# Section 19 Flood Risk Investigation

# Flood Risk Investigation Report

## Prepared for London Borough of Redbridge


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Version 2.1

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# EXECUTIVE SUMMARY

This flood risk investigation report was written as part of the London Borough of Redbridge's (Redbridge) duty as Lead Local Flood Authority (LLFA) under Section 19 of the Flood and Water Management Act (2010). The heavy showers and thunderstorms of the 25th July 2021 caused widespread flooding which resulted in 54 reports of internal flooding, 55 reports of external flooding and 70 reports of flooded highways, spread over 130 streets. This report was carried out in response to the flood event and aims to investigate the causes of flooding as well as the actions of the Risk Management Authorities (RMAs) with flood risk management functions. The RMAs include Redbridge, the Environment Agency (EA), Thames Water Utilities Limited (TWUL) and Transport for London (TfL).

To carry out the investigation and due to the large number of flooded locations, four hydrological catchments were defined, and ten hotspots were identified (***Error! Reference source not found.***). The hotspots are small areas with clusters of flood incidents or of severe highway flooding, in line with Redbridge's flood incident criteria. For each hotspot, the flooding mechanisms and various flood risks were assessed, the actions of RMAs before, during and after the flooding were recorded (where known), and recommendations were formulated.

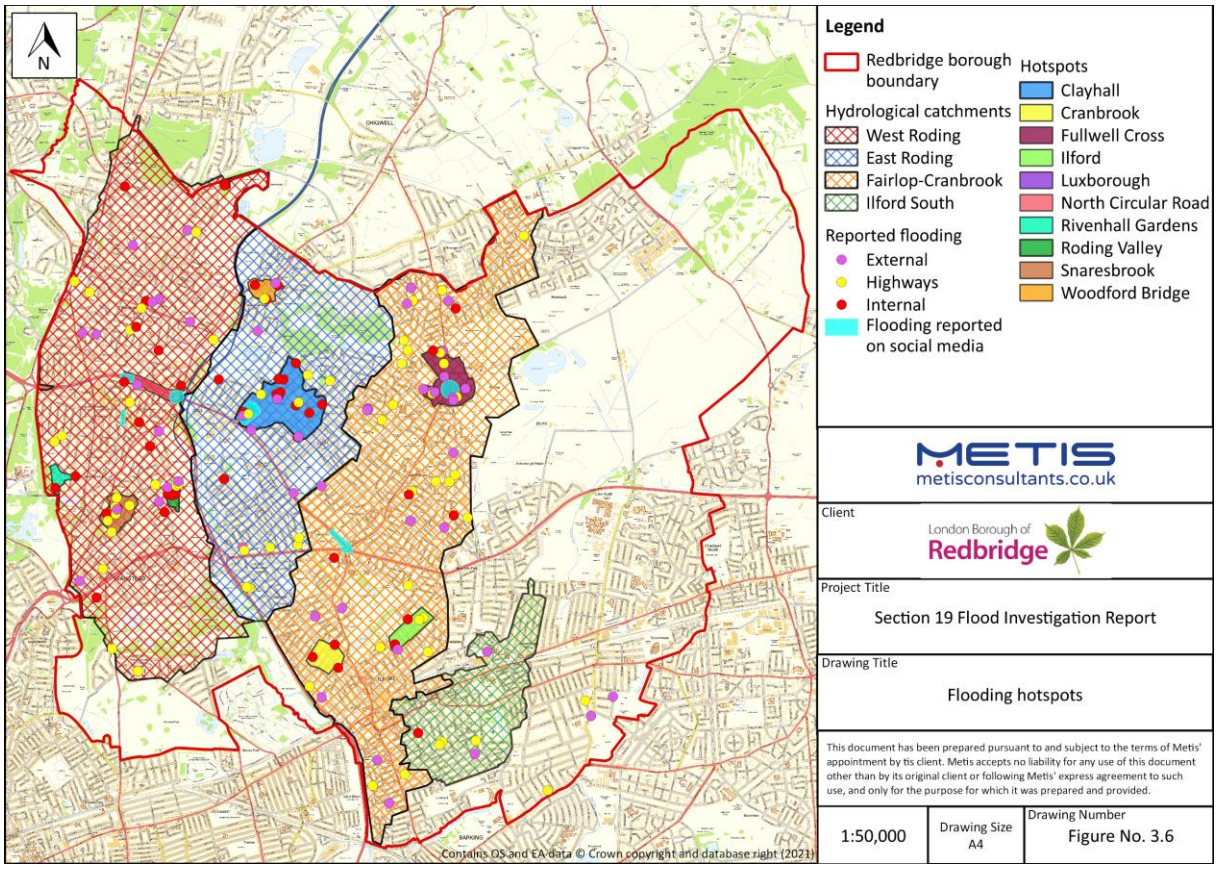


**Figure A.1: Map showing the reported flooding, the hydrological catchments, and the hotspots**

Redbridge's Emergency Planning response and assurance arrangements were deployed during the flood, and Redbridge collaborated with Thames Water Utilities Limited (TWUL) and emergency services to help affected residents. A rest centre was opened on Sunday 25th July in Sir James Hawkey Hall in Woodford Green to provide shelter for residents that could not stay in their homes, but it was

not needed and closed on Monday 26th July. TWUL made a flood clean-up service available for customers who had reported having suffered flooding from overland flows. A total of four clean-ups were recorded by TWUL. Redbridge checked and cleared gullies in roads for which reports of flooding were received.

Across all hotspots, the surface water sewers were overwhelmed by the amount of surface water entering the drainage network. The rainfall event has been reported to have a return period of over a 1 in 100 year event whereas typical surface sewer networks only have enough capacity to accommodate for up to the 1 in 30 year rainfall events. Other factors, such as topography, blockages and network configurations also exacerbated the flooding. The main recommendations for each of the ten hotspots (mapped in ***Error! Reference source not found.***) are as follows:

- **Luxborough:** Redbridge to investigate raising kerb levels in front of flooded properties in Buckhurst Road to guide surface water away from properties. Please reference Section 8.2 for TWUL's actions.
- **North Circular Road**: Please reference Section 8.2 for Redbridge's and TWUL's actions.
- **Rivenhall Gardens**: Redbridge should also investigate why the surface water runoff bypasses the gully at the intersection between Malford Grove and Hermitage Walk and results in flooding to the property. If the water is seeping from Gilbert's Slade, Redbridge should investigate if SuDS or attenuation features could be incorporated in Gilbert's Slade to alleviate and prevent the flooding. Please reference Section 8.2 for TWUL's actions.
- **Roding Valley**: Redbridge should investigate the slow draining gully in front of 40 Lorne Gardens. Please reference Section 8.2 for TWUL's actions.
- **Snaresbrook**: Please reference Section 8.2 for Redbridge's and TWUL's actions.
- **Clayhall**: Please reference Section 8.2 for Redbridge's and TWUL's actions.
- **Woodford Bridge**: Redbridge should investigate raising kerb levels in front of flooded properties in Waltham Road to guide surface water away from properties. Redbridge should regularly check and clean, if needed, the gullies in Gaynes Hill Road. Please reference Section 8.2 for TWUL's actions.
- **Cranbrook**: Redbridge should investigate the gully with sunken tarmac in The Drive. Please reference Section 8.2 for TWUL's actions.
- **Fulwell Cross**: Redbridge should investigate the design of the drain in Craven Gardens. Please reference Section 8.2 for TWUL's actions.
- **Ilford**: Please reference Section 8.2 for Redbridge's and TWUL's actions.

In addition to hotspot specific recommendations, it is recommended that Redbridge investigates sustainable drainage systems (SuDS) opportunities in locations where flooding has been reported, in order to reduce the surface water runoff and increase the capacity of the drainage network. Following the completion of the 2022 London Flood Review, it is recommended that TWUL are to prioritise inspections and sewer cleaning at sites where the sewer is causing issues to customers.

Upon publication of the Drainage Wastewater Management Plans (DWMP) TWUL will work with Redbridge, in its role as the LLFA, to understand existing risks associated with their sewers and work towards mitigating these risks. Risk areas will be shared between Risk Management

Authorities to identify areas which can benefit from a range of mitigation options and upgrades, ranging from installation of SuDS, other flood alleviation measures or, as part of the DWMP, sewer capacity increase.

At government level, the strengthening of national planning policy will help to further promote SuDS and will ensure that properties are better protected from flooding in the future.

The flooding that occurred on the 25th July was severe because of the very high return period of over 1 in 100 year. London's sewer infrastructure is a heritage from the Victorian era and was not designed to accommodate such large volumes of surface water entering the network in the intense durations experienced in this event. Even a fully functioning drainage system would have been overwhelmed by the amount of rainwater. Storms are natural phenomena and when they are of this magnitude, flooding cannot be entirely prevented. Retrofit SuDS or flood alleviation schemes might not prevent flooding during a similar storm, but could reduce the risk of flooding and protect properties during storms of lower return periods.

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# FIGURES AND TABLES

# Acronyms and Abbreviations

| Abbreviation | Definition |
|---|---|
| BST | British Summer Time |
| DWMP | Drainage and Wastewater Management Plans |
| EA | Environment Agency |
| FWMA | Flood and Water Management Act (2010) |
| GIS | Geographic Information System |
| LFB | London Fire Brigade |
| LFRMS | Local Flood Risk Management Strategy |
| LiDAR | Light Detection and Ranging |
| LLFA | Lead Local Flood Authority |
| Redbridge | London Borough of Redbridge |
| RMA | Risk Management Authority |
| RoFSW | Risk of Flooding from Surface Water |
| SuDS | Sustainable Drainage Systems |
| TfL | Transport for London |
| TWUL | Thames Water Utilities Limited |

# 1 INTRODUCTION

## 1.1 Background Policy and Information

This flood risk investigation report has been prepared by Metis Consultants Ltd for the London Borough of Redbridge ('Redbridge').

As a unitary authority, Redbridge is a Lead Local Flood Authority (LLFA). LLFAs are defined as a Risk Management Authority (RMA) under Section 6, Part 1, Chapter 29 of the Flood and Water Management Act (FWMA) 2010. LLFAs are required to investigate flood incidents under Section 19, Part 1 of the FWMA 2010. A LLFA must, to the extent that it considers it necessary or appropriate, investigate:

- Which risk management authorities have relevant flood risk management functions, and
- Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

After the completion of each flood investigation, Redbridge must publish the results of its investigation and notify the relevant RMAs of the report's conclusions and recommendations.

LLFAs often have flood investigation criteria to define what events should trigger a Section 19 investigation. Such criteria for Redbridge are published in the Local Flood Risk Management Strategy (LFRMS) (2015) and states that flood incidents are defined as when:

- One or more properties are flooded internally.
- Highway flooding impedes pedestrians and/or vehicles from passing on more than three occasions within a one year period.

The flooding incidents that occurred in July 2021 surpass Redbridge's criteria, with 54 internally flooded properties and at least one highway incident that impeded vehicles.

It has also been requested by Redbridge that this report covers:

- A detailed and evidenced explanation for why sandbags would not have helped in the areas that flooded.
- Recommendations for the short, medium, and longer term to alleviate the risk of flooding to properties.
- Where the responsibility lies, what the Council can do, what the Government should do and what Thames Water Utilities Limited (TWUL) and the Environment Agency (EA) should do.
- Recommended immediate steps, such as taking up paved front gardens, installing soakaways, and drain cleaning.

## 1.2 Methodology

The first step of this investigation was a data collection exercise during which data was requested from RMAs and subsequently reviewed. A search on social media platforms was also performed to gather more information about flooding. Considering the short timeframe for the production of this report, TWUL were not able to provide asset data or details about any actions taken before, during or after the flooding event. Therefore, any TWUL data used in this report might not accurately represent

existing assets as the data Redbridge had on file and therefore used herein is from 2015. This report is to be updated once TWUL has provided their data prior to public availability. The data obtained during this step is summarised in *Table 1.1.*

**Table 1.1: Data sources**

| Data | Source |
|---|---|
| Assets significant to flood risk | EA / Redbridge / TWUL |
| Geological information | British Geological Survey |
| Groundwater information | EA |
| Blocked gully reports | Redbridge |
| Historic flood records | Redbridge / Social Media |
| Light Detection and Ranging (LiDAR) topographical data) | EA |
| Photos of the flooded sites | Redbridge |
| Rainfall data | EA |
| Sewer network | TWUL / Redbridge |
| Surface water, fluvial and artificial flood maps | EA |
| Detailed River Network | EA |

Redbridge was asked to provide historic flood records, assets significant to flood risk and incident specific data (including reports, photos and responsive actions). TWUL was asked to provide maps of their sewer network, sewer flood risk and capacity mapping and any responsive actions taken. The EA was asked to provide assets significant to flood risk, the detailed river network, flood risk mapping, rainfall data, LiDAR data and any responsive actions taken. The data was analysed as part of a desktop study to identify the flood mechanisms for the local area.

The available historical, topographical, drainage, geological and land use data was used to explore all potential flood risk sources throughout the flooded locations. The data was also used to establish the hydrological catchments and overland flow routes. A site visit was conducted in key locations to collect any local data available and complement the desktop findings. The responsibility of each RMA was then documented alongside the key actions taken before, after or following the flood incidents where available.

For each hotspot identified, recommendations were formulated based on the flooding mechanism. Some recommendations are directed at RMAs in the hope that they can be included into their programme of work going forward. All RMAs have been consulted on these recommendations before the publication of this report. Although not a legal requirement of a flood investigation report under Section 19 of the FWMA 2010, Redbridge has chosen a proactive approach to reducing the risk of flooding by providing these recommendations.

Finally, the results of the investigation were compiled and general recommendations on flood risk mitigation and potential next steps were provided in *Section 8*.

# 2 Risk Management Authorities

Several parties are responsible for managing the risks of flooding, depending on the source. *Table 2.1* provides an overview of the different RMAs at a borough level.

**Table 2.1: Relevant Risk Management Authorities**

| RMAs | Relevant authorities | Risk management responsibilities |
|---|---|---|
| EA | EA | Main rivers, the sea, and reservoirs |
| LLFA | Redbridge | Surface water, ordinary watercourses, and groundwater |
| Water and Sewerage Company | TWUL | Surface water, foul and combined sewer systems |
| Highway Authority | Redbridge & TfL | Highway drainage |

## 2.1 Environment Agency

The EA is a lead RMA in flood risk management. Section 165 of the Water Resources Act (1991) appoints permissive powers related to Main Rivers to the EA, including the maintenance and improvement of existing works as well as the construction of new works. The FWMA 2010 also gives responsibility for the management of fluvial (river) flooding to the EA. Fluvial flood risk is mapped in different Flood Zones with the following risk boundaries:

- Flood Zone 3: Areas with a greater than 1 in 100 years (>1%) annual probability of river flooding
- Flood Zone 2: Areas with an annual probability of river flooding between 1 in 100 years and 1 in 1,000 years (1% to 0.1%)
- Flood Zone 1: Areas with less than a 1 in 1000 years (<0.1%) annual probability of river flooding

The Main Rivers within the borough of Redbridge are:

- River Roding
- Cran Brook (tributary of the River Roding)
- Seven Kings Water and Loxford Water (tributary of the River Roding)

As part of their permissive powers, the EA performs regular maintenance activities, including the inspection of any flood risk assets (EA or third party owned) for debris build up. Under the Civil Contingencies Act (2004), the EA is also regarded as a Category One Responder (see *Section 2.6*).

## 2.2 London Borough of Redbridge

Redbridge has multiple RMA roles and functions, including as a Highway Authority, an LLFA, a landowner, and a Category One Responder.

As a Highway Authority, Redbridge is responsible for maintaining any highway assets on adopted roads which are not on the Strategic Road Network (which is managed by TfL). Highway drainage, such as drains, kerbs, road gullies, ditches and pipes, has to be managed and routinely inspected to ensure that highway runoff on and from highways is well managed. Redbridge's highway drainage responsibilities include highway gullies and pipework up to the point it connects to the public sewer

network, where it become TWUL's responsibility, hence cooperation with TWUL is key.

As an LLFA, Redbridge is the lead RMA for managing flood risk from surface water, ordinary watercourse, and groundwater sources. Their functions include:

- Development, implementation, and maintenance of a LFRMS.
- Maintenance of a register of structures or features which are likely to have a significant effect on flood risk in the area.
- Undertaking Section 19 flood risk investigations as per the FWMA 2010.
- Reviewing and consulting of surface water drainage proposals for major planning developments.
- Regulating works within the proximity of ordinary watercourses (consenting and enforcement).

Under the FWMA 2010, all other RMAs have a duty to cooperate with the LLFA where necessary to undertake the above responsibilities. Redbridge can also carry out work to help alleviate surface water, groundwater, and ordinary watercourse flooding in collaboration with other RMAs. Surface water flooding has been mapped by the EA in its Risk of Flooding from Surface Water (RoFSW) maps, with areas defined as follows:

- High flood risk: Areas with an annual probability of surface water flooding greater than 1 in 30 years (>3.3%)
- Medium flood risk: Areas with an annual probability of surface water flooding between 1 in 30 and 1 in 100 years (3.3% and 1%)
- Low flood risk: Areas with an annual probability of surface water flooding between 1 in 100 and 1 in 1000 years (1% and 0.1 %)
- Very low flood risk: Areas with an annual probability of surface water flooding less than 1 in 1000 years (<0.1%)

As a landowner, Redbridge has a responsibility to safeguard their own land and property against flooding. Landowners are required by common law to not increase the risk of flooding to a neighbouring property, through carrying out maintenance tasks of their assets, such as drain cleaning. As a riparian owner, Redbridge has the responsibility of carrying out maintenance tasks for the Main Rivers and watercourses that fall within Redbridge owned land.

Redbridge's Emergency Planning team are a Category One Responder under the Civil Contingencies Act (2004) (see *Section 2.6*). They are responsible for responding to incidents and emergencies that occur within the borough, of which flooding is one such potential emergency.

## 2.3 Thames Water Utilities Limited

TWUL is the regional water and sewerage company responsible for managing the risk of flooding from sewers including surface water, foul and combined sewer systems. Under Section 94 of the Water Industry Act (1991), TWUL have a duty to inspect, maintain, and repair their sewers and other drainage assets. TWUL should advise the LLFA about any works being carried out and provide a platform for which sewer flooding incidents can be reported by residents. TWUL data has been used in this report to analyse local drainage networks.

TWUL is also a clean water provider in Redbridge and is responsible for mitigating water main leaks including reinstatement of the public highway if any damage occurs.

## 2.4 Landowners

Landowners have the primary responsibility of safeguarding their own land and property against flooding. Under common law they are also required to ensure that they do not take action to their property in a way that increases the risk of flooding to a neighbouring property. Common law also enables landowners to take reasonable measures to protect their property from flooding, provided the measures do not cause harm to others. Riparian landowners are responsible for ensuring that any structure(s) on their land linked to a neighbouring watercourse is kept clear of debris and the watercourse can flow naturally.

## 2.5 Transport for London

TfL are responsible for managing the operation of the public transport network across London and the drainage of surface water of the red routes of their Strategic Road Network. TfL's red routes within the borough are the following:

- A113 – Charlie Brown's roundabout
- A12 – Eastern Avenue
- A12 – Gants Hill roundabout
- A12 – Redbridge roundabout
- A1400 – Southend Road
- A1400 – Woodford Avenue
- A406 – North Circular Road
- A406 – Southend Road (North Circular Road)

## 2.6 Category One Responders

The Civil Contingencies Act (2004) categorises all blue light emergency services as Category One Responders. For flood incidents within the borough, the most relevant services are the London Fire Brigade (LFB) and the Metropolitan Police Service.

# 3 FLOOD INCIDENT DETAILS

## 3.1 Rainfall Event

On the 25th July 2021, heavy showers and thunderstorms caused widespread flash flooding across Redbridge. The incident caused significant disruption to transport and some roads were closed. Redbridge received 54 reports of properties across the borough having experienced internal flooding. Numerous reports of flooded drives, gardens and roads were also communicated to Redbridge. Redbridge's Emergency Planning response and assurance arrangements were deployed, and Redbridge collaborated with TWUL and emergency services to help affected residents. A rest centre was opened on Sunday 25th July in Sir James Hawkey Hall in Woodford Green to provide shelter for residents that could not stay in their homes, but it was not needed and closed on Monday 26th July. TWUL made a flood clean-up service available for customers who had reported having suffered flooding from overland flows. A total of four clean-ups have been recorded by TWUL across Redbridge for the summer 2021 flooding mitigation operations.

TWUL has produced some maps showing the return periods of the 25th July rainfall event using Met Office data as shown in *Figure 3.1*. From their analysis, a large area in the western part of Redbridge experienced rainfall with a return period of greater than 1 in 100 year. According to the Met Office and as reported by Thames Water in their Internal Review, the return period of the storm that occurred on the 25th July 2021 is 1 in 118 year, although it has not been specified for which area of London this figure is valid.

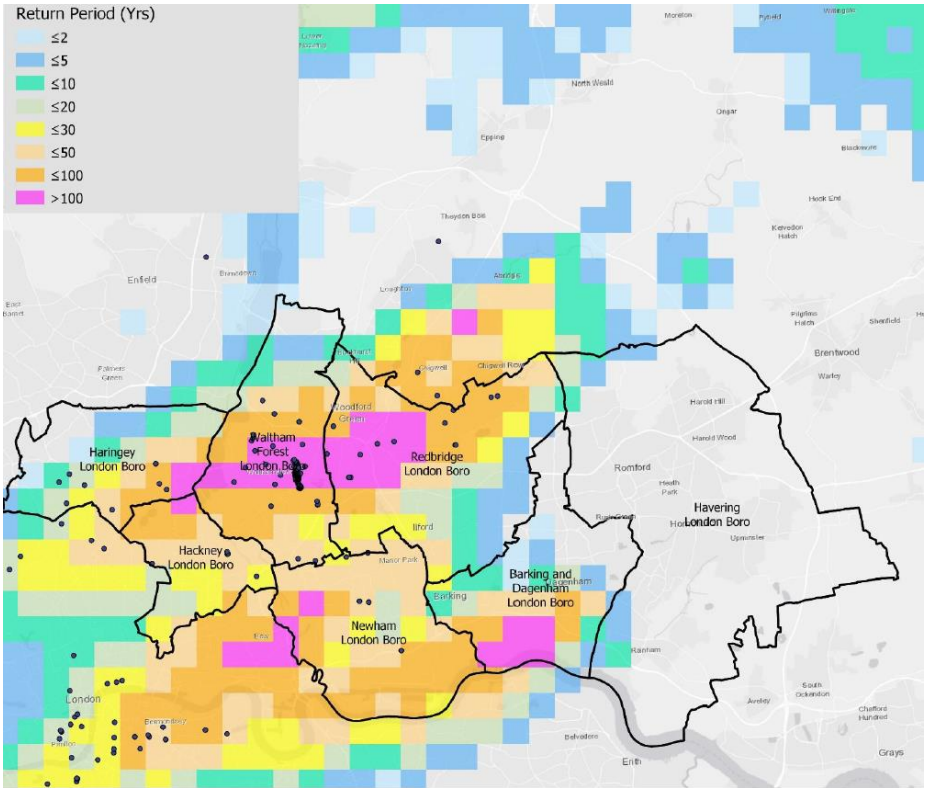


**Figure 3.1: Rainfall return period and reported flooding incidents for the 25th July 2021 (RARA data using FEH 99) (Thames Water, 2021)**

## 3.2 Rain gauge data

The EA has made data available from the rainfall event, as recorded by rain gauges. Four rain gauges are in proximity of Redbridge, one of which has been reported to be faulty during the rainfall event by the EA (Havering Bower). *Figure 3.2* shows the location of the rain gauges in and around Redbridge and *Table 3.1* shows the summary of the rainfall event.

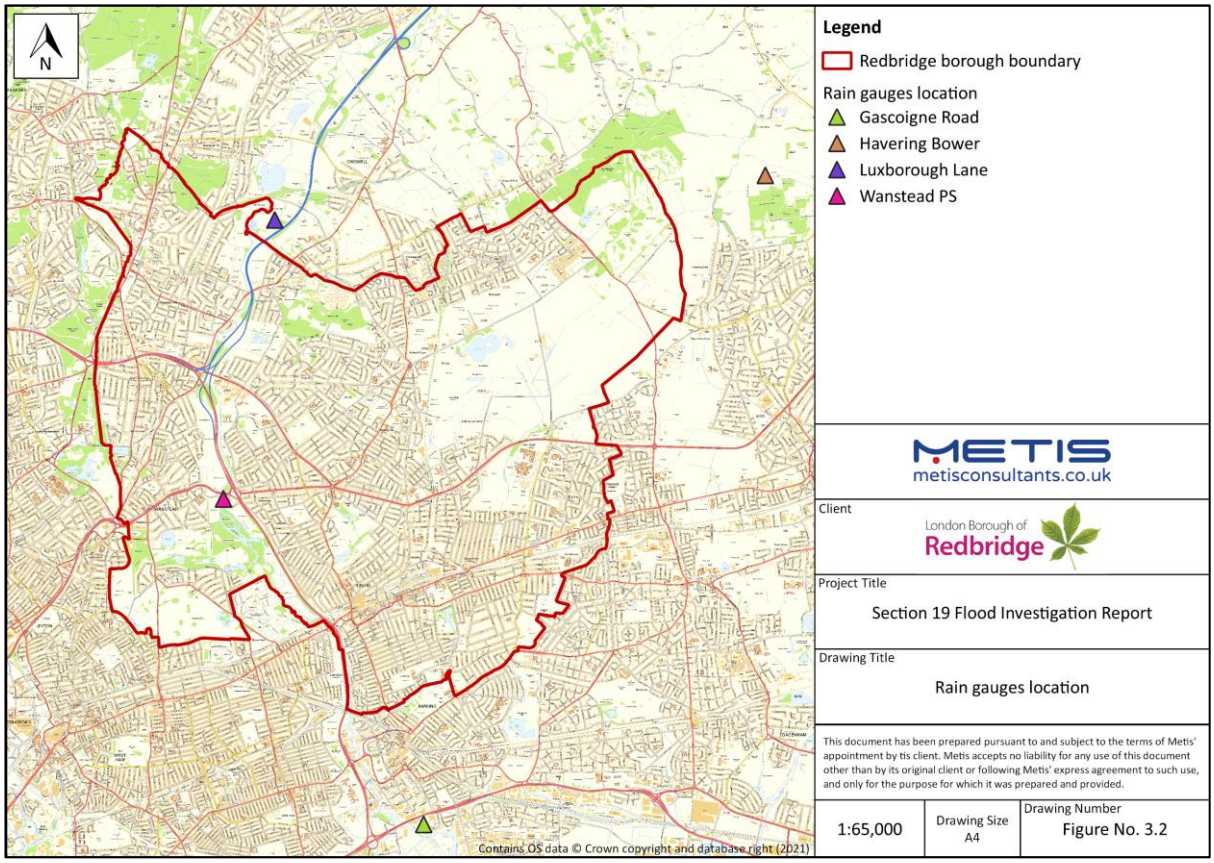


**Figure 3.2: Rain gauges location**

**Table 3.1: Summary of rainfall event**

| Rain gauge | Distance to the Borough | Peak time | Peak rainfall amount |
|---|---|---|---|
| Gascoigne Road | 2km | 15:00 | 22.69mm |
| Luxborough | 0.15km | 14:30 | 14.07mm |
| Wanstead PS | Within Borough boundary | 15:45 | 12.4mm |
| Havering Bower | 2km | Not operational | Not operational |

Rainfall started in the early afternoon on 25th July and peaked between 2:30pm and 4pm, with slight variations between the different rain gauges because of their location in relation to the Borough. The rain gauge data can be found in *Table A.1*. The total cumulative amount of rainfall recorded over two hours and fifteen minutes by the Wanstead PS rain gauge is 54.1mm.

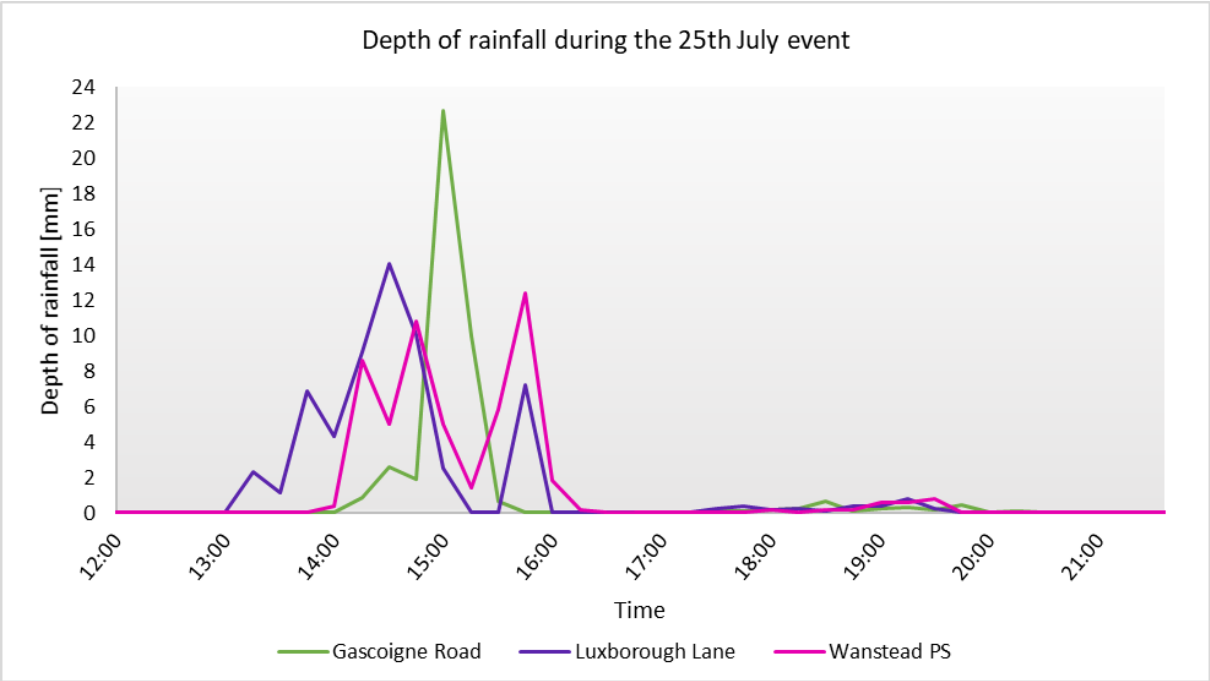


**Figure 3.3: Depth of rainfall during the 25th July event**

## 3.3 Affected locations and hydrological catchments

During and after the rainfall event of the 25th July, residents reported to Redbridge and to TWUL that properties and roads were flooded. Depending on the extent of the flooding, the reports were classified into three categories:

- Internal flooding: Flooding inside of the building, including basements.
- External flooding: Flooding within property boundaries but not to buildings, including gardens and driveways.
- Highways flooding: Flooding of roads and pavements

Redbridge received a total of 179 flooding reports from residents, from 130 different streets throughout the borough. *Figure 3.4* shows the geographic spread of all reported flooded locations. A search across social media platforms provided information on areas that also experienced flooding. *Table 3.2* lists all the locations of reported flooding in the borough, the type of flooding where known, and the relevant chapter for further information.

