collapsed gullies. Croydon Council officers have met with TWUL to understand how the sewer network has been investigated as residents had reported that the sewers were surcharging in the road and foul sewage entered their properties. TWUL concluded that the sewer has sufficient capacity for foul flows and surface water had entered the foul sewer system during the flood event. Croydon Council has agreed with SCC and TWUL to work together on a wider project to address the issues which connect Caterham on the Hill and Caterham Drive. This will help identify connections of surface water to the sewer and identify opportunities for open space SuDS in the parkland areas.

Table 4-2 TWUL Response

TWUL Response
<p>Immediate Response (7th June 2016)</p> <ul style="list-style-type: none"> Attended Caterham Drive with personnel, contractors and equipment to help protect properties and drainage infrastructure Instructed Lanes for Drains (contractor) to attend flooding on Caterham Drive as flooding was believed to be related to TWUL assets on 7th and 8th June. Approximately 40 calls were received by TWUL for the area on the 7th June 2016 and another 40 on the 8th of June 2016. TWUL also attended to several floods in Caterham on the Hill reported from the surface and foul sewer network. The initial investigation of the area carried out by TWUL concluded that the sewer network had become overloaded due to the significant volume of surface water. This caused the system to hydraulically overload, resulting in flooding in excess of 900mm deep. <p>Ongoing Actions</p> <ul style="list-style-type: none"> Meeting held with Croydon Council on 8th July 2016 to discuss how TWUL had investigated the sewers along Caterham Drive as residents had reported foul sewer flooding and surcharge entering their properties. TWUL relayed at the meeting that the sewers have sufficient capacity and surface water had entered the foul sewer during the flood event. Additionally a previously unrecorded sewer had been discovered connecting Stites Hill Road in Tandridge to Caterham Drive crossing Coulsdon Common – this may be carrying significant extra flow to Caterham Drive from Caterham on the Hill (see unrecorded sewer on Appendix A).

TWUL Response

- Since the 7th June 2016 event, TWUL has been providing customer assistance throughout the recovery stage, including basic clean up service internally and externally as required to customer properties. TWUL has also inspected all of their main sewer assets throughout the catchment via CCTV and have found no defects.

Table 4-3 Environment Agency Response**Environment Agency Response****Ongoing Actions**

The Environment Agency has supported the Section 19 Flood Investigation by providing rainfall data, and general advice

4.2 Emergency Response

Table 4-4 LFB Response**London Fire Brigade Response****Immediate Response (7th June 2016)**

- The London Fire Brigade started receiving calls from the public regarding the severity of the flash flooding in the early afternoon of 7th June 2016. Three of these calls were received from residents on Caterham Drive and the adjoining Rydon's Lane.
- The London Fire Brigade attended properties E and F on the southern end of Caterham Drive to deal with flood hazard related matters. The specific details of the emergency response were not recorded, however, London Fire Brigade have confirmed that the activities involved mitigating the effect of flood water, or reducing the impact on the occupants.

4.3 Other Response

Table 4-5 Resident Response**Residents Response****Immediate Response (7th June 2016)**

- Personal property protection methods were employed in preparation by residents at properties A-D on the northern end of Caterham Drive.
- On the 7th June 2016 as floodwaters accumulated, a builder working on Caterham Drive dug away the earth at the end of the road which was acting as a bund holding back the water. During rainfall in the following days surface water was able to flow off Caterham Drive and into the woodland through the passage way that was dug out on the 7th June 2016 (Table 4 02).

4.4 Have Flood Risk Management Functions been appropriately carried out?

The duties and responsibilities of Croydon Council, TWUL and SCC as well as local residents as described in Section 1.5 are listed in the tables below with a comment on the success and any improvements that could be made in the future.

4.4.1 Croydon Council

Table 4-6 Croydon Council responsibilities and lessons learned

Responsibility	Achieved?	Lessons Learned
Investigate significant surface water events	Yes	Croydon Council has followed up this flood event with a Flood Investigation Report, a CCTV investigation and survey of the drainage infrastructure. The damage found at Gullies 9 and 10 have been rectified.
Ensure highways are drained of surface water and where necessary maintain all drainage systems.	Yes	The gullies in Caterham Drive are scheduled to be inspected/cleaned four times a year as part of Croydon Council's cyclical gully cleansing programme. The records held by Croydon Council show that the gullies were last inspected / cleaned on 20 th May 2016 prior to the flooding incident and no defects were identified with any of the gullies. Therefore, the blockages and collapsed pipes identified by the CCTV survey may have been as a consequence of the flooding.

