Merton Section 19 Flood Risk Investigation Report

Prepared for London Borough of Merton

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EXECUTIVE SUMMARY

This flood risk investigation report was written as part of the London Borough of Merton Council's (Merton Council) duty as Lead Local Flood Authority (LLFA) under Section 19 of the Flood and Water Management Act (2010). The extreme rainfall events that occurred on the 12th July 2021 and the 25th July 2021 caused significant flooding across the London Borough of Merton (LB Merton). This report was carried out in response to these flood events with the aim of investigating the various causes of flooding across LB Merton alongside the actions of the Risk Management Authorities (RMAs) who hold different roles in responding to flood events. The RMAs include Merton Council, the Environment Agency (EA), and Thames Water Utilities Limited (TWUL).

Merton Council received 65 reports of flooding incidents across 35 different roads during the 12th July event, alongside 35 reports of flooding across 21 different roads during the 25th July event. A further ten reports of incidents of flooding across four different roads and two incidents of flooding across two different roads were reported to social media during the 12th July and 25th July events respectively. In total, this report analysed 112 instances of flooding across both events. Of these, nine and four incidents of internal flooding were reported to Merton Council during the 12th July and 25th July events, respectively. The remainder of the reports pertained to instances of external flooding or highways flooding. Due to the high number of flooded locations, a total of five hotspots across LB Merton where reports of flooding were highly concentrated were selected for analysis. These hotspots were delineated as small areas based upon topographic and drainage network information. The locations of reported flood incidents and associated hotspots across LB Merton during both events are shown in the below figures, which correspond to *Figure 4.9* and *Figure 4.10* within the main report.

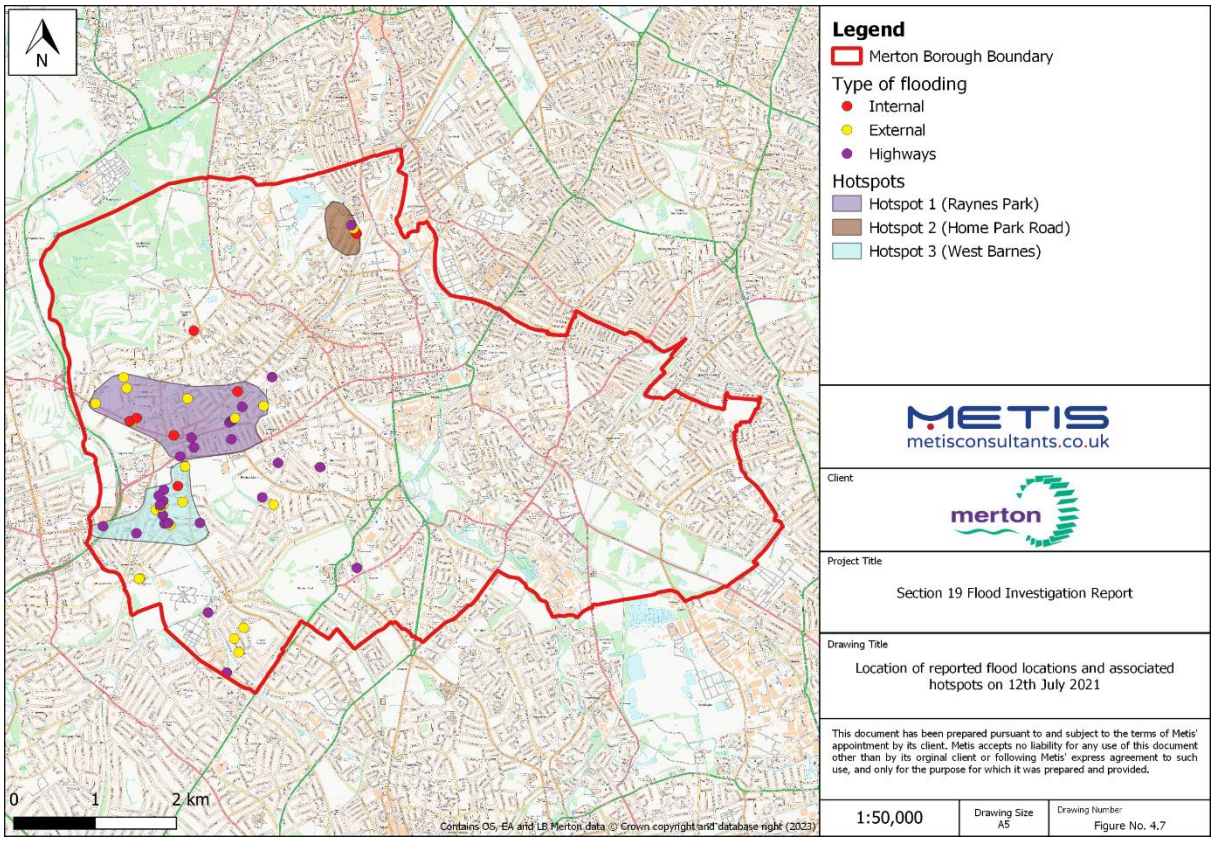

Figure 4.9: Location of reported flood locations and associated hotspots on 12th July 2021

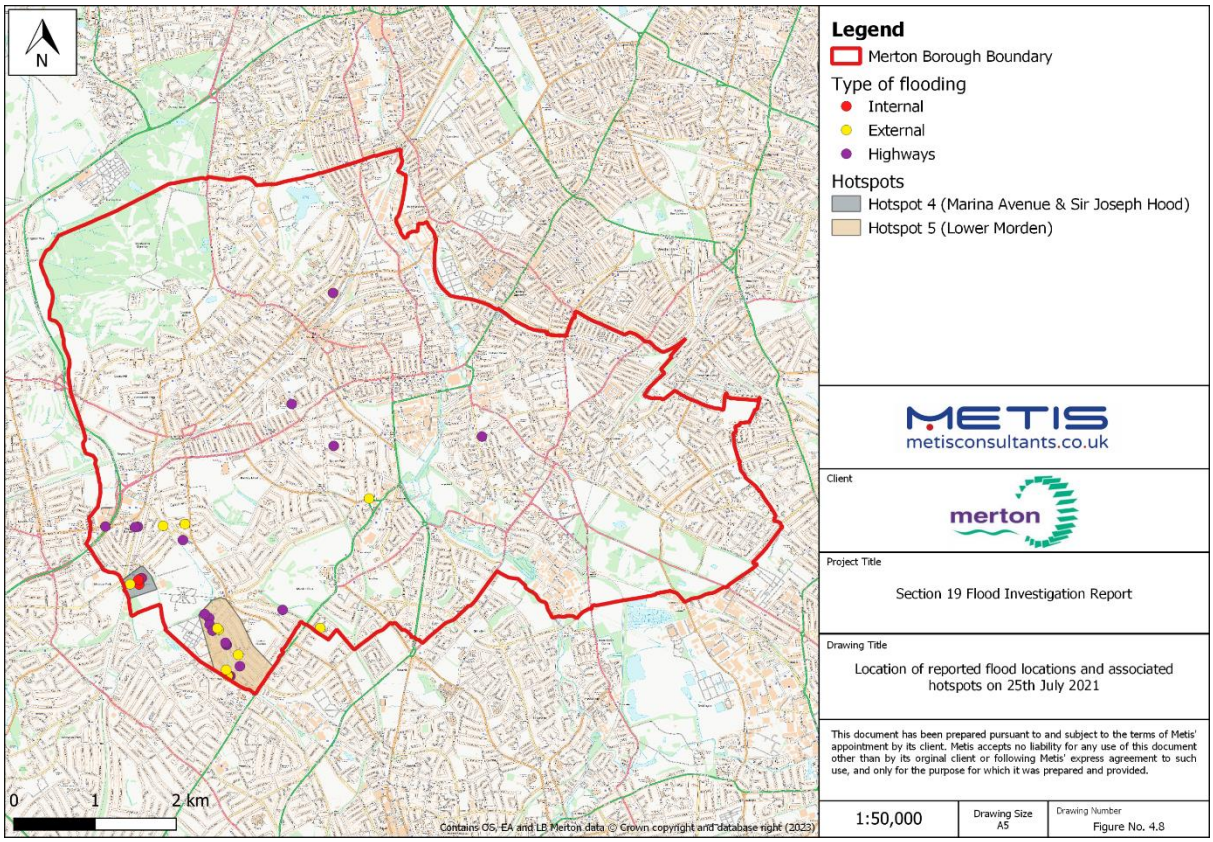

Figure 4.10: Location of reported flood locations and associated hotspots on 25th July 2021

The reported flood incident details were mapped and analysed within each hotspot, whilst flood mechanisms and flood risks were also assessed. Where known, the various actions taken by RMAs before, during and after the flood events within each hotspot were recorded, with recommendations formulated to mitigate future flooding at each hotspot. Merton Council's Flood Incident Criteria, as specified in the 2015 Local Flood Risk Management Strategy (LFRMS), was used to ascertain whether flooding within each hotspot met the threshold criteria for a full Section 19 investigation.

During both events, sewer capacity across all hotspots was exceeded due to the extreme volume of surface water generated entering the surface water network. Along the Pyl Brook, high river levels resulted in a backflow and capacity issue, with the outfalls located along the river channel being surcharged and thus unable to discharge increased volumes of surface water runoff into the channel. Additionally, high river levels along the Beverley Brook exceeded channel capacity, resulting in fluvial flooding to some locations within LB Merton. The extreme rainfall that occurred during both events was responsible for the widespread flooding across London and south-eastern England. Specifically, Hydromaster data provided by Merton Council estimated return periods of up to 1 in 100 years during the 12th July event within the borough, and return periods of up to 1 in 20 years during the 25th July event. TWUL rainfall return period maps indicate that rainfall return periods exceeded 1 in 100 years across much of the south-west of LB Merton during the 12th July event, whilst rainfall return periods peaked between 1 in 30 years and 1 in 50 years during the 25th July event. TWUL Rainfall Radar (RaRa) Flood Estimation Handbook 2013 (FEH13) data of affected locations estimated maximum rainfall return periods of between 1 in 48 years and 1 in 1171 years during the 12th July event, alongside maximum rainfall return periods of between 1 in 23 and 1 in 84 years during the 25th July event. Other factors including topography, gully blockages, and sewer network configuration compounded the flooding issues across LB Merton during these rainfall events.

Merton Council have worked on mitigating flood risks in various ways, such as through actioning recommendations from the 2019 LB Merton Section 19 investigation report that followed the flood events during 2016 and 2017 across the borough. Several actions have also already been taken by both Merton Council and TWUL across LB Merton at the affected locations following the July 2021 flooding. These actions included undertaking CCTV surveys of sewer networks, installing 4G sensors, silt clearing, and upgrading a pumping station in Raynes Park. The proposed flood alleviation scheme located along the Beverley Brook upstream of LB Merton in the Cuddington Recreation Ground is designed to provide flood storage to reduce surface water and fluvial flood risk to downstream locations such as LB Merton. Further recommendations for each of the five hotspots analysed (mapped in *Figure 4.9* and *Figure 4.10*) are as follows:

Hotspot 1 (Raynes Park)

- TWUL and Merton Council should investigate potential locations for additional resilience measures and sustainable drainage systems (SuDS) to Coombe Lane and Abbott Avenue.
- TWUL should monitor the Abbott Avenue attenuation tank and the Worple Road Combined Sewer Overflow.
- TWUL should investigate switching off the Abbott Avenue pumping station during extreme rainfall events and provide additional upstream storage.
- Merton Council should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer networks and the upgraded pumping station below the railway at Approach Road.
- TWUL should investigate upgrading sewer network capacity along Lower Downs Road.
- Merton Council should work collaboratively with stakeholders to consider implementing SuDS elsewhere in the catchment closer to runoff sources.
- TWUL, Merton Council, Network Rail (NR), and the EA should continue collaborative drainage modelling of the Apostles area.

Hotspot 2 (Home Park Road)

- Merton Council and TWUL should use future TWUL Surface Water Management Programme (SWMP) funding to utilise Kenilworth Green for attenuation and install SuDS features (including rain gardens) across the hotspot.
- TWUL and NR should work collaboratively to undertake investigation of defects (and repairs if required) within the main surface water sewer line running below the railway behind Home Park Road.
- TWUL and NR should investigate upgrading the main surface water sewer line running below the railway. TfL should facilitate the early review of proposals for the sewer network upgrade.
- Merton Council should ensure ongoing inclusion of Home Park Road gullies in each year's high-priority cleansing programme.
- TWUL should continue to progress the permissions with NR to repair the main line below the railway.

- Merton Council should investigate increasing thresholds to at-risk properties through localised property-level protection.

Hotspot 3 (West Barnes)

- TWUL should ensure high-frequency inspections and an increase in size of the main surface water sewer at Westway.
- TWUL and Merton Council should investigate the benefit of introducing highway SuDS retrofits along West Barnes Lane, Westway, and Burlington Road/Shannon Corner.
- Merton Council should engage with Transport for London (TfL) regarding SuDS measures at Shannon Corner that could impact traffic flow on the A3 flyover.
- TWUL should improve surface water sewer network capacity and Merton Council should increase gully cleansing frequency at Burlington Road.

Hotspot 4 (Marina Avenue & Sir Joseph Hood)

- EA should request access from NR to conduct a full survey on the section of main river culvert located below the railway line.
- Merton Council should improve the sports pitch drainage within the Sir Joseph Hood Memorial Playing Fields whilst being mindful to not increase flows to the Beverley Brook or downstream.
- Merton Council should ensure that the blocked outlet at Sir Joseph Hood is cleared and gullies are inspected more frequently.

Hotspot 5 (Lower Morden)

- TWUL and Merton Council should expand the use of Lynmouth Gardens for flood storage.
- TWUL and Merton Council should investigate introducing SuDS retrofits to properties and highways in the affected areas.
- TWUL should ensure increased inspection and clearance frequency of the Garth Road surface water sewer network.

The following additional general recommendations are applicable to any relevant location across LB Merton:

- Merton Council should engage with TfL on any future flood alleviation works and SuDS opportunities along its red route network (A3, A24, A297), particularly if these are part of greater scheme projects.
- Flood RMAs including TWUL should adhere to the 28 recommendations provided during the independent London Flood Review, listed within the London Flood Review's Stage 4 Summary Report.
- TWUL should finalise and publish their final Drainage and Wastewater Management Plan (DWMP), providing long-term actions for the DWMP areas.
- TWUL should consider the recommendations of the London Flood Review and continue to prioritise inspection and sewer cleaning based on the behaviour and impact of the operation of the sewer network at all sites.

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FIGURES AND TABLES

Acronyms and Abbreviations

Abbreviation	Definition
AStGWF	Areas Susceptible to Groundwater Flooding
CAF	Capacity Assessment Framework
DC	Drainage Catchment
DRN	Detailed River Network
DWMP	Drainage and Wastewater Management Plan
EA	Environment Agency
FAS	Flood Alleviation Scheme
FEH	Flood Estimation Handbook
FWMA	Flood and Water Management Act 2010
GIS	Geographic Information System
LB Merton	London Borough of Merton
LFB	London Fire Brigade
LFRMS	Local Flood Risk Management Strategy
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
MAFP	Multi-Agency Flood Plan
Merton Council	London Borough of Merton Council
MPS	Metropolitan Police Service
NR	Network Rail
RaRa	Rainfall Radar
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SFHD	Sewer Flooding History Database
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable drainage systems
SWMP	Surface Water Management Programme
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 Merton Council (Merton Council). As a unitary authority, Merton Council is a Lead Local Flood Authority (LLFA). LLFAs are defined as a Risk Management Authority (RMA) under Section 6(13) of the Flood and Water Management Act 2010 (FWMA). LLFAs are required to investigate significant flood incidents under Section 19 of the FWMA and publish the results. A LLFA must, to the extent that they consider it necessary or appropriate, investigate:

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

After completing each flood investigation, Merton Council must publish the results of its investigation and notify the relevant RMAs.

LLFAs set out the criteria which defines what flood event should trigger a Section 19 investigation. The criteria for Merton Council are outlined below in *Figure 1.1*, taken from Figure 5-2 of the 2015 Local Flood Risk Management Strategy (LFRMS).

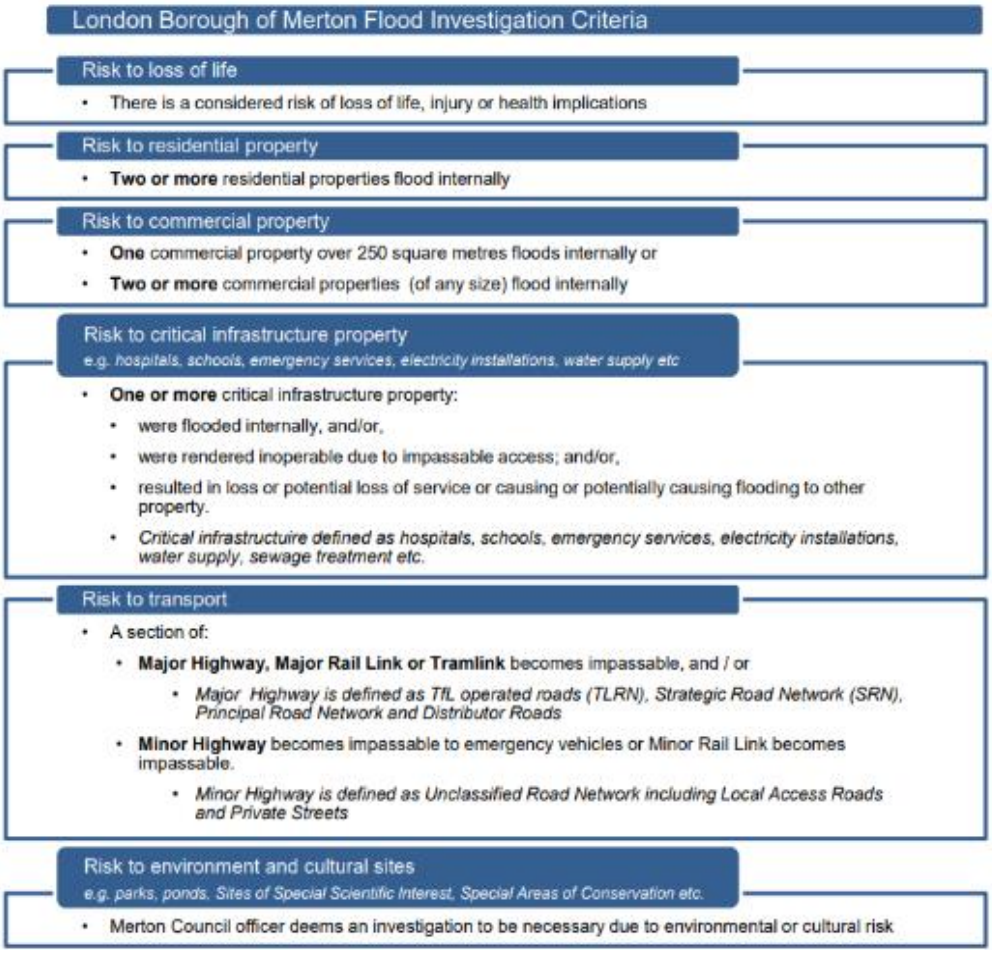

Figure 1.1: Merton Council Flood Investigation Criteria

There were two significant flood events that took place in LB Merton in 2021 which triggered a Section 19 investigation. These took place on the 12th and 25th July. During these dates there were a total of 112 reports of flooding, with nine internally flooded properties and one highway incident that impeded road access to emergency vehicles across five roads. These reports came from five different hotspot locations, four of which are located in the western half of the borough and the fifth is located in LB Merton's north-east.