Most of the flooding reported appeared to be associated with surcharging gullies, which occurs when there is insufficient capacity in the surface water sewer network to accommodate for the surface water runoff entering the network during a rainfall event.

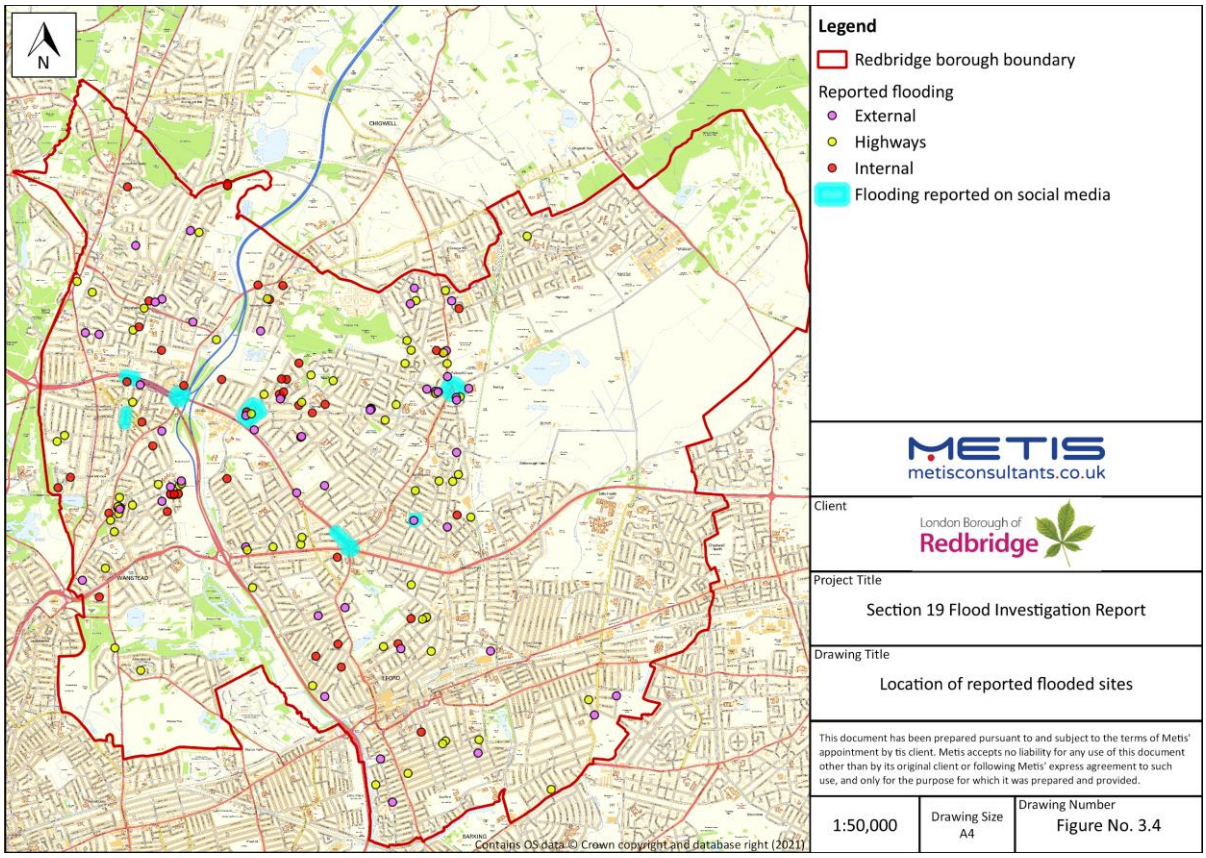


**Figure 3.4: Location of reported flooded sites**

**Table 3.2: Reference table of the reported flooded locations**

| Location | Catchment | Flooding type – number of reports received | | | Reference in the report |
|---|---|---|---|---|---|
| | | Internal | External | Highways | |
| Aberdour Road | - | | 1 | | - |
| Aintree Crescent | Fairlop-Cranbrook | | 4 | 2 | *Section 6* |
| Aragon Drive | Fairlop-Cranbrook | | 1 | 1 | *Section 6* |
| Ashley Avenue | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Ashurst Drive | Fairlop-Cranbrook | | 1 | 1 | *Section 6* |
| Atherton Road | East Roding | 3 | 1 | | *Section 5* |
| Auckland Road | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Balfour Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Bernards Close | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Blake Hall Crescent | West Roding | | | 1 | *Section 4* |
| Brading Crescent | West Roding | | | 1 | *Section 4* |
| Broadmead Road | West Roding | | | 1 | *Section 4* |

| Location | Catchment | Flooding type – number of reports received | | | Reference in the report |
|---|---|---|---|---|---|
| | | Internal | External | Highways | |
| Broadwalk | West Roding | | | 1 | *Section 4* |
| Buckhurst Way | West Roding | 3 | | | *Section 4* |
| Budoch Drive | - | | | 1 | - |
| Buntingbridge Road | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Cambridge Road | West Roding | | 1 | | *Section 4* |
| Campbell Road | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Carlton Drive | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Caterham Avenue | East Roding | 1 | | | *Section 5* |
| Cavendish Avenue | West Roding | | | 1 | *Section 4* |
| Cecil Road | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Chalford Walk | West Roding | | | 1 | *Section 4* |
| Chalgrove Crescent | East Roding | | | 1 | *Section 5* |
| Chase Lane | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Cheriton Avenue | East Roding | | | 1 | *Section 5* |
| Cheyne Avenue | West Roding | | | 1 | *Section 4* |
| Chigwell Road | West Roding & East Roding | 1 | 1 | | *Section 4* |
| Clarence Avenue | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Claybury Broadway | East Roding | | 1 | | *Section 5* |
| Clayhall Avenue | East Roding | 1 | | | *Section 5* |
| Coburg Gardens | East Roding | | 1 | | *Section 5* |
| Colombo Road | Fairlop-Cranbrook | | 1 | 2 | *Section 6* |
| Colvin Gardens | West Roding | | | 1 | *Section 4* |
| Coventry Road | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Cowley Road | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Craven Gardens | Fairlop-Cranbrook | | 2 | | *Section 6* |
| Crown Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Dangan Road | West Roding | | | 1 | *Section 4* |
| Deynecourt Gardens | West Roding | 1 | | 2 | *Section 4* |
| Ellesmere Gardens | East Roding | | | 1 | *Section 5* |
| Elmcroft Avenue | West Roding | | 1 | 2 | *Section 4* |
| Elmhurst Drive | West Roding | 1 | | | *Section 4* |
| Endsleigh Gardens | Fairlop-Cranbrook | 1 | | | *Section 6* |

| Location | Catchment | Flooding type – number of reports received | | | Reference in the report |
|---|---|---|---|---|---|
| | | Internal | External | Highways | |
| Ewellhurst Road | East Roding | 1 | | | *Section 5* |
| Fair Oak Place | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Falmouth Gardens | East Roding | 1 | | | *Section 5* |
| Fencepiece Road | Fairlop-Cranbrook | | 2 | 1 | *Section 6* |
| Forest Road | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Genas close | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Glade Court | East Roding | | | 1 | *Section 5* |
| Glebe Avenue | West Roding | | | 1 | *Section 4* |
| Goodmayes Lane | - | | 1 | | - |
| Grange Road | Ilford South | | | 2 | *Section 7* |
| Green Lane | Ilford South | 1 | | | *Section 7* |
| Grosvenor Gardens | West Roding | 1 | | | *Section 4* |
| Grosvenor Road | Ilford South | 1 | | | *Section 7* |
| Haldon Close | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Hampton Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Heathside Close | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Hedgeley | East Roding | | 1 | | *Section 5* |
| Henley Road | Ilford South | | 1 | | *Section 7* |
| Hereford Road | West Roding | 2 | | | *Section 4* |
| Hermitage Walk | West Roding | 1 | | | *Section 4* |
| Hermon Hill | West Roding | 1 | | | *Section 4* |
| High Road | West Roding | | | 1 | *Section 4* |
| High Street | West Roding | | | 1 | *Section 4* |
| Highfield Road | East Roding | | 1 | | *Section 5* |
| Horns Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Kingsley Road | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Kingston Road | Ilford South | | | 1 | *Section 7* |
| Knighton Drive | West Roding | 1 | | | *Section 4* |
| Longcourt Mews | West Roding | | 1 | | *Section 4* |
| Longwood Gardens | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Lorne Gardens | West Roding | 4 | 1 | | *Section 4* |
| Ludham Close | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Manford Way | Fairlop-Cranbrook | | 1 | | *Section 6* |

| Location | Catchment | Flooding type – number of reports received | | | Reference in the report |
|---|---|---|---|---|---|
| | | Internal | External | Highways | |
| Manorway | - | | 1 | | - |
| Margaret Way | East Roding | | | 1 | *Section 5* |
| Melbourne Road | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Milkwell Gardens | West Roding | | 1 | | *Section 4* |
| Milton Crescent | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Monkhams Avenue | West Roding | | 1 | | *Section 4* |
| Morgan Way | East Roding | 1 | | | *Section 5* |
| Natal Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Neville Road | Fairlop-Cranbrook | 1 | | 1 | *Section 6* |
| New North Road | Fairlop-Cranbrook | 1 | | | *Section 6* |
| Northbrook Road | Fairlop-Cranbrook | 1 | | | *Section 6* |
| North Cross Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Onslow Gardens | West Roding | | 1 | | *Section 4* |
| Peel Place | East Roding | 1 | | 1 | *Section 5* |
| Primrose Road | West Roding | | 1 | 1 | *Section 4* |
| Prospect Road | West Roding | | | 1 | *Section 4* |
| Purley Close | Fairlop-Cranbrook | | 3 | | *Section 6* |
| Radnor Crescent | East Roding | | | 1 | *Section 5* |
| Redbridge Lane East | East Roding | | 1 | | *Section 5* |
| Rivenhall Gardens | West Roding | 1 | | | *Section 4* |
| Roding Avenue | East Roding | 1 | | 1 | *Section 5* |
| Roding Lane North | West Roding | | | 1 | *Section 4* |
| Roding Lane South | West Roding | | | 1 | *Section 4* |
| Roundaway Road | East Roding | 1 | | | *Section 5* |
| Rutland Road | West Roding | | 1 | | *Section 4* |
| Selsdon Road | West Roding | 1 | | | *Section 4* |
| Silver Birch Mews | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Southview Drive | West Roding | 1 | | | *Section 4* |
| Springfield Gardens | West Roding | | 1 | | *Section 4* |
| St Albans Road | Ilford South | | 2 | | *Section 7* |
| St Barnabas Road | West Roding | 1 | 1 | | *Section 4* |
| St Clair Close | East Roding | | | 1 | *Section 5* |
| Staines Road | Ilford South | | | 1 | *Section 7* |
| Stalham Way | Fairlop-Cranbrook | | | 1 | *Section 6* |

| Location | Catchment | Flooding type – number of reports received | | | Reference in the report |
|---|---|---|---|---|---|
| | | Internal | External | Highways | |
| Starch House Lane | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Stoneleigh Road | East Roding | 2 | 1 | | *Section 5* |
| Sussex Close | East Roding | | | 1 | *Section 5* |
| The Drive | Fairlop-Cranbrook | 1 | | | *Section 6* |
| The Glade | East Roding | 1 | | | *Section 5* |
| The Square | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Thurlstone Avenue | - | | | 1 | - |
| Valentines Road | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Vicarage Lane | Ilford South | | 1 | | *Section 7* |
| Victoria Road | West Roding | 1 | | | *Section 4* |
| Waltham Road | East Roding | 1 | | | *Section 5* |
| Wanstead Park Road | East Roding & Fairlop-Cranbrook | | 1 | 3 | *Section 6* |
| Warley Road | West Roding | 1 | | | *Section 4* |
| Wellesley Road | West Roding | | | 1 | *Section 4* |
| Wellington Road | West Roding | 2 | 1 | 5 | *Section 4* |
| Wensleydale Avenue | East Roding | 1 | | | *Section 5* |
| Westview Drive | East Roding | 1 | | | *Section 5* |
| Wincanton Gardens | Fairlop-Cranbrook | | | 1 | *Section 6* |
| Wingate Road | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Wolsey Gardens | Fairlop-Cranbrook | | 1 | | *Section 6* |
| Total | | 54 | 55 | 70 | 179 |

Due to the large number of flooding incidents reported, four hydrological catchment areas were defined to help understand the linkages of incidents and potential causes of flooding and to provide a clearer structure to the investigation. A hydrological catchment is an area of land where any rainfall falling on the area drains to the same point, whether it is a topographical low point, a waterbody or a flow path. The catchments were defined by using Light Detection and Ranging (LiDAR) data provided by the EA. *Figure 3.5* shows the boundaries of each catchment and the flooded locations within each catchment. Four flood incidents fall outside of the four main catchments due to their location. Additional catchments would be needed to include them, and this was not deemed a priority on the basis that they were not reports of internal flooding.

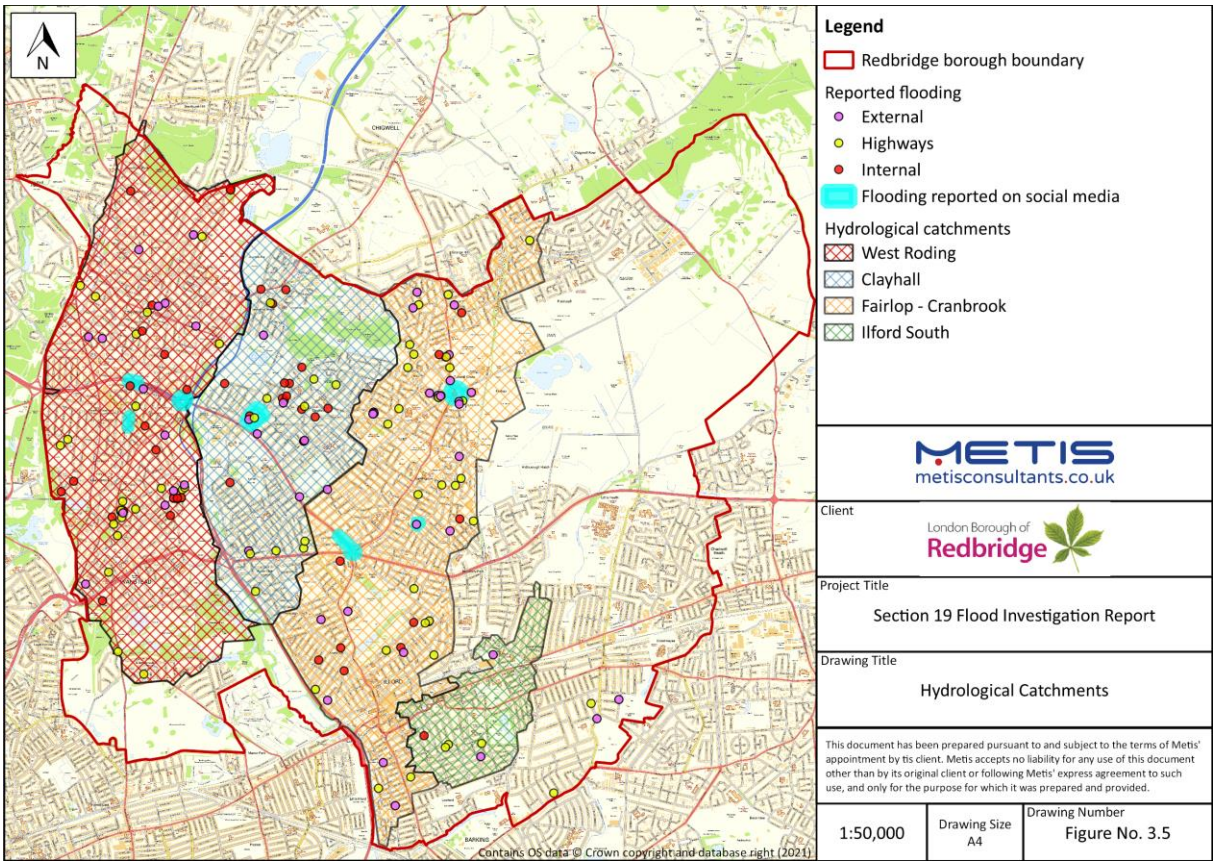


**Figure 3.5: Hydrological catchments**

## 3.4 Hotspots of flooded locations

Due to the high number of internally flooded properties recorded, it is not possible to investigate each flooding event at property level. Instead, ten hotspots were identified throughout the borough (*Figure 3.6*). In line with Redbridge's 'flood incident' criteria (see *Section 1.1*), the hotspots were chosen where there were clusters of internal flooding incidents reported within a small area or where highways flooding had stopped traffic. Nearby locations of reported external and highways flooding were also included in the hotspots. A detailed analysis of the flood mechanism within each hotspot can be found in *Sections 0* to *7*.

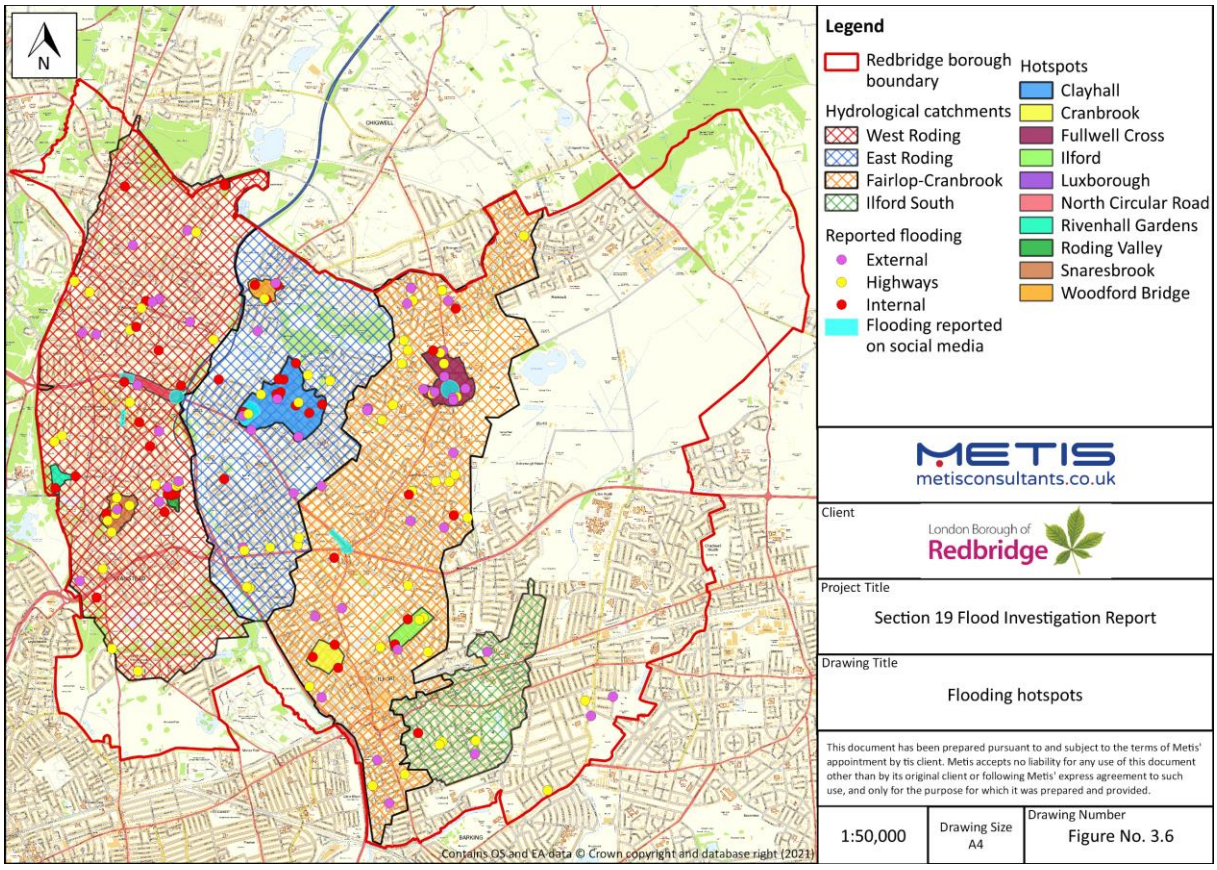


**Figure 3.6: Flooding hotspots**

# 4 West Roding Catchment

The West Roding hydrological catchment spans from Woodford Wells to Aldersbrook and is located to the west of the River Roding (*see Figure 4.1*). Residents in this catchment reported 24 internally flooded properties, 13 externally flooded properties and 24 cases of flooding to the highway, totalling at 61 reports. The flood mechanism and various flood risks within each of the six hotspots are assessed in this section.

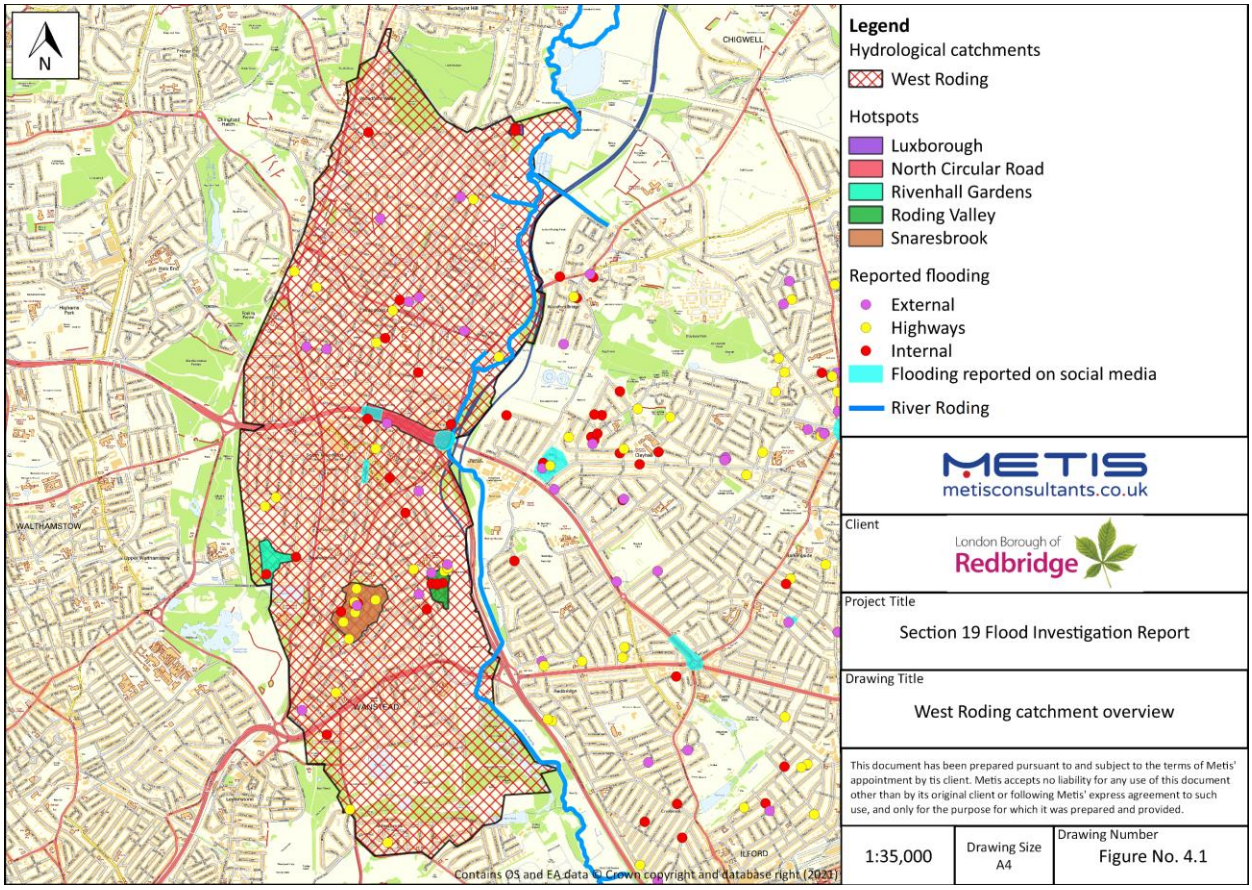


**Figure 4.1: West Roding catchment overview**

Although maps for various types of flood risks have been produced at the scale of the hotspots throughout this report, the EA's Areas Susceptible to Groundwater Flooding data is provided as 1km tiles and therefore is provided at the scale of the catchment within *Figure 4.2*.

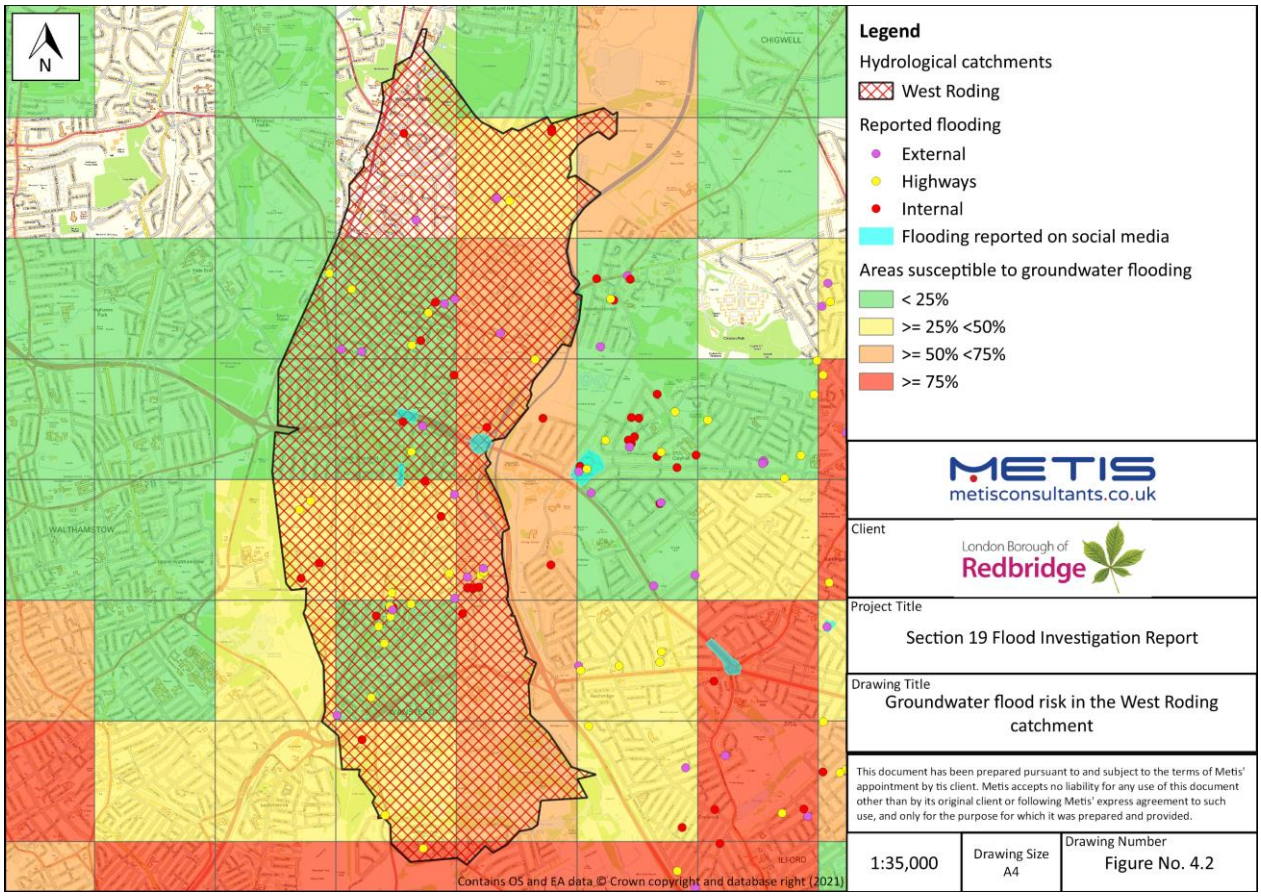


**Figure 4.2: Groundwater flood risk in the West Roding catchment**

## 4.1 Hotspot 1 – Luxborough

The Luxborough Hotspot is located on the north-west border of the Borough.

### 4.1.1 Location-wide flood incident(s)

Following the heavy downpour on the 25th July 2021, three reports of internal flooding in Buckhurst Way near the intersection with Cherry Tree Rise were received by Redbridge. A homeowner has described that excess water from the road ponded in a dip created by insufficient drainage and ran into three properties.

### 4.1.2 Local drainage network

*Figure 4.3* shows the TWUL sewer network within the local area. The intersection between Buckhurst Way and Cherry Tree Rise is a connection point of three separate surface water sewers. A surface water sewer with a diameter of 225mm flows in a southerly direction from Buckhurst Way, starting near the railway line. A second surface water sewer with interchanging diameters of 150mm and 225mm flows in an easterly direction along Cherry Tree Rise and a third surface water sewer with interchanging diameters of 150mm, 225mm and 300mm flows in a southerly direction along the west section of Cherry Tree Rise and is redirected in a north-easterly direction along Buckhurst Way. All three sewers connect at the intersection between Buckhurst Way and Cherry Tree Rise and discharge to a 300mm surface water sewer that flows in an easterly direction for approximately 260m before discharging into the River Roding. There is also a separate foul water

sewer network that follows a similar layout, with the addition of a sewer connecting from Bush Road, and the sewers discharging to the 825mm combined sewer that broadly follows the River Roding.

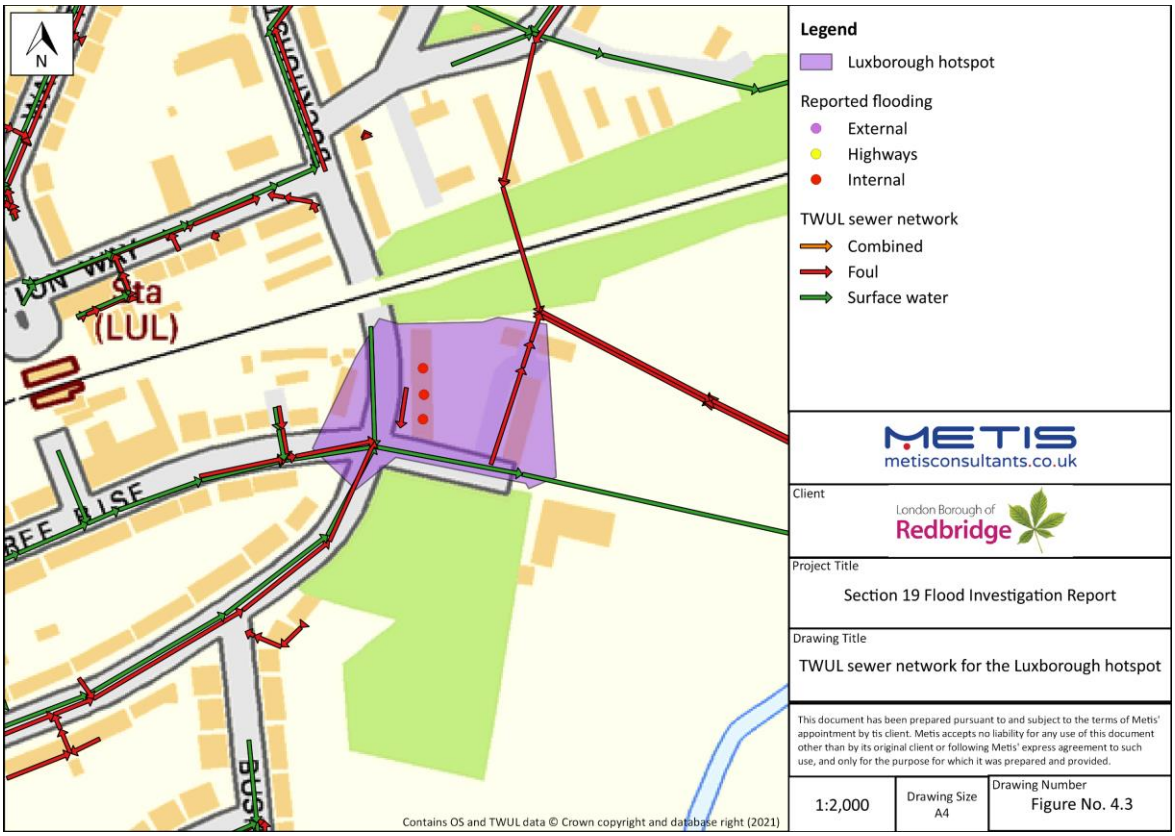


**Figure 4.3: TWUL sewer network for the Luxborough hotspot**

### 4.1.3 Local flood mechanism

A watershed analysis of the area using Geographic Information System (GIS) provided small hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 4.4*). LiDAR data shows that the flooded properties in Buckhurst Way lie on a topographical low point within the hydrological catchment. This means that surface water within the defined catchment will naturally flow towards the area and pond near the intersection with Cherry Tree Rise and behind the properties.