4.4.2 TWUL

Table 4-7 TWUL responsibilities and lessons learned

Responsibility	Achieved?	Lessons Learned
Managing the risks of flooding from sewers	Partially	<p>Lanes for Drains were deployed to Caterham Drive following complaints of flooding to aid with pumping, sucking and sweeping of floodwater and debris.</p> <p>Whilst the sewer network has adequate capacity for foul flows for which it is designed, surface water storm flows are entering the system and causing it to surcharge during extreme events. TWUL will need to work with Croydon Council as the Highway Authority to identify how surface water can be more effectively managed and prevented from entering the sewer system.</p>
<p>Duty to provide and maintain a system of public sewers so that the areas for which they are responsible are effectively drained</p> <p>All information must be shared amongst the other RMAs</p>	Partially	<p>Since the event TWUL has inspected all affected drains on Caterham Drive via CCTV survey and shared this information with Croydon Council</p> <p>However, the flooding has highlighted problems with the sewer system in this location which may be a result of surface water connections or poor condition of assets allowing surface water ingress. TWUL should continue to work with local authorities to identify where these issues can be located and rectified. It is further recommended that any permissions to connect (via the panning system) are reviewed.</p>

4.4.3 SCC

Table 4-8 SCC responsibilities and lessons learned

Responsibility	Achieved?	Lessons Learned
Investigate significant surface water events	Yes	Section 19 Flood Investigation Report Caterham on the Hill, published 11 th November ¹⁹ . This area is located to the southeast of Caterham Drive.
Ensure highways are drained of surface water and where necessary maintain all drainage systems.	Partially	<p>There are two soakaways previously recorded to have surcharged on Stites Hill Road – this should be investigated further.</p> <p>There is a soakaway at Coulsdon Common prone to surcharge – this should be investigated further.</p>

4.4.4 Local Residents

Table 4-9 Local Residents responsibilities and lessons learned

Responsibility	Achieved?	Lessons Learnt
Residents who are aware that they are at risk of flooding should take action to ensure that they and their properties are protected.	Partially	<p>Sandbags were utilised and flood walls were erected.</p> <p>To further mitigate flood risk the following should be considered:</p> <ul style="list-style-type: none"> Construct SuDS to reduce runoff from residential property. These look like normal garden features and work by storing water to prevent it from reaching downstream flood hotspot. These may include water butts, rain gardens, rain water harvesting etc. (For more information, visit www.susdrain.org) Install Property Level Protection (PLP) measures to prevent flood water from entering property. These may include flood doors, temporary barriers, air brick covers etc. (For more information, visit www.nationalfloodforum.org.uk/what-is-plp) Ensure all drains within, and in the vicinity of, residential property are kept clear of debris and do not pour oil, fat, concrete or other similar objects down a drain. Report any blocked highway drain to the local authority Driveways must be constructed in a way that allows surface water runoff to drain into a porous/permeable area or drainage system within the property boundary, or should be formed of porous materials on a porous base.

¹⁹ Atkins (2016) Caterham-on-the-Hill Surface Water Management Study Surrey County Council

Responsibility	Achieved?	Lessons Learnt
Residents should report flooding incidents or potential problems (such as blockages) to the LLFA or appropriate organisation if known.	Yes	There has been a long history of reports and ongoing enquiry on the flooding on Caterham Drive. This has been backed up by evidence from residents in the form of photography and video.

4.4.5 Summary and Lessons Learnt

Overall Croydon Council, SCC and TWUL carried out their legal responsibilities in their response to this event. However, there were a number of actions identified to better address mitigation of flood risk in this area. These are addressed in Section 5. A key action going forward will be to encourage further engagement between stakeholders (RMAs and residents); this will ease the movement of knowledge and ensures potential flood risk is communicated before it becomes actual risk.