1.2 Methodology

To conduct this investigation, data was collected from the relevant RMAs. A list of the data and their sources is compiled below in *Table* 1.1. To supplement the information received from the RMAs, a search on social media platforms was conducted to gather further information into the flood events that occurred. Along with the data collected by the LLFA during and following the flood events, this enabled a better understanding of what happened prior to writing this report.

Table 1.1 Data sources

Data	Source
Actions taken before, after or during each event	EA / Merton Council / TWUL
Actions taken on previous Section 19 recommendations	Merton Council / TWUL
Detailed River Network	EA
Flooding reports	Merton Council / TWUL / Social Media
Historic flood records	Merton Council
Flood risk mapping	EA / Merton Council
Gully cleansing history	Merton Council
map16 Gully sensor information	Merton Council
Rainfall data	Merton Council / Hydromaster
Flood Alert data	EA
Return periods for each flood event	Merton Council / TWUL
Sewer network and cleansing information	TWUL
Event Duration Monitoring Combined Sewer Overflow points	TWUL
Multi-agency flood plan	Merton Council
Drainage and wastewater management plan modelling	TWUL

The available historical, topographical, drainage, and geological data was used to explore all potential flood risk sources throughout the flooded locations. The data from Merton Council was used to produce maps using a geographical information system (GIS) to show the affected locations. The hydrological catchment areas were defined using the LB Merton 2020 Level 1 Strategic Flood Risk Assessment (SFRA) which identified 19 Drainage Catchments (DCs) based upon the borough's topography, watercourse catchments, and artificial barriers to flow. These DCs can be accessed under the Surface Water Flooding tab of the 2020 LB Merton Level 1 SFRA mapping tool. Merton Council's previous Section 19 in 2018 was analysed to understand what progress was made on previous recommendations. The responsibilities of the RMAs for each hotspot / event were identified. Further information on this can be found in *Section 2*.

The results of the investigation were compiled and are outlined in this report. Recommendations on flood risk mitigation and potential next steps are provided in *Section 7.2*.

2 Risk Management Authorities

There are multiple RMAs who are responsible for managing the risks of flooding, as referred to in *Section 1.1*. These are shown in *Table* 2.1 where they are listed at a borough level. Further information on each RMA is provided below.

Table 2.1 Borough level Risk Management Authorities

Risk Management Authority	Borough-specific Authority	Flood risk management responsibilities
Environment Agency (EA)	EA	Main rivers and reservoirs
LLFA	Merton Council	Surface water, ordinary watercourses, and groundwater
Water and Sewerage Company	Thames Water Utilities Limited (TWUL)	Surface water, foul and combined sewer systems (Sewer flooding)
Highway Authority	Merton Council and Transport for London (TfL)	Public highway drainage

2.1 Environment Agency

The EA is responsible for managing flood risk from main rivers, the sea, and reservoirs. They also supervise and work with other RMAs to manage the risk of flooding. The EA has an important role in advising Local Planning Authorities on how development proposals may influence flood risk and issuing consent for works that may be on or near main rivers. They also take part in emergency planning and response to flooding events.

The eight main rivers defined by Merton Council that flow through the borough are:

- River Wandle
- Beverley Brook
- Pyl Brook (both main channel and East Branch)
- River Graveney
- Bunce's Ditch
- The Pickle
- Wandle Park side channel
- Figges Marsh Ditch.

The Pyl Brook runs through Hotspots 3 and 5 which may be a source of flooding at these locations, while the Beverley Brook runs adjacent to Hotspot 4. The EA therefore may have direct responsibilities as a RMA from these events.

2.2 Merton Council

Merton Council has multiple RMA roles, predominantly as a LLFA, but also as a Highway Authority, landowner, and a Category One responder. The LLFA's main responsibility is to manage the risk of

flooding from surface water, groundwater, and ordinary watercourses. Under the FWMA and the Flood Risk Regulations 2009 (2009/3042), they are responsible for, amongst other duties:

- Developing, implementing, maintaining, and monitoring a LFRMS.
- Maintaining a register of structures and features that have a significant effect on flood risk.
- Preparing and maintaining preliminary flood risk assessments, flood hazard maps, flood risk maps and flood risk management plans.
- Reviewing and acting as a statutory consultee on surface water drainage proposals for major developments.
- Undertaking flood risk investigations.

Other RMAs have a duty to co-operate with LLFAs where necessary to undertake the above responsibilities. The LLFA can also carry out work to help alleviate surface water, groundwater, and ordinary watercourse flooding in collaboration with other RMAs. Under the powers granted to them, the LLFA can make by-laws to ensure that flood risk management work is effective.

As a **Highway Authority**, Merton Council are responsible for providing and managing public highway assets that are not managed by Transport for London (TfL) or National Highways. Merton Council is the Highway Authority for most of LB Merton's public roads, the remainder being the responsibility of TfL. Part of their responsibility includes managing surface water drainage from the highways and minimising flooding on their roads. They are also responsible for the maintenance of roads, the highway gullies and drains that run beneath the road surface, road surfaces, and footpaths.

As a **landowner**, Merton Council have a responsibility to safeguard their own land and property against flooding. Common law also requires that they do not increase the risk of flooding to a neighbouring property through carrying out tasks such as drain clearing and maintaining any existing flood defences.

As a **Category One Responder** under the Civil Contingencies Act 2004, Merton Council plays a lead role in emergency planning and recovery after a flood event. They therefore must have plans in place ready to respond to any emergency, such as a flooding event, and make sure that they can manage or reduce the impact of the event by liaising with relevant stakeholders (including other Category One Responders). A Multi-Agency Flood Plan (MAFP) is required since LB Merton is potentially vulnerable to both fluvial and surface water flooding, with this MAFP detailing a borough-based response to a community-level assessment of flood risk.

Merton Council are responsible for leading the Raynes Park Flood Alleviation Scheme (FAS) as the LLFA, which has been developed alongside TWUL to reduce flood risk within Raynes Park. The actions associated with the Raynes Park FAS include the installation of 4G Gully Sensors in Raynes Park Town, CCTV surveys of >3km of highway drainage and sewer assets, high-pressure jet cleaning of drainage connections, increasing gully cleaning attendance, upgrading TWUL pumps, and reconstructing sewers where defective.

2.3 Thames Water Utilities Limited

TWUL is the regional water and sewerage company and is the RMA responsible for managing the risk of flooding from public sewers including surface water, foul and combined sewer systems. They must manage and maintain their water supply and sewerage systems and make sure that they are resilient to flooding. They have a duty under Section 94 of the Water Industry Act 1991 to make sure that the

area they serve is effectively drained and will continue to be effectively drained in the future. TWUL data has been used in this report to analyse local drainage and wastewater sewer networks.

As part of their responsibility for ensuring flood resilience, TWUL commissioned an independent London Flood Review following the Summer 2021 floods, which resulted in 28 recommendations being provided to reduce the future impact of such storms. These 28 recommendations are listed within Chapter 3 of the London Flood Review's Stage 4 Summary Report, and are discussed in detail within Chapter 4 of the full Stage 4 Technical Report.

TWUL is responsible for various assets in LB Merton, such as the sewer network and manholes, and are therefore involved in the Raynes Park FAS.

2.4 Transport for London

TfL are responsible for managing the operation of London's public transport network (including London Underground lines and stations) and surface water drainage along the red routes of their Strategic Road Network. TfL's red routes within LB Merton are the A3, the A24, and the A297.

2.5 Key Stakeholders

There are several Key Stakeholders within LB Merton, including landowners, Category One Responders, and Network Rail (NR).

Landowners

Landowners have the primary responsibility of safeguarding their own land and property (including private roads) against flooding. Under common law, they are also required to ensure that they do not develop their land or 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 that the measures do not cause harm to others. Riparian owners 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. Typically, they are also responsible for maintaining the banks and bed of an ordinary watercourse or main river as it passes through or adjacent to their land, up to halfway across the watercourse.

Category One Responders

Schedule 1 to the Civil Contingencies Act 2004 categorises all Local Authorities and all blue light emergency services as Category One Responders. For flood incidents within LB Merton, the most relevant services are the London Fire Brigade (LFB), the Metropolitan Police Service (MPS), and the EA. MPS co-ordinates emergency services and assists with evacuations, and LFB is responsible for saving lives, but may also pump out floodwater.

Network Rail

NR are responsible for managing the operation and maintenance of all national rail network infrastructure across LB Merton that do not fall under the responsibility of TfL.

3 Reflection on Previous Flooding Incidents

LB Merton experienced three flooding incidents during June 2016 and July and August 2017 that reached the Section 19 investigation threshold. 14 locations were affected overall, of which nine met the Section 19 investigation threshold. Several of these fourteen locations experienced flooding during the events of July 2021, namely: the Apostles area, Coombe Lane, Abbott Avenue, West Barnes Lane, and Burlington Road. These locations will be reflected on in this report to understand why these locations were affected again, and what progress has been made on the previous recommendations. *Figure 3.1* shows the locations across LB Merton that were affected during the 2016 and 2017 flood events, alongside those that were affected during the 2021 flood events.

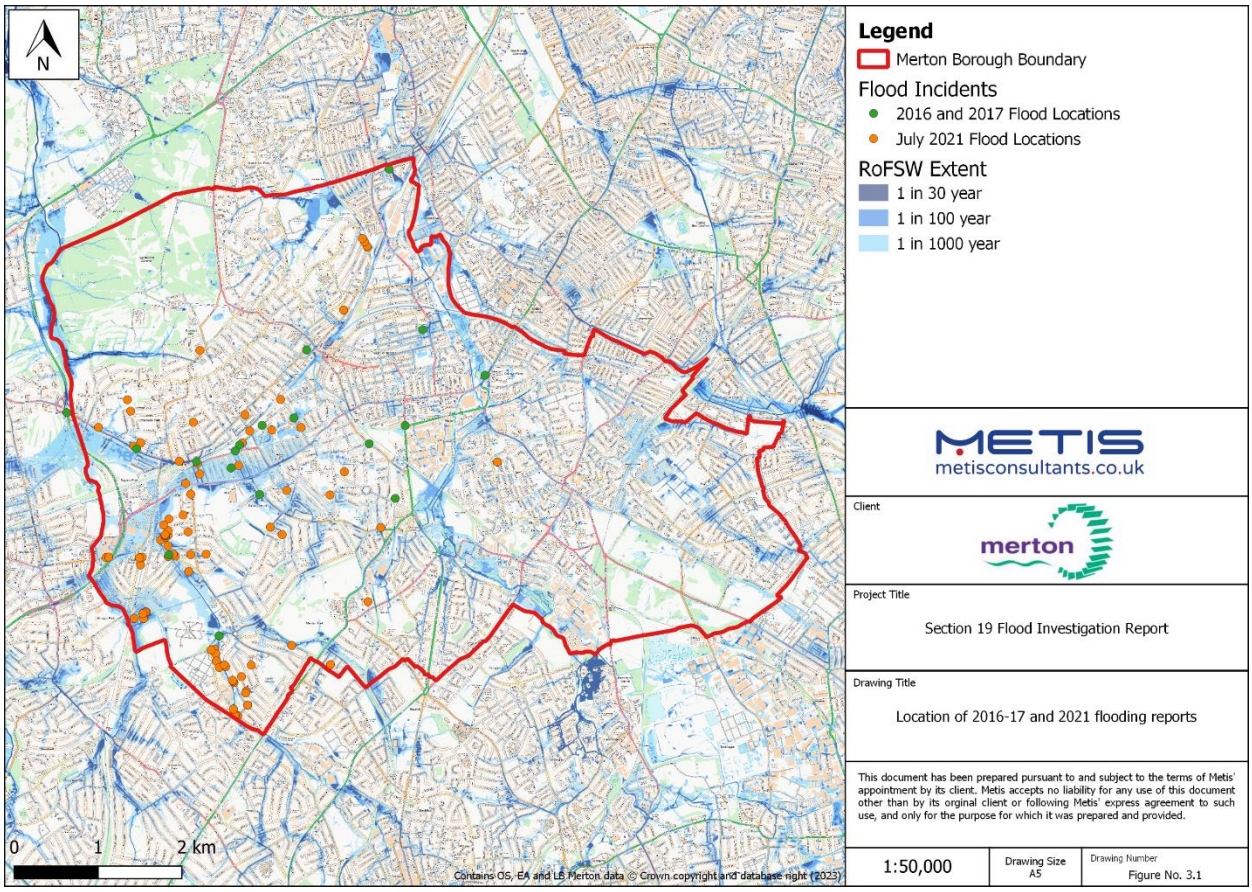

Figure 3.1: Location of 2016-17 and 2021 flooding reports across LB Merton

3.1 Summary from previous Section 19 in 2018

3.1.1 The Apostles area (including Dupont Road)

The Apostles area of Raynes Park is composed of twelve residential roads that run in a north-south direction. The road levels within the Apostles area slope towards Bushey Road, which runs along the south of these twelve roads. Flooding during the June 2016 rainfall event was caused by the blockage of the surface water sewer at the junction of Dupont Road and Dorien Road, alongside its connection via three 90° turns into the main trunk sewer on Bushey Road which also acts as a hydraulic throttle to any flow attempting to enter from the Apostles area roads.

3.1.2 Coombe Lane (including Raynes Park railway bridge)

Coombe Lane, and subsequently Raynes Park railway bridge are located in a local low point which collects water from multiple sewers that flow southwards down towards these roads. The drainage from the bridge discharges southwards into a pump station on Approach Road, and then into the Grand Drive and subsequently Bushy Road sewer. This drainage network was believed to be the predominant cause for the flooding experienced here, combined with the area also receiving a large amount of surface water runoff from higher ground. It was noted that the amount of rainfall experienced probably exceeded the designed capacity of the sewers.

3.1.3 Abbott Avenue

The predominant causes of flooding on Abbott Avenue in June 2016 and July 2017 seemed to be the high amount of foul water draining downstream of the railway line and surface water that could have potentially entered the foul system. The foul sewer surcharged on Abbot Avenue which is at a topographical low point within the catchment area, and the pumping station on Abbott Avenue failed for 12 hours due to an electrical fault however this is not believed to have increased the volume of flooding. It was believed that flooding was caused due to surface water entering the foul sewer from misconnections in the sewer network, in addition to the steeply sloping topography in the area.

3.1.4 West Barnes Lane

Flooding occurred at this location during all three flood incidents, although the Section 19 threshold was reached only during the June 2016 and July 2017 incidents. Flooding occurred to properties on West Barnes Lane due to the fall of local topography and their back-sloping driveways, meaning that any surface water runoff unable to flow into the sewer network via highway gullies was channelled towards these properties. The high level of runoff experienced due to the extreme rainfall likely exceeded the capacities of the drainage system's various components.

3.1.5 Burlington Road (including Shannon Corner junction)

The junction of Burlington Road and Shannon Corner was impacted during all three previous rainfall incidents, although Section 19 criteria were not reached. Nevertheless, this location is known to flood regularly. The likely cause of flooding during these events was a combination of the limited gradient of the Burlington Road surface water sewer, which discharges into the Pyl Brook, alongside the heavily-silted surface water sewers at Shannon Corner. These factors mean that the location is susceptible to surcharges and back flows.

3.2 Progress made on any 2018 Section 19 recommendations

The recommendations relevant to the above-mentioned areas are provided below in *Table* 3.1, with a summary of any progress that has been made since these recommendations were made.

Table 3.1 Progress made on recommendations from 2018 Section 19 report

Relevant area	Previous recommendation	Progress made
Apostles Area	Investigation or CCTV survey by TWUL of the main surface water sewer in Bushey Road and the few connections from the Apostles side roads to the main surface water sewers. Investigation of options to address the hydraulic throttle effect alongside alternatives to remove the 90º turns in the sewers to reduce blockage potential.	Progress not yet made by TWUL, but CCTV survey to be carried out in 2023. No structural changes are to be investigated.
	Collaborative drainage modelling of the area by TWUL, NR, the EA, and Merton Council, alongside identification of sustainable drainage system (SuDS) feature opportunities along and at the junctions of the twelve Apostles roads with Bushey Road. This would reduce incoming runoff into the main surface water sewer, increase its capacity potential, and provide an 'overflow' safety to the system.	As part of the Raynes Park FAS, this is being undertaken by TWUL in partnership with Merton Council, NR, and the EA. All stakeholders have been identified as being responsible for drainage assets in the catchment that could contribute to flood risk in the area. The "Raynes Park Partnership Agreement" is currently being drafted to form an overarching agreement that enables joint working between stakeholders to achieve successful flood alleviation. A number of the longer term partnership opportunities have been identified and included with TWUL's Drainage and Wastewater Management Plan (DWMP).
	CCTV investigation of the Chestnut Road sewer network by Merton Council and TWUL to identify whether surface water runoff is drained into the mapped foul sewer. If so, opportunities to disconnect the runoff from the combined network should be identified.	TWUL have confirmed that they do not have any surface water lines mapped on this road, and will organise for a network engineer to attend on-site to determine whether there are any.
	Further engagement between Merton Council and the area's street champion volunteers to provide awareness about flooding issues to other residents.	Merton Council have attended the Raynes Park Forum alongside the street champions. Communications are provided with written updates that are uploaded onto Merton's webpages, including the Raynes Park Forum meeting minutes.
Coombe Lane	Investigation of condition and operation of the pumps underneath Raynes Park railway bridge by TWUL and Merton Council, and incorporate pumps into surface water and sewer flood modelling.	Merton Council and TWUL have assessed and identified faults in the foul water sewer and Pump Station. TWUL subsequently upgraded the pumping station under the railway in 2022 and are now satisfied with their capacity to handle high flows after undertaking modelling of storm impacts. At the time of writing of this report, TWUL are handing over responsibility of the pump assets under the railway to Merton Council.