The primary flow paths are the main overland flow routes for surface water in the defined catchment. For this specific catchment, the primary flow path generally flows in an easterly direction towards River Roding.

The properties on the east side of the intersection are known to be slightly lower than the road, with the driveways dipping towards the front of the properties.

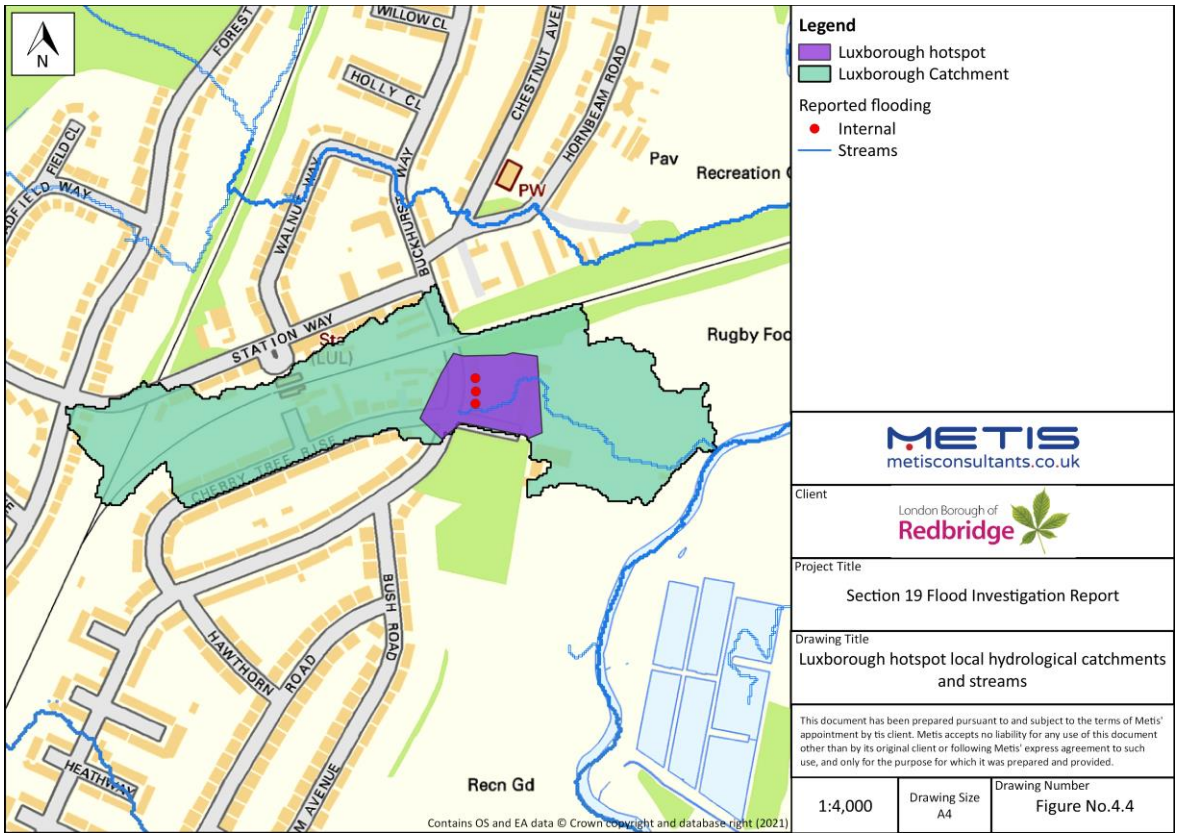


**Figure 4.4: Luxborough hotspot local hydrological catchments and streams**

### 4.1.4 Local flood risk

To gain an understanding of the flooding mechanisms in play during the flooding event of the 25th July, it is useful to investigate the various local flood risks, namely the risks of flooding from surface water, from ordinary watercourses, from Main Rivers (known as fluvial flooding), from groundwater and from sewers.

#### Surface Water Flood Risk

Surface water flooding arises due to the accumulation of water at ground level following prolonged or intense rainfall. When rainwater does not drain away through the constructed drainage systems, or soak into the ground, it flows over the ground surface, leading to the risk of flooding in the surrounding areas.

A review of the EA's Risk of Flooding from Surface Water (RoFSW) data shows that the surface water is predicted to flow from adjacent roads towards the intersection between Buckhurst Road and Cherry Tree Rise. The mapping also shows that the intersection is at risk from the 1 in 30 year, 1 in 100 year and 1 in 1000 year events (see *Figure 4.5*) with flood depths ranging between 0.15m and 0.60m. The flooding extents of the 1 in 100 year and the 1 in 1000 year events encroach on the properties that have reported internal flooding. Overall, the Luxborough hotspot is at high risk of surface water flooding.

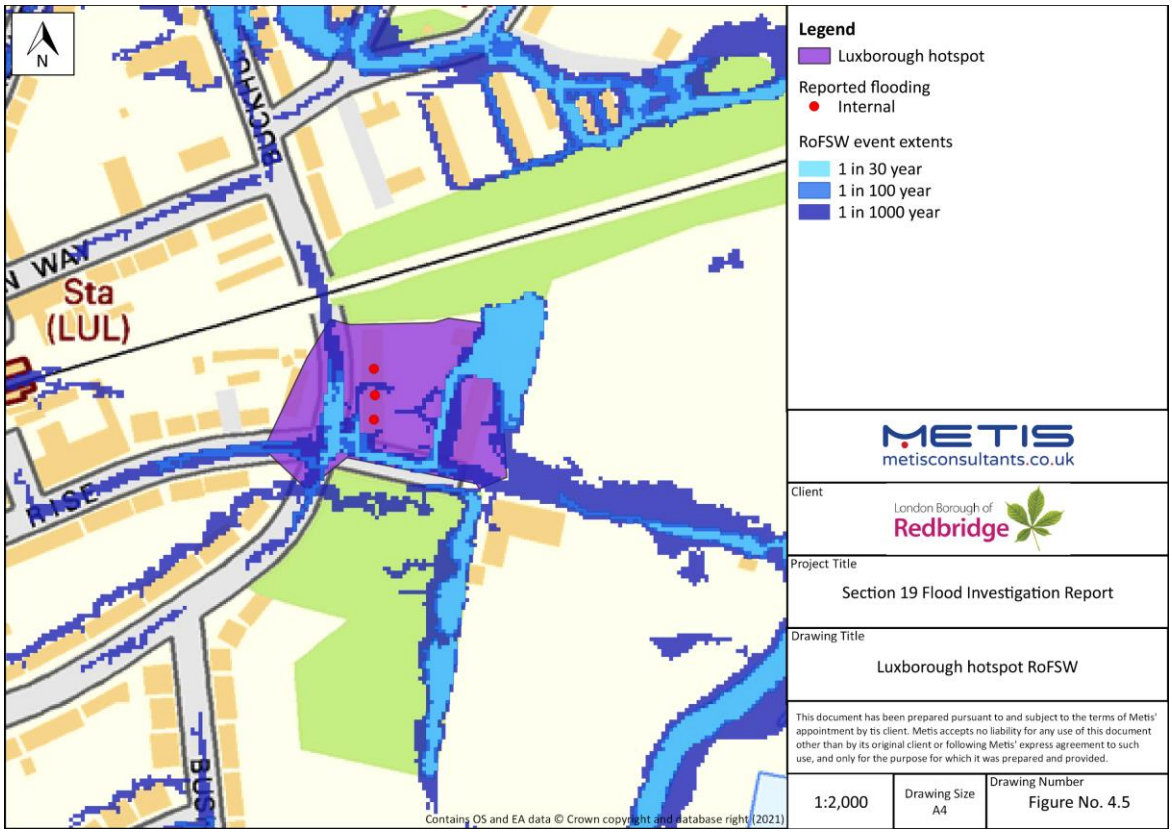


**Figure 4.5: Luxborough hotspot RoFSW**

## Ordinary Watercourse Flood Risk

Ordinary watercourses are rivers, ditches and streams that are not designated by the EA as 'Main Rivers'. Significant rainfall events cause increased peak flows into the watercourses which may exceed the capacity of the channels and lead to surface water flooding over ground.

The EA's RoFSW map includes flooding from ordinary watercourses. A review of the EA's Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of Buckhurst Way. Therefore, the Luxborough hotspot is not at risk of flooding from ordinary watercourses.

## Fluvial Flood Risk

Fluvial flooding can occur when watercourses designated as 'Main Rivers' by the EA exceed their hydraulic capacity as a result of heavy of excessive rainfall.

According to the EA's online Flood Map for Planning, the Luxborough hotspot is located in Flood Zone 1 and therefore is not at risk of fluvial flooding.

## Groundwater Flood Risk

Groundwater flooding can occur when the below-ground water table has risen after a significant period of rainfall. If the water table is too high, rainfall is no longer able to infiltrate into the ground, causing flooding at the surface. In extreme circumstances, flooding can be caused by water directly emerging from the ground. The area's ground composition and the presence of aquifers can further exacerbate the effects of groundwater flooding.

The Luxborough hotspot lies within the '>=25 % <50%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 4.2*). The flooding report does not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

### Sewer Flood Risk

Sewer flooding occurs when the hydraulic capacity of a given sewer system is exceeded by the inflow of water from a significant rainfall event. Drains and sewers can also become full when a blockage occurs downstream in the sewer system. This can cause water to back up in a sewer system and cause flooding.

As reported by the resident, the water ponded at the intersection between Buckhurst Road and Cherry Tree Rise and flooding properties because of insufficient drains. Considering the large return period of the rainfall event of the 25th July, it is possible that surface water drains did not have sufficient capacity to deal with the amount of water entering the network, causing surface water to surcharge and flow into neighbouring properties. The sewer network, as shown in *Figure 4.3*, is made of three surface water sewers that merge into a single surface water sewer at the road intersection. The diameter of the outflow sewer is not significantly bigger than the diameters of the sewers that connect to it. Based on this information, it is believed that this flooding incident can be attributed to insufficient sewer capacity.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the Luxborough hotspot sits outside of the predicted reservoir flooding extent. Therefore, the Luxborough hotspot is at a low risk of flooding from any other sources.

## 4.1.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 4.1: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>Following a report of a blocked gully at this location root penetration was removed from the gully connection in November 2017. There have been no reported issues since.<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations. |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | Eight adjacent gullies were checked at this location. Seven were found to be functioning correctly. One was found to be restricted. Works required to surface levels and drainage were identified. This is ongoing. |
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>No known actions taken |

### 4.1.6 Recommendations

- Redbridge to investigate raising kerb levels in front of flooded properties in Buckhurst Road to guide surface water away from properties.
- Redbridge to investigate if the installation of new gullies in Buckhurst Way would be beneficial to prevent further flooding. It should be noted that adding new gullies will not prevent future flooding if the surface water sewer does not have sufficient capacity for the additional surface water entering the network.
- For TWUL actions, refer to Section 8.2.

## 4.2 Hotspot 2 – North Circular Road

The North Circular Road catchment is in the west of the borough and spans from the railway underpass near South Woodford Station to Charlie Brown's roundabout. This road section is part of TfL's red route network.

### 4.2.1 Location-wide flood incident(s)

During the rainfall event, the section of the Southend Road and the North Circular Road below the railway underpass experienced severe flooding and traffic had to be stopped. Charlie Brown's roundabout also experienced flooding that impacted traffic flow in the area. Both flooding occurrences were mentioned on social media and in news outlets. Two properties in this hotspot also reported internal flooding due to the heavy downpour. The first property is located at the eastern end of Elmhurst drive and the second is on Chigwell Road, near the junction with Raven Road. A TWUL manhole at the corner of Primrose Road was severely surcharging during the rainfall event. A report of external flooding to the garden of a property on Primrose Road was also received by Redbridge.

### 4.2.2 Local drainage network

*Figure 4.6* shows the TWUL sewer network within the local area. There is a single surface water sewer serving both Southend Road and the North Circular Road between the railway line and Charlie Brown's roundabout. The sewer flows in an easterly direction following the northern border of Southend Road and is redirected to a southerly direction

until reaching the southern border of the North Circular Road. The sewer is then redirected to an easterly direction and follows the North Circular Road. The pipe diameter of the sewer interchanges between 225mm, 450mm and 600mm until reaching the North Circular Road after which the diameter decreases to 525mm and increases again to 575mm, 750mm until reaching Charlie Brown's Roundabout, where it decreases to 675mm until the discharge point to the River Roding approximately 180m to the east. The surface water sewer in Elmhurst Drive flows in an easterly direction with a diameter interchanging from 100mm to 225mm and to 300mm at which point it connects to a 300mm surface water sewer flowing parallel to the North Circular Road until reaching Primrose Road. The sewer then flows southerly along Primrose Road, easterly along Violet Road with a diameter of 525mm and Maybank Avenue with a diameter of 375mm, at which point two sewers from Woodville Road (225mm diameter) and Essex Road (225mm) connect into it. The 375mm sewer discharges into the 525mm sewer in the North Circular Road. The foul sewer network in the hotspot is divided into two. A first foul sewer starts at the intersection between Woodville Road and Maybank Road and flows easterly along the North Circular Road with a diameter interchanging from 225mm to 450mm. The second foul sewer network is made of two parallel sewers with a diameter of 375mm, both flowing easterly along the edges of Southend Road and the North Circular Road, that connect at the intersection with Latchett Road. The discharge point for both foul sewers is the combined sewer bordering the River Roding.

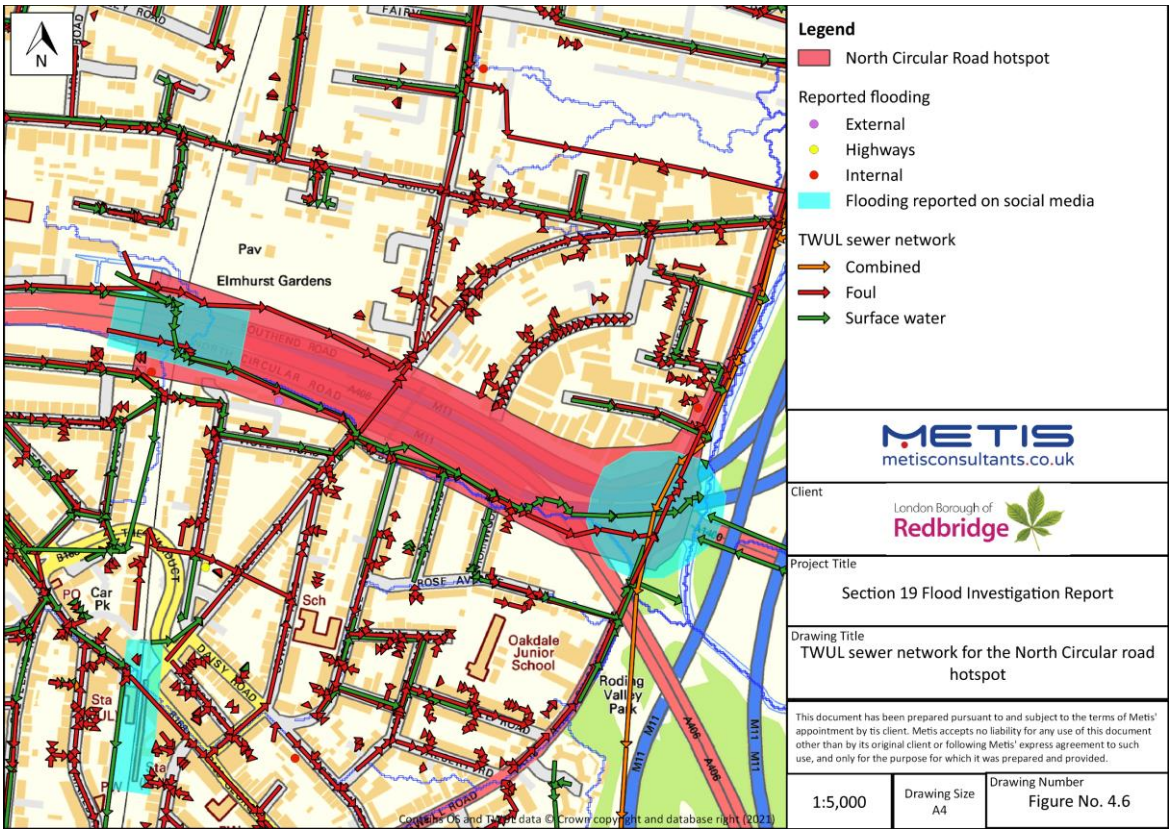


**Figure 4.6: TWUL sewer network for the North Circular Road hotspot**

### 4.2.3 Local flood mechanism

A watershed analysis of the area using GIS provided several hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 4.7*).

LiDAR data shows that the railway underpass lies on a topographical low point within the area. Surface water is therefore likely to flow towards the area. The primary flow paths of the sub-catchments that include the hotspots intersect near the underpass. Charlie Brown's roundabout also borders a primary flow path. Furthermore, both locations having reported internal flooding are located on or in close proximity to the flow paths. The primary flow paths all connect to the River Roding which borders the hotspot to the east.

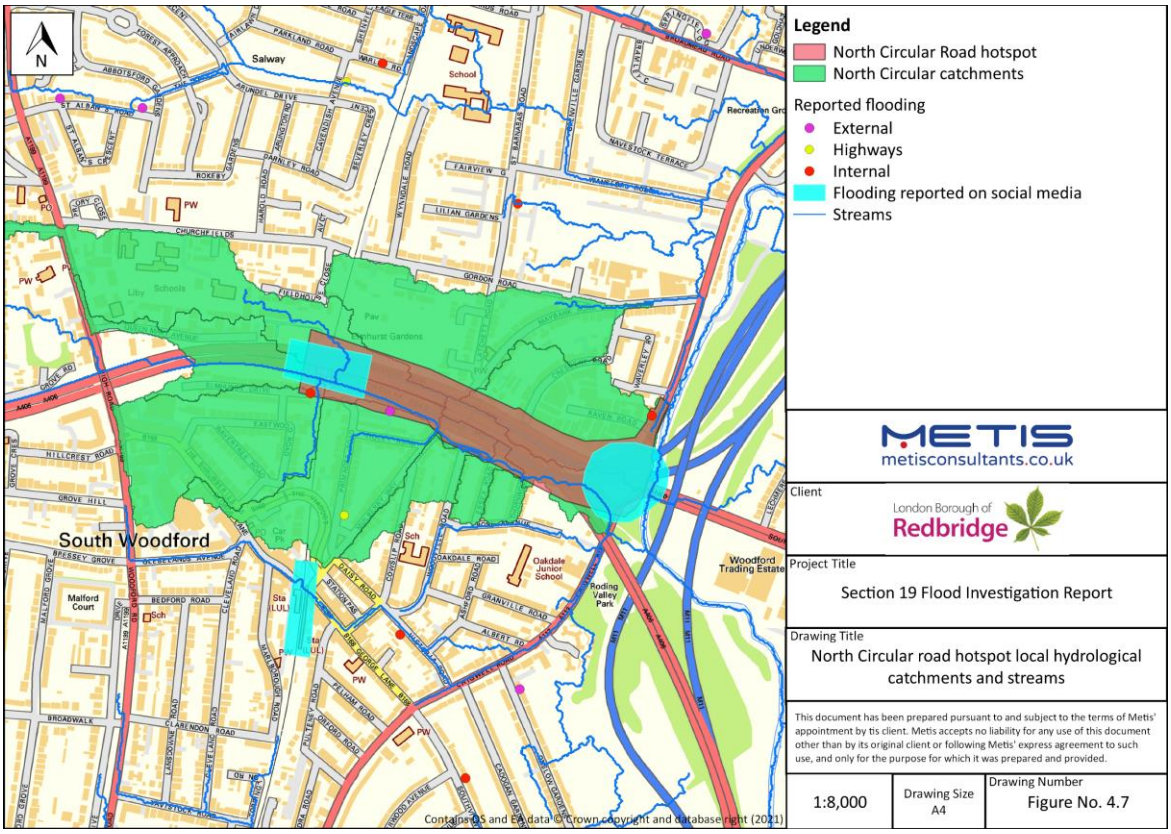


**Figure 4.7: North Circular Road hotspot local hydrological catchments and streams**

### 4.2.4 Local flood risk

#### Surface Water Flood Risk

A review of the EA's Risk of Flooding from Surface Water data shows that water is predicted to flow from the North Circular Road and neighbouring roads to the underpass (*Figure 4.8*). The mapping shows that the underpass is at risk of flooding from the 1 in 30 year, 1 in 100 year and 1 in 1000 year events with flood depths ranging between 0.15m to over 1.2m. The south-west section of Charlie Brown's roundabout is also at risk of flooding from the 1 in 30 year, 1 in 100 year and 1 in 1000 year events with depths ranging between 0.15m and 0.90m. From the mapping, the properties on Chigwell Road and Elmhurst Drive are not explicitly at risk of flooding from surface water, they are however in close proximity to the predicted flooded areas. Overall, the railway underpass and Charlie Brown's roundabout are at high risk of surface water flooding.

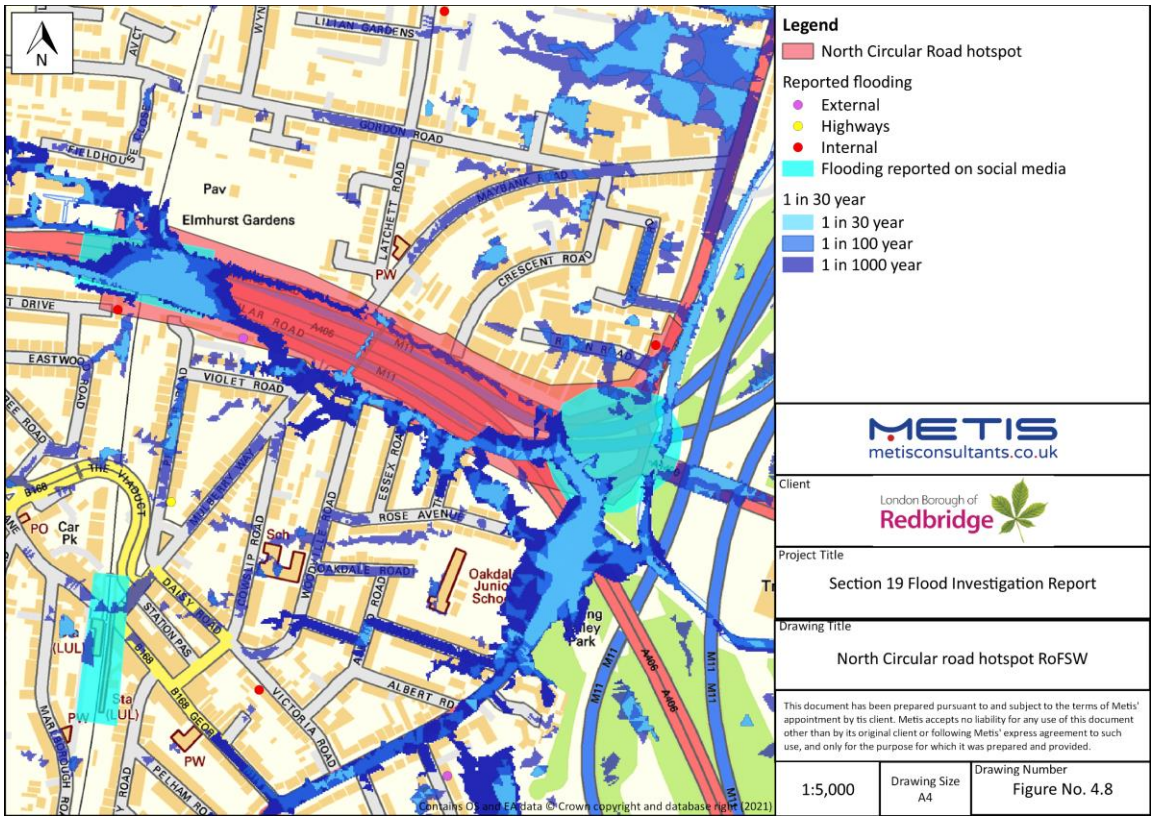


**Figure 4.8: North Circular Road hotspot RoFSW**

## Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of the North Circular Road hotspot and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

## Fluvial Flood Risk

According to the EA's online Flood Map for Planning, Charlie Brown's roundabout is located partially within Flood Zone 2 and Flood Zone 3. The property in Chigwell Road is located in Flood Zone 3. Although parts of the hotspot are located in Flood Zone 3, the flooding that occurred on the 25th July has been confirmed to be surface water flooding and not fluvial by Redbridge operational staff, and no flood alerts or flood warnings were issued. Based on this information, Charlie Brown's roundabout and the surrounding area is at high risk of fluvial flooding, but the source of flooding for the 25th July flooding event is not fluvial.

## Groundwater Flood Risk

The North Circular Road hotspot lies within the '<25%' and the '>=50% <75%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 4.2*). The flooding report does not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

### Sewer Flood Risk

Based on the photos illustrating news articles, water was ponding below the underpass and around Charlie Brown's roundabout. The surcharging manhole in Primrose Road is located downstream of Elmhurst Drive. A surcharge in the sewer network in Primrose Road would impact the sewer upstream and exacerbate the flooding in Elmhurst Drive. Based on this information, the flooding in Elmhurst Drive can be attributed to sewer flooding.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the North Circular Road hotspot sits outside of the predicted reservoir flooding extent. Therefore, the North Circular Road hotspot is at low risk of flooding from other sources.

## 4.2.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 4.2: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br>The gullies in Elmhurst drive were checked after Redbridge received the flooding report and were found to be free flowing. The gullies have last been checked on the 23rd August 2021, with three not inspected due to parked vehicles and one found to have tarmac or concrete in the gully pot. It has since been identified that TWUL's surface water sewer was surcharging just downstream of this location in Primrose Road.<br>A site visit was conducted on the 6th October 2021 to investigate the flooding reported on Elmhurst Drive. During this initial high-level assessment, it was noticed that the property was located at a topographical low point, with airbricks flush with ground level and the garage below ground level. |
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After*** |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | No known actions taken |
| *London Fire Brigade* | ***Before***<br>No known actions taken<br>***During***<br>The London Fire Brigade (LFB) intervened at Charlie Brown's roundabout to remove water. A pump was requested from the EA but was not used as the water level subsided by themselves.<br>***After***<br>No known actions taken |
| *TfL* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>No known actions taken |

### 4.2.6 Recommendations

- For Redbridge and TWUL actions, refer to Section 8.2.

## 4.3 Hotspot 3 – Rivenhall Gardens

The Rivenhall Gardens hotspot is located near the western border of the Borough in the Snaresbrook area, between Eagle Pond and the recreation grounds behind Cheyne Avenue.

### 4.3.1 Location-wide flood incident(s)

Two properties reported internal flooding in the hotspot. The first property is located at the back of the housing blocks in Rivenhall Gardens and the second property is located on Hermitage Walk between the intersections with Malford Grove and The Drive. The resident from Rivenhall Gardens has stated that the flooding looked like it came from a burst pipe higher up the road that was causing ponding near another water drain further downhill. The resident from Hermitage Walk has reported that his garage has flooded due to water flowing from the road into his property.

### 4.3.2 Local drainage network

*Figure 4.9* shows the TWUL sewer network within the local area. Along Rivenhall Gardens, a surface water sewer flows in southerly direction until Snaresbrook Road, with diameters increasing from 300mm to 450mm after the connection with the surface sewer in Althorne Gardens (300mm diameter). In Hermitage Walk, a surface water sewer with a 300mm diameter flows in a south-easterly direction. A 675mm surface sewer originating from Cheyne Avenue and High View Road to

the north of the hotspot connects to the sewer in Hermitage Walk, and the outflow pipe has a diameter of 375mm. The surface water sewer in Malford Grove (300mm diameter) also discharges into the sewer serving Hermitage Walk, without any increase in diameter for the receiving pipe.

The foul sewer network follows a similar configuration to the surface water sewer network.

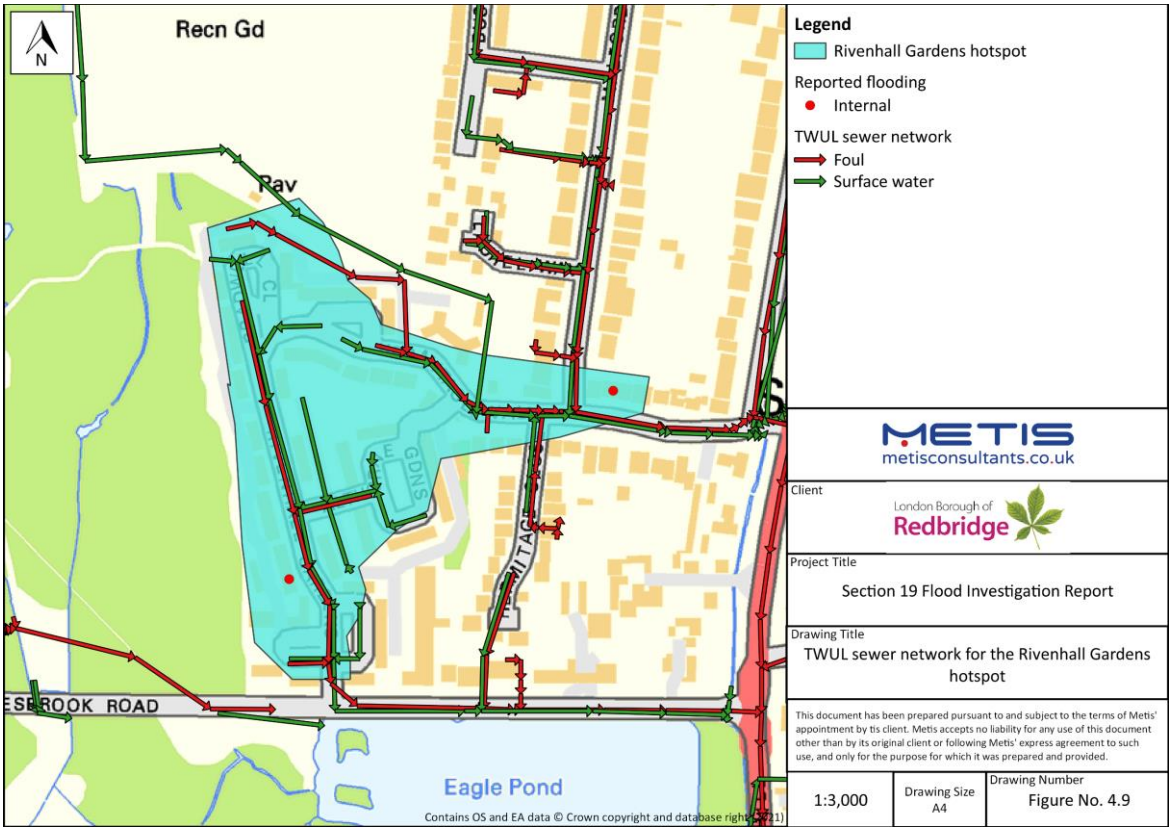


**Figure 4.9: TWUL sewer network for the Rivenhall Gardens hotspot**

### 4.3.3 Local flood mechanism

A watershed analysis of the area using a GIS provided several hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 4.10*).