5 Way Forward

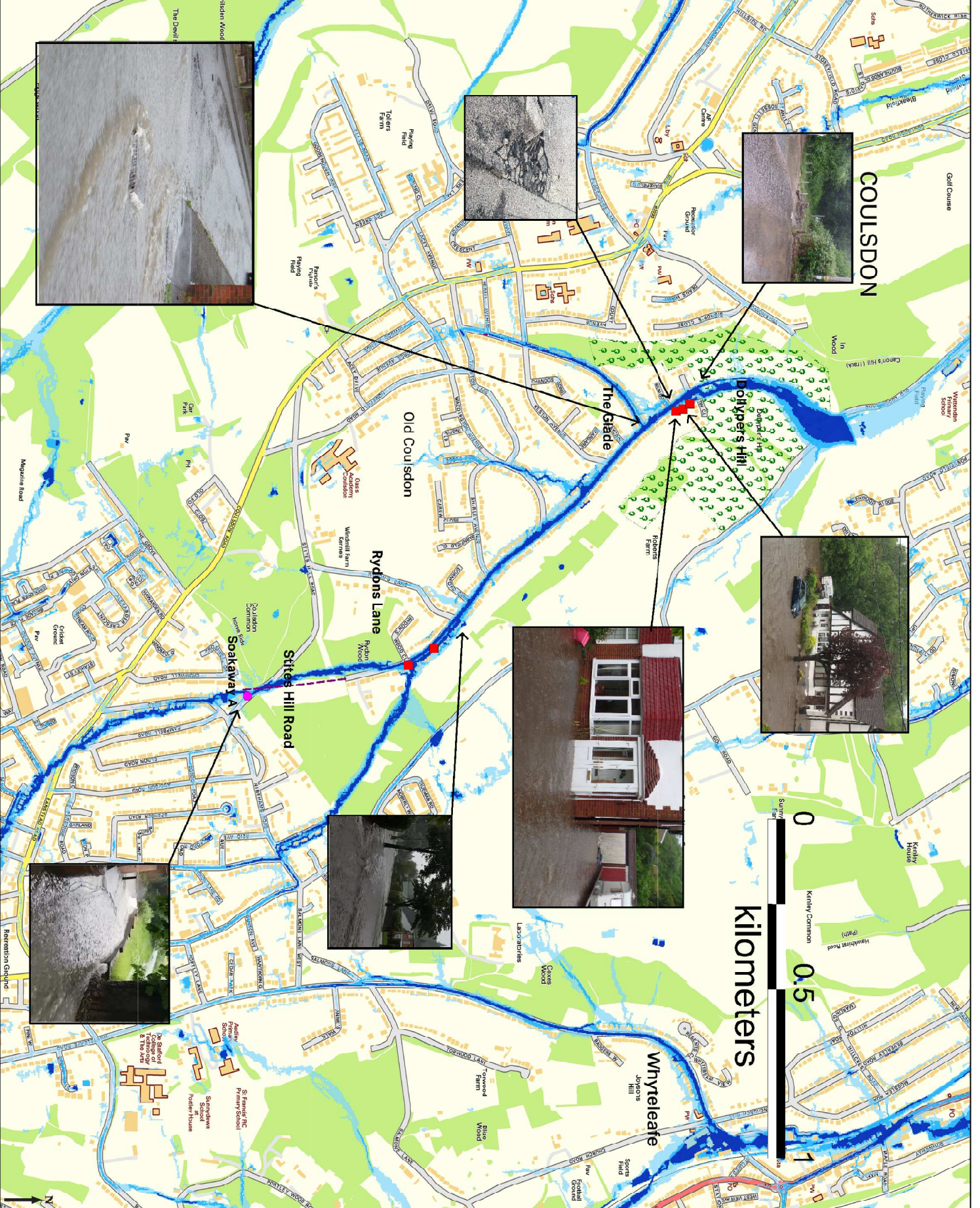
Table 5-1 Next Steps for Local Stakeholders

ID	Action	Details	Stakeholders Involved	Potential Funding
01	Liaison	Under Section 19 (2) of the FWMA, CC should publish the results of the flood investigation and notify any relevant RMA's, stakeholders and residents.	CC	
02	Liaison/Flood Management	CC with neighbouring authorities should engage with local landowners and residents about shared responsibility and develop a long-term plan. Croydon is part of the Caterham and Old Coulsdon Flood Action Group, which was set with the help of the Nation Flood Forum after the flooding.	CC, SCC, resident groups	
03	Liaison	Agree clearer chain of command in the event of a large scale major incident between CC and emergency responders, which is in line with the London Emergency Services Liaison Panel procedure ²⁰ .	CC, SCC, LFB, TW	
04	Liaison/Recording	The RMA's should work together to identify assets and ownership in the catchment. These should be incorporated into the relevant authority's maintenance schedules. This will detect any unknown pipelines, infrastructure and connections, and should further explore the unrecorded sewer connecting Stites Hill Road to Caterham Drive.	CC, TW, EA, Highways, TfL, EA	
05	Recording	CC should follow up with residents that reported flooding to acquire additional details of flooding (consequences, damage caused etc.) and to provide advice as to property level protection measures.	CC, resident groups, EA	Repair and renewal grants
06	Liaison	CC should work with the EA to provide local homeowners with information on flood resilience measures.	CC, EA	
07	Liaison/Flood Management	Collaborative working between Croydon Council, TWUL and SCC should be further built upon through the newly created Multi-Agency Project Board. This will provide an opportunity to better understand the capacity of the existing surface water sewer and drainage infrastructure, particularly at Coulsdon Common adjacent to the Tandridge/Croydon administration boundary as well as a providing a platform to discuss the feasibility and completion of works across the catchment.	CC, TW, SCC, EA	
08	Liaison	CC, Highways and TW should communicate more regularly about upgrades to the sewer network and planned improvements.	CC, TW	
09	Investigation	Croydon Council Highways and TWUL to investigate 'mis-connections' to foul water drainage network and to review options to reduce internal sewer flooding.	CC, England Highways, TW	
10	Maintenance	Croydon Council to review gully cleaning regimes and check functionality of gullies and soakaways in flooding hotspots. Correspondence with Croydon Council has confirmed that there are plans in place to review the gully cleansing programme and change the frequency of gully cleaning.	CC	
11	Flood Management	Consider the use of SuDS in urban areas and upstream open park land, which will help slow the flow of water reaching the drainage network.	CC, EA, SCC	FCERM, GiA