Relevant area	Previous recommendation	Progress made
	General improvements of the foul and surface water sewer networks in the local catchment by TWUL. This could be achieved in parallel to the Crossrail 2 project through close cooperation of Merton Council and TWUL with Crossrail 2 (TfL and NR). Potential improvements should assess whether the sizes of the surface water sewers are sufficient given the size of the contributing catchment, especially whether the sewer between the highway gullies and the pump capacity needs to be increased.	TWUL have agreed to investigate why surface water is overloading their foul sewer network and causing sewage flooding on streets and in people's homes. Merton Council have installed 4G gully sensors across most of Raynes Park town centre which monitor silt and water levels in the gullies they are placed in to track blocked drains. Merton Council and TWUL have undertaken a CCTV survey of 3km of sewers, with TWUL clearing 21 tonnes of silt within the surface water sewer network at Raynes Park Station through high pressure jet cleaning and Merton Council having undertaken gully clearance, upgraded pumps, and reconstructed sewers. Merton Council have inspected all gullies in this area to assess their ability to effectively function, and they have since prevented flooding to Raynes Park town centre and underneath the railway bridge post-2021 flooding. Future plans include surveying a further 3km of drains and increasing pump flows.
	Collaborative Merton Council and TWUL scheme: creation of upstream storage in Wimbledon Hill Park, Cottenham Park and/or Holland Garden should decrease the amount and rate of run off flowing towards Coombe Lane.	Not yet undertaken as of December 2022, but all options such as these will be assessed in the Raynes Park FAS optioneering study.
	Identification of SuDS feature opportunities by Merton Council along Pepys Road and Lambton Road which are upstream of Coombe Lane and are at high or medium risk of surface water flooding.	A large SuDS rain garden is being constructed at the junction of Coombe Lane, Pepys Road, and Wyke Road, funded directly through Merton Council's capital drainage budget. Merton Council have submitted two unsuccessful bids to TWUL's SWMP fund for SuDS features along Pepys Road and Worple Road.
Abbott Avenue	Full review and prioritised surveys and investigations by Merton Council and TWUL of foul and surface water sewer network(s) across the Cottenham Park area (whole area drains towards Abbott Avenue and Coombe Lane). Any additional information, mapping or previously unknown hydraulic controls should be incorporated into Merton Council's Cottenham Park critical drainage area flood risk modelling and TWUL asset records. Additional information already identified	Merton Council officers proactively participate in TWUL's drainage and asset management plans to try and ensure that TWUL include records of historic surface water flooding at places like Raynes Park and other areas of LB Merton in deciding where to prioritise their repairs and resources. TWUL have agreed to seek internal approval to embark on hydraulic modelling within Raynes Park and other areas. TWUL have collaborated with Merton Council to install CCTV over 3km of sewer network to

Relevant area	Previous recommendation	Progress made
	through survey work by TWUL should also be incorporated.	confirm that assets were performing as designed.
	Collaborative Merton Council and TWUL investigation of the connections to the network of recent private developments upstream of the pumping station to identify misconnections that may contribute surface water into the foul sewer system draining towards Abbott Avenue.	TWUL have investigated and surveyed foul and surface water assets, all of which were free-flowing and defect-free. TWUL not aware of any joint investigations with Merton Council into surface water connections.
West Barnes Lane	Investigation of the local surface water sewer network by TWUL around the affected roads to determine preferential network flow routes. Any blockages should be cleared and remedial works programmed if necessary.	TWUL working with Merton Council, NR, and the EA on the "Raynes Park Partnership Agreement" to improve the local flood alleviation strategy, which may serve to mitigate flooding at this location.
	Investigation of the culverted Pyl Brook behind properties on West Barnes Lane and the Westway by the EA. If the EA do not already hold asset information for the culvert, a survey should be taken and TWUL's sewer asset records updated.	Culvert running along West Barnes Lane surveyed in January 2021, with the apparent issue being the lateral connection with the sewer network that causes flooding on West Barnes Lane and Westway when river levels are high.
	Introduction of a small highway SuDS retrofit scheme on Adela Avenue before the raised table by Merton Council to provide additional runoff storage capacity.	Merton Council investigated and identified that the issue here was a private extension foundation that severed and blocked the TWUL surface water line into the Pyl Brook culvert. TWUL are progressing a repair, which should improve the system's capacity to manage excess runoff.
Burlington Road	Clearance of the sewer network by TWUL, particularly where siltation has been previously identified. This should also identify the preferential flow between the A3 surface water sewers and those under Burlington Road.	No progress has been made by TWUL as of January 2023.
	Introduction of a Merton, TfL and TWUL collaborative highway SuDS retrofit scheme at the available green space on the east side of Shannon Corner.	This has not been taken forward by the landowners, TfL. Merton Council have instead liaised with the developers of the Tesco site on Burlington Road regarding introducing rain gardens on their site.

4 Flood Incident Details

4.1 Rainfall Events

4.1.1 12th July Rainfall Event

The rainfall event that occurred on 12th July 2021 triggered widespread flooding across the south-east of England and London, including in LB Merton. During this event, rainfall began in London in the early afternoon and continued until late evening, with rainfall peaking within LB Merton at approximately 16:00 BST (all times included within this report are in British Summer Time [BST]). This flooding caused substantial disruption to roads across LB Merton, temporarily limiting road access to Category One responder vehicles and private vehicles in some locations. Merton Council directly received 65 reports of flooding during this event, with flooding reported to highways alongside both internal and external areas of properties. A further ten incidents of flooding were reported to social media. The majority of these flood reports occurred primarily within four 'hotspots' (described subsequently in *Section 4.3*) across the west and north-east of LB Merton.

This rainfall event primarily affected the western half of LB Merton. Hydromaster data obtained from Merton Council and visualised in *Figure 4.1* shows that the largest storm return periods of up to between 1 in 500 and 1 in 1000 years were observed in areas across LB Merton's north-west. TWUL's 2021 independent review of the July 2021 flooding events produced rainfall return period analysis during this event using Met Office data, shown in *Figure 4.2*., with much of the borough's south-west experiencing rainfall with a return period greater than 1 in 100 years. Using Rainfall Radar (RaRa) Flood Estimation Handbook 2013 (FEH13) data, TWUL network gauges have estimated return periods for this event across LB Merton of between 1 in 48 and 1 in 1171 years.

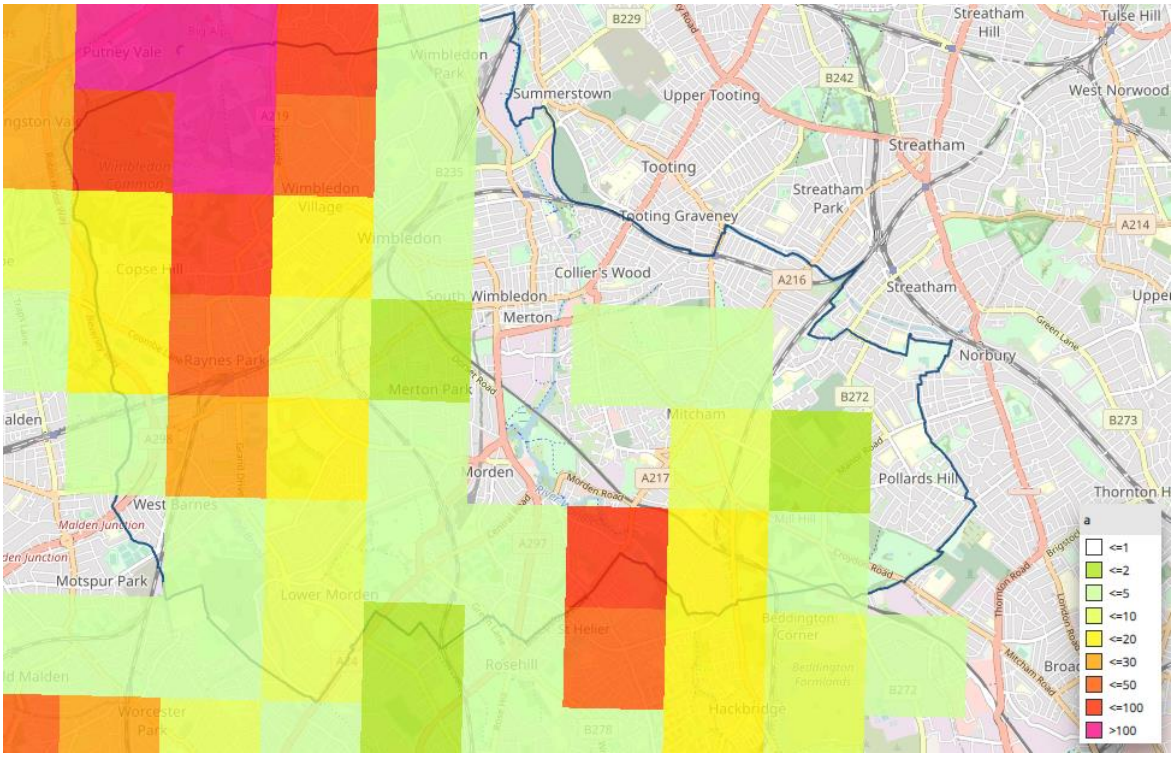

Figure 4.1: Hydromaster maximum 1 hour rainfall return period across LB Merton on 12th July 2021.

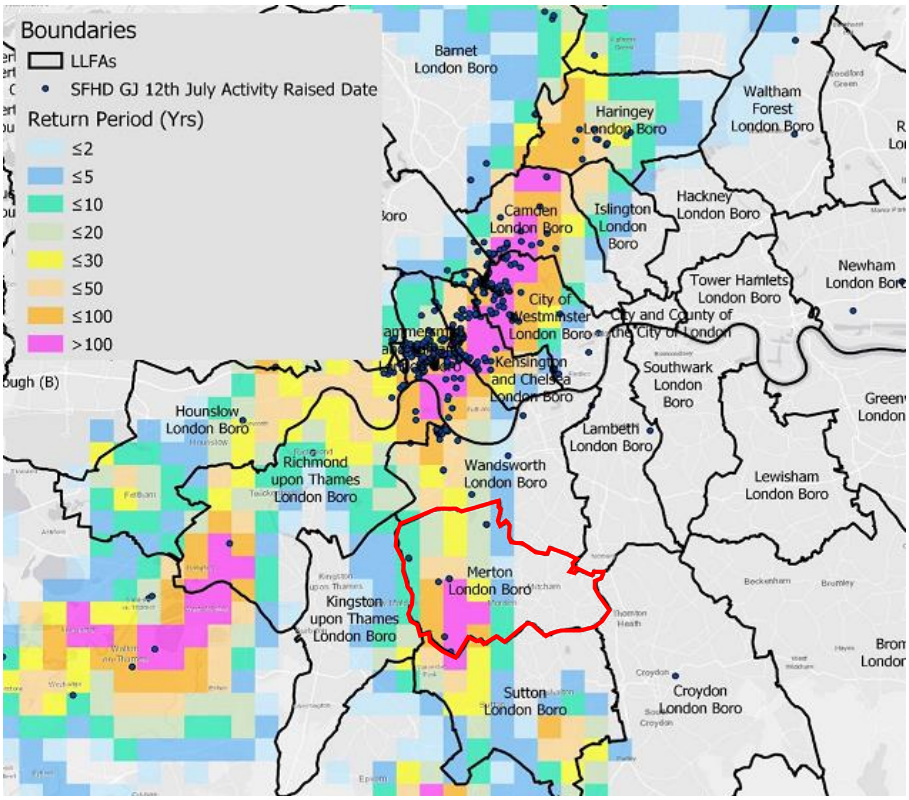

Figure 4.2: FEH 99 rainfall return period on 12th July 2021 (adapted from TWUL, 2021)

4.1.2 25th July Rainfall Event

The rainfall event that occurred on 25th July 2021 triggered substantial flooding across the south-east of England and London, including in LB Merton. During this event, light rain showers occurred periodically across London from the early morning, with LB Merton experiencing intense rainfall at approximately 14:00, after which lighter rainfall continued until the late evening. Merton Council directly received 35 reports of flooding during this event, with highways alongside both internal and external areas of properties being affected by flooding. A further two incidents of flooding were reported to social media. Most of these flood reports occurred primarily within two 'hotspots' in the south-western corner of LB Merton.

This rainfall event primarily affected the southern half of LB Merton. Hydromaster data obtained from Merton Council and visualised in *Figure 4.4* shows that largest storm return periods of up to between 1 in 75 years and 1 in 100 years were observed across LB Merton's north-western areas. TWUL's rainfall return period analysis of this event using Met Office data in their 2021 independent review is shown in *Figure 4.3*. This analysis shows that parts of the borough's south-west experienced rainfall with a return period of between 1 in 30 and 1 in 50 years. Using RaRa FEH13 data, TWUL network gauges have estimated return periods for this event of between 1 in 23 and 1 in 84 years at the affected sites across LB Merton during this event.

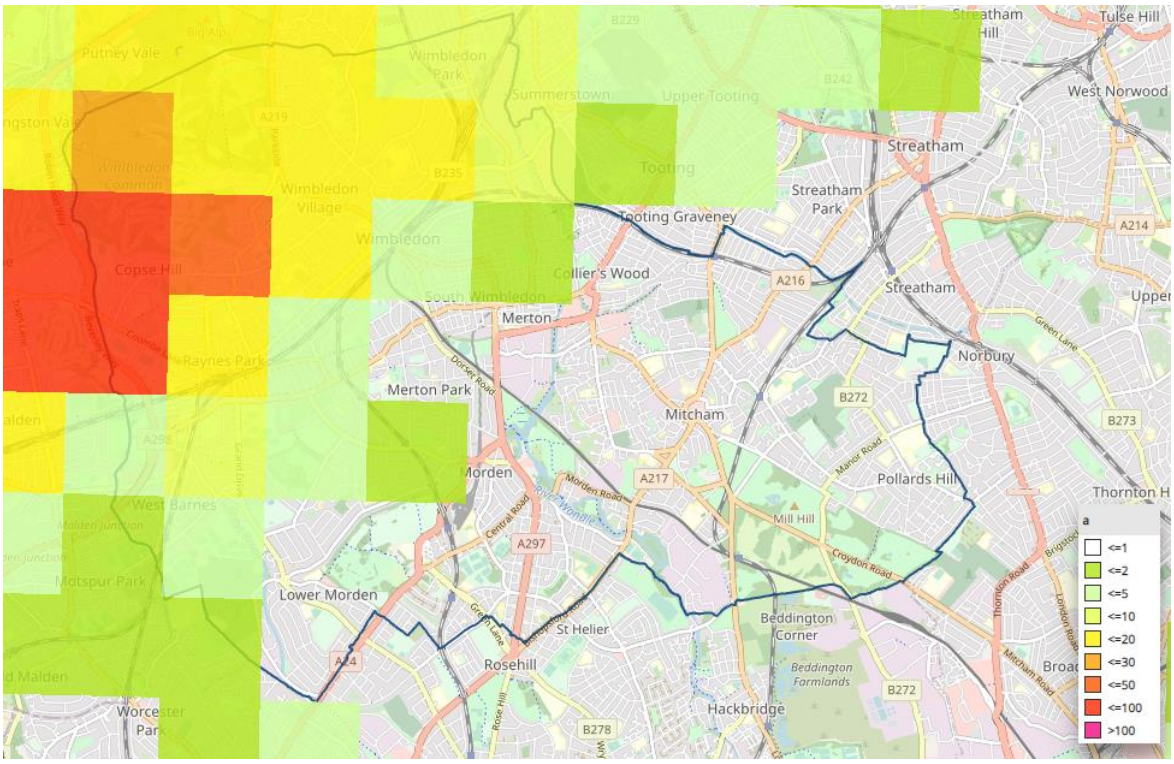

Figure 4.4: Hydromaster maximum 1 hour rainfall return period across LB Merton on 25th July 2021.

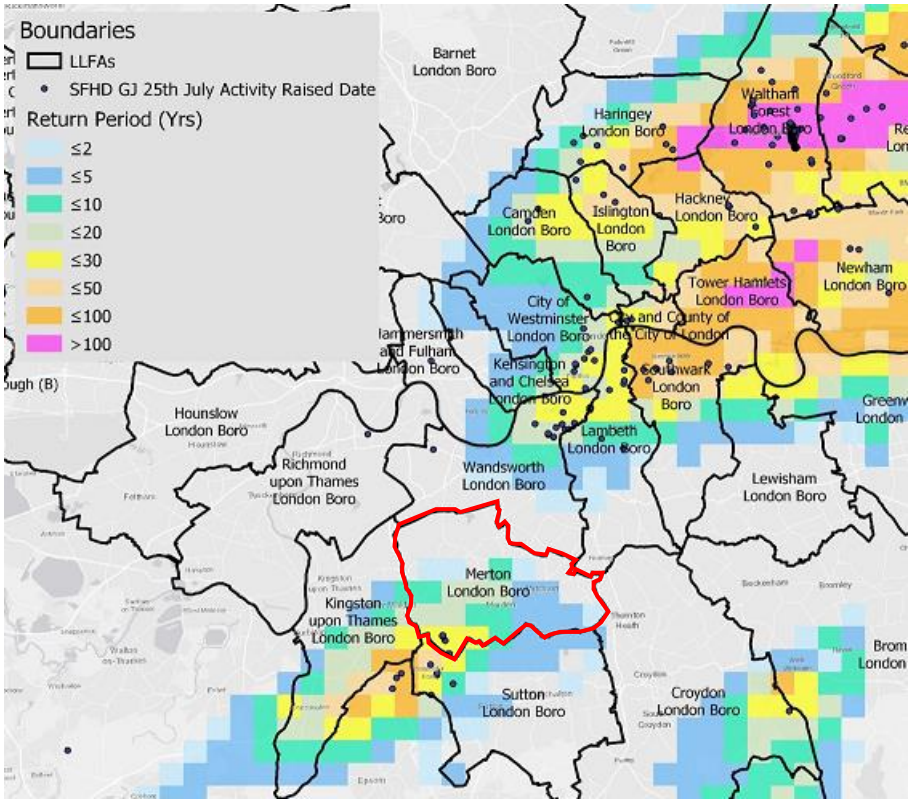

Figure 4.3: FEH 99 rainfall return period on 25th July 2021 (adapted from TWUL, 2021)

4.2 Rain Gauge Data

Rainfall data from five rain observation stations has been provided by the EA and used to assess the two July 2021 rainfall events that impacted LB Merton. Although only one of these observation stations (Colliers Wood) is situated within LB Merton's boundaries, the other four rain gauge stations lie within 1-2km of the boundary. Whilst these EA observation stations provide hourly rainfall totals, data from 10 Hydromaster gauges set up as a pin point locations in Hydromaster to measure data and set alerts provide a more localised insight into rainfall across LB Merton during the two rainfall events. *Figure 4.5* and *Figure 4.6* depict the locations of these EA observation stations and Hydromaster hotspot location gauges respectively, whilst *Tables Table* 4.1-*Table* 4.4 summarise the characteristics of the two rainfall events at each location.