LiDAR data does not show that the flooded properties in Rivenhall Gardens and Hermitage Walk are in topographical low points within the area. The primary flow paths are the main overland flow route for surface water in the defined catchment. Both properties having reported internal flooding are located on or near the primary flow paths of the local sub-catchments.

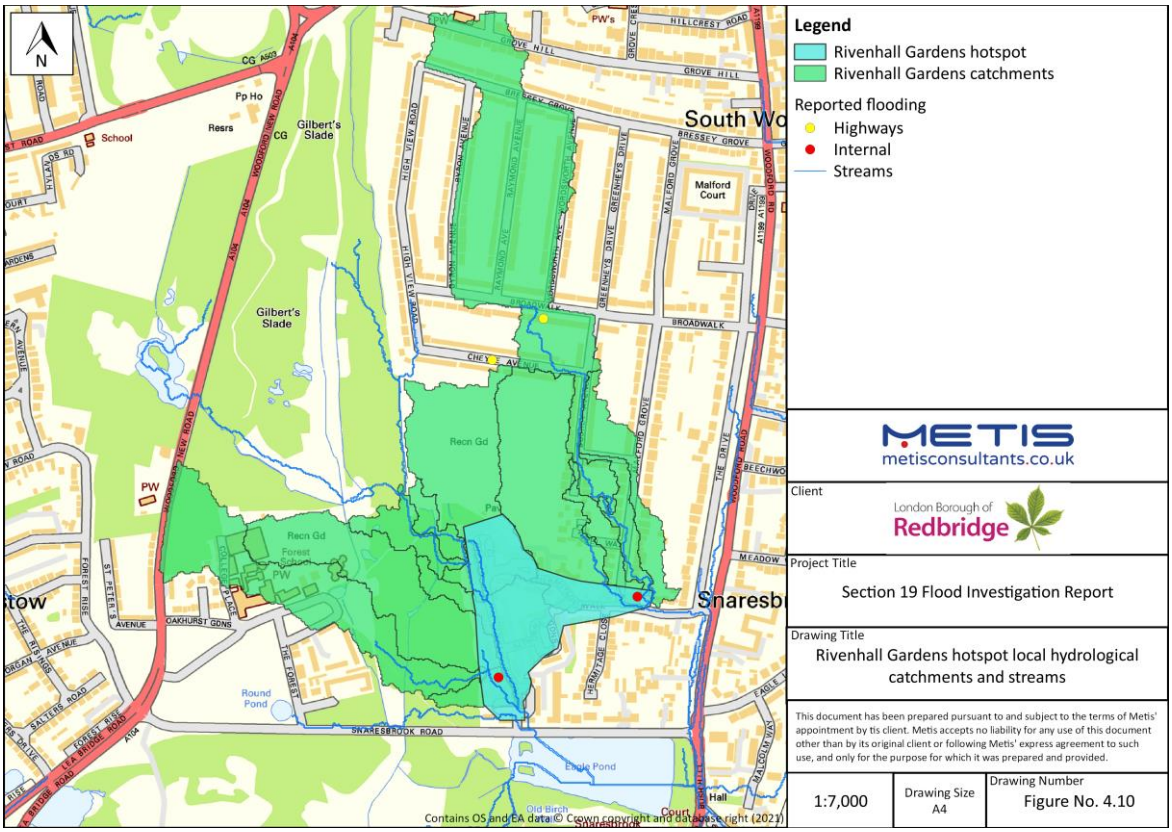


**Figure 4.10: Rivenhall Gardens hotspot local hydrological catchment and stream**

### 4.3.4 Local flood risk

#### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 4.11*) shows that both the property on Hermitage Walk and the property at the back of Rivenhall Gardens are at risk of flooding in the 1 in 30 year, 1 in 100 year and 1 in 1000 year rainfall events, with predicted depths ranging between 0.15m and 0.60m. Therefore, the Rivenhall Gardens hotspot is at high risk of surface water flooding.

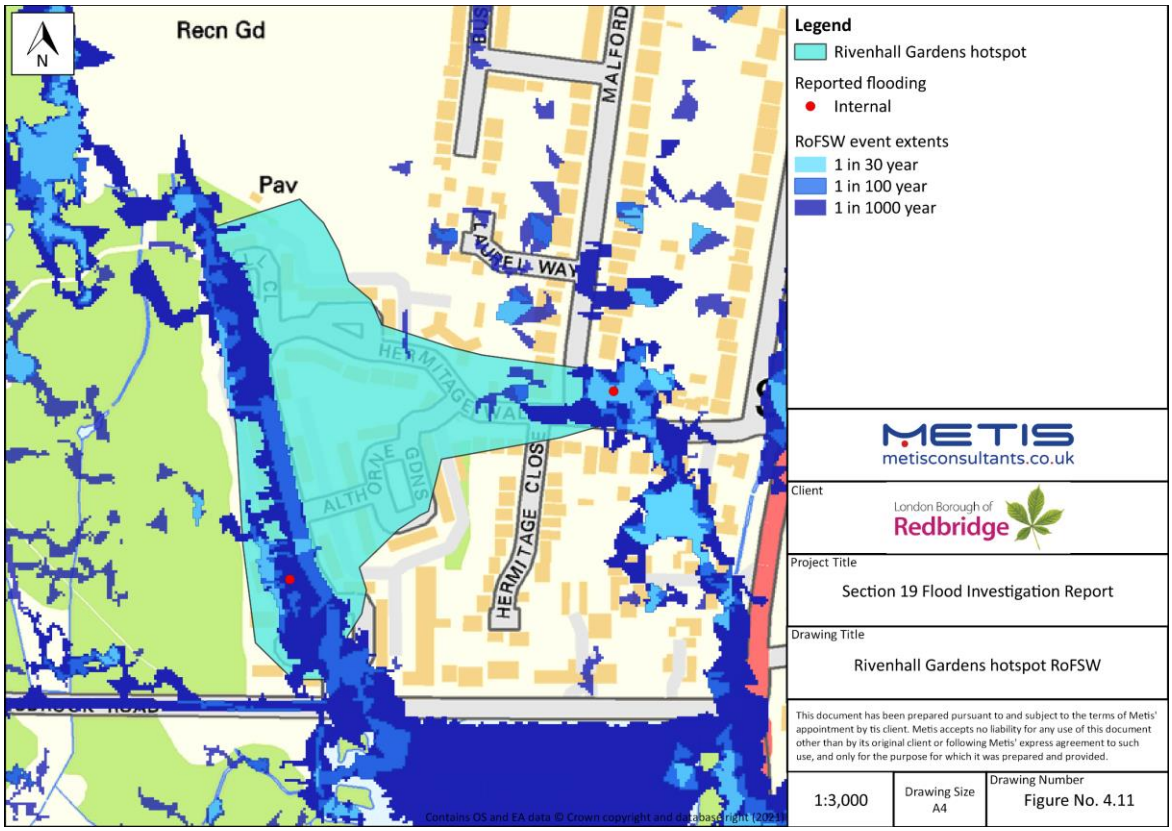


**Figure 4.11: Rivenhall Gardens hotspot RoFSW**

### Ordinary Watercourse Flood Risk

Flooding from ordinary watercourses is included within the EA's RoFSW map. There is an unnamed to the west and to the south of the hotspot, approximately 75m away.

### Fluvial Flood Risk

According to the EA's online Flood Map for Planning, the Rivenhall Gardens hotspot is located within Flood Zone 1 and therefore is not at risk of fluvial flooding.

### Groundwater Flood Risk

The Rivenhall Gardens hotspot lies within the '>=25% <50%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 4.2*). The flooding reports do not mention groundwater as the source of flooding but there is water seepage on the site coming from the west of the Rivenhall Gardens from what could be a burst pipe or groundwater.

### Sewer Flood Risk

As mentioned in *Section 4.3.1*, anecdotal evidence from residents would suggest that the surface water sewer in Hermitage Walk cannot accommodate the large amount of surface water runoff during a severe rainfall event. Furthermore, as the sewer in Hermitage Walk receives multiple connections from large pipes, it is not surprising that the gullies in the road would surcharge during a rainfall event of this magnitude. Further investigations have found tree root blockages in Hermitage Walk.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the Rivenhall Gardens hotspot sits inside the predicted reservoir flooding extent. Therefore, the hotspot is predicted to be at risk of flooding from other sources. The flooding experienced during the 25th July 2021 was however not due to reservoir flooding.

## 4.3.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 4.3: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>The kerb in front of the property having reported internal flooding has previously been increased in height to protect against flooding.<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br><br>The gullies in Malford Grove and Hermitage Walk were checked on the 28th September 2021 and on the 23rd September 2021 respectively. Five gullies in Malford Grove were not checked due to parked vehicles, 39 gullies in Malford Grove were found to be free flowing, five gullies in Malford Grove were cleared of blockages, three gullies could not be cleared and are programmed for further works, and two blocked gullies were identified in Hermitage Walk. One was cleared and one is programmed for further works. The remaining gullies were found to be free flowing. A restriction to flow has been identified within TWUL's surface water sewer at its outfall to a ditch in Woodford Road. This is currently being investigated.<br><br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that the property in Hermitage Walk was at a lower level that the pavement, with a slightly raised kerb which would not have stopped water from entering the driveway during the 25th July rainfall event. Water reportedly flowed down Malford Road, around the corner and into the property. In Rivenhall Gardens, the flooding was ongoing during the site visit. Water was seeping out from the ground and in any crack in the garage driveways. The gullies were dry and free flowing. |
| *TWUL* | ***Before***<br><br>No known actions taken<br><br>***During*** |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | No known actions taken<br><br>***After***<br><br>TWUL have carried out works to clear a major blockage of tree roots from within their surface water sewer in Hermitage Walk. |

### 4.3.6 Recommendations

- If the water is seeping from Gilbert's Slade, Redbridge should investigate if SuDS or attenuation features could be incorporated in Gilbert's Slade to alleviate and prevent the flooding.
- For TWUL actions, refer to Section 8.2.

## 4.4 Hotspot 4 – Roding Valley

The Roding Valley hotspot is located to the west of the Borough, to the south of Roding Valley Park.

### 4.4.1 Location-wide flood incident(s)

Four reports of internal flooding were received in this hotspot, spread between Lorne Gardens and Deynecourt Gardens. Residents of Lorne Gardens reported that water was flowing from the streets into their properties, whilst residents of Deynecourt Gardens reported that the flooding was due to water flowing from the properties in Lorne Gardens into their properties. External and highways flooding incidences were also reported in the area and nearby streets, notably on Elmcroft Avenue and Longcourt Mews. Reports suggest that the drains and gullies in Lorne Gardens were blocked and/or surcharging due to the high volumes of surface water entering the sewer network, with surface water breaching the kerbing and flowing into properties and gardens.

### 4.4.2 Local drainage network

*Figure 4.12* shows the TWUL sewer network within the local area. There is a single surface water sewer in Lorne Gardens, flowing in a northerly direction from Laura Close to Elmcroft Avenue with interchanging diameters between 225mm, 300mm and 375mm. The pipe connects to a 1200mm pipe in Elmcroft Avenue flowing in a north-easterly direction. The surface sewer in Deynecourt Gardens flows in a northerly direction between Eaton Rise and Elmcroft Avenue with interchanging diameters between 225mm, 300mm and 375mm. The surface sewer in Elmcroft Avenue separates in two at the eastern end of the road with a 300mm pipe connecting to the 1050mm combined sewer flowing in a southerly direction and a 1200mm pipe connecting to a 1800mm surface sewer that flows easterly and discharges to the River Roding 200m away. The surface water sewers in Lorne Gardens discharges downstream to the combined sewer whereas the surface water sewer in Deynecourt Gardens only discharges to the larger surface water sewer. The foul sewer network flows in a southerly direction in both Lorne Gardens and Deynecourt Gardens. The pipes in Deynecourt Gardens have a diameter of 300mm whereas the pipes in Lorne Gardens have diameters of 1219mm near the intersection with Elmcroft Avenue and reduce to 1066mm and 750mm before connecting to the combined sewer flowing in a southerly direction approximately 225m to the south-east of the intersection between Lorne Gardens and Eaton Rise.

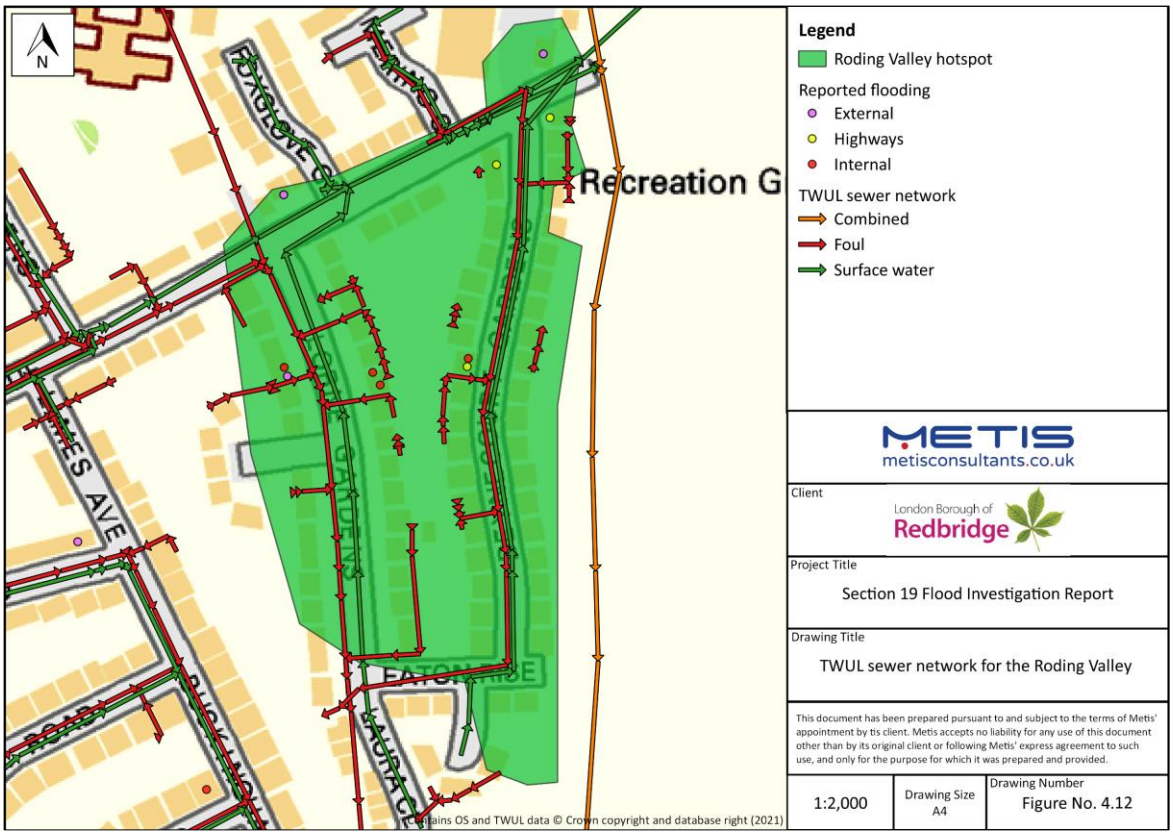


**Figure 4.12: TWUL sewer network for the Roding Valley hotspot**

### 4.4.3 Local flood mechanism

A watershed analysis of the area using a GIS provided several hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 4.13*).

LiDAR data shows that the internally flooded properties reported in Lorne Gardens lie near in a topographical low point in the hotspot and surrounding area. The properties having reported internal flooding in Lorne Gardens are located on the overland flow path of the local sub-catchments. Surface water that falls within these catchments will naturally drain past these properties until reaching Deynecourt Gardens and flowing north until Elmcroft Avenue and flowing into the Recreation Ground. The locations of all the flooding reported in the hotspot lie in close proximity to the primary flow paths.

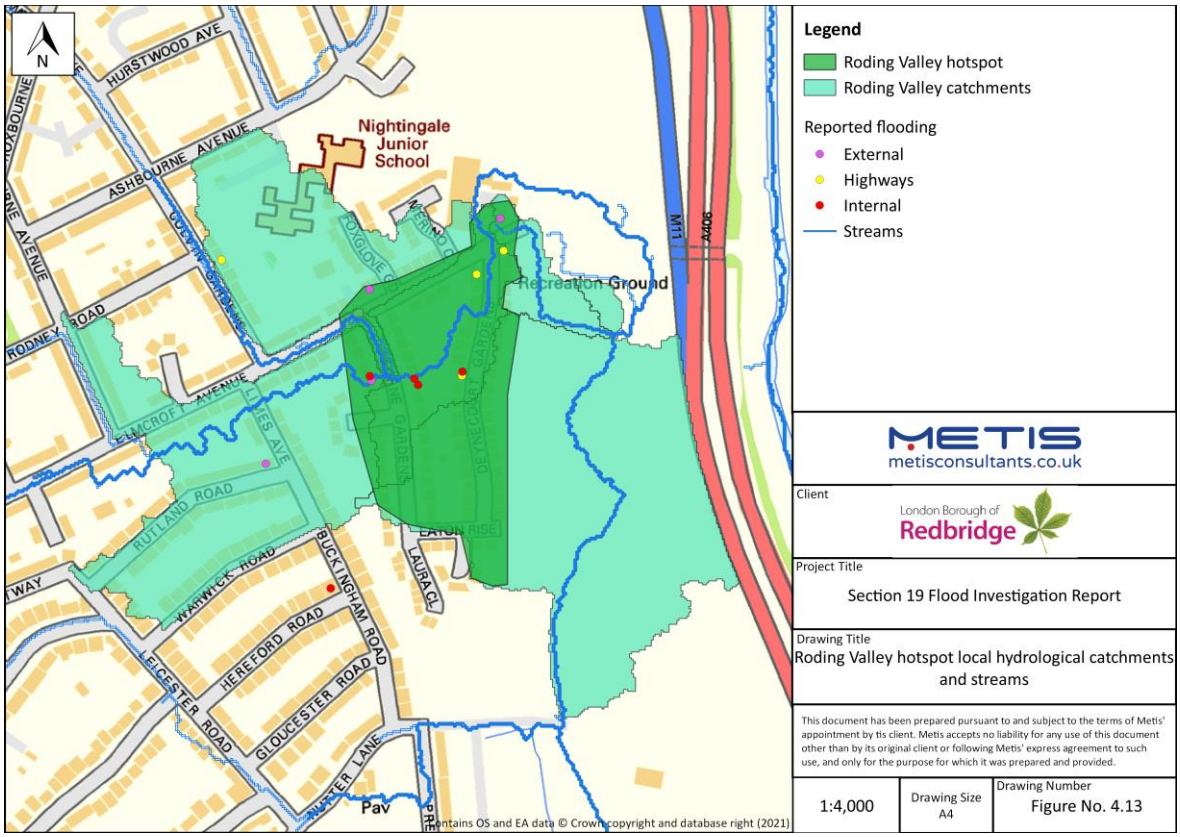


**Figure 4.13: Roding Valley hotspot local hydrological catchment and stream**

### 4.4.4 Local flood risk

#### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 4.14*) shows that surface water is predicted to flow in a north-easterly direction across Lorne Gardens and Deynecourt Gardens before reaching the Recreation Grounds and allotments. Surface water accumulates between the properties in Lorne Gardens and Deynecourt Gardens, at the intersection with Foxton Gardens, and in the Recreation Grounds and allotments. The properties having reported flooding in Lorne Gardens are predicted to be at risk of flooding from the 1 in 30 year, 1 in 100 year and 1 in 1000 year, with predicted depths ranging between 0.15m and 1.2m. Deynecourt Gardens is predicted to be at risk of flooding from the 1 in 1000 year event, with some section predicted to be at risk of flooding from the 1 in 30 year and 1 in 100 year event, with predicted depths ranging between 0.15m and 1.2m. The largest depths are predicted in the gardens of the properties on Deynecourt Gardens. Therefore, the hotspot is at high risk of surface water flooding.

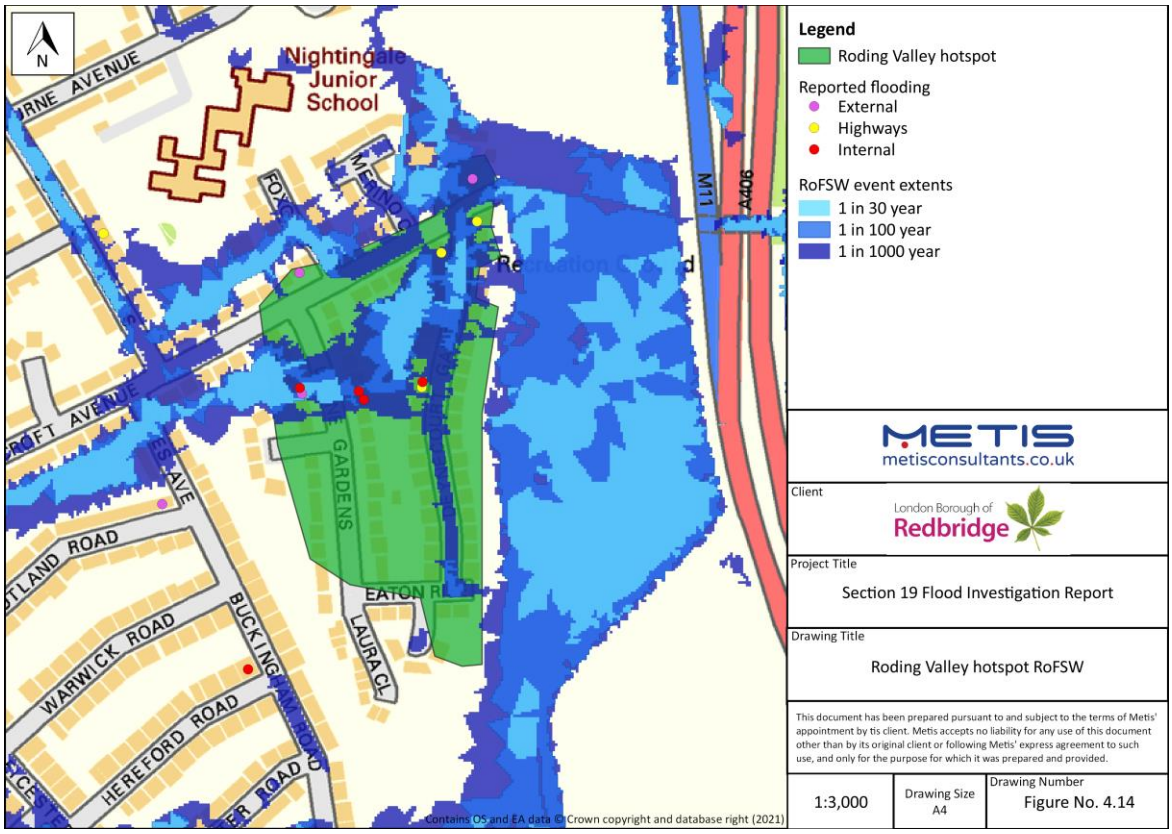


**Figure 4.14: Roding Valley hotspot RoFSW**

### Ordinary Watercourse Flood Risk

Flooding from ordinary watercourses is included within the EA's RoFSW map. There is an ordinary watercourse to the south of the hotspot approximately 200m away. The hotspot is however not directly at risk of flooding from ordinary watercourses.

### Fluvial Flood Risk

According to the EA's online Flood Map for Planning, Deynecourt Gardens is located within Flood Zone 2 and the nearby allotments within Flood Zone 3. However, the flooding that occurred on the 25th July has been confirmed to be surface water flooding and not fluvial by Redbridge operational staff, and no flood alerts or flood warnings were issued.

### Groundwater Flood Risk

The Roding Valley hotspot lies within the '>=50% <75%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 4.2*). The flooding reports do not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

### Sewer Flood Risk

As mentioned in *Section 4.4.1*, anecdotal evidence from residents would suggest that the drains in Lorne Gardens were overwhelmed with surface water during the rainfall events. The gully in front of 40 Lorne Gardens was found to drain slowly but all other gullies were found to be free flowing.

The surcharging of gullies would instead point towards insufficient capacity in the network to accommodate surface water runoff. Lorne Gardens, Elmcroft Avenue, Foxglove Gardens and Merino Close all discharge to a surface water sewer that connects in part to a combined sewer whereas Deynecourt Gardens discharge to a parallel surface water sewer network. The flooding experienced in Deynecourt Gardens was not linked to surcharging gullies although that was the case for the neighbouring streets. Based on this information, it is believed that the flooding incident in Lorne Gardens, Elmcroft Avenue, Foxglove Gardens and Merino Close can be attributed to sewer flood sources.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the northern part of Lorne Gardens and Deynecourt Gardens sit inside the predicted reservoir flooding extent. Therefore, the hotspot is predicted at risk of flooding from other sources. The flooding experienced during the 25th July 2021 was however not due to reservoir flooding.

## 4.4.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 4.4: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>No known actions taken<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report.<br><br>The gullies in Lorne Gardens and Elmcroft Avenue were checked after Redbridge received the flooding report and were found to be free flowing except for the gully in front of 40 Lorne Gardens. The gullies in Deynecourt were not checked as the reports said the flooding came from Lorne Gardens and the gullies in Deynecourt were working fine. These gullies have last been checked on the 10th August 2021, with one not inspected due to parked vehicles, two that could not be lifted and one slow draining. The gullies in Elmcroft Avenue have last been checked on the 19th August 2021. The blocked gully was re-attended, and an obstruction cleared on 8th October 2021.<br><br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that properties in Lorne Gardens were located in a low lying area and it was noticed that the air bricks were low or flush with the ground level. |
| *TWUL* | ***Before*** |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>No known actions taken |

### 4.4.6 Recommendations

- Redbridge should investigate the slow draining gully in front of 40 Lorne Gardens.
- For TWUL actions, refer to Section 8.2.

## 4.5 Hotspot 5 – Snaresbrook

The Snaresbrook hotspot is located to the west of the borough and spans between Nelson Road and High Street.

### 4.5.1 Location-wide flood incident(s)

Three reports of internal flooding were received in this hotspot following the rainfall event of the 25th July 2021. In Wellington Road, residents reported that the flooding to their properties, driveways and back gardens was due to gullies surcharging under the high volume of surface water. A resident from Hermon Hill reported a flooded basement, also due to surcharging drains.

### 4.5.2 Local drainage network

*Figure 4.15* shows the TWUL sewer network within the local area. Along Wellesley Road, a surface water sewer with a diameter increasing from 300mm to 375mm and 450mm flows in a westerly direction before connecting to the surface water sewer in Hermon Hill. The surface water sewer in Hermon Hill flows in a northerly direction with a diameter of 600mm until it combines with a 1050mm diameter pipe flowing across Sylvania Road. The outflow pipe has a diameter of 1050mm and flows in an easterly direction perpendicular to Wellington Road. The diameter of the pipe increases to 1200mm at the intersection with Cowley Road before decreasing back to 1050mm approximately 30m further downstream. The surface water sewer then flows in an easterly direction in Elmcroft Avenue (see *Section 4.4.2* for the sewer network in the neighbouring Roding Valley hotspot). The foul sewer network broadly follows the surface sewer network. The central foul sewer pipe flows in an easterly direction perpendicular to Wellington Road with an interchanging diameter between 839mm and 750mm. Foul sewers in Hermon Hill (300mm diameter pipes), Wellington Road (300mm and 375mm diameter pipes), Halstead Road (300mm

diameter pipes) and Cowley Road (225mm diameter pipe) connect to the main foul sewer which runs along Elmcroft Avenue.

### 4.5.3 Local flood mechanism

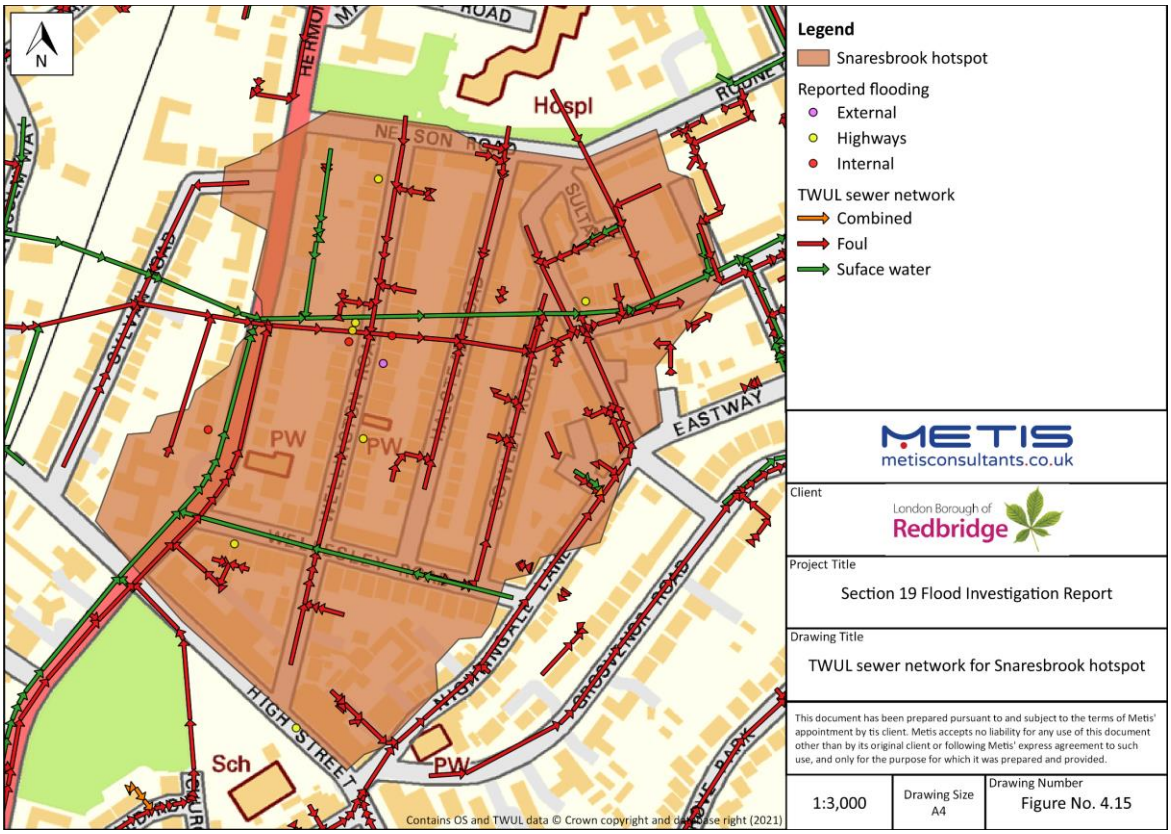


**Figure 4.15: TWUL sewer network for the Snaresbrook hotspot**

A watershed analysis of the area using GIS provided several hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 4.16*). The properties having reported internal flooding in Wellington Road are located on the primary flow path of the local sub-catchments. Surface water that falls within these catchments will naturally drain past these properties and flow in an easterly direction until reaching Elmcroft Avenue. The internal flooding reported in Hermon Hill also lies near a primary flow path.