²⁰ Available at: <http://www.leslp.gov.uk/>

ID	Action	Details	Stakeholders Involved	Potential Funding
12	Flood Management	Discussion with Croydon CC during the site visit highlighted that land at the northern end of Caterham Drive owned by the City of London known as 'Dollypers Hill' could be further enhanced to mitigate flooding in this area. This could be considered in conjunction with the incorporation of a brow ditch or interceptor drain to intercept runoff from the adjacent steep slopes thereby reducing the volume of overland flooding in this area. To quantify the feasibility and benefit of this flood option will require further investigation by flood management specialists.	CC, EA, City of London	FCERM, GiA
13	Flood Management	Residents who are aware that they are at risk of flooding should take action to ensure that they and their properties are protected (see Section 4.4.4).	CC	

Appendix A. 7th June 2016 Caterham Drive Flood Event Overview



LEGEND

- Flooded Properties
- Soakway A
- Unrecorded Sewer
- uFMSW High (1:30 AEP)
- uFMSW Medium (1:100 AEP)
- uFMSW Low (1:1000 AEP)
- Woodland

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Drawing Title		Date	
CATERHAM DRIVE FLOOD INVESTIGATION REPORT		15/06/17	
Drawing Status		Scale	
FINAL		A3	
Author	Checked	Drawn	Reviewed
SEB	SK		

**ENVIRONMENT AGENCY
 JFMSW FOR CATERHAM
 DRIVE WITH JUNE 2016
 FLOOD IMPACTS**

THIS DOCUMENT HAS BEEN PREPARED IN ACCORDANCE WITH THE TERMS OF AGREEMENT SIGNED BETWEEN THE ENVIRONMENT AGENCY AND THE LOCAL AUTHORITY. IT IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF THE ENVIRONMENT AGENCY. THE ENVIRONMENT AGENCY ACCEPTS NO LIABILITY FOR ANY LOSS OR DAMAGE CAUSED BY THE USE OF THIS DOCUMENT.

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AECCM Infrastructure & Environment UK Ltd
 2nd Floor
 100 Broad Street
 Birmingham B1 2EG
 Tel: 0121 616 2939

Appendix B. Flowline CCTV Survey: Caterham Drive

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Project-information

Project name :
04072016 RP KIER CROYDON

Project Number :

Contact :

Date :
04/07/2016

Client: **KIER HIGHWAYS - LB CROYDON**
 Contact Name: **MICHAEL BEDDING**
 Department: **PURLEY OAKS DEPOT**
 Road: **1A RIDDLEDOWN ROAD**
 Town: **CROYDON**
 County: **SURREY, CR8 1DG**
 Telephone:
 Fax:
 Mobile:
 E-mail:

Site: **L B CROYDON**
 Contact Name: **DAISI OSIBONA**
 Department: **O/N: HWY0067009**
 Road: **CATERHAM DRIVE**
 Town: **CROYDON**
 County: **SURREY**
 Telephone:
 Fax:
 Mobile:
 E-mail:

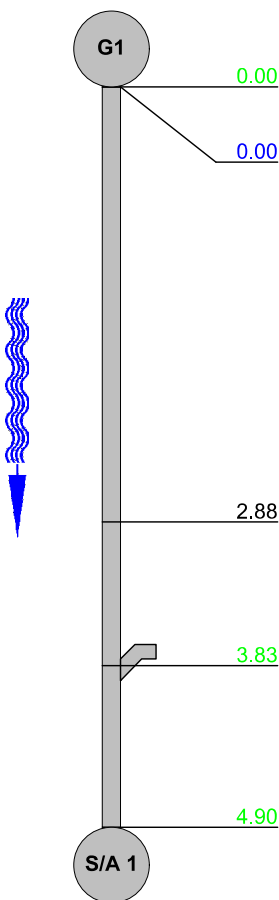
Contractor **FLOWLINE LTD**
 Contact Name: **IAN HUMPHREYS**
 Department:
 Road: **RAWRETH LANE IND EST**
 Town: **RAYLEIGH**
 County: **ESSEX, SS6 9RL**
 Telephone: **01268 654410**
 Fax: **01268 781672**
 Mobile:
 E-mail: **ian.humphreys@flowlineltd.co.uk**