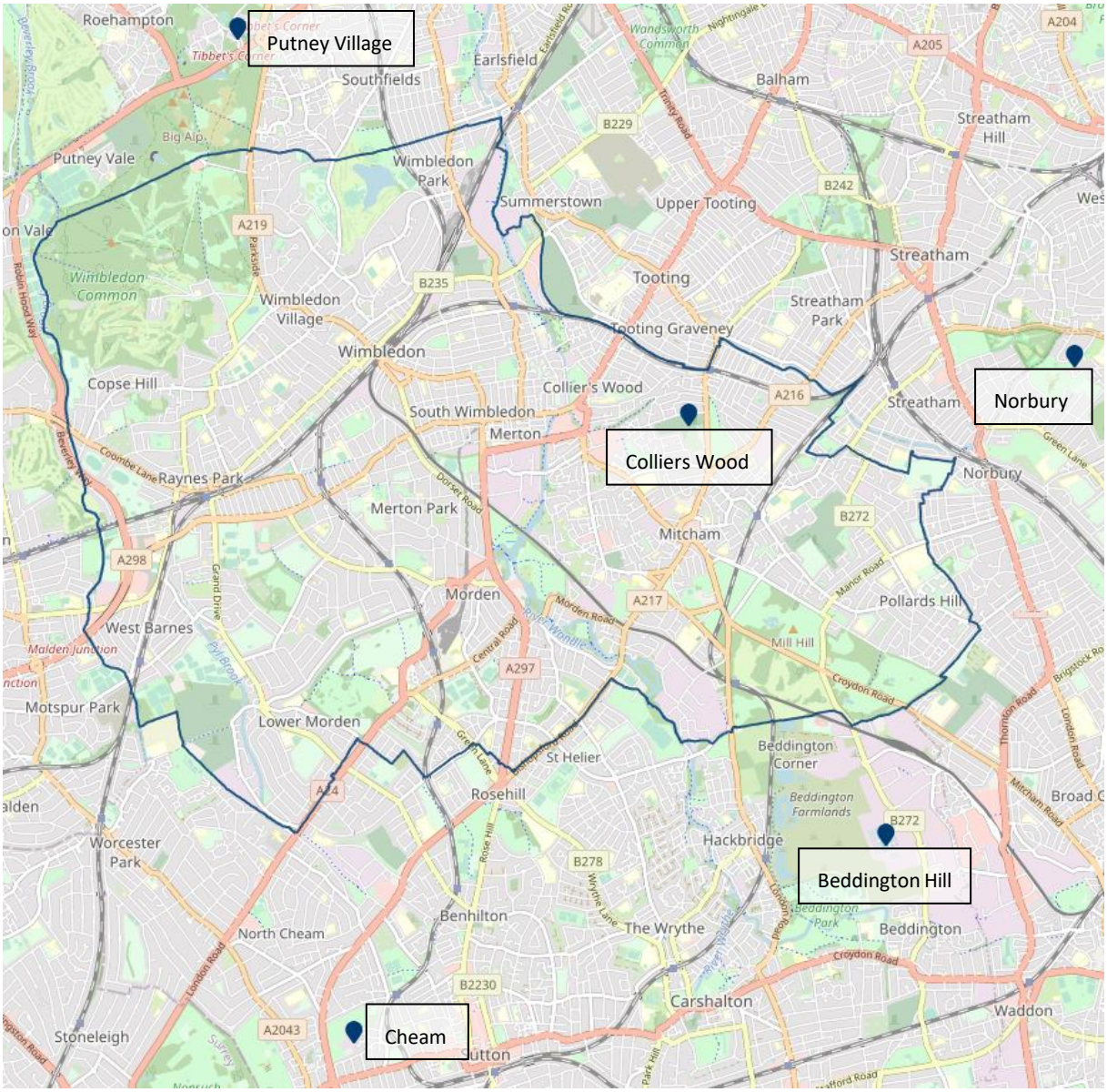

Figure 4.5: Location of local EA rain gauge stations within or nearby LB Merton (adapted from Hydromaster, 2022)

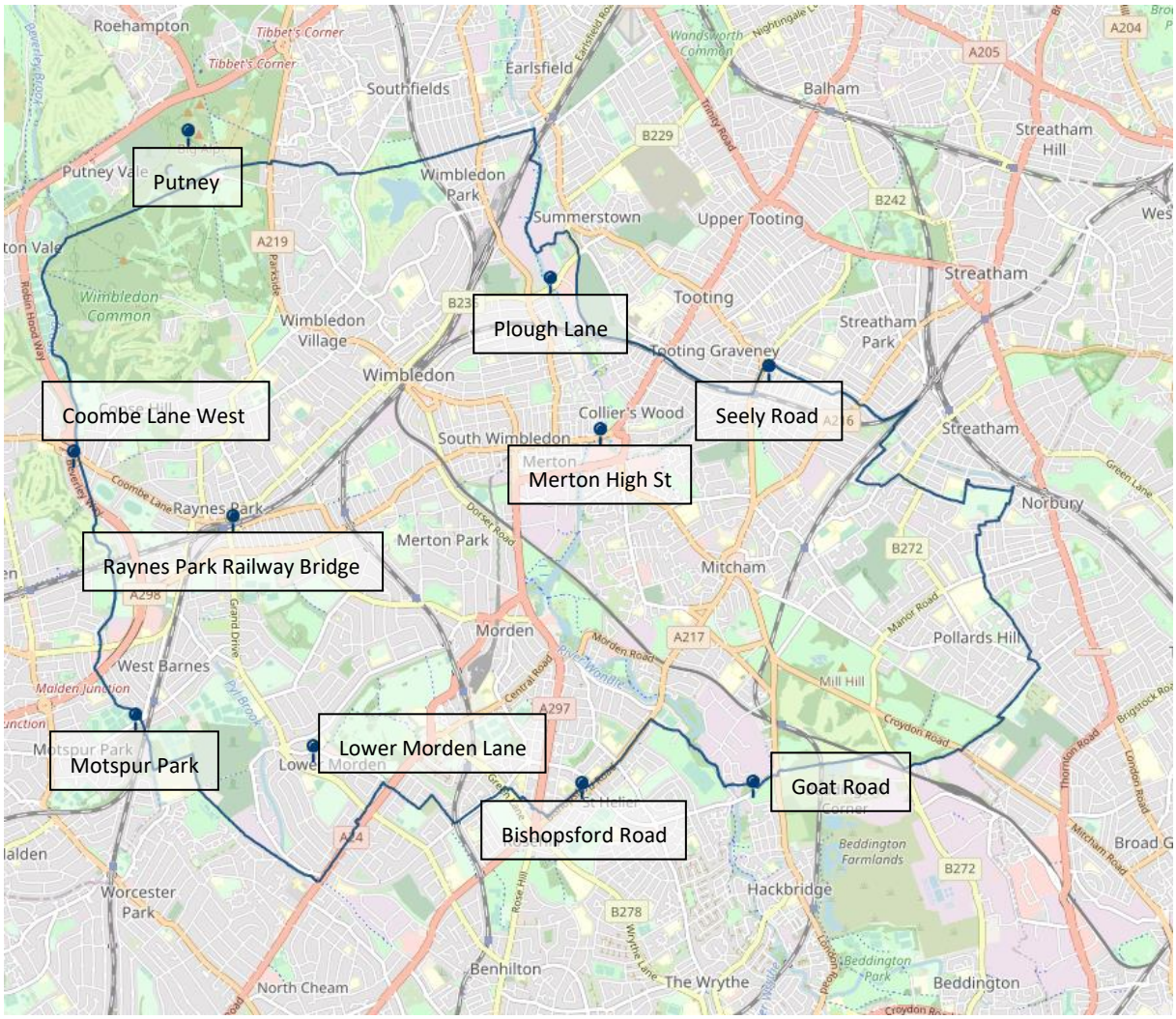

Figure 4.6: Location of local Hydromaster hotspot location gauges within or nearby LB Merton (adapted from Hydromaster, 2022)

4.2.1 12th July Rainfall Event

Hydromaster hotspot location gauges show that rainfall in LB Merton on the 12th July began just before 15:00, with hourly rainfall totals peaking between 15:55 and 17:10. However, this varied depending on location within LB Merton: while eastern areas experienced rainfall beginning earlier (from approximately 14:55-15:15) and hourly rainfall totals peaking earlier (from approximately 15:55-16:25), the western half of LB Merton experienced rainfall beginning later (from approximately 15:30-15:50) and hourly rainfall totals peaking later (from approximately 16:45-17:10). Rainfall was most intense in the north-west of LB Merton, with hourly rainfall total of 63.03mm being recorded at 16:45 at Putney gauge (located <400m from LB Merton's north-western boundary). Rainfall continued across LB Merton with varying intensities until approximately 18:00, after which only smaller instances of lighter rainfall occurred for the rest of

the evening. EA rain gauge data suggest that hourly rainfall peaked between 17:00 and 18:00 across LB Merton. *Table* 4.1 *and Table* 4.2 present rain gauge data from the EA and Hydromaster. *Figure 4.7* presents the local variations in 5-minute rainfall intensity recorded at each Hydromaster hotspot location gauge throughout the event, with the approximate location of each gauge within LB Merton relative to cardinal directions shown in the legend.

Table 4.1: EA rain gauge summary of rainfall event characteristics (12th July 2021)

Rain gauge	Location	Peak time	Peak hourly rainfall total
Putney Village	1km outside of NW borough boundary	17:00	31.30mm
Cheam	2km outside of SW borough boundary	17:00	15.90mm
Colliers Wood	North-eastern area of borough	18:00	0.70mm
Beddington Hill	1.1km outside of SE borough boundary	18:00	2.00mm
Norbury	1.6km outside of E borough boundary	00:00 (13th July)	0.20mm

Table 4.2: Hydromaster hotspot location gauge summary of rainfall event characteristics (12th July 2021)

Rain gauge	Location	Peak time	Peak hourly rainfall total
Coombe Lane West	Western area of borough	16:00	24.2mm
Motspur Park	South-western area of borough	16:00	6.7mm
Putney	400m outside of NW borough boundary	16:00	58.7mm
Raynes Park Railway Bridge	Central-western area of borough	16:00	35.3mm
Lower Morden Lane	South-western area of borough	16:00	20.7mm
Plough Lane	Northern area of borough	16:00	4.9mm
Bishopsford Road	20m outside of S borough boundary	15:00	10.9mm
Merton High St	Central-eastern area of borough	15:00	3.2mm
Goat Road	South-eastern area of borough	15:00	24.3mm
Seely Road	Eastern area of borough	15:00	7.3mm

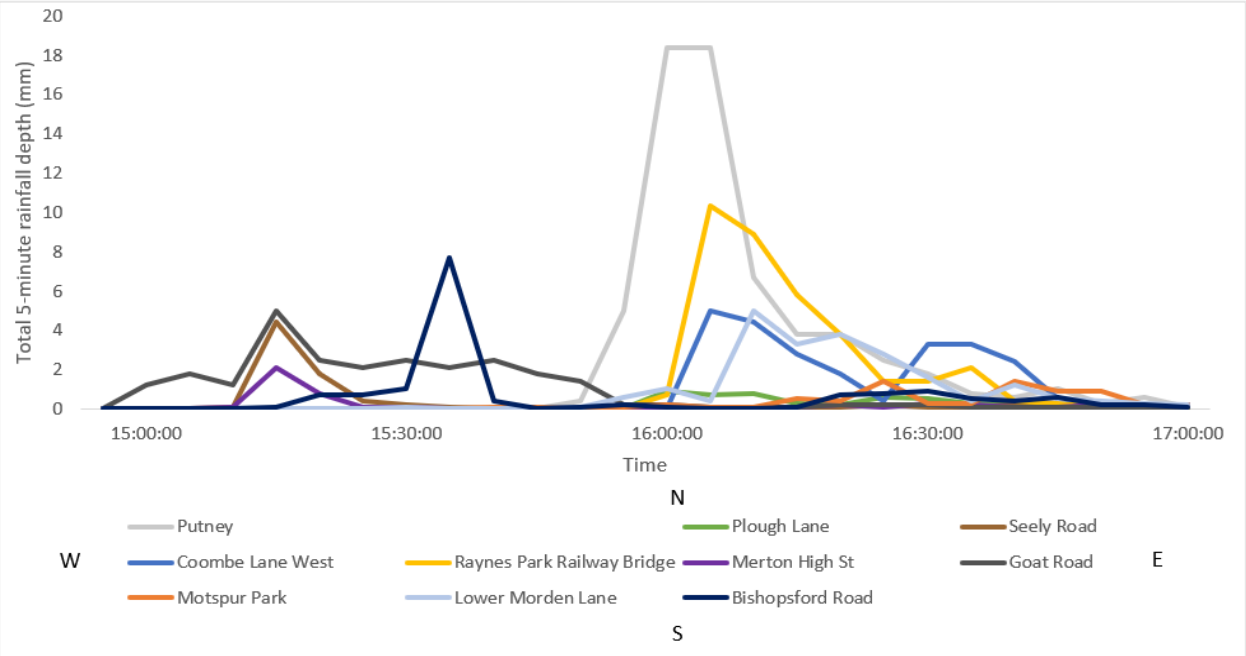

Figure 4.7: 12th July 2021 Hydromaster hotspot location gauge total 5-minute rainfall

4.2.2 25th July Rainfall Event

Hydromaster hotspot location gauge data show that rainfall on the 25th July in LB Merton began in the form of several short, low-intensity showers that occurred sporadically between approximately 04:00 and 13:30. The rainfall that caused flooding on 25th July arrived into the northern areas of LB Merton by approximately 13:50 and reached the southern areas by approximately 14:00. Hourly rainfall totals at the 10 Hydromaster hotspot location gauges peaked from 14:45-14:55 and 14:55-15:05 across the northern and southern halves of LB Merton, respectively. Rainfall intensity was greatest across the west of LB Merton, with peak hourly rainfall totals of 38.17mm recorded at Coombe Lane West gauge. Following the highest-intensity rainfall, lower-intensity showers continued until approximately 22:00. Overall, this rainfall event was less intense than the 12th July event. EA rain gauge data indicate that rainfall during this event peaked between 14:00 and 16:00. *Table* 4.3 *and Table* 4.4 present rain gauge data from the EA and Hydromaster. *Figure 4.8* presents the local variations in 5-minute rainfall intensity recorded at each Hydromaster hotspot location gauge throughout the event, with the approximate location of each gauge within LB Merton relative to cardinal directions shown in the legend.

Table 4.3: EA rain gauge summary of rainfall event characteristics (25th July 2021)

Rain gauge	Location	Peak time	Peak hourly rainfall total
Putney Village	1km outside of NW borough boundary	16:00	8.2mm
Cheam	2km outside of SW borough boundary	15:00	7.9mm
Colliers Wood	Eastern area of borough	15:00	11.9mm
Beddington Hill	1.1km outside of SE borough boundary	14:00	10.0mm
Norbury	1.6km outside of E borough boundary	15:00	4.8mm

Table 4.4: Hydromaster hotspot location gauge summary of rainfall event characteristics (25th July 2021)

Rain gauge	Location	Peak time	Peak hourly rainfall total
Coombe Lane West	Western area of borough	14:00	38.2mm
Motspur Park	South-western area of borough	14:00	7.3mm
Putney	400m outside of NW borough boundary	14:00	21.2mm
Raynes Park Railway Bridge	Central-western area of borough	14:00	26.8mm
Lower Morden Lane	South-western area of borough	14:00	9mm
Plough Lane	Northern area of borough	14:00	16.9mm
Bishopsford Road	20m outside of S borough boundary	14:00	5.8mm
Merton High St	Central-eastern area of borough	13:00	5.8mm
Goat Road	South-eastern area of borough	14:00	2.9mm
Seely Road	Eastern area of borough	13:00	6.1mm

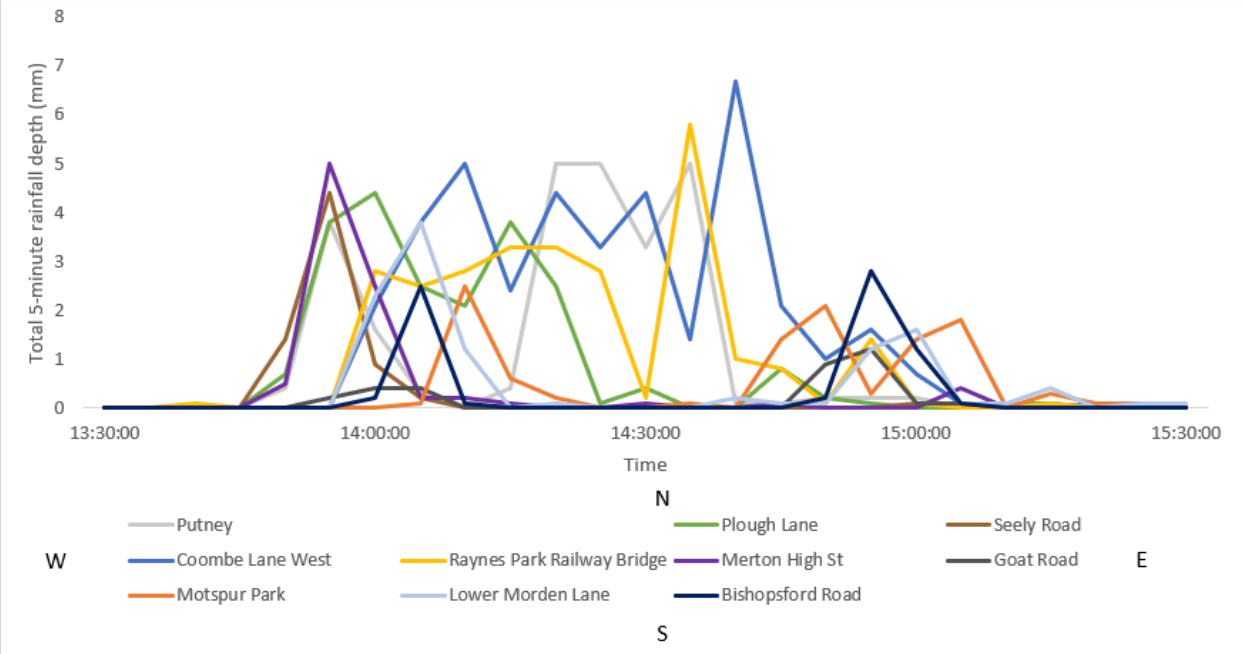

Figure 4.8: 25th July 2021 Hydromaster hotspot location gauge total 5-minute rainfall

4.3 Affected Locations, Hydrological Catchments and Hotspots

During the rainfall events of the 12th and 25th July 2021, residents reported instances of flooding to Merton Council and on various social media platforms. Merton Council undertook a further public consultation exercise to ensure that residents and businesses had a further opportunity to report information on these flood events online. This consultation exercise generated a further 19 and four responses for the 12th July and 25th July events, respectively, with flood reports concentrated within the highly-affected areas primarily across LB Merton's west. For the 12th July event, LB Merton directly received a total of 65 flooding reports by residents from 35 different streets across the borough, whilst 10 social media reports of flooding across 4 different streets were recorded. For the 25th July event, Merton Council received a total of 35 flooding reports by residents from 21 different streets across the borough, whilst 2 social media reports of flooding across 2 different streets were recorded. A total of nine incidents of internal flooding were reported to Merton Council during the 12th July event, whilst Merton Council received four reports of internal flooding during the 25th July event.

As there were a large number of flood reports during the two rainfall events, it is not possible to investigate each specific incident of flooding. Five hotspots were therefore identified, separating areas across LB Merton where flood reports were clustered. These hotspots were selected to facilitate improved analysis of the mechanisms and impacts of flooding at each hotspot during the two rainfall events, and provide clear recommendations for actions that can be taken within each hotspot to reduce the risk of similar flood incidents occurring in future. Nevertheless, there were a few instances of flooding to locations outside of these five hotspots.

Merton Council have defined various hydrological catchments across the borough, which can be accessed on the Surface Water Flooding tab of the 2020 LB Merton Level 1 SFRA mapping tool.

Figure 4.9 and *Figure 4.10* display the locations of the flood reports within LB Merton during the 12th and 25th July 2021 events respectively, alongside their respective hotspots. *Sections 5.1-5.3* and *Sections 6.1-6.2* provide analysis of flood mechanisms within each hotspot for the rainfall events of 12th July 2021 and 25th July 2021 respectively.