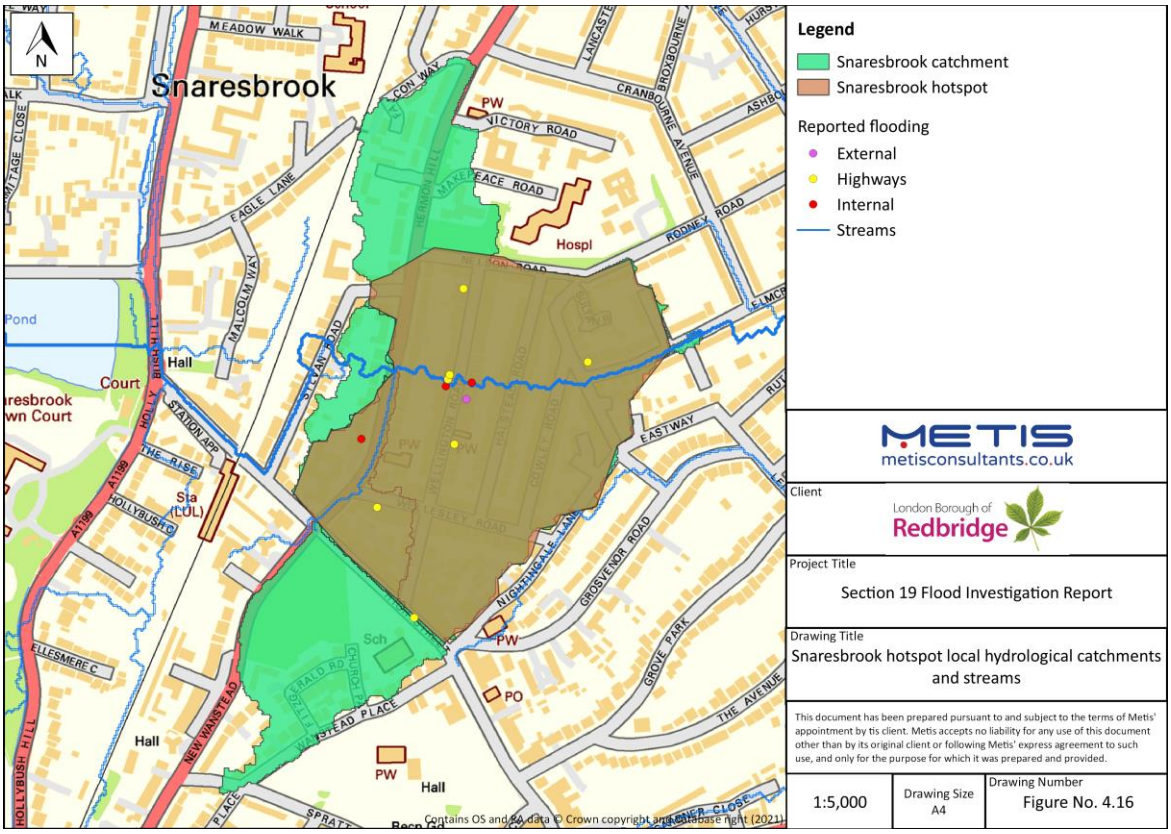


**Figure 4.16: Snaresbrook hotspot local hydrological catchment and stream**

### 4.5.4 Local flood risk

#### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 4.17*) shows that surface water is predicted to flow in an easterly direction across Wellington Road, Halstead Road, and Cowley Road. Surface water also accumulates at the junction between Hermon Hill and Wellesley Road. The properties that have reported flooding in Wellington Road are at a predicted risk of flooding from the 1 in 30 year, 1 in 100 year and 1 in 1000 year rainfall events, with predicted depths ranging between 0.15m and 0.6m. The property on Hermon Hill is at a predicted risk of flooding from the 1 in 1000 year rainfall event with predicted depths ranging between 0.3m and 0.9m. Therefore, the hotspot is at high risk of surface water flooding.

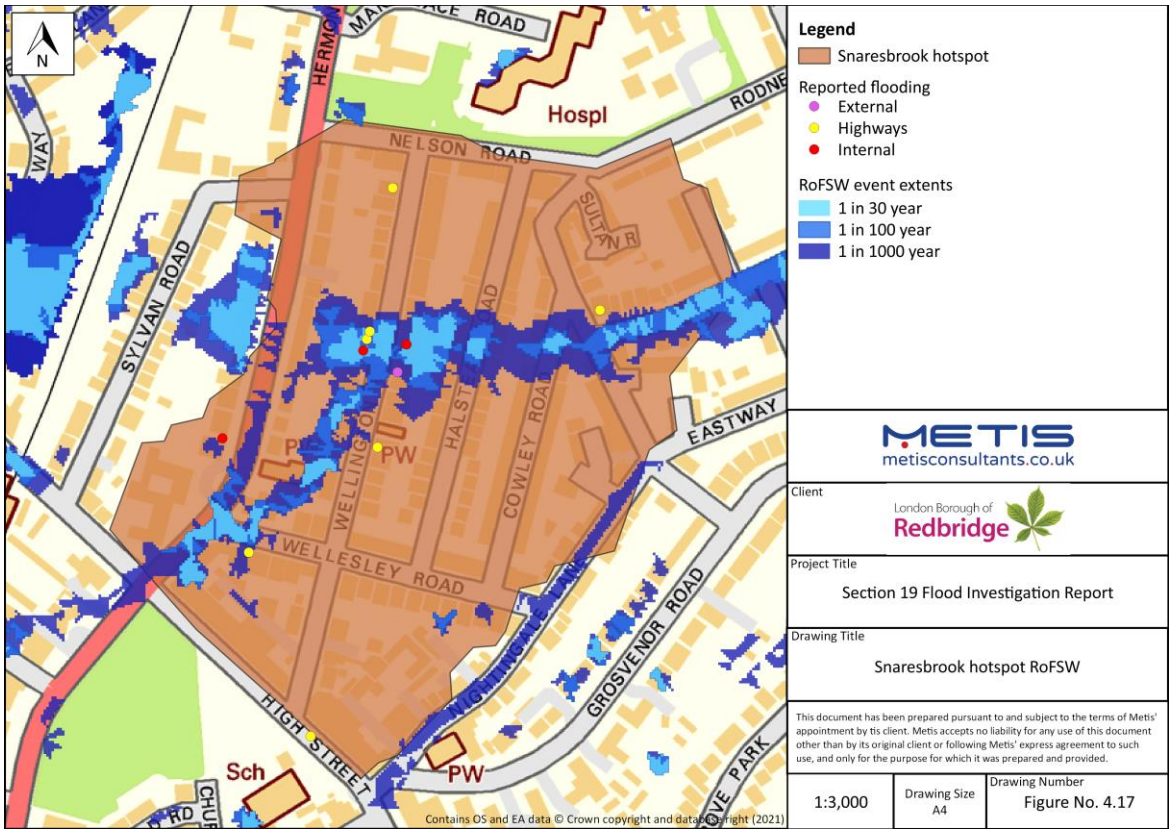


**Figure 4.17: Snaresbrook hotspot RoFSW**

### Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of the Snaresbrook hotspot and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

### Fluvial Flood Risk

According to the EA's online Flood Map for Planning, the Snaresbrook hotspot is situated in Flood Zone 1 and therefore is not at risk of fluvial flooding.

### Groundwater Flood Risk

The Snaresbrook hotspot lies within the '<25%' and the '>=25% <50%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 4.2*). The flooding report does not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

### Sewer Flood Risk

As mentioned in *Section 4.5.1*, anecdotal evidence from residents would suggest that gullies in Wellington Road were overwhelmed with surface water during the rainfall event. This would suggest that there is insufficient capacity in the network to accommodate surface water runoff. Based on this information, it is believed that this flooding incident can be attributed to sewer flood sources.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that a section of Hermon Hill, Wellington Road Halstead Road, and Cowley Road sit inside the predicted reservoir flooding extent. Therefore, the hotspot is predicted at risk of flooding from other sources. The flooding experienced during the 25th July 2021 was however not due to reservoir flooding.

## 4.5.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 4.5: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br>The gullies in Wellington Road and Hermon Hill were checked after Redbridge received the flooding report. Gullies were checked again on the 5th August and the 13th September respectively. Gullies were checked in Wellington Road following the floods on the 5th August 2021. Two gullies were not checked due to parked vehicles. One gully found to be blocked was cleared. All other gullies were found to be running freely. Gullies in Hermon Hill were checked on 10th August 2021 with further gullies checked on 13th September 2021. Gullies in Grosvenor Gardens were checked on the 4th August 2021 and seven were found to be running freely. One gully was blocked and was cleared on the 29th October 2021.<br>5 gullies found to be blocked were cleared. There are 4 gullies blocked that could not be cleared. These require further programmed works. 26 other gullies checked were running freely.<br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that properties in Wellington Road were located in a low lying area and it was noticed that certain paths between properties were lower than the road and sloping towards the back gardens. |
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | ***After***<br><br>No known actions taken |

### 4.5.6 Recommendations

- For Redbridge and TWUL actions, refer to Section 8.2.

## 4.6 Other locations within the catchment

Multiple other reports of internal flooding were received in the West Roding Catchment which were not located within the hotspots. Flooding has been reported in the following streets:

- Hereford Road
- Selsdon Road
- Southview Drive
- Victoria Road
- St Barnabas Road
- Warley Road
- Grosvenor Gardens
- Knighton Drive

# 5 EAST RODING CATCHMENT

The East Roding hydrological catchment spans from Woodford Bridge to Lincoln Gardens and is located to the east of the River Roding (*Figure 5.1*). Residents in this catchment reported 17 internally flooded properties, eight externally flooded properties and 14 cases of flooding to the highway, totalling at 39 reports. Two hotspots have been identified within this catchment and their flood mechanisms and flood risks are assessed in this section.

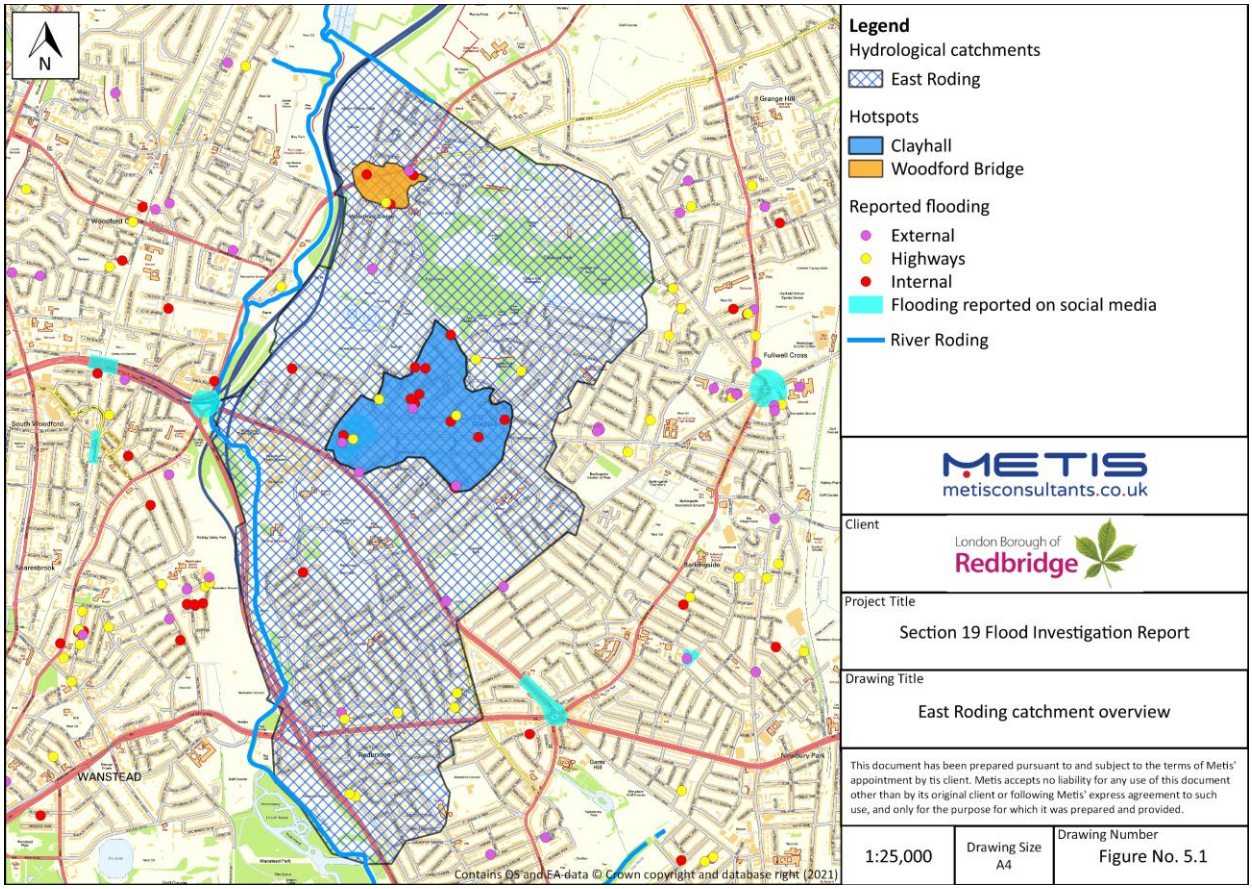


**Figure 5.1: East Roding catchment overview**

Although maps for various types of flood risks have been produced at the scale of the hotspots throughout this report, the EA's Areas Susceptible to Groundwater Flooding data is provided as 1km tiles and therefore is provided at the scale of the catchment with *Figure 5.2*.

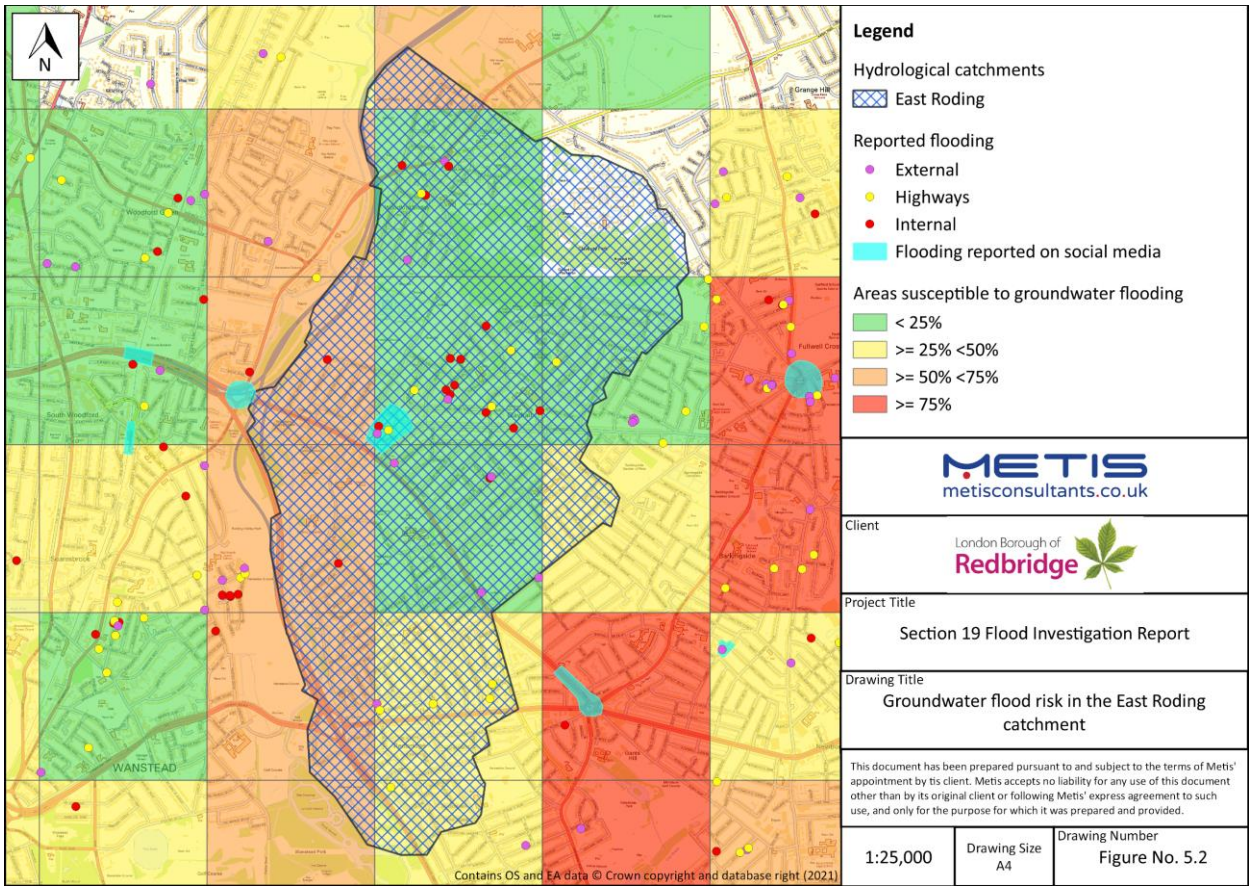


**Figure 5.2: Groundwater flood risk in the East Roding catchment**

## 5.1 Hotspot 6 – Clayhall

The Clayhall hotspot is located in the Clayhall neighbourhood to the centre north-west of the Borough.

### 5.1.1 Location-wide flood incident(s)

The Clayhall area is one of the areas which was most impacted by flooding during the 25th July rainfall event. Reports of internal flooding have been received for Peel Place, The Glade, Atherton Road, Roundaway Road, Wensleydale Avenue, Ewellhurst Road, Clayhall Avenue, Caterham Avenue, Claybury Broadway and Stoneleigh Road. News articles and social media posts also reported severe flooding in Peel Place, Coburg Gardens, The Glade and Vienna Close.

In Peel Place, residents reported surcharging manhole covers and drains, and severely flooded properties. The TWUL foul water pumping station was also flooded. In The Glade and at the intersection with Atherton Road, foul sewer flooding was reported. The gullies in Clayhall Avenue and at the rear of a property on Claybury Broadway were reported blocked by a resident. In all other roads, residents reported that the gullies were surcharging from the volume of surface water entering the network.

### 5.1.2 Local drainage network

*Figure 5.3* shows the TWUL sewer network within the local area. The surface water sewers in all the streets to the north-east of Peel Place up to the edge of Claybury Park flow in a south-westerly direction, until discharging to the 1200mm diameter pipe that

runs through Peel Place and Coburg Gardens. The pipes connecting to this sewer have diameters of 225mm (Chalgrove Crescent and Couchmore Avenue), 300mm (Harewood Drive), 375mm (Coburg Gardens flowing easterly), 450mm (Peel place, flowing north-westerly), 600mm (Wensleydale Avenue), and 825mm (Atherton Road). The surface water sewer in Clayhall Avenue flows in a westerly direction with pipe diameter gradually increasing from 225mm to 750mm before connecting to the 1200mm sewer in Claybury Broadway. The surface water sewer in Stradbroke Grove follows a similar layout, with a pipe diameter increasing from 225mm to 450mm before connecting to the sewer in Claybury Broadway, All the surface water sewers in the hotspot connect to the 1500mm sewer that flows in a south-westerly direction until reaching River Roding approximately 275m away. There is no connection further upstream between the sewers in Ewellhurst Road, Clayhall Avenue and Stradbroke Grove.

The foul water sewer network in Peel Place and Coburg Gardens is not connected to the surrounding pipes. In The Glade, where foul water flooding was reported, two parallel foul water pipes with 225mm diameters run in a south-easterly direction. At the intersection with Atherton Road, the outflow pipe has a diameter of 150mm. The other foul sewers in the area flow in a south-westerly direction until the connect to the 300mm diameter sewer that flows in a south-westerly direction to the south of Clayhall Avenue.

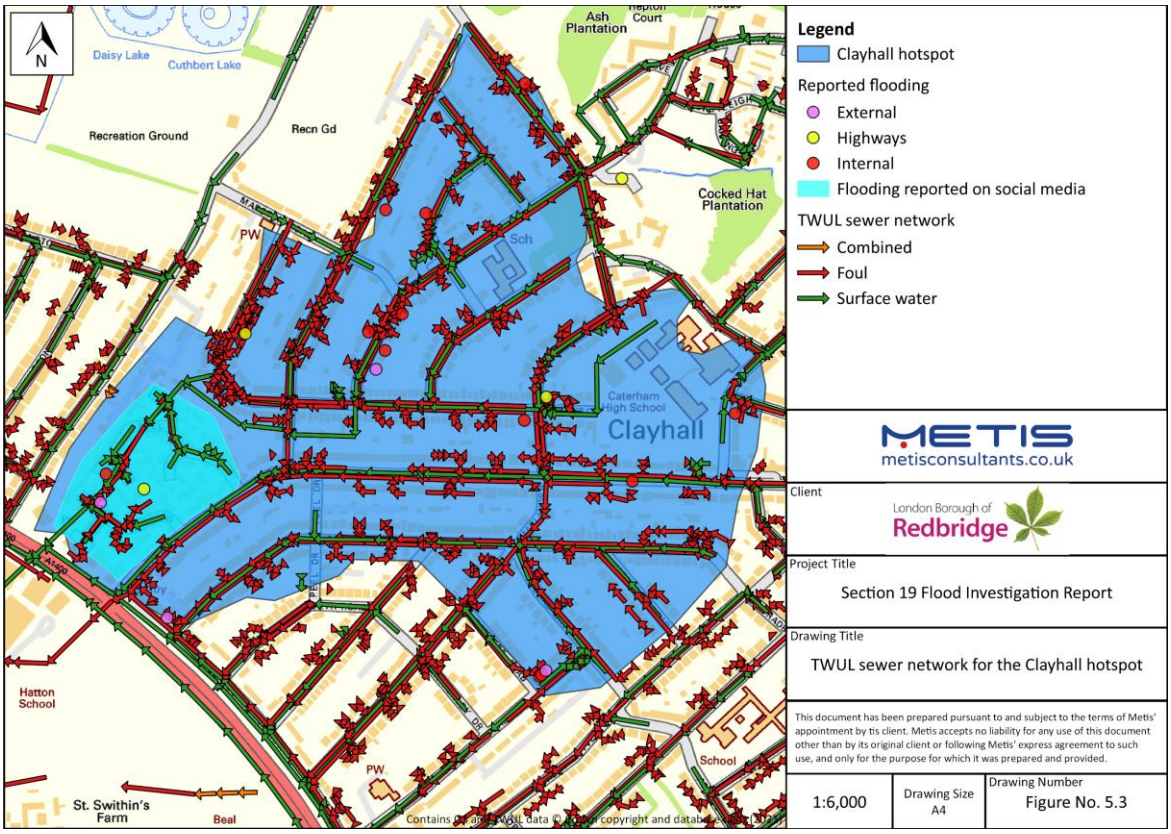


**Figure 5.3: TWUL sewer network for the Clayhall hotspot**

### 5.1.3 Local flood mechanism

A watershed analysis of the area using GIS provided small hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 5.4*). LiDAR data shows that the flooded properties in the Clayhall hotspot lie on a topographical low point within the wider catchment. This means that surface water within the defined catchment will naturally flow towards the area and pond near Peel Place and Coburg Gardens.

The primary flow paths are the main overland flow routes for surface water in the defined catchment. For this specific catchment, the primary flow paths flow in a general south-westerly direction towards River Roding.

All the reported properties with internal flooding within the hotspot lie on or in close proximity to the primary flow paths of the local sub-catchments. The flow paths from The Glade, Atherton Road and neighbouring roads merge before reaching Peel Place.

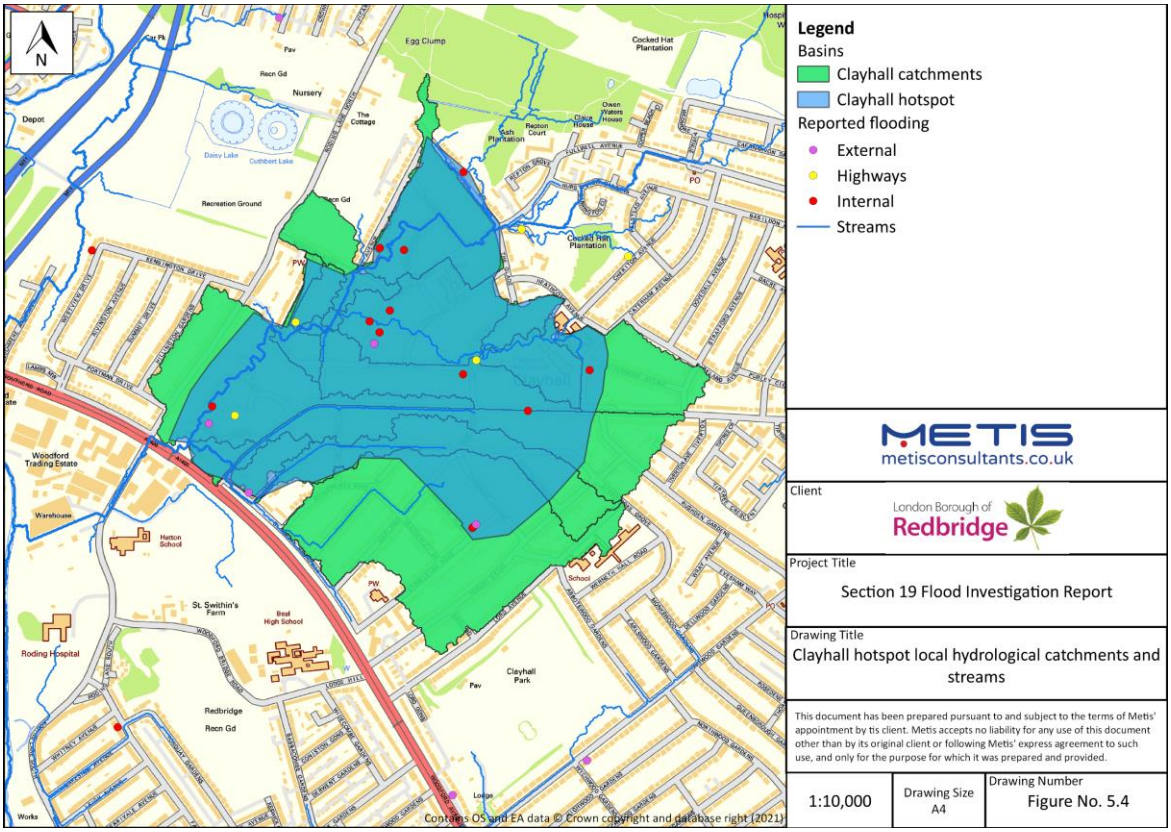


**Figure 5.4: Clayhall hotspot local hydrological catchment and stream**

### 5.1.4 Local flood risk

#### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 5.5*) shows that nearly all of the reported locations, without distinction of the type of flooding, fall within the predicted surface water flood risk extent for the 1 in 30 year, 1 in 100 year and 1 in 1000 year rainfall events. In Peel Place and Coburg Gardens, the predicted flood depths reach over 1.2m in all three rainfall events. In the other roads, the predicted

depth of flooding ranges from 0.15m to 0.9m. Therefore, the Clayhall hotspot and surrounding area is at high risk of surface water flooding.

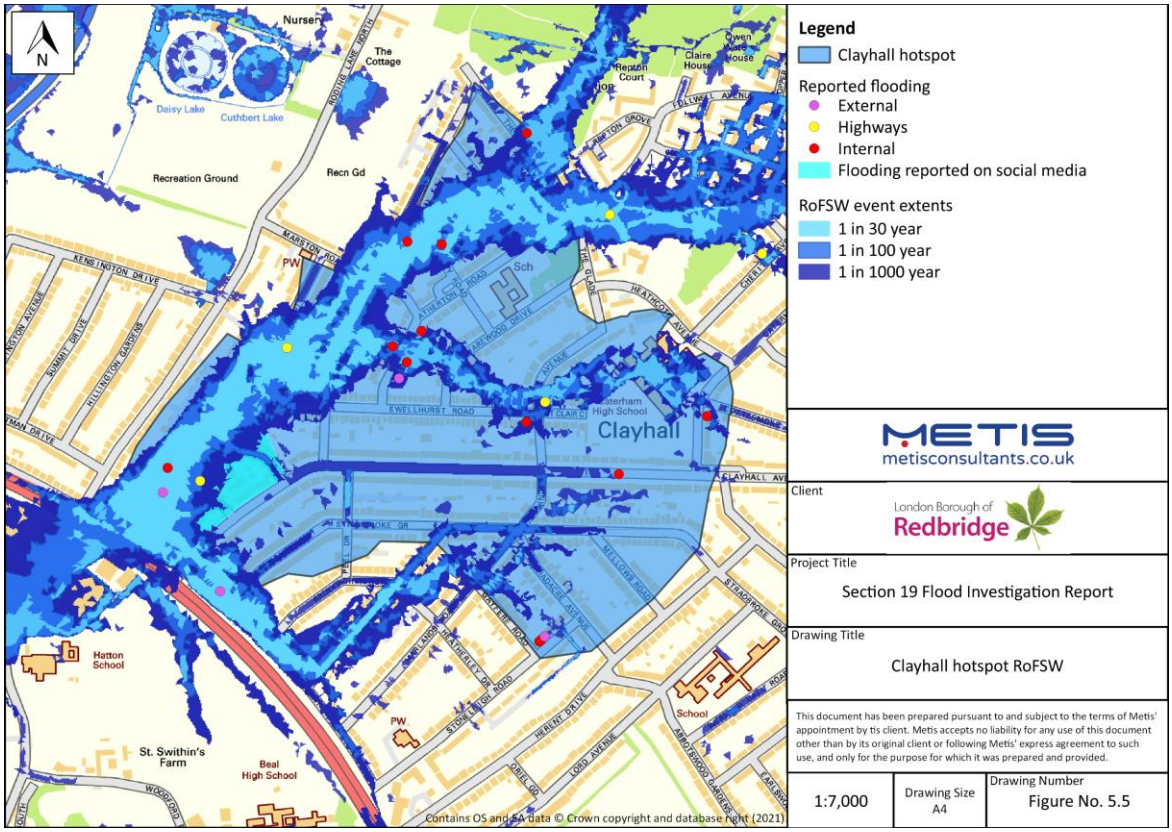


**Figure 5.5: Clayhall hotspot RoFSW**

## Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of the Clayhall hotspot and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

## Fluvial Flood Risk

According to the EA's online Flood Map for Planning, the Clayhall hotspot is situated in Flood Zone 1 and therefore is not at risk of fluvial flooding.