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 1	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G1
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : S/A 1
Inspection G1 (D/S) S/A 1	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 4.90 m	Lining :	

Comment :

1:50	Position	Code	Observation	Grade
Depth: 0				
	0.00	GY	Start node type, gully, reference number : G1	(Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0
	2.88	REM	General remark Remarks: MAIN REACHED AT THIS POINT. SURVEY CONTINUES DOWN TO S/A 1	(Misc) 0
	3.83	JN	Junction, at 10 o'clock, diameter 150mm Remarks: FROM G2	(Constr) 0
	4.90	MHF	Finish node type, manhole reference number: S/A 1	(Constr) 0
Depth: 0				



2.88 m

Structural Defects

Constructional Features

Service Defects

Miscellaneous Features

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Place :



FLOWLINE LTD
RAWRETH LANE IND EST
RAYLEIGH
Tel: 01268 654410
Fax: 01268 781672
Email: ian.humphreys@flowlineltd.co.uk

Inspection pictures

Place : CROYDON	Road : CATERHAM DRIVE	Date : 04/07/2016	Section number : 1	PLR Suffix : X
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Photo: 0000001.jpg, 00:00:00
2.88m, General remark

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 2	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G2
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : S/A 1
Inspection G2 (D/S) S/A 1	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 7.47 m	Lining :	

Comment :

1:60 Depth: 0	Position	Code	Observation	Grade
	G2			
	0.00	GY	Start node type, gully, reference number : G2	(Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0
	0.95	LL	Line deviates left	(Serv) 0
	3.48	BJ	Broken pipe at joint, from 6 to 12 o'clock	(Struct) 4
	5.42	LL	Line deviates left	(Serv) 0
	6.38	REM	General remark Remarks: MAIN REACHED AT THIS POINT	(Misc) 0
	7.47	MHF	Finish node type, manhole reference number: S/A 1	(Constr) 0
	S/A 1			
Depth: 0				



3.48m

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection pictures

Place :
CROYDON

Road :
CATERHAM DRIVE

Date :
04/07/2016

Section number :
2

PLR Suffix :
X

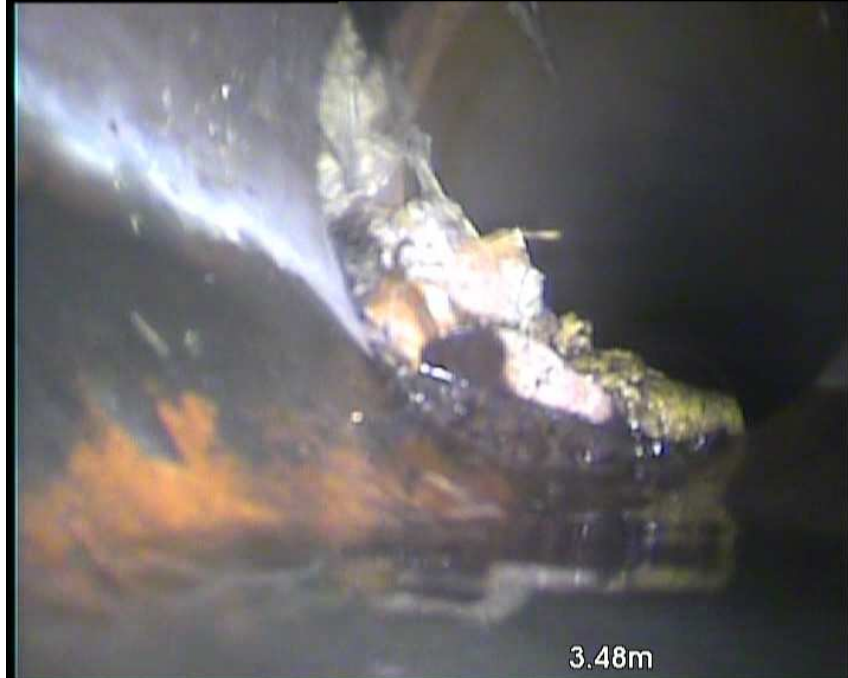


Photo: 0000002.jpg, 00:00:00
3.48m, Broken pipe at joint, from 6 to 12 o'clock

Inspection pictures

Place : CROYDON	Road : CATERHAM DRIVE	Date : 04/07/2016	Section number : 3	PLR Suffix : X
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Photo: 0000003.jpg, 00:00:00
2.37m, Fracture, multiple, from 7 to 9 o'clock

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 4	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G5
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : S/A 2
Inspection G5 (D/S) S/A 2	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 3.63 m	Lining :	

Comment :