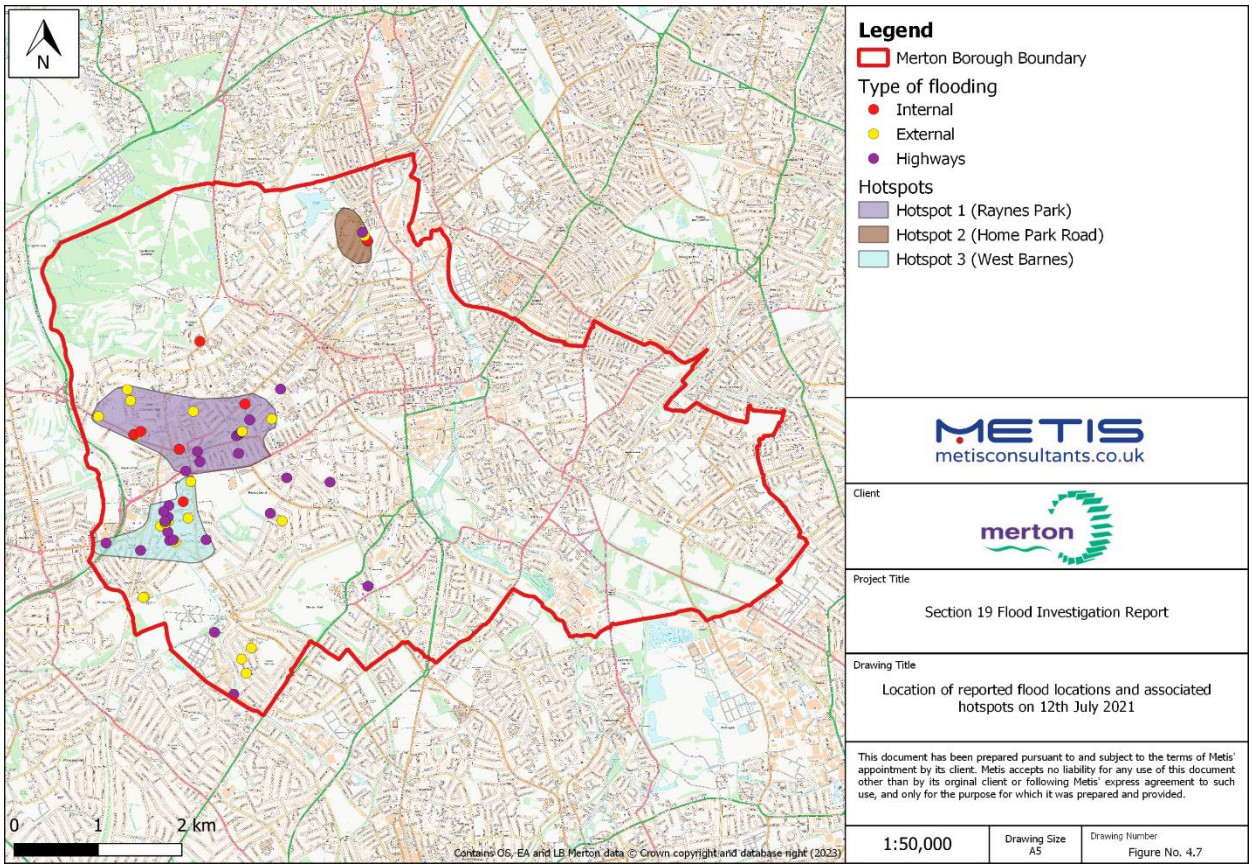

Figure 4.9: Location of reported flood locations and associated hotspots on 12th July 2021

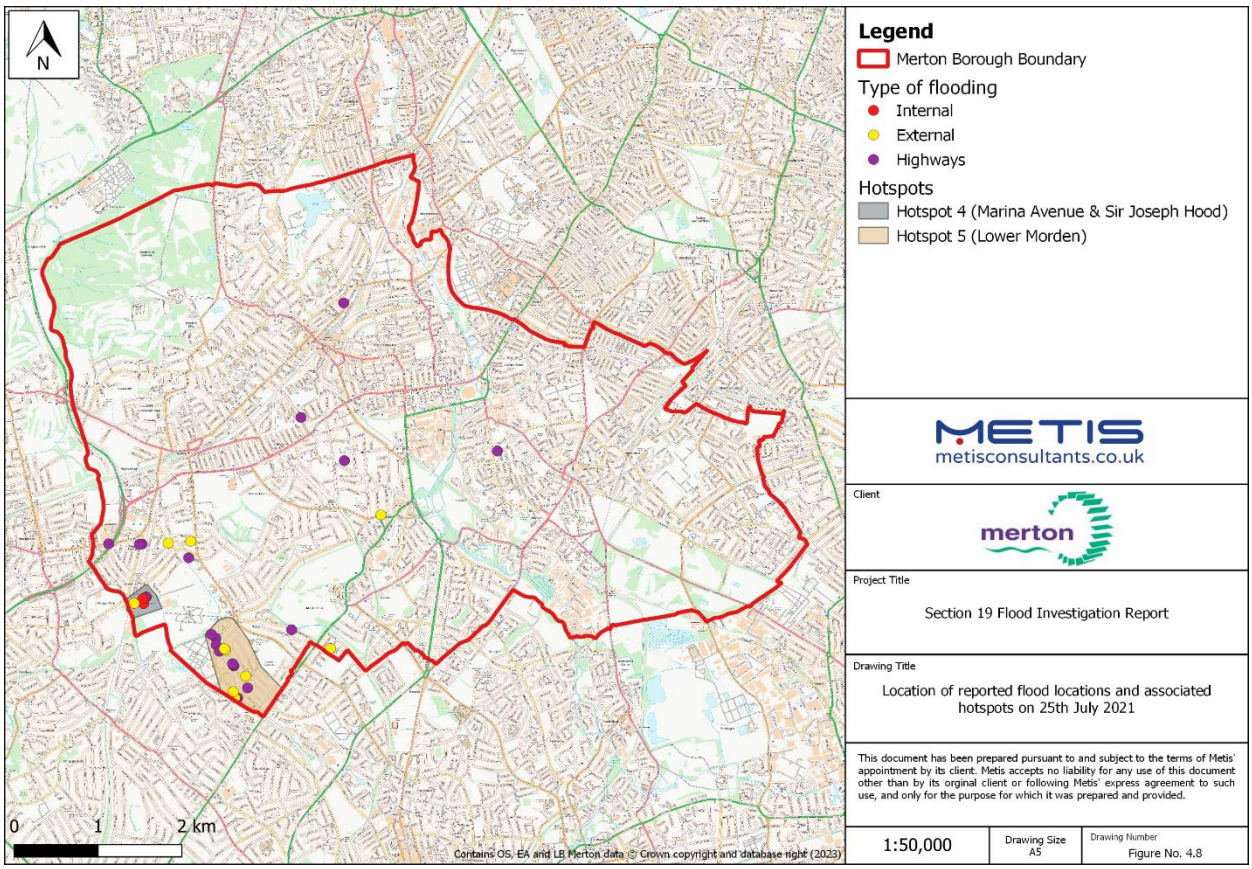

Figure 4.10: Location of reported flood locations and associated hotspots on 25th July 2021

Due to the high number of flood reports received during these events, 14 different locations across seven hydrological catchments and five hotspots have been distinguished. Splitting the flood reports into these locations enables more efficient analysis of the primary flood locations across LB Merton where multiple reports of flooding occurred and provides a clearer structure to the investigation. Analysis of these locations enables identification of specific areas that reached Merton Council's threshold criteria to trigger a Section 19 investigation as defined in Figure 5-2 of the 2015 LB Merton LFRMS. Classifying these flood events into three categories based on flood extent aided in determining whether Section 19 threshold criteria were met. These categories were:

- Internal flooding, involving flooding that occurred to inside areas of buildings (including basements)
- External flooding, involving flooding that occurred inside property boundaries but not to buildings themselves (including gardens and driveways)
- Highways flooding, involving flooding that occurred to pavements and roads.

The flood mechanism for each location varied, with most flooding being a result of surcharging gullies. This can occur due to blockages, defects, or siltation within the main sewer that limits its capacity to manage high volumes of surface water runoff, or due to the sewer network design capacity being exceeded following extreme rainfall events. In Nevertheless, local topography characteristics often also resulted in a combination of surface water flooding and sewer flooding, whilst flooding from fluvial sources also occurred on the 25th July event. In general, highway and sewer drainage systems are designed to standards that manage flows during rainfall events with return periods of up to 1 in 5 years and up to 1 in 30 years, respectively. During the two flood events, some locations across LB Merton other than these primary locations were affected by flooding; however, flood reports in these locations were sporadic and were limited to highways and/or external areas, and therefore would not have met Section 19 threshold criteria.

Table 4.5 details the primary locations of these flood events, their hotspot, their hydrological catchments, and their estimated maximum return period for each flood event. The Hydromaster return period data were sourced from Hydromaster data obtained from Merton Council, whilst TWUL return periods were sourced from TWUL FEH13 model data in which each location's return period was obtained from the highest value from the 1km^2 grid cell covering the location and the 8 adjacent grid cells.

Key for *Table* 4.5:

✓ = Flooding occurred and Section 19 threshold was reached

* = Flooding occurred, but Section 19 threshold was not reached

X = No flooding occurred

Table 4.5: Reference table of the fourteen primary flooded locations across LB Merton

Flooding Location Number	Location	Hotspot	Hydrological catchment	Flooding Event Date and maximum Hydromaster return period		Flooding Event Date and maximum TWUL FEH13 return period		Reference in the report
				12th July 2021	25th July 2021	12th July 2021	25th July 2021	
1	Coombe Lane area (incl. Raynes Park railway bridge)	1 – Raynes Park	DC28	✓ 1 in 50 to 1 in 100 yr	X	✓ 1 in 393.2 yr	X	*Chapter 5.1, p.23*
2	Abbott Avenue		DC27	✓ 1 in 5 to 1 in 10 yr		✓ 1 in 393.2 yr		*Chapter 5.1, p.23*
3	Worple Road and Lower Downs Road		DC27 / DC28	✓ 1 in 10 to 1 in 20 yr		✓ 1 in 177.86 yr		*Chapter 5.1, p.23*
4	Apostles area (incl. Dupont Road)		DC27 / DC29	* 1 in 50 to 1 in 100 yr		* 1 in 393.2 yr		*Chapter 5.1.8, p.38*
5	Home Park Road	2 – Home Park Road	DC16 / DC18	✓ 1 in 2 to 1 in 5 yr	X	✓ 1 in 48.4 yr	X	*Chapter 5.2, p.36*
6	Westway	3 – West Barnes	DC29	* 1 in 20 to 1 in 30 yr	X	* 1 in 1120.75 yr	X	*Chapter 5.3.1, p.46*
7	West Barnes Lane		DC29 / DC30	* 1 in 20 to 1 in 30 yr	* 1 in 10 to 1 in 20 yr	* 1 in 1120.75 yr	* 1 in 22.79 yr	*Chapter 5.3.1, p.46*
8	Burlington Road and Shannon Corner junction		DC30	* 1 in 2 to 1 in 5 yr	* 1 in 2 to 1 in 5 yr	* 1 in 122.44 yr	* 1 in 23.33 yr	*Chapter 5.3.2, p.47*

Flooding Location Number	Location	Hotspot	Hydrological catchment	Flooding Event Date and maximum Hydromaster return period		Flooding Event Date and maximum TWUL FEH13 return period		Reference in the report
				12th July 2021	25th July 2021	12th July 2021	25th July 2021	
9	Marina Avenue	4 – Marina Avenue & Sir Joseph Hood	DC30	* 1 in 2 to 1 in 5 yr	✓ 1 in 2 to 1 in 5 yr	* 1 in 1170.51 yr	✓ 1 in 76.31 yr	*Chapter 6.1, p.49*
10	Sir Joseph Hood			X	✓ 1 in 2 to 1 in 5 yr	X	✓ 1 in 22.79 yr	*Chapter 6.1, p.49*
11	Lynmouth Avenue	5 – Lower Morden	DC33	X	* 1 in 2 to 1 in 5 yr	X	* 1 in 78.03 yr	*Chapter 6.2.1, p.57*
12	Kingsbridge Road			* 1 in 10 to 1 in 20 yr	* <= 1 in 1 yr	* 1 in 1126.3 yr	* 1 in 78.03 yr	*Chapter 6.2.1, p.57*
13	Garth Road			X	* 1 in 2 to 1 in 5 yr	X	* 1 in 84.25 yr	*Chapter 6.2.1, p.57*
14	Wydell Close, Rosebery Close, Essex Close, Garth Close				* 1 in 2 to 1 in 5 yr		* 1 in 78.03 yr	*Chapter 6.2.2, p.58*

5 12TH JULY EVENT

5.1 Hotspot 1 – Raynes Park

The Raynes Park Hotspot is located in the west of LB Merton as shown in *Figure 4.9*, and contains the wards of Raynes Park, Village, Hillside, and Dundonald. This hotspot generally corresponds with Drainage Catchment (DC) DC28, but also covers the northern portions of DC26, DC27 and DC29 as defined on the Surface Water Flooding tab of the LB Merton 2020 Level 1 SFRA mapping tool.

5.1.1 Areas affected

The four main areas within this hotspot that were impacted by flooding during this event are shown in *Figure 5.1*. These are locations 1-4 in *Table* 4.5 and are namely:

- The Coombe Lane area (including Raynes Park Railway Bridge)
- Abbott Avenue
- Worple Road and Lower Downs Road
- The Apostles Area (including Dupont Road).

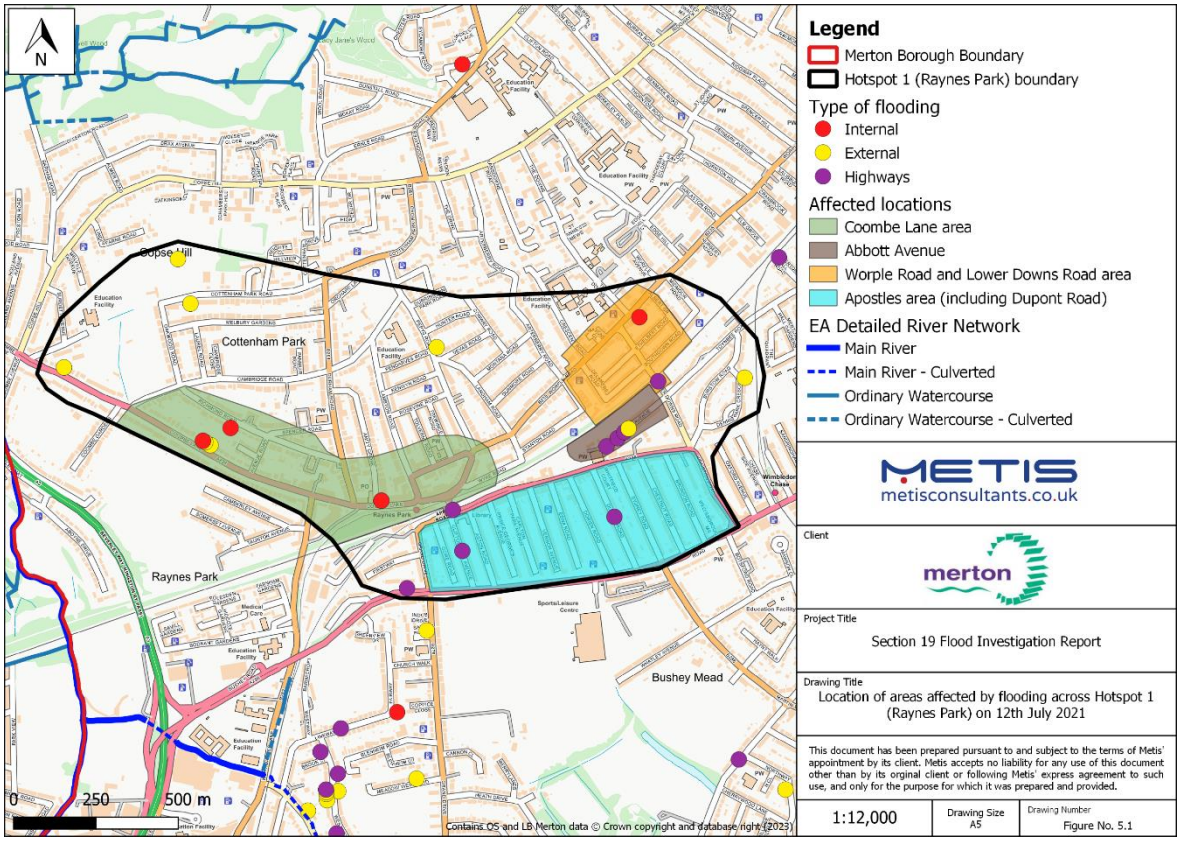

Figure 5.1: Location of areas affected by flooding across Hotspot 1 (Raynes Park)

Flooding at this hotspot began at approximately 16:00 on the 12th July 2021 and resulted in internal flooding to two residential properties on Coombe Lane and Richmond Road, and to several commercial properties along Coombe Lane near Raynes Park railway station. Basement areas of properties along Worple Road near the junction with Lower Downs Road were also impacted during this event. Flooding to external areas of properties also occurred throughout this hotspot, whilst

highway flooding resulted in the MPS closing access to Coombe Lane, Abbott Avenue, Worple Road, and the railway underpasses at Lower Downs Road and Approach Road (as shown in *Figure 5.2* and *Figure 5.3*), thus impacting access routes for emergency services. The most severe flooding occurred along Coombe Lane where floodwaters were deepest running parallel to the railway embankment and within the underpass, shown in *Figure 5.3*.

Figure 5.2: Flooding to the Lower Downs Road underpass on 12th July 2021 (Resident's photo submitted to Merton Council)

Figure 5.3: Flooding to the Approach Road underpass in Raynes Park on 12th July 2021 (Resident's photo submitted to Merton Council)

The TWUL Sewer Flooding History Database (SFHD) indicates that postcode areas SW20 0 and SW20 8 experienced three and five instances of sewer flooding respectively during this event. Most of the Coombe Lane area is situated within postcode area SW20 0, while postcode area SW20 8 contains the remainder of the Coombe Lane area alongside the entirety of Abbott Avenue and the Worple Road and Lower Downs Road location.

Due to the internal flooding to residential and commercial properties, alongside closure of several roads to emergency vehicles, flooding to the Coombe Lane area (including Raynes Park Railway Bridge) during this event therefore reached the "Risk to residential property" and "Risk to commercial property" Section 19 threshold criteria as defined in *Figure 1.1*. As access to Abbott Avenue and Lower Downs Road were also closed during this event, flooding to both the Abbott Avenue location and the Worple Road and Lower Downs Road location also met the "Risk to transport" Section 19 threshold criteria. Despite the Apostles Area experiencing flooding during this rainfall event, this was limited solely to external areas of properties and to highways (although access to emergency vehicles was not inhibited) and therefore the Section 19 threshold criteria were not reached in the Apostles Area. Consequently, flooding to the three primary locations within this hotspot (the Coombe Lane area, Abbott Avenue, and Worple Road and Lower Downs Road) will be investigated fully in the subsequent sub-chapters, whilst flooding to Abbott Avenue will be investigated in less depth.