## Groundwater Flood Risk

The Clayhall hotspot lies within the '<25%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 5.2*). The flooding reports do not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

## Sewer Flood Risk

As mentioned in *Section 5.1.1*, anecdotal evidence from the residents' reports would suggest that the surface water network in Peel Place and Coburg Gardens was not able to accommodate the amount of surface water entering the network, with gullies and manholes surcharging. Similar reports of surcharging gullies were received in the roads upstream of Peel Place. This would suggest

that there is insufficient capacity in the surface sewer network for a rainfall event of this magnitude. Furthermore, foul water flooding was reported in The Glade and at the intersection with Atherton Road. Based on this information, it is believed that this flooding incident can be attributed to sewer flood sources.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the Clayhall hotspot sits outside of the predicted reservoir flooding extent. Therefore, the Clayhall hotspot is predicted to be at low risk of flooding from other sources.

## 5.1.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 5.1: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>No known actions taken<br><br>***During***<br><br>A visit to Peel Place, Coburg Gardens, Vienna Close and The Glade was organised on the 26th July; the Leader of Redbridge attended. It was observed that the level of water had significantly subsided.<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations<br><br>Skips were made available to residents in Peel Place and Coburg Gardens on the 28th July 2021.<br><br>The gullies in Peel Place, Coburg Gardens, Atherton Road and surrounding streets were checked after Redbridge received the flooding report. Gullies were visually inspected on 26th July 2021 and again during rain on 28th July 2021 in Peel Place, Coburg Gardens and Vienna Close. Gullies were all observed to be free flowing. The gullies were then checked by gully tanker on the 2nd and 3rd August 2021 and all gullies were free flowing. Gullies were also checked in Atherton Road, Roundaway Road, Wensleydale Avenue, Ewellhurst Road, Clayhall Avenue, Caterham Avenue, Claybury Broadway, and Stoneleigh Rd. There were no blockages in Atherton Rd, Roundaway Rd, Ewellhurst Road, Clayhall Avenue, Caterham Avenue, Claybury Broadway or Stoneleigh Road. There were two blockages cleared in Wensleydale Avenue.<br><br>The issue at The Glade was with the Thames Water Foul Water Sewers and therefore the road gullies were not involved.<br><br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | properties in Peel Place and Coburg Gardens were located in a low lying area. In Atherton Road, it was noticed that driveways slope towards the front of the properties, which is below the level of the road. |
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>A clean-up operation was organised in Peel Place by TWUL on the 26th July 2021.<br>***After***<br>TWUL gave confirmation on the 27th July that they had attended to the pumping station in Peel Place after the flooding. |
| *LFB* | ***Before***<br>No known actions taken<br>***During***<br>LFB attended to properties in Atherton Road to help remove water from inside properties.<br>***After***<br>No known actions taken |

### 5.1.6 Recommendations

- For Redbridge and TWUL actions, refer to Section 8.2.

## 5.2 Hotspot 7 – Woodford Bridge

The Woodford Bridge hotspot is located at the north-west of the Borough and spans between Gaynes Hill Road and Stoneycroft Road.

### 5.2.1 Location-wide flood incident(s)

Three reports of internal flooding were received in the Woodford Bridge hotspot, in Waltham Road, Morgan Way and Roding Avenue following the rainfall event of the 25th July. Residents in Morgan Way have specified that a blocked drain in a private parking is causing flooding to their properties and flooding the back garden of properties in Chigwell Road. Residents in Roding Avenue have mentioned that the gullies in Gaynes Hill Road are not performing as they should, and that surface water therefore runs into Roding Avenue from Gaynes Hill Road.

### 5.2.2 Local drainage network

*Figure 5.6* shows the TWUL sewer network within the local area. A surface water sewer flows in an easterly direction along Chigwell Road, with pipe diameters increasing from 300mm to 375mm at the intersection with Waltham Road. A 225mm surface

water sewer connects into Chigwell Road from Green Way. The surface water sewer in Morgan Way flows in an easterly direction with a 225mm diameter before being redirected in a southerly direction and connecting to the 450mm surface water sewer flowing in an easterly direction along Gaynes Hill Road. The sewers in Chigwell Road and Gaynes Hill Road merge into a 1200mm sewer that discharges into the River Roding 150m to the south-west of the hotspot.

The foul sewer network in the area does not follow the surface water sewer network. The foul sewers in Roding Avenue flow in a northerly direction with a pipe diameter of 225mm until Green Way, where it connects with the sewer originating in Morgan Way. There is no clear discharge point of these sewers. Foul sewers in this section of Chigwell Road originate at the intersection with Manor Road (225mm diameter) and are diverted in a southerly direction until reaching Gaynes Hill Road, at which point they are redirected in a north-westerly direction until re-joining Chigwell Road. The foul sewer network discharges to the combined sewer flowing parallel to the River Roding, approximately 200m to the west of the hotspot.

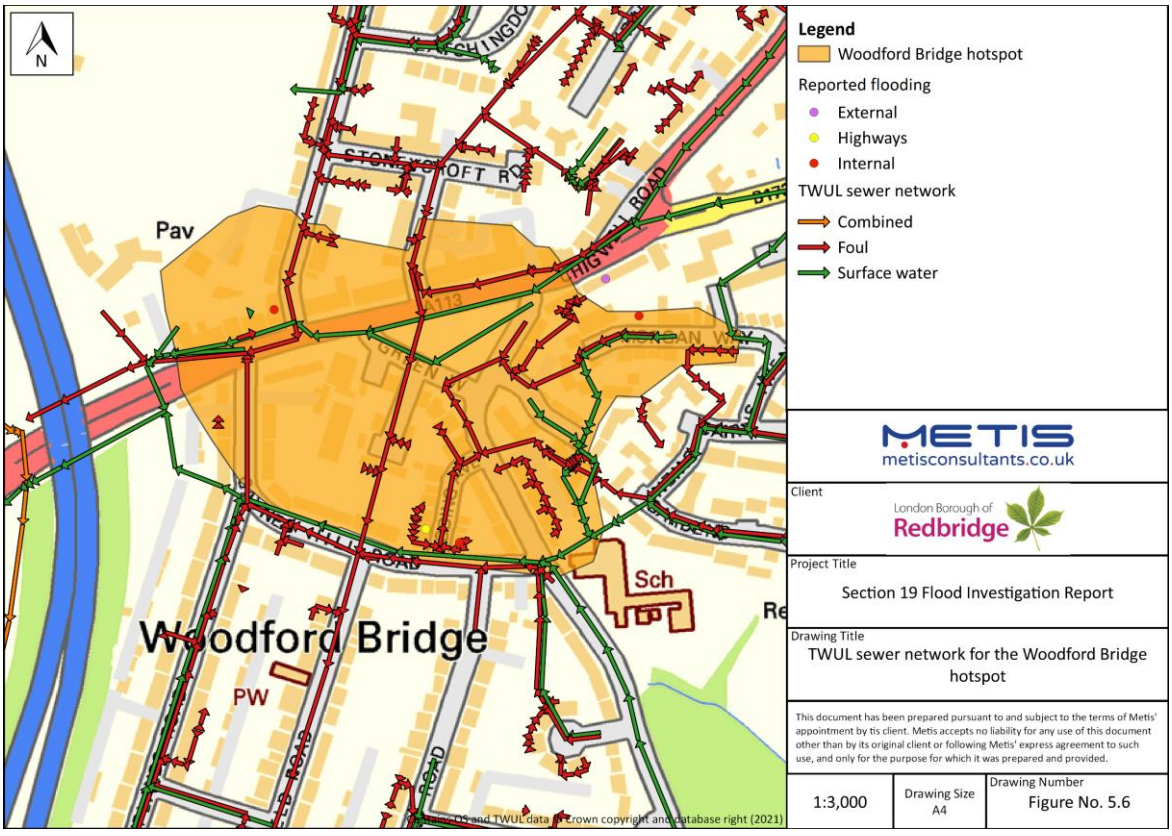


**Figure 5.6: TWUL sewer network for the Woodford Bridge hotspot**

### 5.2.3 Local flood mechanism

A watershed analysis of the area using GIS provided small hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 5.7*).

LiDAR data shows that the flooded properties in Waltham Road and Roding Avenue lie on topographical low points within the hotspot. This means that surface water within the defined catchment will naturally flow towards the area.

The primary flow paths are the main overland flow routes for surface water in the defined catchment. For this specific catchment, the primary flow paths flow in a general westerly direction until reaching the M11 at which point the flow paths change direction and flow in a southerly direction, broadly following the shape of the road.

The reported properties with internal flooding in Roding Avenue and Waltham Road lie on or in close proximity to the primary flow paths of the local sub-catchments.

The flooding reported in Morgan Road is due to a blocked drain and is not located on a primary flow path.

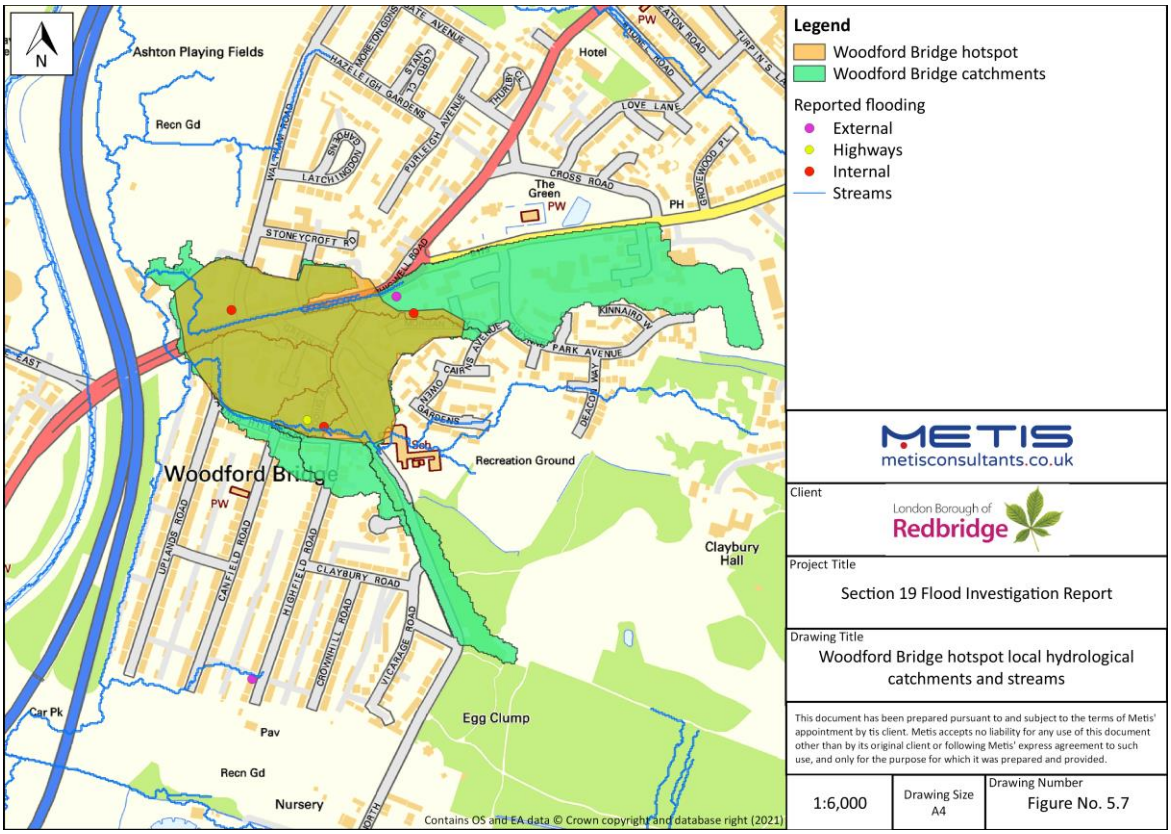


**Figure 5.7: Woodford Bridge hotspot local hydrological catchment and stream**

## 5.2.4 Local flood risk

### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 5.8*) shows that the south of Roding Avenue falls within the predicted surface water flood risk extent for the 1 in 30 year, the 1 in 100 year and the 1 in 1000 year rainfall event, with predicted depths ranging between 0.15m and 0.60m. The property in Waltham Road lies adjacent to the predicted extents of flooding for the 1 in 30 year, 1 in 100 year, and 1 in 1000 year events. As before, it is not inconsistent that Morgan Way does not lie within the predicted flooding extents. Based on this information, properties at the south of Roding Avenue and in Waltham Road are at high risk of flooding from surface water.

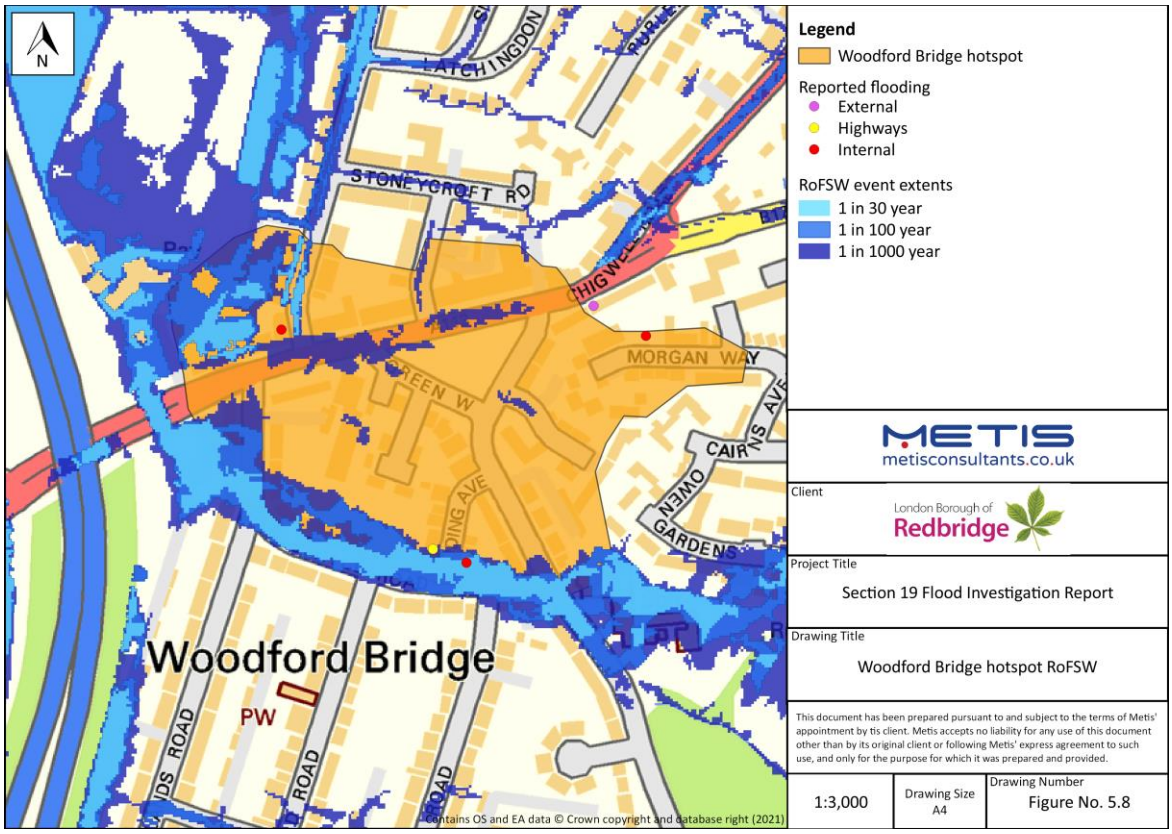


**Figure 5.8: Woodford Bridge hotspot RoFSW**

### Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there are no ordinary watercourses within the local vicinity of the Woodford Bridge hotspot and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

### Fluvial Flood Risk

According to the EA's online Flood Map for Planning, Waltham Road is situated in Flood Zone 2 and the rest of the hotspot is located in Flood Zone 1. However, the flooding that occurred on the 25th July has been confirmed to be surface water flooding and not fluvial by Redbridge operational staff, and no flood alerts or flood warnings were issued.

### Groundwater Flood Risk

The Woodford Bridge hotspot lies within the '<25%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 5.2*). The flooding reports do not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

### Sewer Flood Risk

The flooding in Morgan Way and subsequently in Chigwell Road is due to a blocked drain in a private car park. As mentioned in *Section 5.2.1*, anecdotal evidence from residents seems to point to blocked gullies in Gaynes Hill Road. These gullies were inspected and found to be slow draining which would explain why surface water would not be entering the network and instead be ponding

in Roding Avenue. Considering the magnitude of the rainfall event and the fact that Roding Avenue is not served by a surface water sewer, it is also likely that the sewer network capacity was exceeded during the rainfall event. Based on this information, it is believed that this incident can be attributed to sewer flood sources.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the Woodford Bridge hotspot sits outside of the predicted reservoir flooding extent. Therefore, the Woodford Bridge hotspot is predicted to be at low risk of flooding from other sources.

## 5.2.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 5.2: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br>The gullies in Gaynes Hill Road and Roding Avenue were checked after Redbridge received the flooding report and the gullies in Gaynes Hill Road were found to be slow draining within the main TWUL sewer. This has been passed to TWUL for investigation. Two gullies were also found to be blocked and require programmed works. The residents of Morgan Way were advised that the blocked gully is within a private area and is not maintained by the Local Authority. Gullies in these streets were last checked on the 23rd August 2021.<br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that properties in Waltham Road were at lower levels than the road, with kerbs flush with the tarmac and areas of sunken pavement. The property in Roding Avenue was found to be at a low point in the area. There was ponding on the private car park in Morgan Way at the time of the visit due to the blocked drain. |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>No known actions taken |

### 5.2.6 Recommendations

- Redbridge should investigate raising kerb levels in front of flooded properties in Waltham Road to guide surface water away from properties.
- Redbridge should regularly check and clean, if needed, the gullies in Gaynes Hill Road.
- For TWUL actions, refer to Section 8.2.

## 5.3 Other locations within the catchment

Two other reports of flooding were received in the East Roding Catchment which were not located within hotspots. Flooding has been reported in the flowing streets:

- Westview Drive
- Falmouth Gardens

# 6 FAIRLOP-CRANBROOK CATCHMENT

The Fairlop-Cranbrook hydrological catchment spans from Manor Road at the northern edge of the Borough to the southern border of the Borough near Little Ilford (*Figure 6.1*). Residents in this catchment reported 11 internally flooded properties, 28 externally flooded properties and 26 cases of flooding to the highway, totalling at 65 reports. Three hotspots have been identified within this catchment and their flood mechanisms and flood risks are assessed in this section.

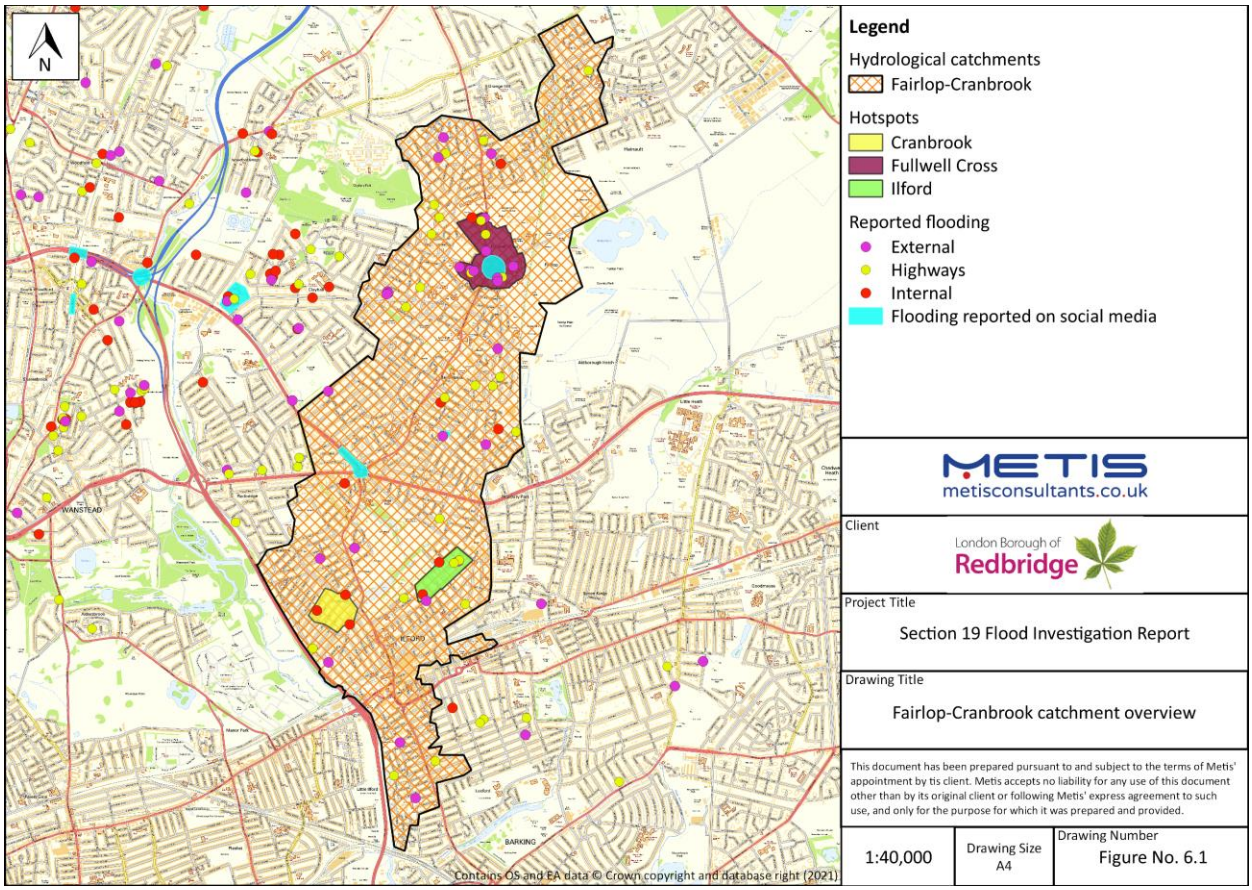


**Figure 6.1: Fairlop-Cranbrook catchment overview**

Although maps for various types of flood risks have been produced at the scale of the hotspots throughout this report, the EA's Areas Susceptible to Groundwater Flooding data is provided as 1km tiles and therefore is provided at the scale of the catchment with *Figure 6.2*.

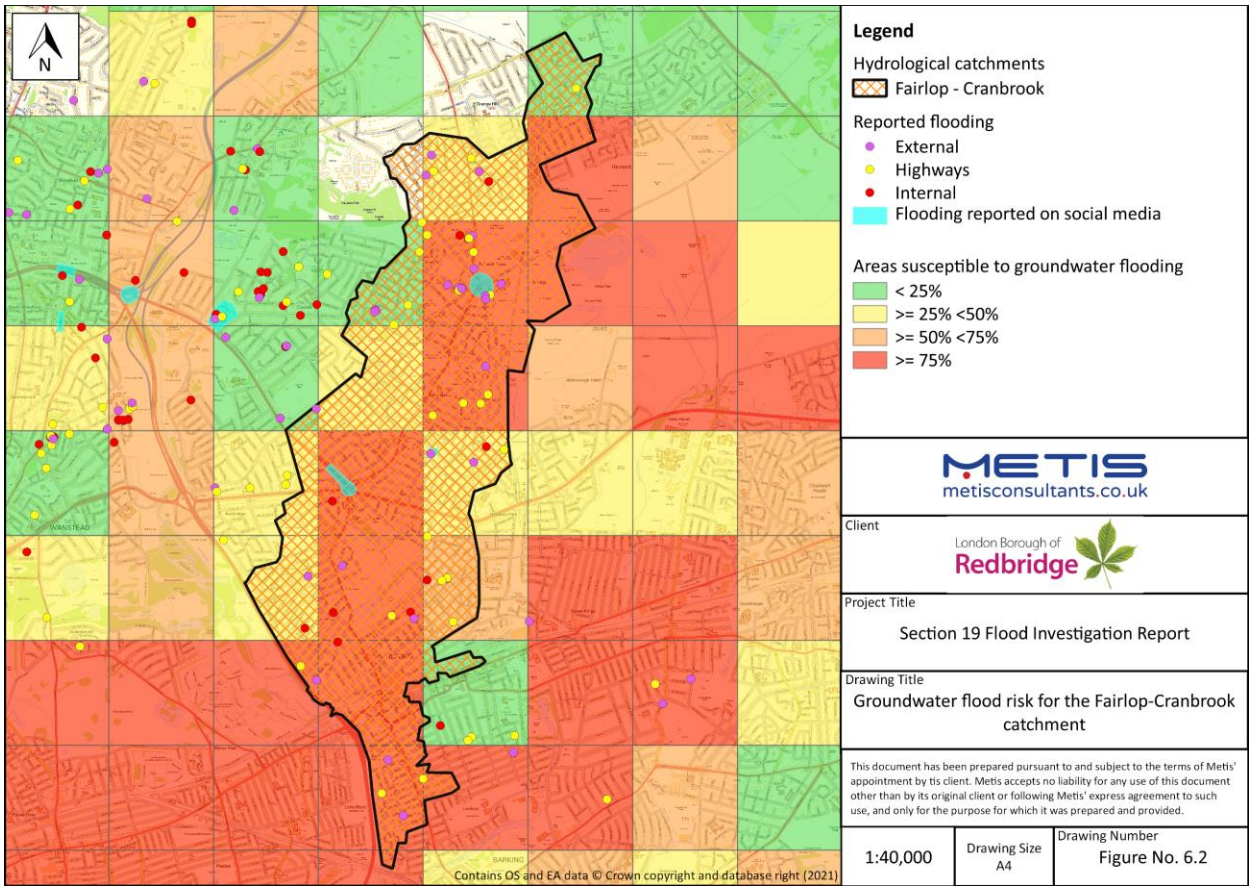


**Figure 6.2: Groundwater flood risk in the Fairlop-Cranbrook catchment**

## 6.1 Hotspot 8 - Cranbrook

The Cranbrook hotspot is located to the north-west of Ilford town centre, to the south of the Borough.

### 6.1.1 Location-wide flood incident(s)

Three incidents of internal flooding were reported in this area following the rainfall event of the 25th July 2021. A resident from The Drive has specified that gullies were surcharging and causing flooding to their property. In Endsleigh Gardens, a resident reported flooding to their basement. In Northbrook Road, a resident reported that water was flooding from the road into their property.

### 6.1.2 Local drainage network

*Figure 6.3* shows the TWUL sewer network within the local area. The surface sewer in Endsleigh Gardens flows in a south-westerly direction with a 225mm diameter until joining the surface water sewer in Wanstead Park Road. Surface water sewers in De Vere Gardens (225mm diameter), Courtland Avenue (375mm diameter), Mayfair Avenue (375mm diameter), Empress Avenue (225mm diameter) and Northbrook Road (525mm and 300mm diameters) all flow in a south-westerly direction before connecting to the culverted Cran Brook Main River that flows between Empress Avenue and Northbrook Road. The culvert discharges into the River Roding approximately 875m to the south-west of the border of the hotspot.

The foul sewer network is constituted of sewers in De Vere Gardens (225mm diameter), Courtland Avenue (225mm diameter), Mayfair Avenue (225mm diameter), Empress Avenue (225mm diameter) and Northbrook Road (375mm diameter) all flowing in a south-westerly direction before connecting to the sewer in Belgrave Road (300mm diameter) that flows in a south-easterly direction. The foul sewer in Endsleigh Gardens (225mm) also connects to a foul sewer in Belgrave Road (225mm diameter) but which flows in a north-westerly direction.

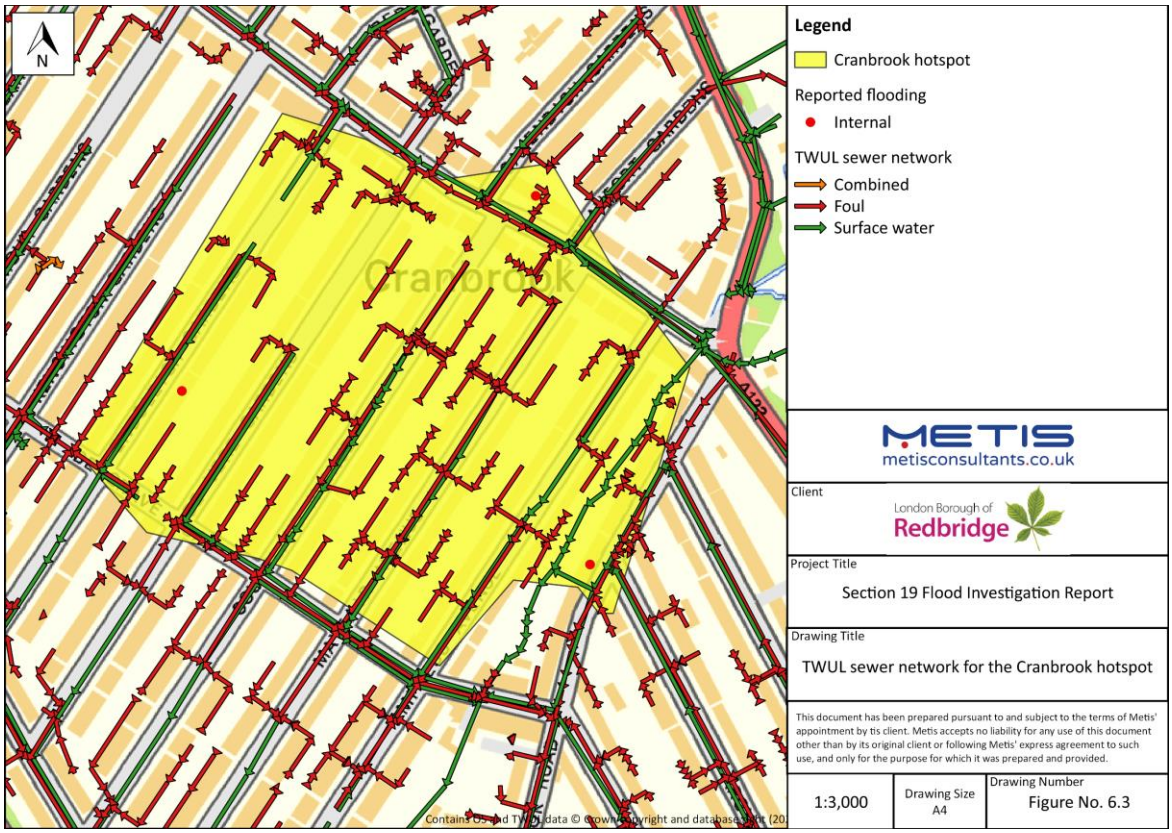


**Figure 6.3: TWUL sewer network for the Cranbrook hotspot**

### 6.1.3 Local flood mechanism

A watershed analysis of the area using a GIS provided small hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 6.4*). LiDAR data shows that the flooded properties in Northbrook Road and to a lesser extent the property in Endsleigh Gardens lie on topographical low points within the area. This means that surface water within the defined catchment will naturally flow towards the area and pond near Northbrook Road and Endsleigh Gardens.

The primary flow paths are the main overland flow routes for surface water in the defined catchment. For this specific catchment, the primary flow path flows in a general south-westerly direction towards River Roding.

The property on Northbrook Road lies on the primary flow path of the local sub-catchment.