1:50	Position	Code	Observation	Grade
Depth: 0				
	0.00	GY	Start node type, gully, reference number : G5	(Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0
	1.62	LD	Line deviates down	(Serv) 0
	2.15	REM	General remark Remarks: MAIN REACHED AT THIS POINT. SURVEY CONTINUES DOWN TO S/A 2	(Misc) 0
	3.63	MHF	Finish node type, manhole reference number: S/A 2	(Constr) 0
Depth: 0				

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 5	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G6
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : S/A 2
Inspection G6 (D/S) S/A 2	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 6.20 m	Lining :	

Comment :

1:60	Position	Code	Observation	Grade
Depth: 0				
	G6			
	0.00	GY	Start node type, gully, reference number : G6	(Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0
	1.48	RFJ	Roots, fine at joint	(Serv) 2
	4.75	LL	Line deviates left	(Serv) 0
	5.52	REM	General remark Remarks: MAIN REACHED AT THIS POINT. SURVEY CONTINUES DOWN TO S/A 2	(Misc) 0
	6.20	MHF	Finish node type, manhole reference number: S/A 2	(Constr) 0
	S/A 2			
Depth: 0				

Structural Defects

Constructional Features

Service Defects

Miscellaneous Features

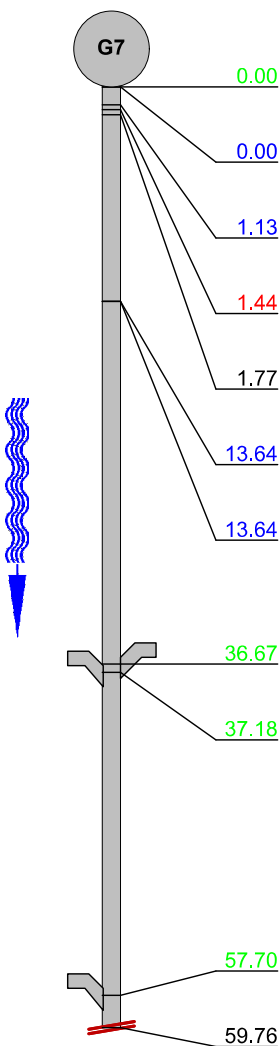
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 6	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G7
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : S/A 3
Inspection G7 (D/S) S/A 3	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 59.76 m	Lining :	

Comment :

1:480 Depth: 0	Position	Code	Observation	Grade
				
	0.00	GY	Start node type, gully, reference number : G7	(Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0
	1.13	LR	Line deviates right	(Serv) 0
	1.44	JDM	Joint displaced, medium	(Struct) 1
	1.77	REM	General remark Remarks: MAIN REACHED AT THIS POINT. SURVEY CONTINUES DOWN TO S/A 3	(Misc) 0
	13.64	DEE	Attached deposits, encrustation, from 8 to 11 o'clock, 5% cross-sectional area loss	(Serv) 3
	13.64	DEE	Attached deposits, encrustation, from 1 to 3 o'clock, 5% cross-sectional area loss	(Serv) 3
	36.67	JN	Junction, at 10 o'clock, diameter 150mm Remarks: FROM G10	(Constr) 0
	37.18	JN	Junction, at 2 o'clock, diameter 150mm Remarks: FROM G9	(Constr) 0
	57.70	JN	Junction, at 2 o'clock, diameter 150mm Remarks: FROM G11	(Constr) 0
	59.76	SA	Survey abandoned Remarks: OUT OF PUSH ROD CABLE (WILL SURVEY REST OF MAIN FROM G11)	(Misc) 0



13.64 m

Structural Defects

Constructional Features

Service Defects

Miscellaneous Features

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	2	4	0.07	4	3

Inspection pictures

Place :
CROYDON

Road :
CATERHAM DRIVE

Date :
04/07/2016

Section number :
6

PLR Suffix :
X



Photo: 0000004.jpg, 00:00:00

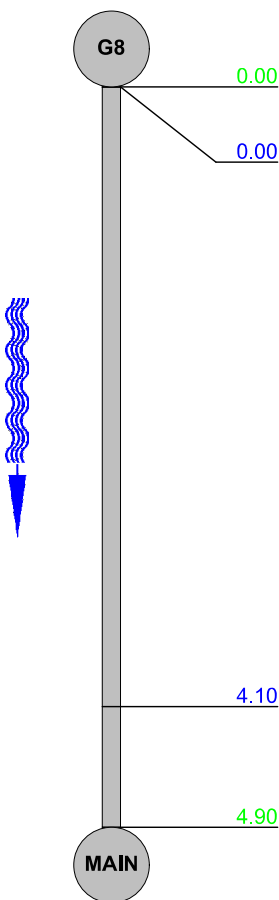
13.64m, Attached deposits, encrustation, from 1 to 3 o'clock, 5% cross-sectional area loss