The Hydromaster hotspot location gauge located within the Raynes Park Hotspot indicates that total 5-minute rainfall peaked at 10.32mm at 16:05, whilst hourly rainfall totals using 5-minute time series data peaked at 35.31mm at 16:55. Hydromaster datasets estimated rainfall across this hotspot to have a maximum return period of between 1 in 50 and 1 in 100 years, whilst TWUL FEH13 data indicated maximum return periods of between 1 in 178 and 1 in 393 years across this hotspot.

5.1.2 Local drainage network

The local TWUL sewer networks at the three primary affected locations within this hotspot are shown in *Figures Figure* 5.4-*Figure* 5.6. This dataset was obtained directly from TWUL.

Local drainage: Coombe Lane

In the Coombe Lane area, many surface water sewers flow towards Coombe Lane in a north-south direction through Lambton Road and Pepys Road, and in an east-west direction through Wyke Road. These surface water sewers then flow along Coombe Lane in a westerly direction towards the Beverley Brook at the boundary of LB Merton and the Royal Borough of Kingston upon Thames, and also to the surface water sewer located to the south of the railway bridge. The surface water sewer network at this location includes a 610mm diameter pipe and a 530mm diameter pipe which converge into a 610mm diameter pipe at the junction of Worple Road and Pepys Road. A 460mm diameter surface water pipe on Wyke Road then merges with this 610mm diameter surface water pipe at its junction with Pepys Road, forming a 1120mm diameter surface water pipe that runs along Pepys Road towards Coombe Lane. This location's surface water sewer network also includes a 460mm diameter pipe from Worple Road and Lambton Road that runs towards Coombe Lane, joining a 915mm diameter pipe on the intersection of Lambton Road and Coombe Lane. There are pumps located to the south of the railway underpass on Approach Road that are connected to a 225mm diameter surface water sewer pipe.

Map16 gully sensor data provided by Merton Council show that the highway gullies in the Coombe Lane area were part of Merton Council's high-priority cleansing programme (whereby they are cleaned at least once annually and on an ad hoc basis following reports of blocked gullies at specific locations) during 2018/19 and 2019/20. Although Map16 data show that gullies along Coombe Lane had last been cleaned in June 2021 and were therefore part of the 2020/21 high-priority cleansing programme, gullies located below the railway line had most recently been cleaned in March 2020 prior to the July 2021 flood event.

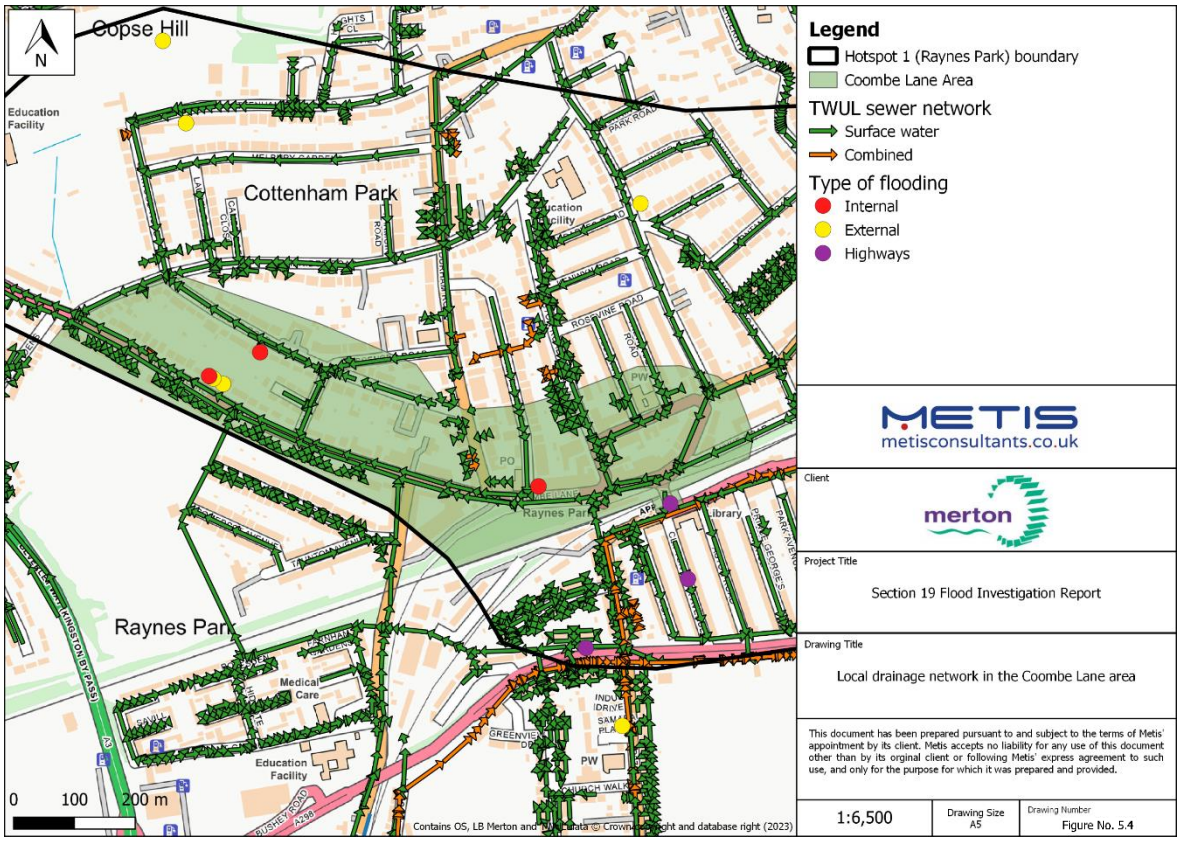

Figure 5.4: Local drainage network in the Coombe Lane area

Local drainage: Abbott Avenue

In Abbott Avenue, the local drainage network is comprised of a 225mm diameter surface water sewer and a 500mm x 1250mm attenuation tank that flow in a north-easterly direction along Abbott Avenue before being diverted south onto Kingston Road below an existing footpath. Another surface water pipe (dimensions unspecified) receives flow from Toynbee Road and flows in a south-westerly direction from the eastern end of Abbott Avenue before being diverted into the same Kingston Road surface water pipe. Two foul sewers also join at Abbott Avenue, one of which has a 460mm diameter pipe and receives flow from the Abbott Avenue foul pumping station.

As stated in Merton Council's previous Section 19 report, the highway gullies in Abbott Avenue were added to Merton Council's high-priority cleansing programme after the 2016 flooding incident for 2016/17 and 2017/18. Map16 gully sensor data provided by Merton Council show that these gullies continued to be part of LB Merton's high-priority cleansing programme during 2018/2019 and 2019/20. This means that they are cleaned at least once annually and on an ad hoc basis following reports of blocked gullies. However, Map16 data also show that prior to the flooding incident, gullies in Abbott Avenue had not been cleaned since March 2020. This indicates that they may not have been included in the 2020/21 high-priority cleansing programme, although it is possible that they were included but had not yet been cleaned prior to the July 2021 flood event.

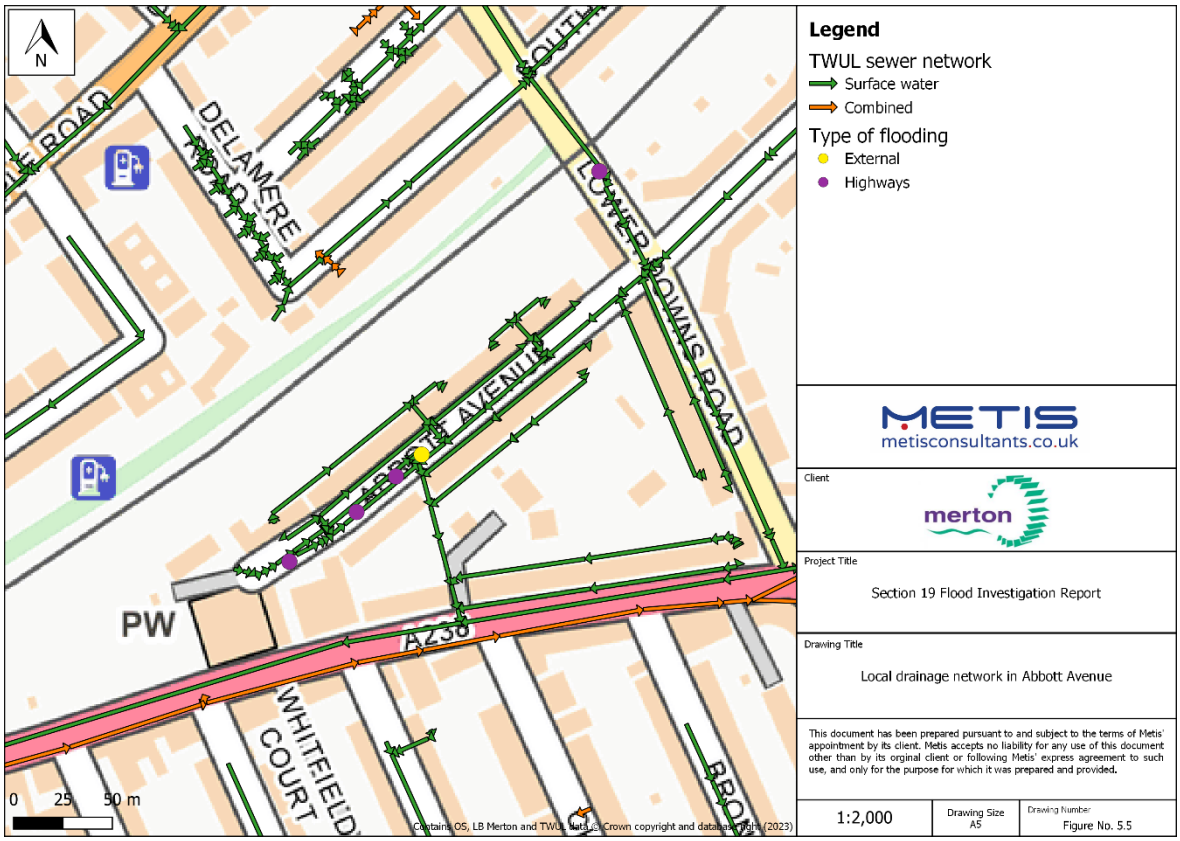

Figure 5.5: Local drainage network in Abbott Avenue

Local drainage: Worple Road and Lower Downs Road

The local drainage network at the Worple Road and Lower Downs Road location is comprised of surface water sewers that flow in a west-east direction along Worple Road towards Coombe Lane, and many surface water sewers along adjacent roads that converge onto Lower Downs Road and subsequently flow in a north-south direction towards the railway underpass on Lower Downs Road. Specifically, a 530mm diameter surface water pipe flows along Worple Road, having received flow from smaller 230mm diameter surface water pipes converging from the higher-elevation roads (The Downs and Worple Avenue) situated immediately adjacent to the affected location. The 230mm diameter surface water pipe flowing in a southerly direction along Lower Downs Road towards the railway underpass receives flow from the 230mm diameter surface water pipes that flow from Albert Grove, Delamere Road, Midmoor Road and Pentney Road and converge onto the 230mm diameter surface water pipes on Ethelbert Road and Southdown Road, which subsequently converge into the 230mm diameter surface water pipe on Lower Downs Road. There are also several combined sewers converging from properties onto the surface water sewer on Ethelbert Road.

Map16 gully sensor data provided by Merton Council show that the highway gullies along Worple Road were part of Merton Council's high-priority cleansing programme during 2018/19, 2019/20 and 2020/21, having been cleaned at least once annually and on an ad hoc basis following reports of blocked gullies. Map16 data also show that prior to the flooding incident, Worple Road's gullies had last been cleaned in June 2021. Although Map16 data show that the gullies on Lower Downs Road (including those below the railway) were part of Merton Council's high-priority cleansing

programme during 2018/19 and 2019/20, the last time that these gullies were routinely cleaned prior to the July 2021 flooding was in March 2020.

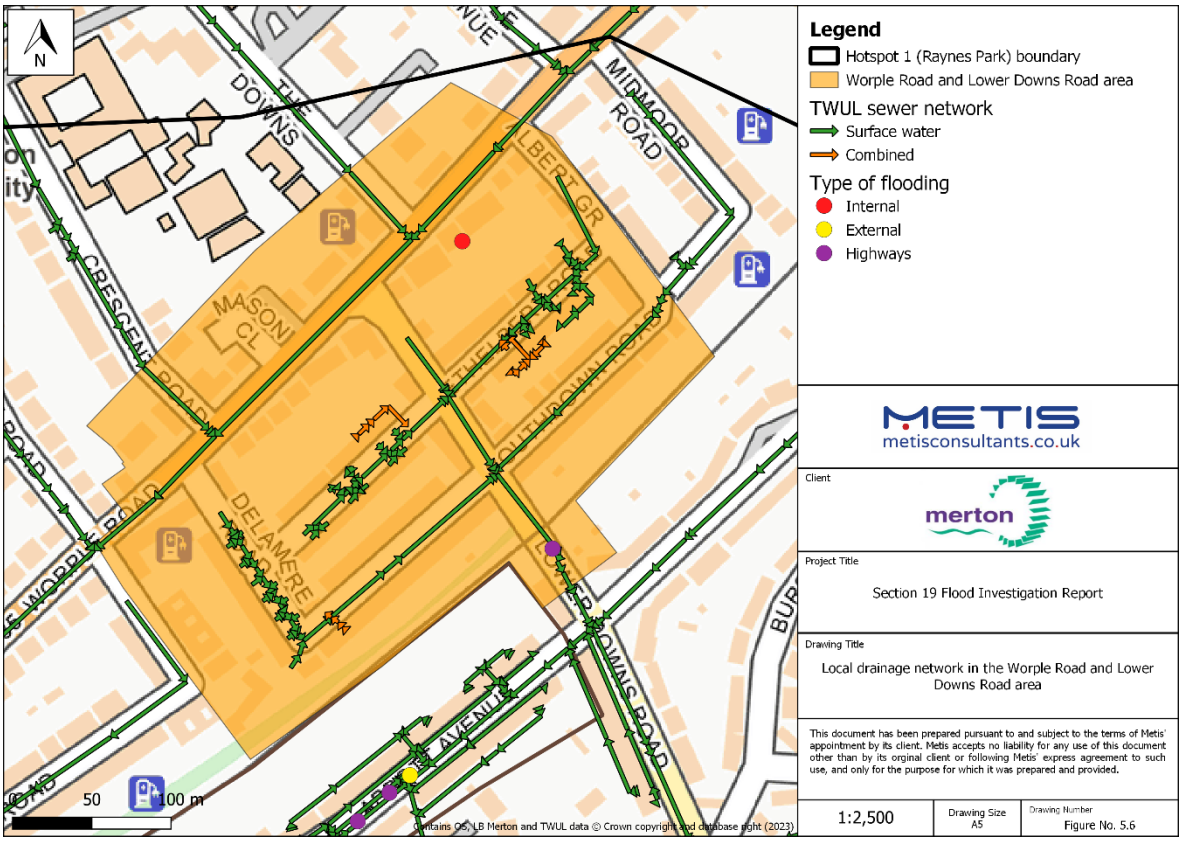

Figure 5.6: Local drainage network in the Worple Road and Lower Downs Road area

5.1.3 Local flood mechanism

Light Detection and Ranging (LiDAR) data indicate a 40m elevation drop between Wimbledon Hill (located to the north of central Raynes Park) and Coombe Lane, with a 5m elevation drop over a 250-300m distance from Rosevine Road to Coombe Lane exemplifying the area's steep topography. These elevation differences encourage flows to run towards the lower-elevation central Raynes Park and collect in the town centre upon contact with the raised railway embankment, reflected in the flooding experienced in the local low points along Coombe Lane and the railway underpass.

Topography of the local area around Abbott Avenue slopes from north to south, with Abbott Avenue being a local low point according to LiDAR data. The raised railway embankment running behind the properties on the north side of Abbott Avenue is a local high point. The low point on Abbott Avenue encourages surface water flows to collect in this location, with the adjacent raised railway embankment compounding this issue by further blocking the movement of any water that may have collected on the road surface or within property boundaries.

LiDAR data show that elevation is 30m greater to the north of Worple Road, with elevation on adjacent roads such as The Downs steeply decreasing by 20m over a 250m distance before reducing further towards Worple Road. As with the Coombe Lane area, this elevation difference encourages flows to run from northern areas towards Worple Road, with the further 5m elevation decrease between the Lower Downs Road / Worple Road junction and the local low point at the Lower Downs Road railway underpass encouraging flows to run from Worple Road along Lower Downs Road and

collect within this low point. The raised railway embankment within this location compounds this issue, redirecting flows from adjacent roads towards the low point on Lower Downs Road.

5.1.4 Local flood risk

In order to ascertain this hotspot's specific flood sources during the 12th July 2021 flood event, it is important to understand the local risks of flooding from surface water, ordinary watercourses, main rivers (fluvial flooding), groundwater, and sewers.

Surface Water Flood Risk

Flooding from surface water arises when water from intense or prolonged rainfall does not sufficiently drain away through constructed sewer systems or ground infiltration, resulting in surface accumulation within surrounding areas. EA Risk of Flooding from Surface Water (RoFSW) maps show the surface water flood risk at the three primary flood locations within this hotspot, within *Figures Figure* 5.7-*Figure* 5.9. The EA define surface water flood risk in three categories:

- **High risk**, where the annual probability of flooding is above 3.3%
- **Medium risk**, where the annual probability of flooding is between 1% and 3.3%
- **Low risk**, where the annual probability of flooding is between 0.1% and 1%

There is a high risk of surface water flooding to around 450m of Coombe Lane in central Raynes Park, to the railway underpass near Raynes Park Railway Station, and to parts of adjacent roads, namely Lambton Road, Worple Road and Pepys Road. Most roads adjacent to this section of Coombe Lane in central Raynes Park are at a medium risk of surface water flooding, including Lambton Road, Pepys Road, Wyke Road, and Avenue Road.