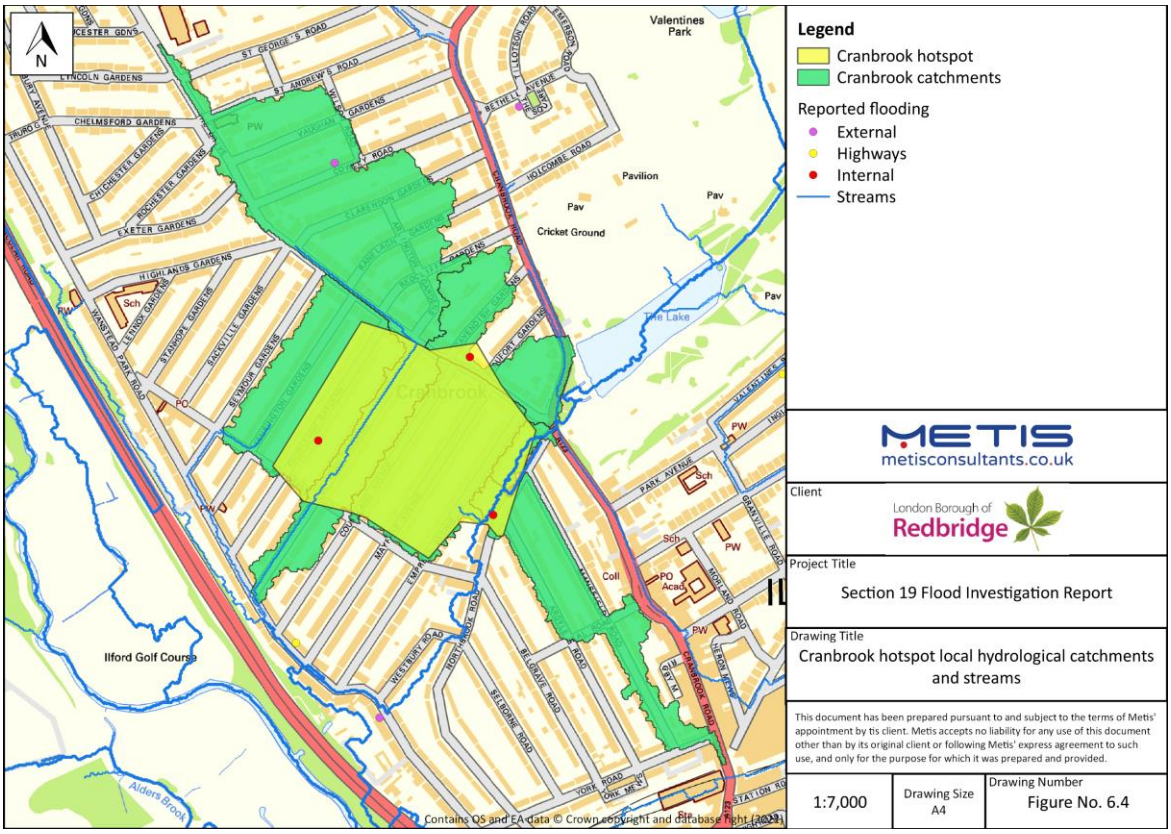


**Figure 6.4: Cranbrook hotspot local hydrological catchment and stream**

### 6.1.4 Local flood risk

#### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 6.5*) shows that the property in Northbrook Road falls within the flooding extent of the 1 in 1000 year rainfall event, with predicted depths ranging between 0.15m and 0.90m. The property in Endsleigh Gardens falls in close proximity to the 1 in 1000 year rainfall event flooding extent, with predicted depths ranging between 0.15m and 0.30m.

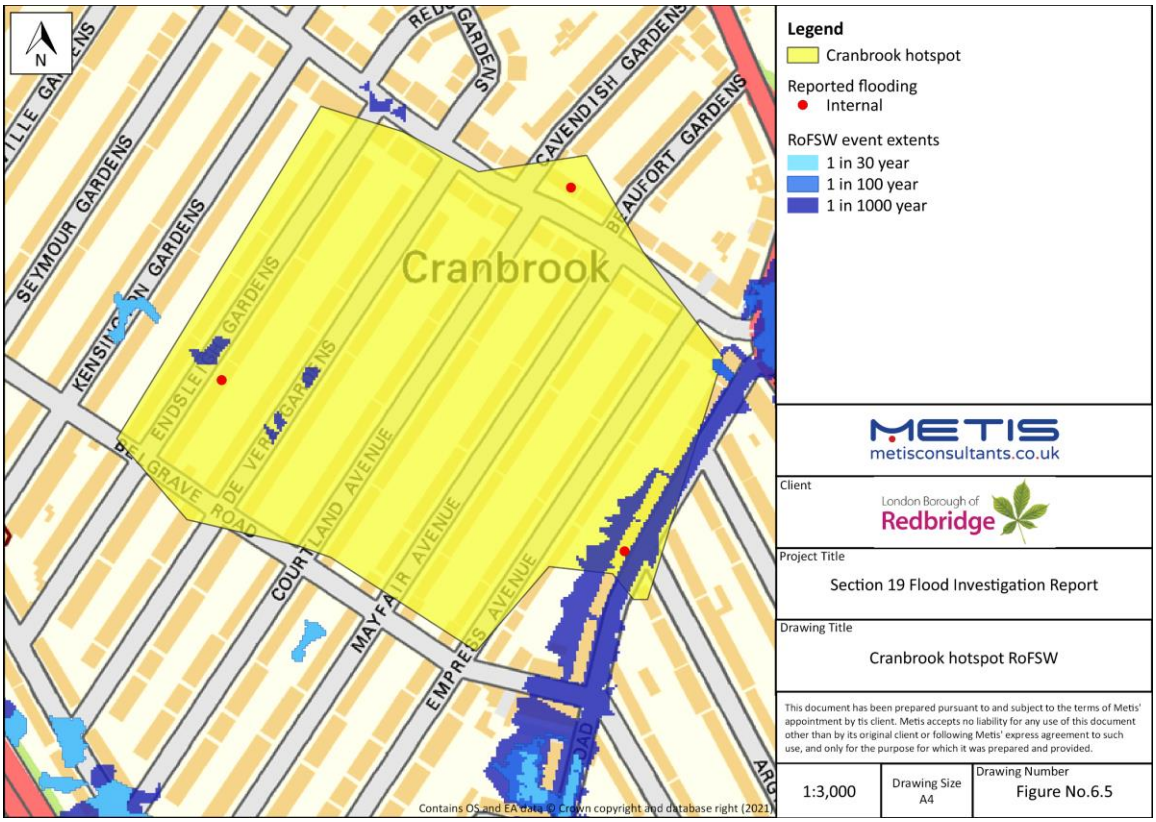


**Figure 6.5: Cranbrook hotspot RoFSW**

### Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there is no ordinary watercourse within the local vicinity of the Cranbrook hotspot and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

### Fluvial Flood Risk

According to the EA's online Flood Map for Planning, Northbrook Road is located within Flood Zone 3. However, the flooding that occurred on the 25th July has been confirmed to be surface water flooding and not fluvial by Redbridge operational staff, and no flood alerts or flood warnings were issued.

### Groundwater Flood Risk

The Cranbrook hotspot lies within the '=>25% <50%' and '>=75%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 6.2*). An incident of a flooded basement has been reported in Endsleigh Gardens, so groundwater flooding cannot be discounted without further information.

### Sewer Flood Risk

As mentioned in *Section 6.1.1*, anecdotal evidence from residents would suggest that one of the gullies in The Drive was surcharging during the rainfall event. This could suggest that there may be insufficient capacity in the network to accommodate surface water runoff. In Northbrook Road, the description of water flowing down the road and onto the property would suggest a similar insufficient capacity. Based on this information, it is believed that this flooding can at least in part be attributed to sewer flood sources.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Northbrook Road and a section of Empress Avenue sit inside the predicted reservoir flooding extent. Therefore, these roads within the hotspot are predicted to be at risk of flooding from other sources. The flooding experienced during the 25th July 2021 was however not due to reservoir flooding.

## 6.1.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 6.1: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>No known actions taken<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br><br>The gullies in Northbrook Road and Endsleigh Gardens were checked after Redbridge received the flooding reports. Three gullies in The Drive were checked on the 6th October 2021 and were found to be free flowing. The gullies in Endsleigh Gardens were checked on the 19th August 2021, of which five were found to be free flowing, one was blocked and required programmed works, and one was not checked due to a parked vehicle. The gullies in Northbrook Road were checked on the 25th August 2021, 13 were found to be free flowing and four found to be blocked, which were cleared.<br><br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that the flooded property in Northbrook Road had a door flush with the ground level and it was unclear whether the closest gully was at a topographical low point. In The Drive, the gully nearest to the flooded property had sunken tarmac all around and therefore was no longer in a low point. It was also noticed that a down pipe from the property discharged onto the pavement, which would exacerbate flooding during a severe rainfall event. The visit to Endsleigh Gardens did not provide a better understanding of the flood mechanisms. |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>A clean-up operation was organised by TWUL in Belgrave Road on the 26th July 2021.<br>***After***<br>No known actions taken |

### 6.1.6 Recommendations

- Redbridge should investigate the gully with sunken tarmac in The Drive.
- For TWUL actions, refer to Section 8.2.

## 6.2 Hotspot 9 – Fulwell Cross

The Fulwell Cross hotspot is located to the north of the Borough, near Fairlop.

### 6.2.1 Location-wide flood incident(s)

Only two reports of internal flooding have been received in this area but ten reports of external flooding and five cases of flooding of highways within the same area justify why this area was chosen as a hotspot. The internal flooding was reported in Neville Road and Kingsley Road. Multiple residents from both streets mention blocked gullies as the cause of flooding, with water not draining away once the rainfall had stopped. In Aintree Crescent, residents mention that gullies are unable to cope with the amount of rainwater entering the network during the rainfall event, which causes ponding and flooding. In Craven Gardens, residents mention slowly draining gullies. Ilford Jewish Primary School on Forest Road reported an incidence of sewage surcharging from a manhole on the school grounds. Flooding around Fulwell Cross was also reported on social media posts.

### 6.2.2 Local drainage network

*Figure 6.6* shows the TWUL sewer network within the local area. The surface sewers in Kingsley Road (225mm diameter) and Neville Road (225mm diameter) both flow in a north-easterly direction before connecting into the 225mm surface sewer in Fencepiece Road flowing in a southerly direction. This sewer merges with 300mm and 825mm surface water sewers at the intersection between Fencepiece Road and Tomswood Hill, and the 900mm outflow pipe is redirected to reach Starch House Lane. The surface water sewers in Aintree Crescent (225mm diameter) connect to a 300mm sewer in Fullwell Avenue that cross Fulwell Avenue and flow in a southerly direction in Craven Gardens until Virginia Gardens.

The foul sewer network data for Kingsley Road and Neville Road does not seem complete. Around Ilford Jewish Primary School, which is the only place in the area having reported foul water flooding, the foul sewer network is made of multiple sewers from adjacent roads (150mm, 225mm and 675mm diameters) that merge into a 675mm pipe that flows in a north-easterly direction along Forest Road.

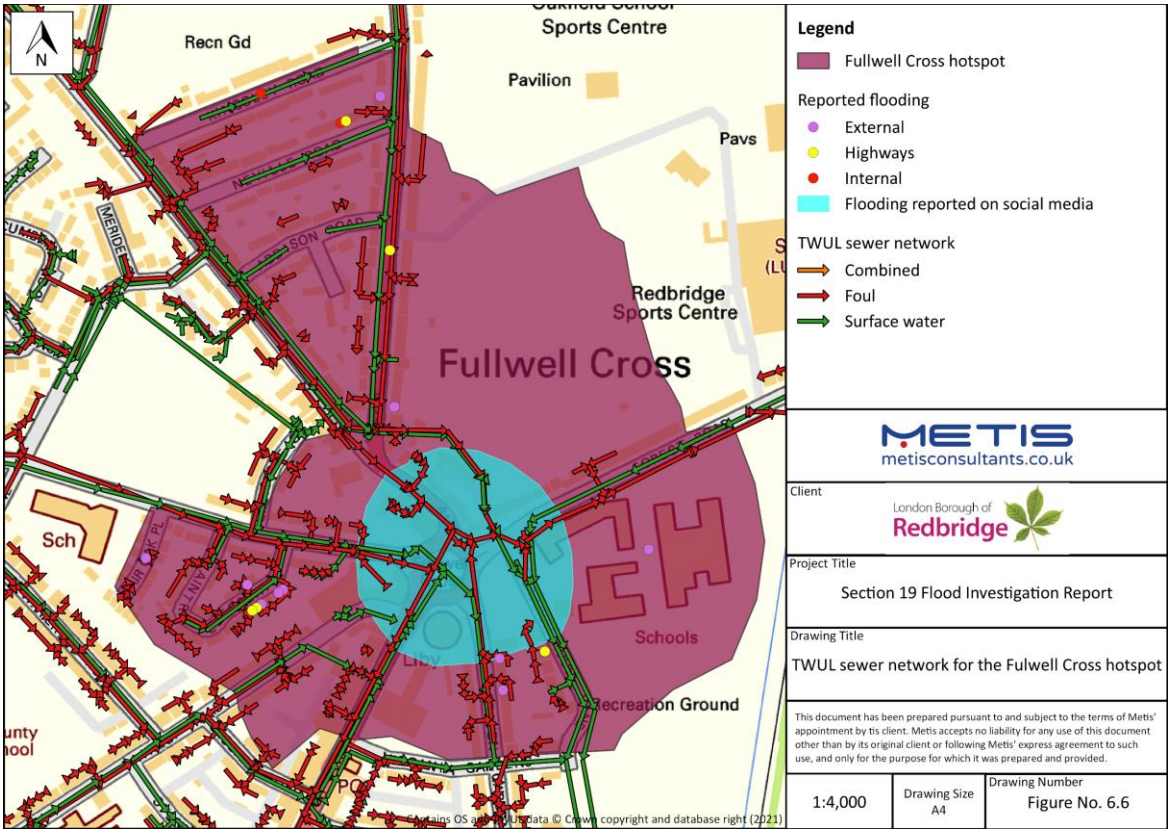


**Figure 6.6: TWUL sewer network for the Fulwell Cross hotspot**

### 6.2.3 Local flood mechanism

A watershed analysis of the area using GIS provided small hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 6.7*). LiDAR data does not show that the any of the flooded properties lies in a local topographical low point.

The primary flow paths are the main overland flow routes for surface water in the defined catchment. For this specific catchment, the overland flow route flows towards Fulwell Cross before

merging and flowing in a southerly direction. The properties in Kingsley Road and Neville Road are located on the overland flow paths of the local sub-catchments.

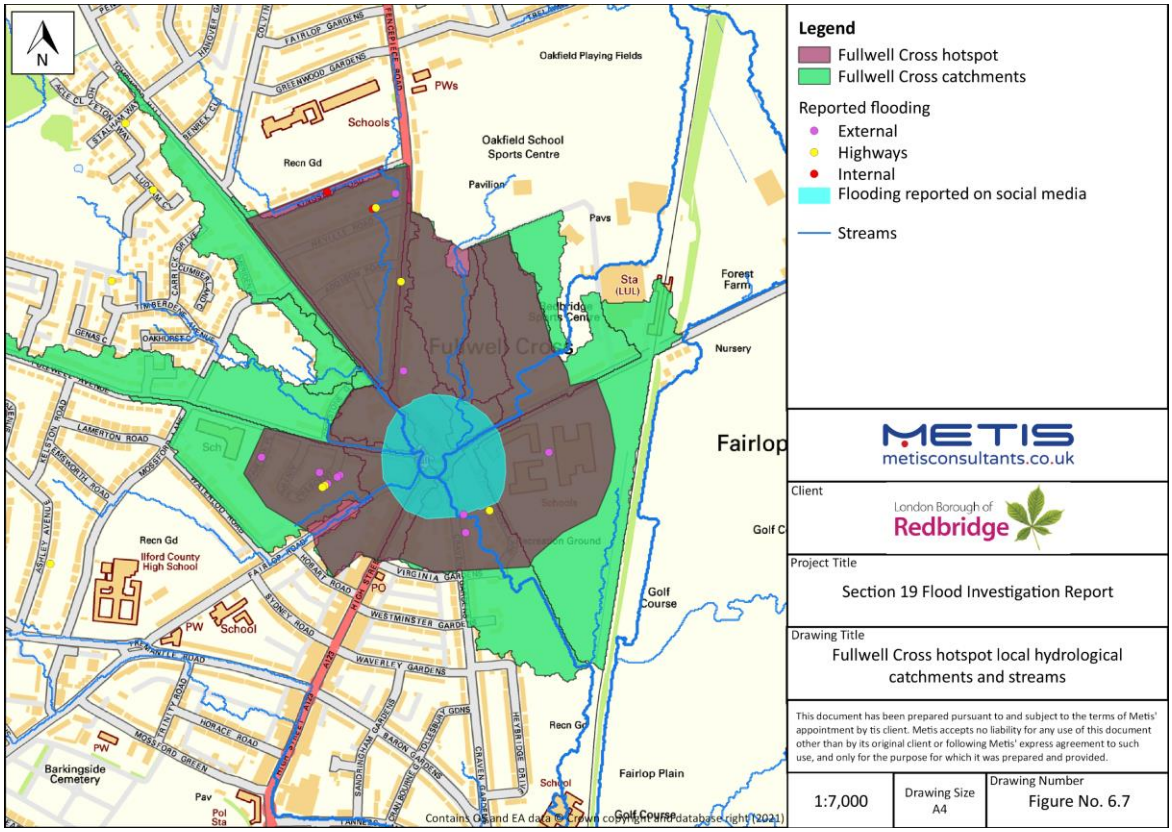


**Figure 6.7: Fulwell Cross hotspot local hydrological catchment and stream**

## 6.2.4 Local flood risk

### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 6.8*) shows that some properties in Kingsley Road are at a predicted risk of flooding from the 1 in 30 year, the 1 in 100 year and the 1 in 1000 year rainfall events, with depths ranging between 0.15m and 0.60m. The properties that reported flooding in Neville Road and Craven Gardens are at risk of flooding from the 1 in 1000 year rainfall event and the predicted depths ranging between 0.15m and 0.30m. The hotspot is at high risk of flooding from surface water.

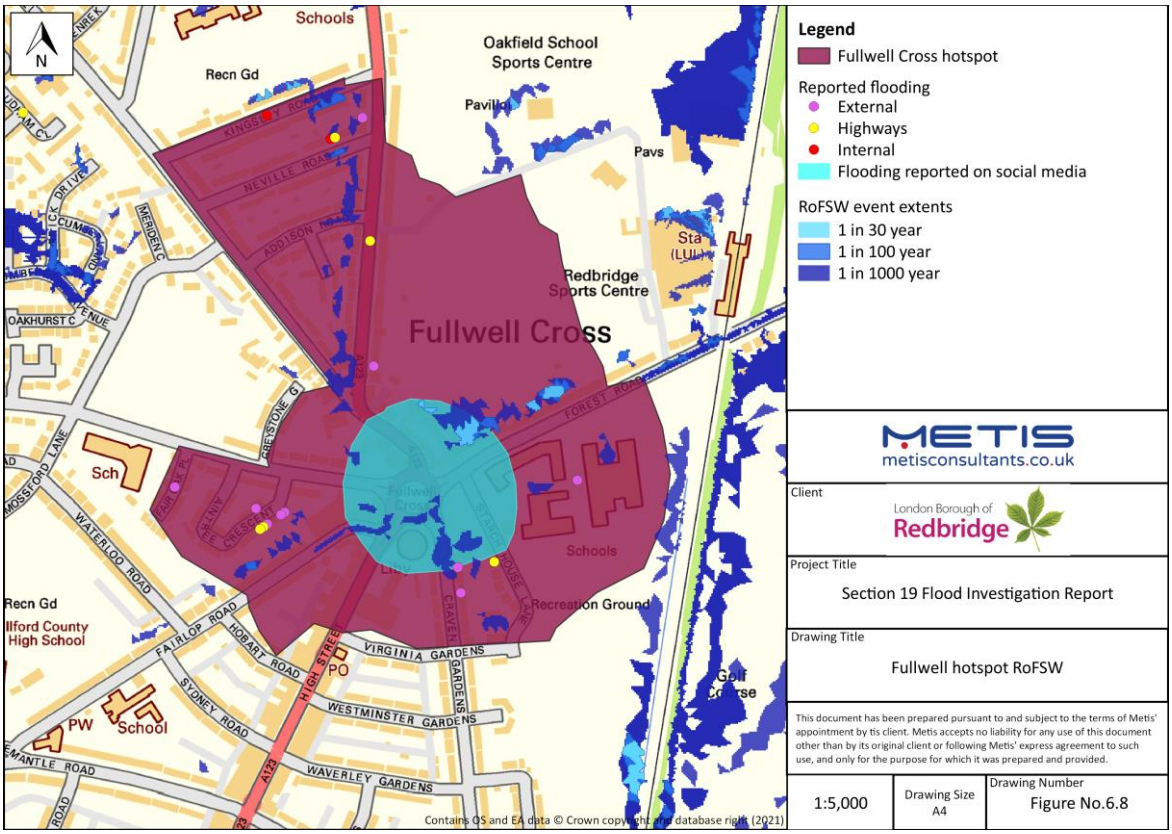


**Figure 6.8: Fulwell Cross hotspot RoFSW**

## Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data shows that there is a tertiary river bordering the Ilford Jewish School recreation ground. However, the hotspot is not at risk of flooding from ordinary watercourses.

## Fluvial Flood Risk

According to the EA's online Flood Map for Planning, Fulwell Cross and the surrounding area is located within Flood Zone 1 and the hotspot is therefore not at risk of fluvial flooding.

## Groundwater Flood Risk

The Fullwell Cross hotspot lies within the '>=75%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 6.2*). The flooding reports do not mention groundwater as the source of flooding and there are no known reports of groundwater flooding elsewhere in the hotspot. Therefore, it is believed that this flood incident cannot be attributed to groundwater flood sources.

## Sewer Flood Risk

As mentioned in *Section 6.2.1*, anecdotal evidence for residents would suggest that the surface water sewer network in Aintree Crescent did not have sufficient capacity to cope with surface water runoff during severe rainfall event. Furthermore, the gullies in Neville Road and Coburg Gardens were found to be free runners during the flooding event, but they were surcharging. Based on this information, it is believed that this flooding incident can be attributed to sewer flood risk.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the Fullwell Cross hotspot sits outside of the predicted reservoir flooding extent. Therefore, Fullwell Cross is predicted to be at low risk of flooding from other sources.

## 6.2.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 6.2: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>No known actions taken<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br><br>The gullies in Neville Road, Aintree Crescent and Craven Gardens were checked after Redbridge received the flooding reports. Gullies in Neville Road were checked on the 31st July 2021 and all eight gullies checked were found to be free flowing. The gullies in Kingsley Road were checked on the 6th August 2021 and all ten gullies were found to be free flowing. The gullies in Aintree Crescent were checked on the 12th August 2021, ten were found to be free flowing and 2 could not be inspected due to parked vehicles. The gullies in Craven Gardens were checked on the 19th August, eight were found to be free flowing and one was found blocked and requires programmed works.<br><br>The flooding at Ilford Jewish Primary School was a TWUL foul drainage issue and did not involve gullies.<br><br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. During this initial high-level assessment, it was noticed that the linear drain in Craven Gardens that flows in the middle of the pavement stops at crossings. However, during the flooding, the small drain would not have been able to have played a significant role due to the scale of the incident. Properties in Neville Road and Kingsley Road were found to have driveways sloping towards the properties, sometimes quite steep. |
| *TWUL* | ***Before***<br><br>No known actions taken<br><br>***During***<br><br>No known actions taken |

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| | ***After***<br><br>No known actions taken |

### 6.2.6 Recommendations

- Redbridge should investigate the linear drain in Craven Gardens. This would not have had an impact on the flooding due to the magnitude on the rainfall event, but it could have an impact on smaller storms.
- For TWUL actions, refer to Section 8.2.

## 6.3 Hotspot 10 – Ilford

The Ilford hotspot is located between Perth Road and Melbourne Road, and between Auckland Road and Coventry Road, to the south of the Borough.

### 6.3.1 Location-wide flood incident(s)

Across the hotspot, two reports of internal flooding were received from residents of Auckland Road and Melbourne Road. Multiple reports of flooding in Colombo Road were also received. A resident in Melbourne Road has described a newly installed gully as blocked and causing flooding to the road and her basement. The resident in Auckland Road reported that their cellar had flooded during the rainfall event. In Colombo Road, multiple residents have complained about blocked gullies, and tree roots in gullies.

### 6.3.2 Local drainage network

*Figure 6.9* shows the TWUL sewer network within the local area. The surface water sewer in Melbourne Road flows in a south-easterly direction with a diameter of 225mm and connects into a 225mm surface water sewer in Coventry Road that flows in a south-westerly direction. The surface water sewers in Auckland Road (225mm diameter) and Colombo Road (225mm diameter) flow in a south-westerly direction until the intersection with Brisbane Road at which point they connect to a 1125mm sewer flowing in a north-westerly direction for approximately 415m before discharging to the Cran Brook.

The main foul sewers are located in Auckland Road (300mm diameter) and Coventry Road (300mm diameters) and flow in a south-westerly direction before connecting at the intersection between Coventry Road and Melbourne Road. Christchurch Road (225mm and 450mm diameters), Toronto Road (225mm diameter) and Brisbane Road (225mm diameter) all connect to the sewer in Coventry Road.

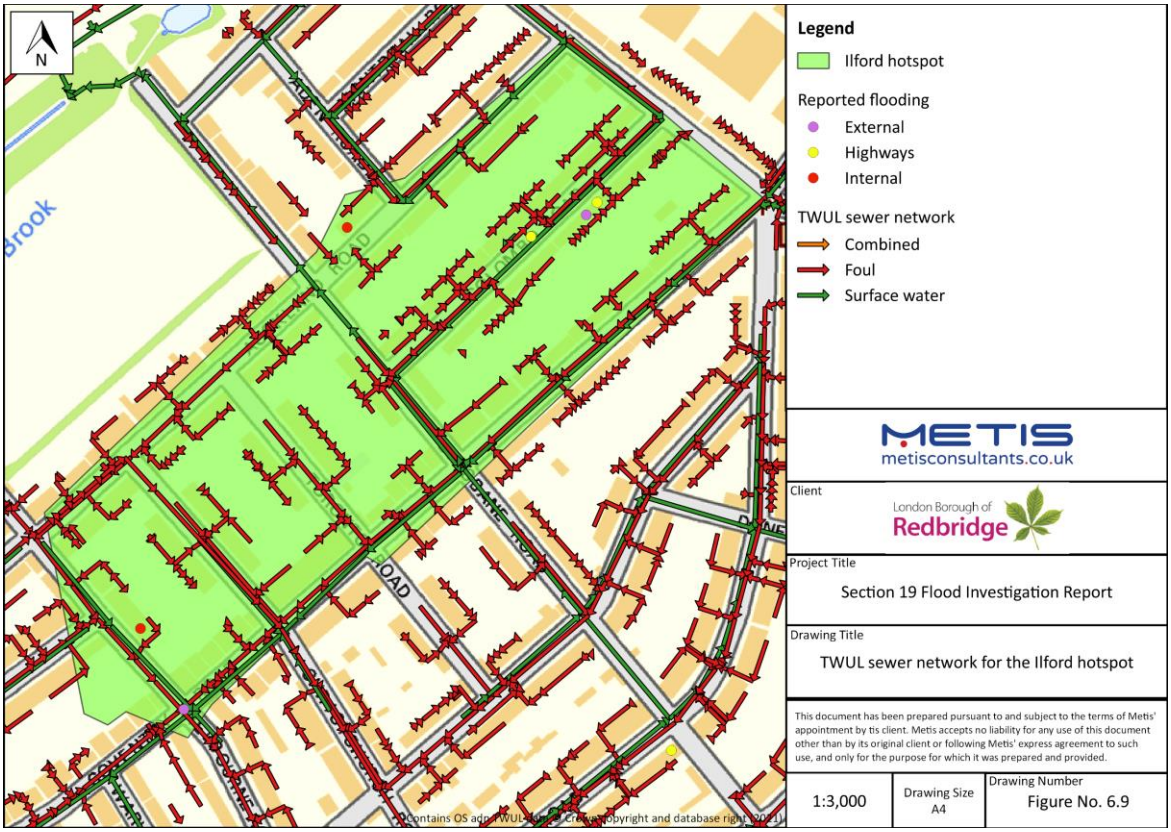


**Figure 6.9: TWUL sewer network for the Ilford hotspot**

### 6.3.3 Local flood mechanism

A watershed analysis of the area using a GIS provided small hydrological sub-catchments along with the primary flow paths (referred to as 'Streams' in *Figure 6.10*). LiDAR data does not show that the any of the flooded properties lies in a local topographical low point.

The primary flow paths are the main overland flow routes for surface water in the defined catchment. For this specific catchment, the overland flow route flows towards Fulwell Cross before merging and flowing in a southerly direction. The property in Melbourne is located in close proximity to the overland flow paths of the local sub-catchments. The other properties having reported flooding are not on or near flow paths.

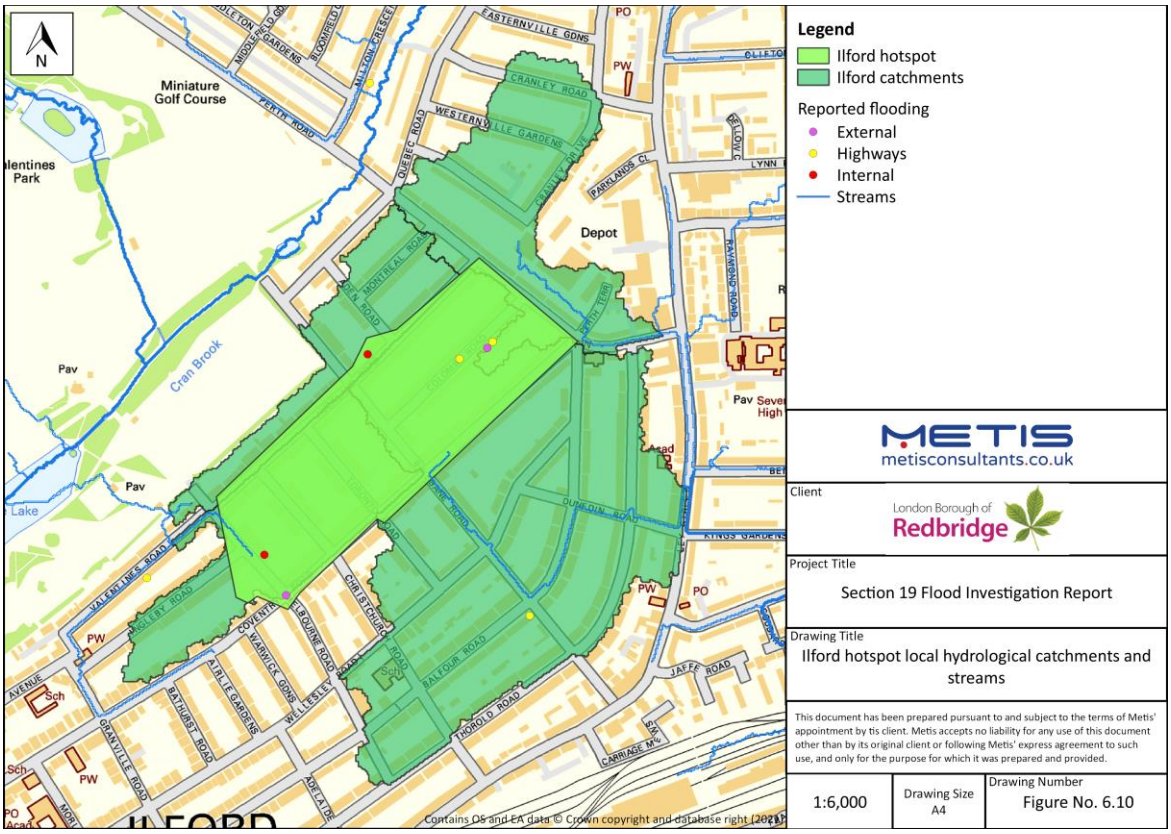


**Figure 6.10: Ilford hotspot local hydrological catchment and stream**

## 6.3.4 Local flood risk

### Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 6.11*) shows that the flooded property in Melbourne Road sits just outside of the extent of flooding in the 1 in 1000 year rainfall event, with predicted depths ranging between 0.15m and 0.30m. Based on this information, the Ilford hotspot is at low risk of surface water flooding.