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 7	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : Road : Location Inspection	CROYDON CATERHAM DRIVE Road G8 (D/S) MAIN	Location details: Catchment: Tape number : Pipe Length	U/S MH : U/S Depth : D/S MH : D/S Depth :	G8 0 MAIN 0
Direction Use: Year laid : Purpose : Total length :	Surface water Z Sample survey to determine asset condition 4.90 m	Pipe shape : Pipe size : Pipe material : Lining :	Circular 150 mm Vitrified clay	

Comment :

1:50	Position	Code	Observation	Grade
Depth: 0				
	0.00	GY	Start node type, gully, reference number : G8	(Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0
	4.10	LL	Line deviates left	(Serv) 0
	4.90	GYF	Finish node type, gully reference number: MAIN	(Constr) 0
Depth: 0				

Structural Defects

Constructional Features

Service Defects

Miscellaneous Features

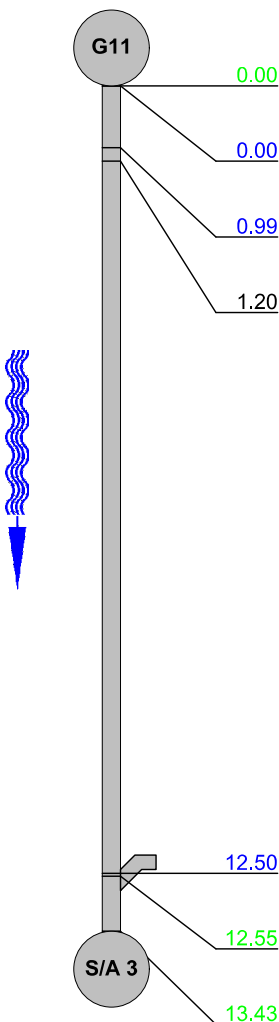
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 8	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : no	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G11
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : S/A 3
Inspection G11 (D/S) S/A 3	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 13.43 m	Lining :	

Comment :

1:120	Position	Code	Observation	Grade
Depth: 0				
		G11	GY	Start node type, gully, reference number : G11 (Constr) 0
	0.00	WL	Water level, 5% of the vertical dimension (Serv) 0	
	0.99	LD	Line deviates down (Serv) 0	
	1.20	REM	General remark Remarks: MAIN REACHED AT THIS POINT. SURVEY CONTINUES DOWN TO S/A 3. (Misc) 0	
	12.50	RFJ	Roots, fine at joint (Serv) 2	
	12.55	JN	Junction, at 10 o'clock, diameter 150mm Remarks: PROBABLY FROM G12 (Constr) 0	
	13.43	MHF	Finish node type, manhole reference number: S/A 3 (Constr) 0	

Depth: 0

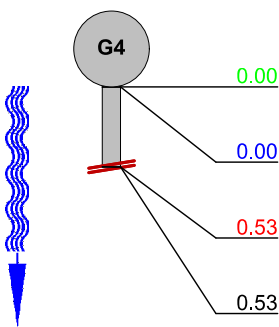

Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 9	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : yes	Operator : Marc Kinsey

Place : Road : Location Inspection	CROYDON CATERHAM DRIVE Road G4 (D/S) MAIN	Location details: Catchment: Tape number : Pipe Length	U/S MH : U/S Depth : D/S MH : D/S Depth :	G4 0 MAIN 0
Direction Use: Year laid : Purpose : Total length :	Surface water Z Sample survey to determine asset condition 0.53 m	Pipe shape : Pipe size : Pipe material : Lining :	Circular 150 mm Vitrified clay	

Comment :

1:50 Depth: 0	Position	Code	Observation	Grade	
	<u>0.00</u>	GY	Start node type, gully, reference number : G4	(Constr) 0	
	<u>0.00</u>	WL	Water level, 5% of the vertical dimension	(Serv) 0	
	<u>0.53</u>	XP	Collapsed drain/sewer Remarks: TOTAL COLLAPSE	(Struct) 5	
	<u>0.53</u>	SA	Survey abandoned Remarks: UNABLE TO PASS COLLAPSED PIPE.	(Misc) 0	

Structural Defects

Constructional Features

Service Defects

Miscellaneous Features

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
1	165	311.32	165	5	0	0	0	0	1