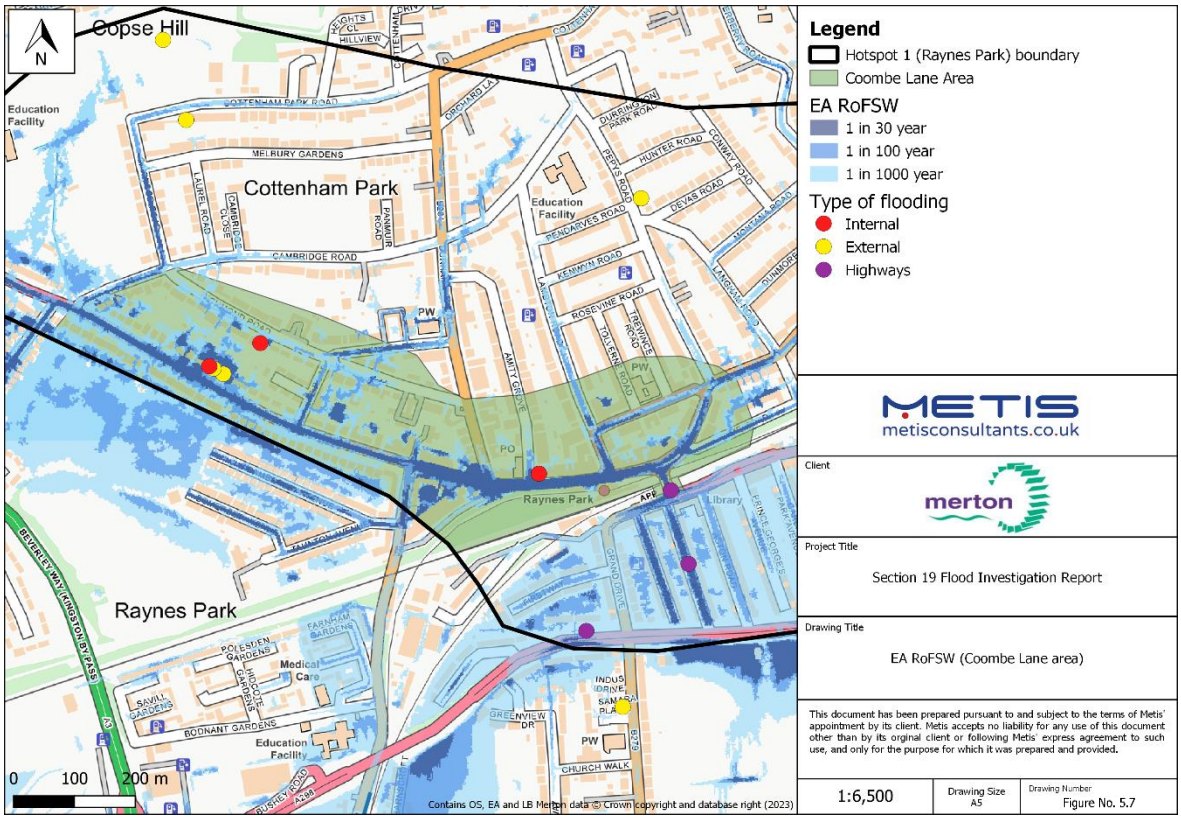

Figure 5.7: EA RoFSW (Coombe Lane area)

Around Abbott Avenue, surface water flood risk is high on Lower Downs Road and the western end of Abbott Avenue, whilst surface water flood risk is medium to the southern side of Abbott Avenue.

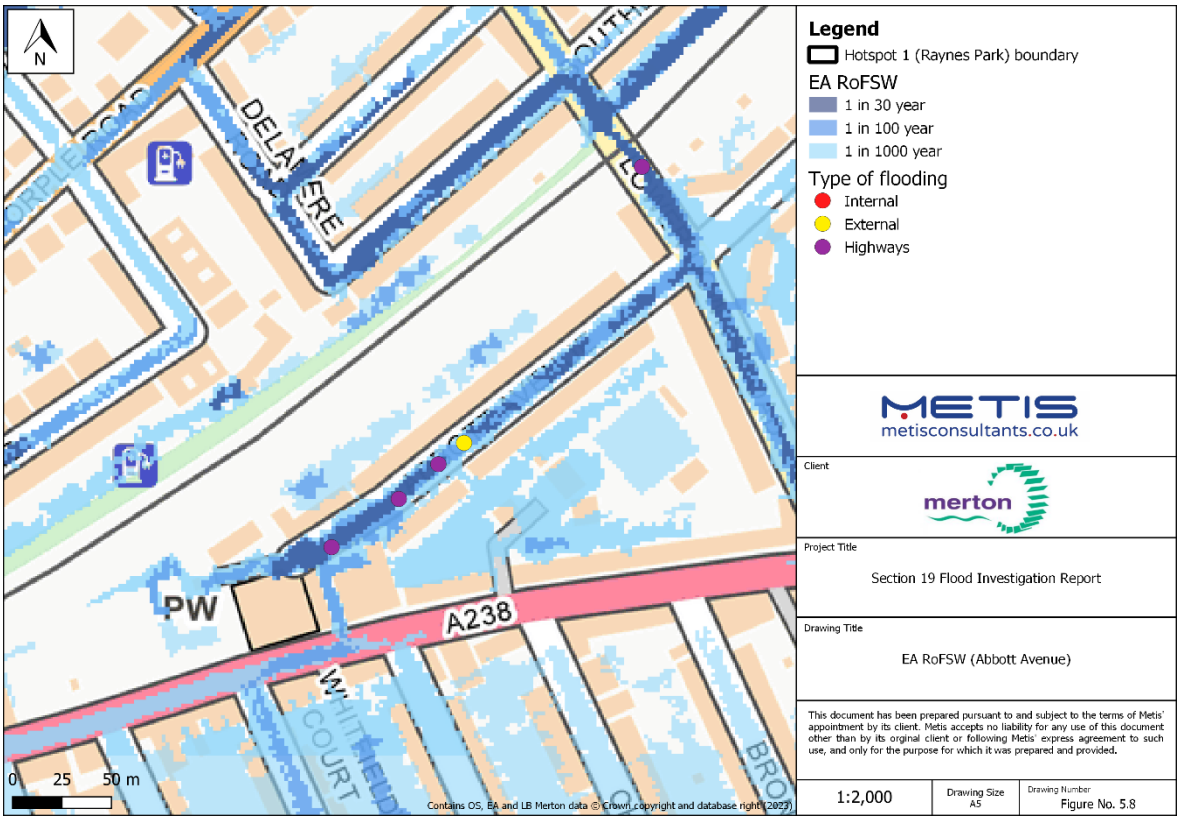

Figure 5.8: EA RoFSW (Abbott Avenue)

Most of Lower Downs Road is at a high risk of surface water flooding, particularly around the local low point at the railway underpass. Surface water flood risk is also high to Southdown Road, situated immediately adjacent to Lower Downs Road near the railway underpass. The remainder of Lower Downs Road is at a medium risk of surface water flooding, alongside parts of Worple Road. Nevertheless, properties are generally not at medium or high risk of surface water flooding.

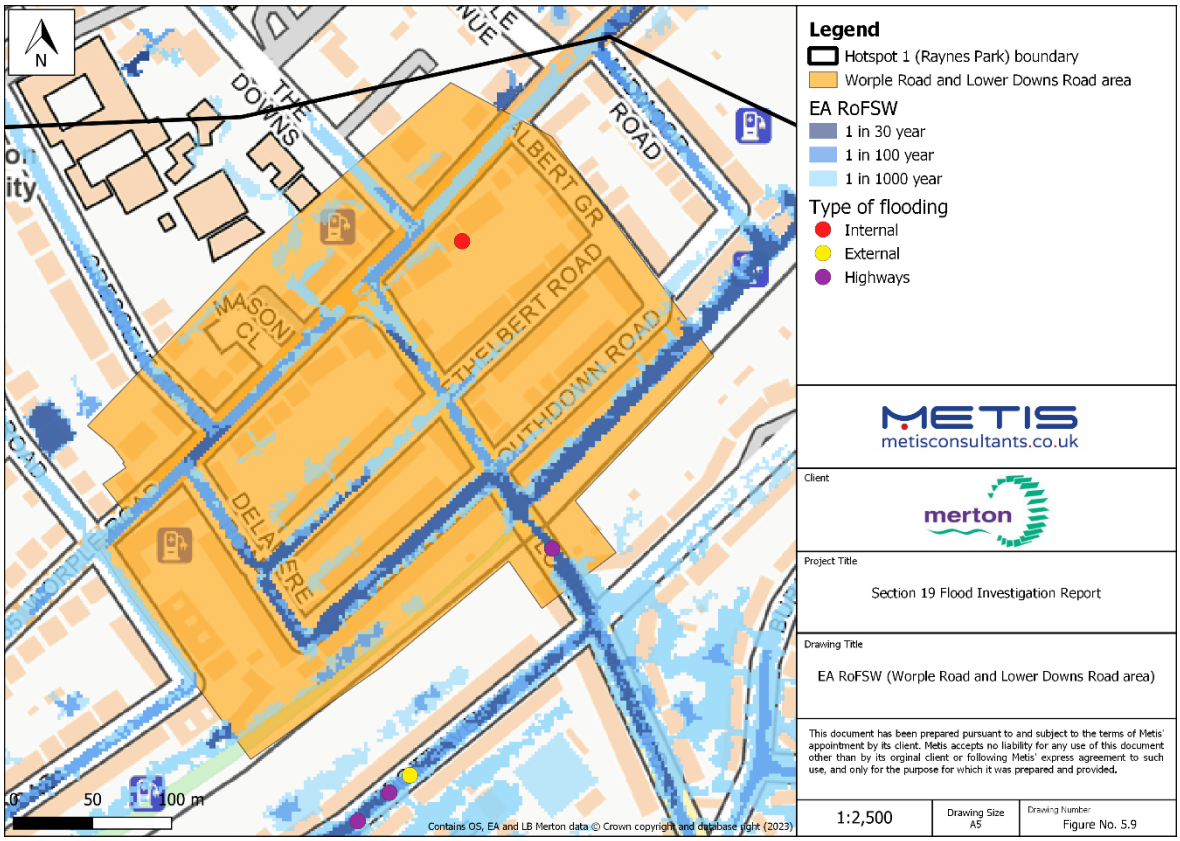

Figure 5.9: EA RoFSW (Worple Road and Lower Downs Road)

Ordinary Watercourse Flood Risk

Ordinary watercourses refer to rivers, streams, and ditches that the EA have not designated as main rivers. Flooding from ordinary watercourses can occur if prolonged or intense rainfall increases peak flows into these ordinary watercourses and consequently exceed channel capacity, resulting in flooding to adjacent areas.

There are no ordinary watercourses located within this hotspot according to EA Detailed River Network (DRN) data, and there is therefore no risk of flooding from ordinary watercourses to any location within this hotspot.

Fluvial Flood Risk

Fluvial flooding occurs when intense or prolonged rainfall results in watercourses that have been designated by the EA as main rivers exceeding their hydraulic capacity. The EA define fluvial flood risk in three categories:

- **Flood Zone 3**, where the annual probability of flooding is above 1% (high)
- **Flood Zone 2**, where the annual probability of flooding is between 0.1% and 1% (medium)
- **Flood Zone 1**, where the annual probability of flooding is less than 0.1% (low).

The EA's online Flood Map For Planning shows that the entirety of this hotspot is situated within Flood Zone 1, and therefore has a low probability of flooding from rivers and the sea.

Groundwater Flood Risk

Groundwater flooding can occur when a significant period of rainfall results in the groundwater table rising to levels that are too high to facilitate infiltration of further rainfall, thus triggering surface flooding. The effects of groundwater flooding can be exacerbated by the presence of aquifers and the area's ground composition, whilst groundwater can emerge directly from the ground during extreme circumstances.

The EA's Areas Susceptible to Groundwater Flooding (AStGWF) data use a 1km^2 grid to show the proportion of each 1km^2 grid square that is susceptible to groundwater flooding emerging. This dataset shows that approximately half of this hotspot is covered by a grid square where >= 75% of this area is susceptible to groundwater flooding. Most of the Coombe Lane area and all of Abbott Avenue are situated within this high-susceptibility area. The rest of this hotspot is primarily located in areas where >= 50% < 75% of land is susceptible to groundwater flood emergence, whilst <25% of land in small areas in the north of the hotspot are susceptible to groundwater flooding. *Figure 5.10* shows the EA AStGWF map for this hotspot.

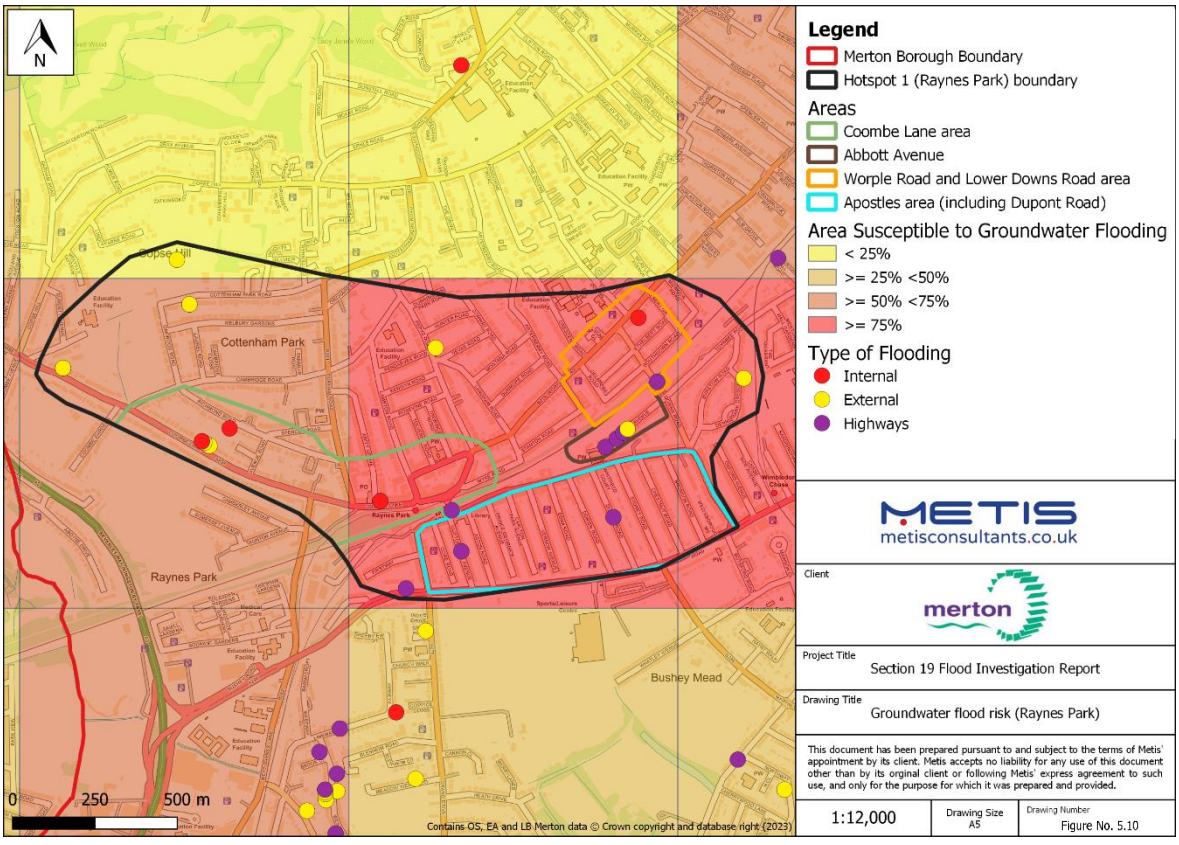

Figure 5.10: Groundwater flood risk (Raynes Park)

Sewer Flood Risk

Sewer flooding can occur when an inflow of water from a significant rainfall event exceeds the hydraulic capacity of a given sewer system. Alternatively, sewer blockages can result in water backing up within the sewer system and causing flooding.

The sewer network in the Coombe Lane area, shown in *Figure 5.4*, is comprised of a large number of surface water sewers flowing southwards towards Coombe Lane and to the surface water sewer located south of the railway bridge. When combining these factors with the area's local topography

where the road slopes down to a local low point underneath the railway bridge, sewer flooding in this area is likely during high-magnitude rainfall events that exceed the design capacity of the local sewer network. The Capacity Assessment Framework (CAF) modelling data provided by TWUL within their DWMP show that there is a high risk of main sewer surcharges along Richmond Road (located to the north of Coombe Lane) and the western portion of Worple Road (near the junctions with Lambton Road, Pepys Road and Coombe Lane). Merton Council also have historical records of the Richmond Road sewer surcharging at a local low point.

As shown in *Figure 5.5*, Abbott Avenue's sewer network is comprised of several surface water sewers, some of which converge directly onto the road itself and some of which flow into the TWUL foul water pumping station located on the western end of Abbott Avenue. This pumping station continues to flow during high-magnitude rainfall events, which puts the sewers at the western end of Abbott Avenue at a high risk of surcharging and flooding the street.

The sewer network within the Worple Road and Lower Downs Road location, shown in *Figure 5.6*, is comprised of a surface water sewer that flows in a westerly direction along Worple Road towards Coombe Lane, alongside many surface water sewers which converge from adjacent roads onto the surface water sewer pipe that runs along Lower Downs Road in a southerly direction towards the local low point below the railway bridge. There are also several combined sewers converging from properties onto the surface water sewer on Ethelbert Road, which in turn converges onto Lower Downs Road. These factors, alongside the area's local topography that encourages flows to run towards this local low point, means that sewer flooding in this area is likely during extreme rainfall events. CAF modelling data within TWUL's DWMP show that there is a high risk of main sewer surcharges along Worple Road near its junction with Lower Downs Road. LB Merton have confirmed that several properties have been affected along Worple Road due to a combined sewer overflow in the sewer network and no non-return devices installed.

The eight instances of sewer flooding within postcode areas inside this hotspot that were reported to TWUL (and discussed in *Section 5.1.1*) strongly suggests that sewer flooding is a key flood source to the affected locations within this hotspot. However, as these postcode areas cover locations outside of these affected areas, it is unclear whether this sewer flooding occurred within this hotspot or elsewhere in the postcode area.

Flood Risk from other sources

EA Risk of Flooding from Reservoirs data show that the predicted reservoir flooding extent does not cover any location within this hotspot, and there is therefore no risk of flooding from other sources in this hotspot.

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

The actions that have been taken prior to, during, and after the 12th July 2021 flood event by the relevant RMAs are detailed *in Table* 5.1.