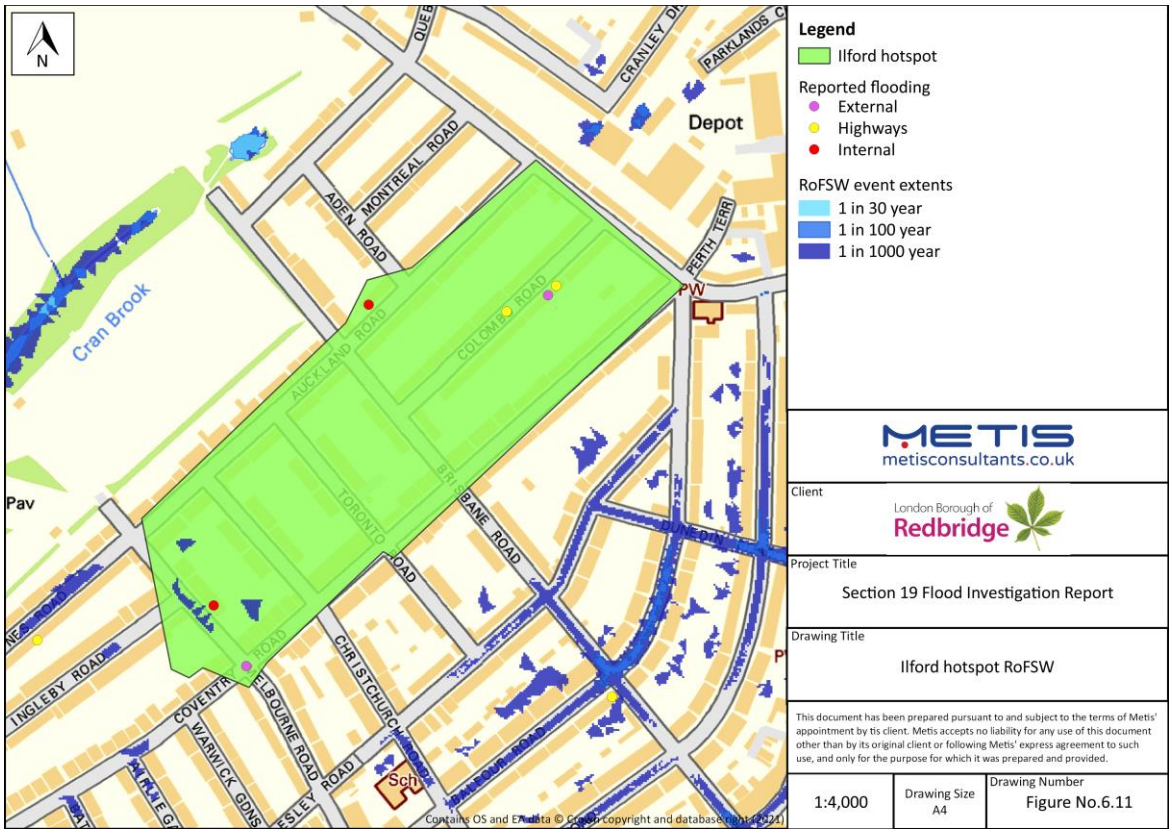


**Figure 6.11: Ilford hotspot RoFSW**

### Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there is no ordinary watercourse within the local vicinity of the Ilford hotspot and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

### Fluvial Flood Risk

According to the EA's online Flood Map for Planning, the Ilford hotspot is situated in Flood Zone 1 and therefore is not at risk of fluvial flooding.

### Groundwater Flood Risk

The Fullwell Cross hotspot lies within the '>=50% <75%' and '>=75%' risk classes of the EA's Areas Susceptible to Groundwater Flooding data (see *Figure 6.2*). An incident of a flooded cellar has been reported in Auckland Road, so groundwater flooding cannot be discounted without further information.

### Sewer Flood Risk

As mentioned in *Section 6.3.1*, anecdotal evidence from residents would suggest that the surface water sewer network in Melbourne Road and Auckland Road did not have sufficient capacity to cope with surface water runoff during severe rainfall event. Based on this information, it is believed that this flooding incident can be attributed in part to sewer flood risk.

### Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that the Ilford hotspot sits outside of the predicted reservoir flooding extent. Therefore, the Ilford hotspot area is predicted to be at low risk of flooding from other sources.

## 6.3.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 6.3: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br><br>Following reports of a blocked gully opposite 34 Melbourne Rd a new gully pot was installed and the connection to TWUL's surface water sewer cleared in January 2021.<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br><br>The gully reported blocked in Auckland Road was checked on the 3rd September 2021 and found to be free flowing. The new gully in Melbourne Road was also checked on the 15th September 2021 and found to be free flowing. The properties in Melbourne Road do not have drains between the road and their sloping driveways. Two gullies in Colombo Road were checked on the 6th August 2021. One gully was cleared on the 6th August and the other was replaced by a new gully pot on the 22nd October 2021.<br><br>The resident on Auckland Road has been advised to ensure that their basement is watertight.<br><br>A site visit was conducted on the 6th October 2021 to investigate the reported flooding in the hotspot. It was noticed that the property in Auckland Road has a downpipe that discharges onto the pavement. |
| *TWUL* | ***Before***<br><br>No known actions taken<br><br>***During***<br><br>No known actions taken<br><br>***After***<br><br>No known actions taken |

## 6.3.6 Recommendations

- For Redbridge and TWUL actions, refer to Section 8.2.

## 6.4 Other locations within the catchment

Multiple other reports of flooding were received in the Fairlop-Cranbrook catchment which were not located in a hotspot. Flooding was reported in the following streets:

- Genas Close
- Clarence Avenue
- Chase Lane
- New North Road

# 7 ILFORD SOUTH CATCHMENT

The Ilford South hydrological catchment spans from the edge of Loxford Park and Seven Kings (*Figure 7.1*). Residents in this catchment reported two internally flooded properties (one of which was not described specifically enough to be mapped), four externally flooded properties (two of which were not described specifically enough to be mapped), and four cases of flooding to the highway, totalling at ten reports. Because the locations of the reported flooding are spread across the entire catchment, arbitrarily grouping properties would not be logical. Instead, this section mostly focuses on the internal flooding reported in Grosvenor Road.

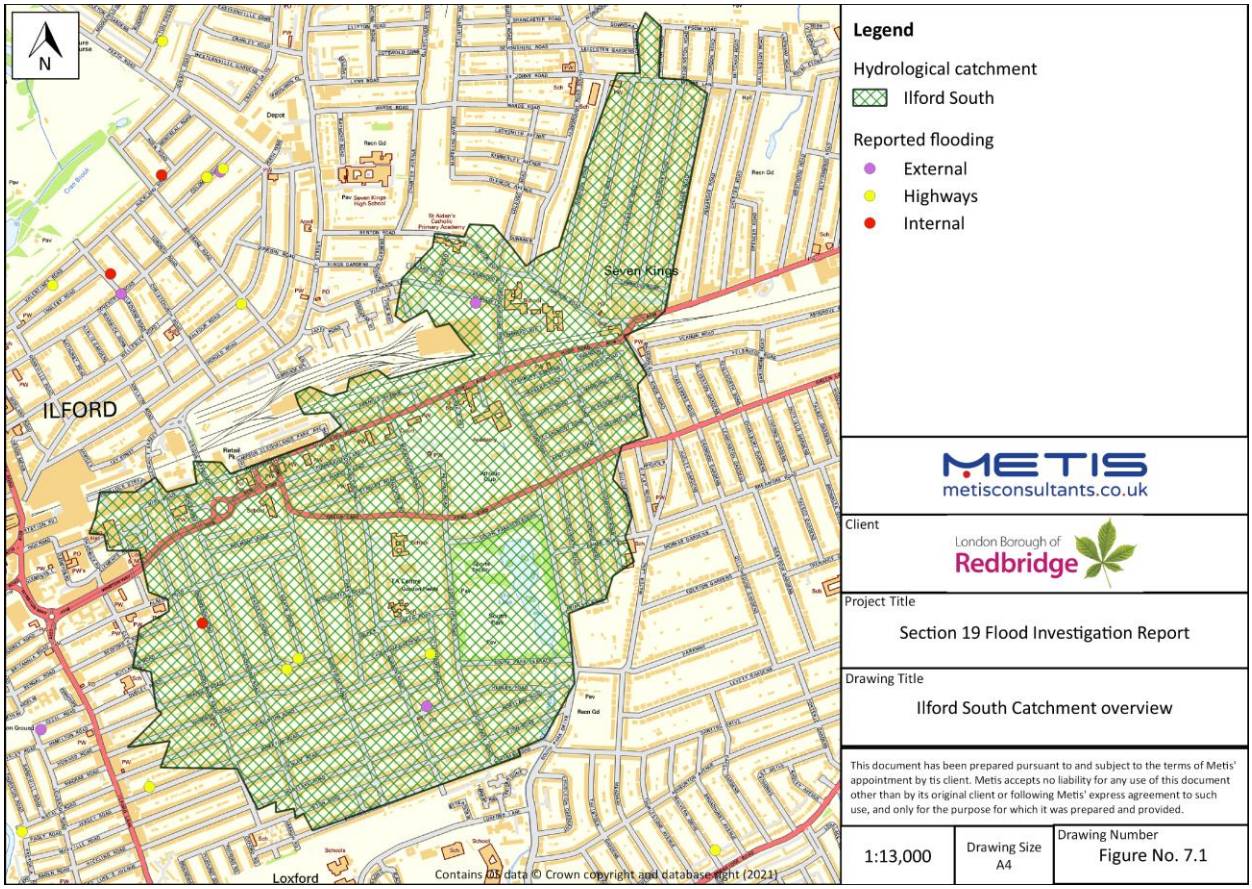


**Figure 7.1: Ilford South catchment overview**

Although maps for various types of flood risks have been produced at the scale of the hotspots throughout this report, the EA's Areas Susceptible to Groundwater Flooding data is provided as 1km tiles and therefore is provided at the scale of the catchment with *Figure 7.2*.

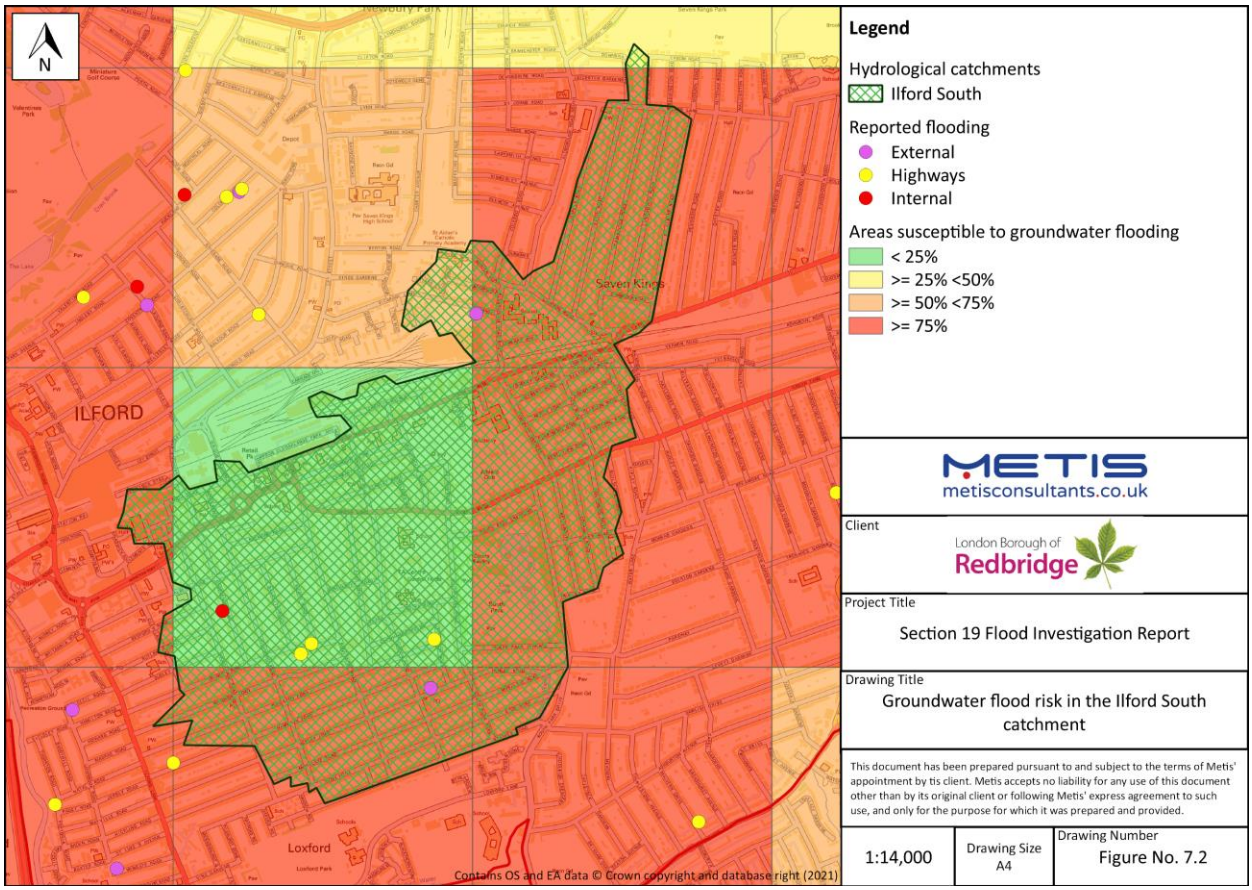


**Figure 7.2: Groundwater flood risk in the Ilford South catchment**

## 7.1 Location-wide flood incident(s)

Internal flooding was reported in Grosvenor Road, external flooding was reported in Henley Road and Vicarage Road, and flooding to highways was reported in Grange Road and Littlemore Road. A resident in Grosvenor Road reported flooding to their basement flowing the rainfall event of the 25th July.

## 7.2 Local drainage network

Grosvenor Road is served by a surface water sewer (225mm diameter) that flows in a south-easterly direction and connects to the 225mm diameter pipe in Grange Road.

## 7.3 Local flood mechanism

The flooded property does not lie on an overland flow path of local sub-catchments.

## 7.4 Local flood risk

### 7.4.1 Surface Water Flood Risk

A review of the EA's RoFSW data (*Figure 7.3*) shows that the flooded property in Melbourne Road sits just outside of the extent of flooding in the 1 in 1000 year rainfall event, with predicted depths ranging between 0.15m and 0.30m. Based on this information, Grosvenor Road is at low risk of surface water flooding.

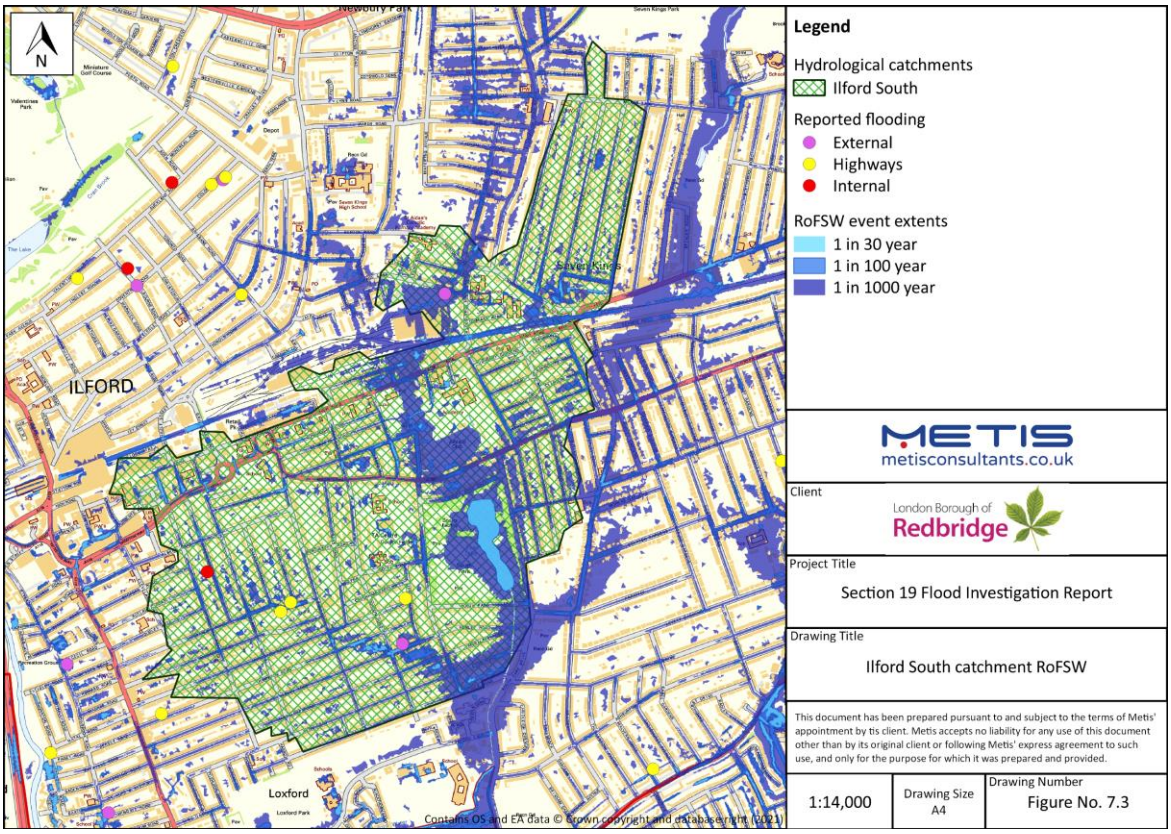


**Figure 7.3: Ilford South catchment RoFSW**

### 7.4.2 Ordinary Watercourse Flood Risk

A review of the EA Detailed River Network data confirms that there is no ordinary watercourse within the local vicinity of Grosvenor Road and therefore, the hotspot is not at risk of flooding from ordinary watercourses.

### 7.4.3 Fluvial Flood Risk

According to the EA's online Flood Map for Planning, Grosvenor Road is situated in Flood Zone 1 and therefore is at low risk of fluvial flooding.

### 7.4.4 Groundwater Flood Risk

Grosvenor Road lies within the '<25%' risk class of the EA's Areas Susceptible to Groundwater Flooding data (*Figure 7.2*). An incident of a flooded basement has however been reported, so groundwater flooding cannot be discounted with further information.

### 7.4.5 Sewer Flood Risk

There have not been mentions of any blockages or surcharging gullies and manholes in Grosvenor Road. It is however still likely that the surface water sewer was unable to cope with the amount of rainfall runoff entering the network.

### 7.4.6 Flood risk from other sources

The EA's Risk of Flooding from Reservoirs map shows that Grosvenor Road sits outside of the predicted reservoir flooding extent. Therefore, the road is predicted to be at low risk of flooding from other sources.

## 7.5 Actions taken by relevant RMAs (and other stakeholders affected)

**Table 7.1: Risk Management Authorities - Actions**

| Authority | Authority Contributing Action to Flooding Incident |
|---|---|
| *Redbridge* | ***Before***<br>No known actions taken<br>***During***<br>No known actions taken<br>***After***<br>A letter was sent by Redbridge to all residents having reported flooding. The reported incidents were collated and compiled. The information collected has provided anecdotal evidence for this Section 19 report. Reports received were forwarded to TWUL for their investigations.<br>The gullies in Grosvenor Road were checked on the 5th August 2021, with all found to be free flowing apart from one that was blocked in the main TWUL surface water sewer. This has been passed on to TWUL. The gullies in Henley Road were checked on the 25th August 2021 and all were found to be free flowing. The gullies in Grange Road and Meath Road were checked on the 25th August 2021, ten were found to be free flowing and two had to be cleared. |
| *TWUL* | ***Before***<br>No known actions taken<br>***During***<br>Two clean-up operations were organised by TWUL is Stanley Road and Gordon Road on the 27th July 2021.<br>***After***<br>No known actions taken |

## 7.6 Recommendations

- For Redbridge and TWUL actions, refer to Section 8.2.

# 8 General Conclusions and Recommendations

## 8.1 Sandbags

Some residents that have experienced flooding during the rainfall event of the 25th July requested sandbags from Redbridge. This is not something that Redbridge provides to residents.

Sandbags would not necessarily have been useful to prevent the flooding that occurred in July. Due to the high intensity of rainfall, roads and properties were flooded in a short amount of time, a type of flooding also referred to as flash flooding. In order for sandbags to efficiently protect properties, it would have been necessary to prepare and install the sandbags ahead of the rainfall event. According to Reeve & Badr[1], the performance of sandbags for flood defences depends on the number of rows of sandbags, with multiple rows providing better protection. Installing multiple rows of sandbags in several properties would therefore require a large number of sandbags, with no evidence that the properties would be fully protected from flooding. The disposal of sandbags is also problematic as they tend to retain contaminants when they come in contact with floodwater and, therefore, they cannot be reused or recycled.

In The Glade, the foul sewer flooding was sudden and unexpected, with properties experiencing flooding moments after the manholes surcharged. There would not have been enough time to install sandbags as the flooding was so sudden.

In Peel Place and Coburg Gardens, surface water and foul water flooding also occurred rapidly, with water levels reaching approximately 1m inside of properties. A large number of sandbags would have had to be installed in a very short amount of time to provide a certain level of protection to properties.

Alternatives to traditional sandbags, such as absorbent sandbags and flood diversion barriers, could provide protection to properties. These solutions can however be expensive, and their effectiveness relies on their correct installation. Although they can be quicker to install than traditional sandbags, their installation would have to be prior to the flooding event. Overall, these alternatives would not have been appropriate for the flash flooding event experienced on the 25th July 2021.

## 8.2 Recommendations

Recommendations for specific hotspots have been provided within the relevant chapters. The following recommendations are suitable for all sites impacted by the July 2021 flood event. The LLFA should prioritise them and incorporate them into Redbridge's LFRMS's action plan when it is next updated.

[1] Reeve, D., & Badr, A. (2003). Performance of sandbags for domestic flood defence. Proceedings of the Institution of Civil Engineers–Water & Maritime Engineering, 156, 341–349. https://doi.org/10.1680/wame.2003.156.4.341

Recommendations for the short term are as follows:

- RMAs should review each hotspot identified in this report to ensure that the incident description and the actions taken reflect what happened during the flooding event. This should be done before the publication of this report.
- Improved communication between Redbridge and TWUL officers to share asset and investigative data in addition to reports during flooding incidents.
- The assessment of the independent London Flood Review (https://londonfloodreview.co.uk/final-report/) into the London floods during the summer of 2021 is publicly available. The four London Flood Review reports can be found at London Flooding – Independent Review (londonfloodreview.co.uk).
- Thames Water will take into account the London Flood Review and continue to prioritise inspections and sewer cleaning based on the behaviour and impact of the operation of the sewer network at all sites. Thames Water, working within their own programmes, reports from residents and the LLFA will prioritise sites where the sewer is causing any issues to customers to ensure the best service possible.
- Redbridge should establish a list of properties having reported internal flooding for which the flooding incident should be further investigated. The properties should be ranked based on giving priority to those which have experienced the most severe flooding. These properties do not have to be located within a defined hotspot (see *Sections 4.6*, *5.3*, and ).
- Increased public awareness work should be promoted between Redbridge, TfL and TWUL so that residents know which authority to contact depending on the source of flooding and how to contact them. This information should be included on Redbridge's website, with relevant hyperlinks to facilitate flooding reports to RMAs.

Recommendations for the medium term are as follows:

- Incorporation of retrofit SuDS features in as many locations as possible in order to reduce the surface water runoff and increase the capacity of the drainage network while providing health and environmental benefits.
- Redbridge should consider incorporating automatic flooding warning systems in areas considered more at risk. These systems, which can be placed in gullies for example, cannot prevent flooding but can help in better preparing for flooding.

Recommendations for the long term are as follows:

- Redbridge should invest in flood alleviation schemes funded using Grant-in-Aid and Local Levy.
- The government should strengthen national planning policy to further promote the use of SuDS. In line with current and future policies, Redbridge should review and, where necessary improve, their local policy requirements.
- Thames Water is in the final stages of its Drainage and Wastewater Management Plans (DWMPs) that look at the current state of drainage and wastewater management. The DWMP takes into account growth, urban creep, and climate change and focuses on long-term plans needed for areas within Thames Water. Further information can be found here

https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management. Upon the publication of the DWMP, Thames Water will work with Redbridge Council, in its role as the LLFA, to understand existing risks associated with their sewers and work towards mitigating these risks. Risk areas will be shared between the Risk Management Authorities to identify areas that can benefit from a range of mitigation options and upgrades, ranging from installation of SuDS, other flood alleviation measures or, as part of the DWMP, sewer capacity increase.

As part of Redbridge's LLFA role, good practice would entail that:

- Redbridge should review their criteria for a 'flood incident' that would trigger a flood risk investigation under Section 19 of the FWMA (see *Section 1.1*).
- Redbridge should collaborate with neighbouring boroughs by engaging in strategic partnerships and committees such as the Thames RFCC.

## 8.3 Conclusions

This borough wide flood risk investigation was triggered due to the extensive flooding that occurred on the 25th July 2021 which caused numerous internal flooding incidents. Rainfall started in the early afternoon on 25th July and peaked between 2:30pm and 4pm, with a total amount of rainfall of 54.1mm which fell in two hours and fifteen minutes. This report provides a summary of the actions taken by the relevant RMAs before, during and after the flooding events.

Four hydrological catchments were identified within Redbridge to better understand the potential causes of flooding at a borough wide scale. Ten hotspots spread over the catchments were chosen based on Redbridge's definition of a flood incident. The hotspots are small areas with clusters of internally flooded properties or severe flooding to highways. For each hotspot, the predicted and known flood mechanisms and flood risks were reviewed.

The data collection exercise and investigation established that the sites were at varying risks of flooding, notably surface water flooding, sewer flooding and groundwater flooding to a lesser extent. Sites that had reported severe flooding were often found to be located at topographical low points and on primary flow paths. The flooding that occurred on the 25th July was severe because of the very high return period of over 1 in 100 year. London's sewer infrastructure is a heritage from the Victorian era and was not designed to accommodate for such large amounts of surface water entering the network. Even a fully functioning drainage system would have been overwhelmed by the amount of rainwater. Storms are natural phenomena and when they are of this magnitude, flooding cannot be entirely prevented. Retrofit SuDS or flood alleviation schemes might not prevent flooding during a similar storm but could protect properties during storms of lower return periods.

It is recommended that Redbridge investigates SuDS opportunities in locations where flooding has been reported in order to reduce the surface water runoff and increase the capacity of the drainage network. Following the completion of the London Flood Review earlier this year, it is recommended that TWUL are to prioritise inspections and sewer cleaning at sites where the sewer is causing issues to customers. Upon publication of the DWMP TWUL will work with Redbridge, in its role as the LLFA, to understand existing risks associated with their sewers and work towards mitigating these risks. Risk areas will be shared between RMAs to identify areas which can benefit from a range of mitigation options and upgrades, ranging from installation of SuDS, other flood alleviation measures or, as part of the DWMP, sewer capacity increase.

At government level, the strengthening of national planning policy will help to further promote SuDS and will ensure that properties are better protected from flooding in the future.

# APPENDICES

## Appendix A – Environment Agency Rain Gauge Data

**Table A.1: 25th July 2021 rain gauge data**

| Time (BST) | 25th July 2021 Depth of rainfall (mm) | | |
|---|---|---|---|
| | Gascoigne Road | Luxborough Lane | Wanstead |
| 12:00 | 0.00 | 0.00 | 0.00 |
| 12:15 | 0.00 | 0.00 | 0.00 |
| 12:30 | 0.00 | 0.00 | 0.00 |
| 12:45 | 0.00 | 0.00 | 0.00 |
| 13:00 | 0.00 | 0.00 | 0.00 |
| 13:15 | 0.00 | 2.30 | 0.00 |
| 13:30 | 0.00 | 1.11 | 0.00 |
| 13:45 | 0.00 | 6.88 | 0.00 |
| 14:00 | 0.00 | 4.30 | 0.40 |
| 14:15 | 0.83 | 9.05 | 8.60 |
| 14:30 | 2.57 | 14.07 | 5.00 |
| 14:45 | 1.90 | 10.02 | 10.80 |
| 15:00 | 22.69 | 2.54 | 5.00 |
| 15:15 | 9.95 | 0.05 | 1.40 |
| 15:30 | 0.67 | 0.05 | 5.80 |
| 15:45 | 0.00 | 7.21 | 12.40 |
| 16:00 | 0.00 | 0.03 | 1.80 |
| 16:15 | 0.00 | 0.00 | 0.20 |
| 16:30 | 0.00 | 0.01 | 0.00 |
| 16:45 | 0.00 | 0.00 | 0.00 |
| 17:00 | 0.00 | 0.00 | 0.00 |
| 17:15 | 0.00 | 0.02 | 0.00 |
| 17:30 | 0.12 | 0.21 | 0.00 |
| 17:45 | 0.08 | 0.35 | 0.00 |
| 18:00 | 0.15 | 0.18 | 0.20 |
| 18:15 | 0.24 | 0.24 | 0.00 |
| 18:30 | 0.65 | 0.10 | 0.20 |
| 18:45 | 0.09 | 0.37 | 0.20 |
| 19:00 | 0.24 | 0.41 | 0.60 |
| 19:15 | 0.33 | 0.79 | 0.60 |
| 19:30 | 0.18 | 0.23 | 0.80 |
| 19:45 | 0.43 | 0.00 | 0.00 |
| 20:00 | 0.02 | 0.01 | 0.00 |
| 20:15 | 0.08 | 0.00 | 0.00 |
| 20:30 | 0.00 | 0.00 | 0.00 |

| | | | |
|---|---|---|---|
| 20:45 | 0.00 | 0.00 | 0.00 |
| 21:00 | 0.00 | 0.00 | 0.00 |
| 21:15 | 0.00 | 0.00 | 0.00 |
| 21:30 | 0.00 | 0.00 | 0.00 |
| 21:45 | 0.00 | 0.00 | 0.00 |
| 22:00 | 0.00 | 0.00 | 0.00 |