Inspection pictures

Place :
CROYDON

Road :
CATERHAM DRIVE

Date :
04/07/2016

Section number :
9

PLR Suffix :
X



Photo: 0000005.jpg, 00:00:00
0.53m, Collapsed drain/sewer

Inspection report

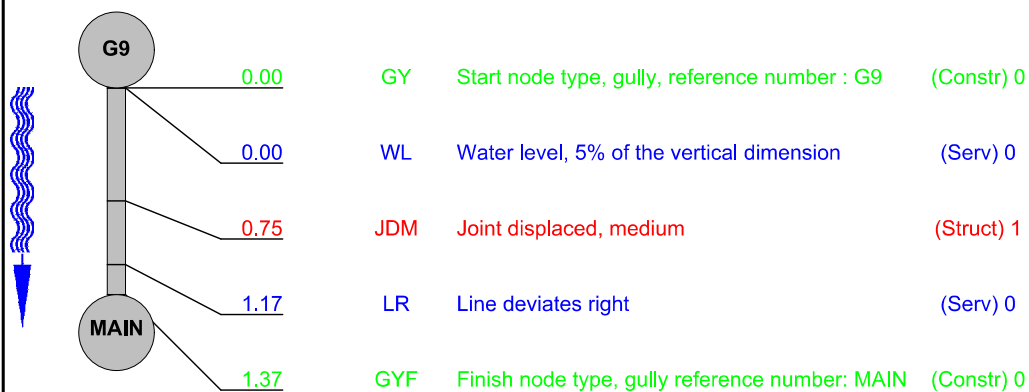
Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 10	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : yes	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G9
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : MAIN
Inspection G9 (D/S) MAIN	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 1.37 m	Lining :	

Comment :

1:50 Position Code Observation Grade

Depth: 0



Depth: 0

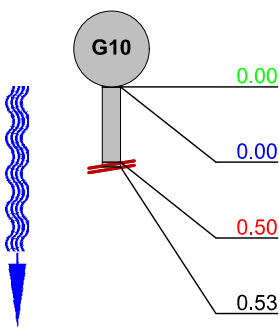
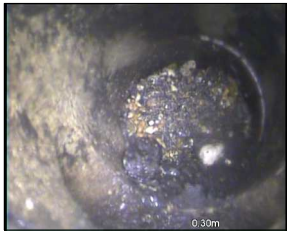
Structural Defects					Constructional Features				
Service Defects					Miscellaneous Features				
STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
0	0	0	0	1	0	0	0	0	1

Inspection report

Date : 04/07/2016	Job number :	Weather : no rain or snow	Operator : Marc Kinsey	Section number : 11	PLR SUFFIX: X
Weather no rain or snow	Vehicle : EF61 HRE	Camera : MINI CAM	Preset :	Cleaned : yes	Operator : Marc Kinsey

Place : CROYDON	Location details:	U/S MH : G10
Road : CATERHAM DRIVE	Catchment:	U/S Depth : 0
Location Road	Tape number :	D/S MH : MAIN
Inspection G10 (D/S) MAIN	Pipe Length	D/S Depth : 0
Direction Use: Surface water	Pipe shape : Circular	
Year laid : Z	Pipe size : 150 mm	
Purpose : Sample survey to determine asset condition	Pipe material : Vitrified clay	
Total length : 0.53 m	Lining :	

Comment :

1:50 Depth: 0	Position	Code	Observation	Grade	
	0.00	GY	Start node type, gully, reference number : G10	(Constr) 0	 <p style="text-align: center;">0.5 m</p>
	0.00	WL	Water level, 5% of the vertical dimension	(Serv) 0	
	0.50	XP	Collapsed drain/sewer	(Struct) 5	
	0.53	SA	Survey abandoned Remarks: POSS COLLAPSE. JET COULD NOT PASS THIS POINT AND IT WAS BRINGING BACK STONE	(Misc) 0	

Structural Defects

Constructional Features

Service Defects

Miscellaneous Features

STR no def	STR peak	STR mean	STR total	STR grade	SER no def	SER peak	SER mean	SER total	SER grade
1	165	311.32	165	5	0	0	0	0	1

Inspection pictures

Place : CROYDON	Road : CATERHAM DRIVE	Date : 04/07/2016	Section number : 11	PLR Suffix : X
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Photo: 0000006.jpg, 00:00:00
0.5m, Collapsed drain/sewer

About AECOM

AECOM (NYSE: ACM) is a global provider of professional technical and management support services to a broad range of markets, including transportation, facilities, environmental, energy, water and government. With approximately 100,000 employees around the world, AECOM is a leader in all of the key markets that it serves. AECOM provides a blend of global reach, local knowledge, innovation, and collaborative technical excellence in delivering solutions that enhance and sustain the world's built, natural, and social environments. A Fortune 500 company, AECOM serves clients in more than 100 countries and has annual revenue in excess of \$6 billion.

More information on AECOM and its services can be found at www.aecom.com.

Midpoint
Alençon Link
Basingstoke
Hampshire
RG21 7PP
United Kingdom
+44 1256 310200