Table 5.1: Risk Management Authorities – Actions taken at the Raynes Park hotspot

Authority	Authority Contributing Action to Flooding Incident
Merton Council	***Before*** ✓ Liaison with TWUL to investigate the drainage network in Coombe Lane ✓ Abbott Avenue added to the high priority gully cleansing programme ✓ Cleaning of gullies on Abbott Avenue and Lower Downs Road in early and late 2017, late 2018 and early 2019, and early 2020 ✓ Investigation with TWUL to identify the flood sources on Abbott Avenue ✓ Attended the Raynes Park Community Forum to raise awareness ***During*** *No known actions taken* ***After*** ✓ An assessment of the surface water sewer and Pump Station at Coombe Lane has been undertaken alongside TWUL to identify faults ✓ Reconstruction, upsizing, and repair of highway drainage with larger connection pipes in Coombe Lane undertaken. ✓ 4G sensors have been installed in the Coombe Lane system and across most of the Raynes Park town centre to track blocked drains through monitoring silt and water levels ✓ CCTV survey of 3km of drains along Coombe Lane undertaken with TWUL ✓ Inspection of all gullies in Coombe Lane area to assess their functionality ✓ Funding requested for SuDS features in Raynes Park proposed along Pepys Road, Worple Road and Mount Acuba Road
Thames Water	***Before*** ✓ Dupont Road site visit on 6th September 2016, cleaned 280m of surface water sewer, removing a large quantity of concrete ✓ Undertook a CCTV survey along 84m of TWUL surface water sewer along Coombe Lane on 8th November 2017. No defects were found, but silt and debris were subsequently removed. ✓ Investigated the foul sewer network along Coombe Lane close to the bridge underpass and cleaned debris in September 2018 ✓ Network investigations post-July 2017 incident, including a CCTV survey and manhole 'lift and look', review and confirmation of pump station arrangement and foul sewer cleaning in Abbott Avenue

	✓ Surveys and cleaning works of the foul sewer system upstream, including Arterberry Road and Crescent Road in October 2018 ✓ August 2017 electrical upgrade of Abbott Avenue Sewage Pumping Station ✓ Emergency response plan for Abbott Avenue created for the protection of nearby properties ✓ Investigation of the Abbott Avenue surface water attenuation tank in October 2018: found to be operating and with minimum silt deposits ✓ Investigation of Abbott Avenue surface water sewer network: flow from western end of Abbott Avenue limited by the unknown diameter surface water sewers flowing from the eastern end (Toynbee Road). ✓ Attended the Raynes Park Community Forum to raise awareness ***During*** *No known actions taken* ***After*** ✓ Upgraded Pump Station located under the railway at Approach Road in 2022 ✓ High-pressure jet cleaning and gully clearance: 21 tonnes of silt removed within the surface water sewer network at Raynes Park Station ✓ Planned investigation to identify cause of surface water overloading the foul sewer network which surcharges onto Coombe Lane ✓ Internal approval to be sought for Raynes Park hydraulic modelling. ✓ On-going assessment of options for storage upstream of the Abbott Avenue Pump Station to reduce discharging flow from the pumps during flooding ✓ Investigating the existing surface water attenuation tank under Abbott Avenue to identify whether and how this could be better utilised
Metropolitan Police Service	***Before*** *No known actions taken* ***During*** ✓ Closed Coombe Lane, Abbott Avenue, Worple Road, and the railway underpasses at Lower Downs Road and Approach Road due to flood waters limiting road access. ***After*** *No known actions taken*

5.1.6 Source and Cause

Sewer flooding was the primary flood source in this hotspot during the 12th July 2021 rainfall event, with flood reports to Merton Council detailing blown manhole covers, combined sewer overflow discharge, and the presence of foul water within property boundaries. These reports are corroborated by the aforementioned TWUL SFHD reports of sewer flooding in postcode areas across this hotspot. It is likely that the sewer systems in this hotspot could not cope with the extreme rainfall that occurred, resulting in their design capacity being exceeded and subsequent surcharging of gullies across the area; however, this could also have been a result of siltation or defects within the sewer network. This is particularly relevant for the Coombe Lane area alongside the Worple Road and Lower Downs Road area where many surface water sewers converge and flow towards a topographic low point below the railway line, with gullies surcharging in these areas. In Abbott Avenue, the continuing operation of the pumping station during extreme rainfall events has been a primary cause of flooding to this location during both previous events and the July 2021 event, with the increased flow onto Abbott Avenue from the pumping station resulting in gully surcharging. Properties along Worple Road near the junction with Lower Downs Road were impacted by sewer backflows due to overflows within the combined sewer network.

Likewise, surface water flooding was a secondary flood source in this hotspot, with the area's topography (as detailed in *Section 5.1.3*) encouraging surface water runoff from the intense rainfall in northern areas of the borough to flow from these higher-elevation areas in the north of the borough towards the lower elevation areas along Coombe Lane, below the railway bridge in central Raynes Park, and along Lower Downs Road. This increased surface runoff towards the hotspot's low points compounded the sewer flooding, with areas of floodwater created in these local low points where increased surface water runoff could not be managed by the already over-capacity sewer network. Likewise, local low points such as those on Abbott Avenue and Coombe Lane could encourage surface water to enter the area's surface water sewers through any misconnections that may exist within the drainage network, exacerbating sewer and surface water flooding in the area.

Groundwater flooding may have also made a minor contribution to flooding in this hotspot, with a resident's report to Merton Council stating that their Coombe Lane property's swimming pool lining was distorted due to groundwater pressures. Therefore, this report alongside the high susceptibility to groundwater flooding in this area (as evidenced in *Section 5.1.4*) means that groundwater flooding may have arisen elsewhere in the Coombe Lane area and compounded the impacts of sewer and surface water flooding during this event.

5.1.7 Recommendations

- TWUL and Merton Council should continue their collaborative working on the Raynes Park Flood Alleviation Scheme and investigate the feasibility and potential locations of additional resilience measures and SuDS to the Coombe Lane area and Abbott Avenue.
- TWUL should monitor the Abbott Avenue attenuation tank and the Worple Road Combined Sewer Overflow to limit flooding and liability to backflows within properties in future.
- TWUL should investigate whether the Abbott Avenue pumping station pumps can be switched off during high-magnitude rainfall events and provide additional storage upstream of the pumping station in order to only allow flows from Worple Road into manholes, thus keeping extreme flows away from the western end of Abbott Avenue.

- Merton Council should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer networks and the upgraded pumping station below the railway at Approach Road to ensure optimal performance levels.
- TWUL should investigate upgrading surface water sewer network capacity along Lower Downs Road to limit gully surcharging and ensure that surface water flows can be managed effectively at the local low point below the railway.
- Merton Council should work collaboratively with stakeholders to consider implementing SuDS elsewhere in the catchment closer to runoff sources to reduce flows towards the town centre.

5.1.8 Non-Section 19 location investigation: the Apostles area

Despite Dupont Road and Clifton Park Avenue being the two Apostles area roads that experienced flooding on 12th July 2021 according to reports to Merton Council, flooding to this location on 12th July 2021 did not meet Section 19 threshold criteria. Maximum Hydromaster data indicate that the Apostles area experienced a rainfall event with a return period of between 1 in 50 and 1 in 100 years, whilst TWUL FEH13 return period data show a 1 in 393-year return period.

Eleven of the twelve roads in the Apostles area (all other than Chestnut Road) are served by surface water sewers that flow from north to south into the rectangular trunk main surface water sewer on Bushey Road, which varies in size between 1980 by 1520mm and 2440 by 1450mm. The 230-305mm diameter surface water pipe on Dupont Road contains three 90° turns when joining the main surface water sewer on Bushey Road, which poses flow blockage issues. In the Apostles area, the twelve roads generally slope from north to south, with higher elevations to the north. Most roads in the Apostles area contain a localised low point around two thirds of the way down towards Bushey Road, which runs along the southern end of the roads. This encourages surface water to naturally flow towards these low points on the Apostles roads.

The Apostles area, Gore Road, Clifton Park Avenue, Dupont Road and Sydney Road are partially or entirely at high risk of surface water flooding. Properties located either side of Clifton Park Avenue, Dupont Road and Sydney Road are at a medium risk of surface water flooding. The Apostles area is located entirely within a 1km^2 grid area where >= 75% of this area is susceptible to groundwater flooding, though there is no risk of flooding from fluvial, ordinary watercourses or reservoirs.

Following the flooding that occurred to this location during the previous flooding incidents in June 2016 and July/August 2017, installation of SuDS tree pits with a high-level overflow connection into the highway drainage network was undertaken by Merton Council at the downstream end of the Apostles area side roads, providing stormwater storage volume of approximately 2m^3 plus infiltration potential. In partnership with Merton Council, NR and the EA, TWUL are undertaking collaborative drainage modelling of the area as part of the Raynes Park FAS and identifying opportunities for SuDS along the Apostles area roads as a result of the flooding that occurred to this location on 12th July 2021.

Flooding to the Apostles area during this event was reported to be primarily due to surface water sewer flooding, with most of Dupont Road and parts of Clifton Park Avenue being flooded by sewer overflow. Thus, TWUL's work to undertake collaborative drainage modelling of the area with Merton Council, NR and the EA should continue. This work could help to identify the specific issues and locations within the sewer network that cause flooding, such as at the Dupont Road surface

water pipe that contains three 90° turns when joining the main surface water sewer on Bushey Road. Ongoing collaboration between various stakeholders including TWUL and Merton Council could help create a programme to identify means of resolving issues in the problematic areas.

5.2 Hotspot 2 – Home Park Road

Home Park Road hotspot is located in the north-east of LB Merton as shown in *Figure 4.9*, within the Wimbledon Park Ward. This hotspot corresponds with DC16 and DC18 as shown on the Surface Water Flooding tab of the LB Merton 2020 Level 1 SFRA mapping tool.

5.2.1 Areas affected

This location correlates to location 5 in *Table* 4.5. Flooding at this location was primarily to properties along the eastern-most portion of Home Park Road, near the junctions with Strathearn Road, Kenilworth Avenue, Dora Road and Vineyard Hill Road. This is shown in *Figure 5.11* alongside the types of reported flooding within the hotspot during this event.

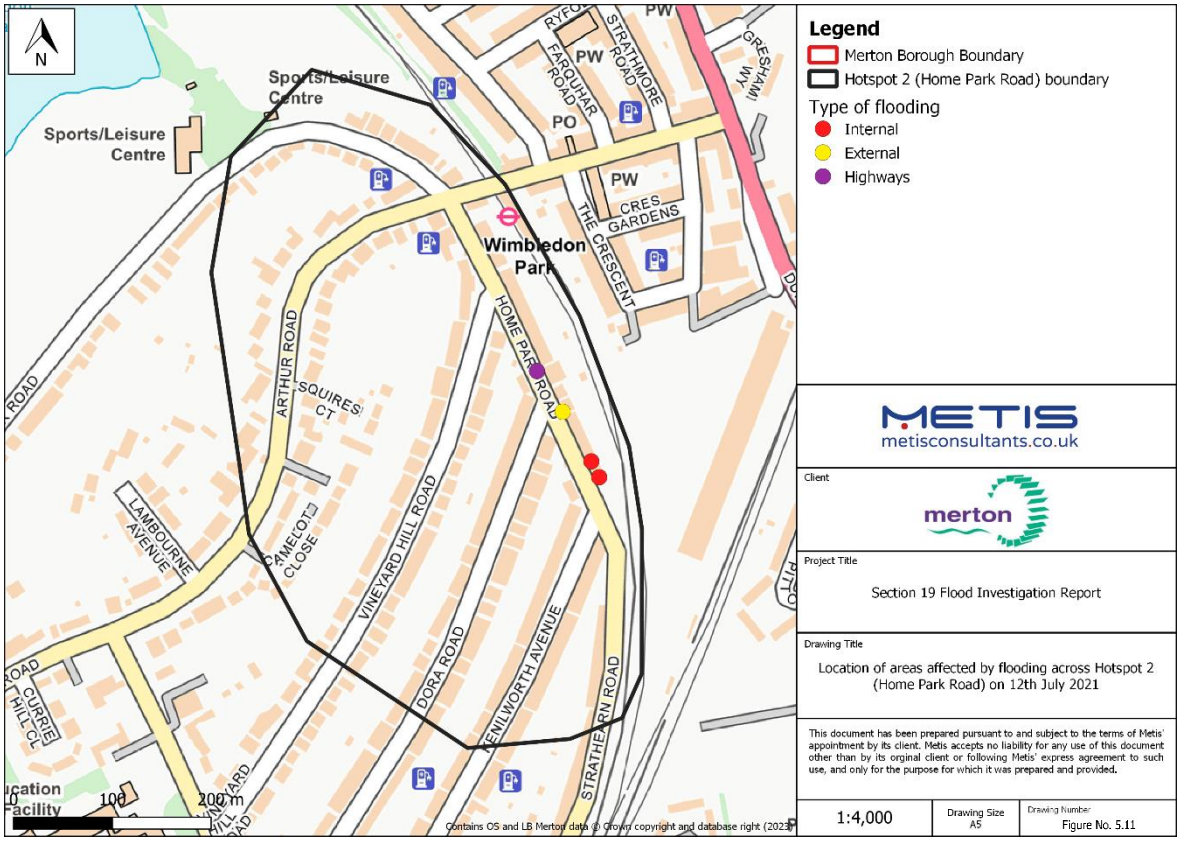

Figure 5.11: Location of areas affected by flooding across Hotspot 2 (Home Park Road)

Highways flooding occurred at this location, with much of this section of Home Park Road being covered by several inches of floodwater, whilst external flooding occurred to the front and rear gardens of several properties. Internal flooding of ground floors and basements occurred to two residential properties, with floodwaters reaching up to the door handles in the basement of one property. A surface water sewer running below Home Park Road near the junction with Dora Road partially collapsed during this event. The TWUL SFHD shows that four instances of sewer flooding occurred within postcode area SW19 7 during this event, in which Home Park Road is situated. Since multiple residential properties flooded internally during this event, flooding at this location

met the "Risk to residential property" Section 19 threshold criteria as defined in *Figure 1.1* and outlined in the LB Merton 2015 LFRMS.

The closest Hydromaster hotspot location gauge to the Home Park Road hotspot is the Plough Lane hotspot gauge, located approximately 0.9km to the south-east. This gauge indicates that 5-minute rainfall totals peaked at 0.89mm at 16:00, whilst hourly rainfall totals using 5-minute moving data peaked at 4.77mm at 16:55. Hydromaster datasets estimated rainfall at this location to have a maximum return period of between 1 in 2 and 1 in 5 years, whilst TWUL FEH13 data indicated a maximum return period of 1 in 48 years.

5.2.2 Local drainage network

Figure 5.12 shows the local TWUL sewer network at the primary affected location within this hotspot using a TWUL dataset. A 300mm diameter surface water sewer pipe flows along Home Park Road in a north-west to south-east direction towards the eastern end of Home Park Road. This pipe increases in diameter to 380mm upon convergence with the 305mm diameter surface water pipe that flows in a south-west to north-east direction from Vineyard Hill Road. The surface water sewer network in this location also includes the 305mm diameter pipes from Dora Road and Kenilworth Avenue flowing in a south-west to north-east direction that also converge onto the 380mm diameter pipe on the eastern end of Home Park Road. A 305mm diameter surface water pipe flows in a south to north direction from Strathearn Road and converges onto the 380mm diameter surface water pipe at the eastern-most extremity of Home Park Road. This 380mm diameter surface water sewer pipe then carries flows away from Home Park Road in a north-east direction underneath the railway track situated immediately behind the properties.

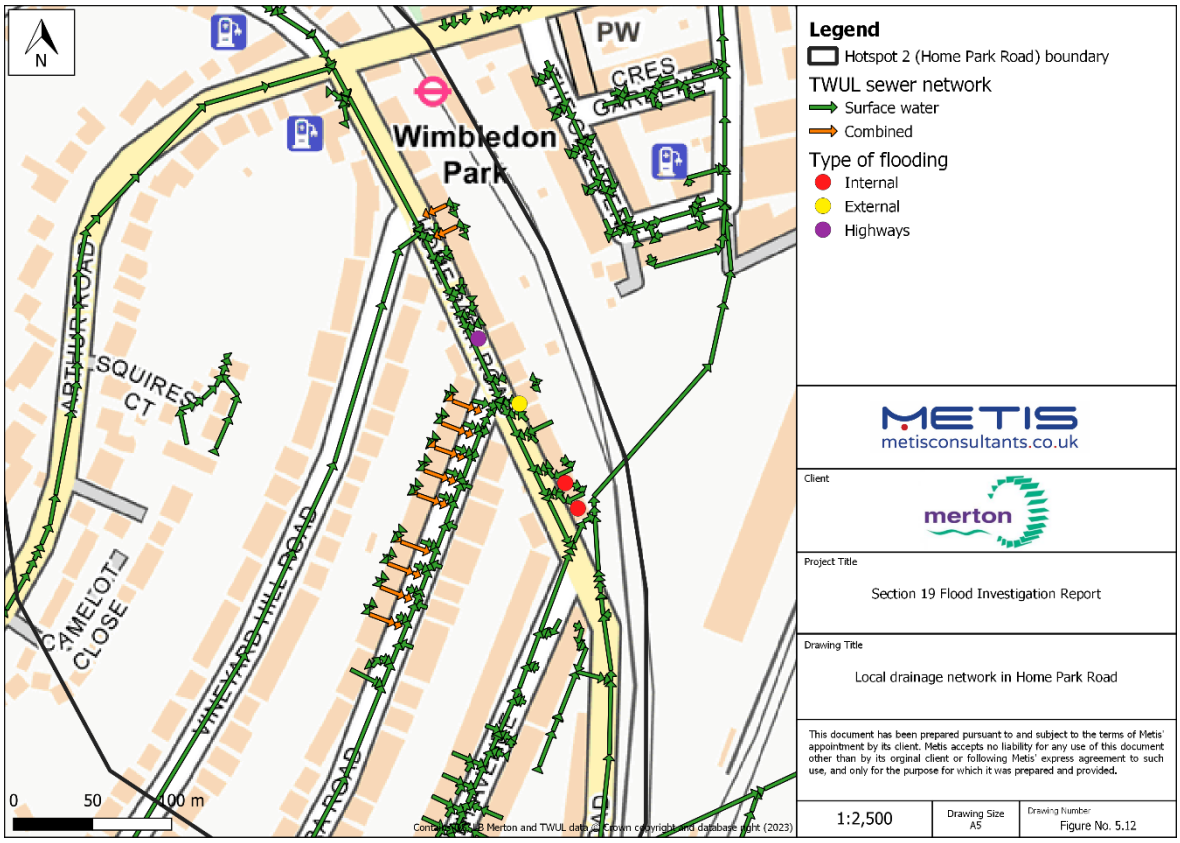

Figure 5.12: Local drainage network in Home Park Road

Map16 gully sensor data provided by Merton Council show that the highway gullies in Home Park Road were part of Merton Council's high-priority cleansing programme (whereby they are cleaned at least once annually and on an ad hoc basis following reports of blocked gullies) during 2018/19, 2019/20, and 2020/21. Prior to the July 2021 flood event, Map16 data also show that some gullies along Home Park had last been cleaned in May 2021, whilst others had not been cleaned since September 2020 due to obstructions from cars in May 2021.

5.2.3 Local flood mechanism

LiDAR data indicate approximately a 30m reduction in elevation between Arthur Road and the eastern portion of Home Park Road. Specifically, elevation reduces by approximately 18m over a 250-300m distance from Arthur Road to its junction with Home Park Road and is therefore an example of a notable steep slope in this area. with a further reduction in elevation of approximately 8m along the distance of approximately 300m from this junction to the eastern end of Home Park Road. There are also reductions in elevation of approximately 6-17m between the low point of Home Park Road and the adjacent Vineyard Hill Road, Dora Road, and Kenilworth Avenue.

Topography of the local area around Home Park Road slopes from west to east, with the eastern portion of Home Park Road being a local low point. Elevation then decreases further towards the railway tracks located behind the properties on this section of Home Park Road. This low point on Home Park Road encourages surface water to collect in this location and flow through any gaps between properties towards their rear gardens and the lower elevation railway line located behind these properties.

5.2.4 Local flood risk

In order to ascertain the specific flood sources within this hotspot during the 12th July 2021 rainfall event, it is necessary to understand the local risks of flooding from surface water, ordinary watercourses, main rivers, groundwater, sewers, and other sources.

Surface Water Flood Risk

Figure 5.13 shows the EA RoFSW map for this hotspot. According to this dataset, approximately 100m of Home Park Road is at a high risk of surface water flooding, from its junction with Kenilworth Avenue to its junction with Vineyard Hill Road. Although this is primarily limited to the road itself, this high risk of surface water flooding extends into the boundaries of some properties. A larger part of this location is at a medium risk of surface water flooding, with estimated flood extent extending onto some adjacent roads.

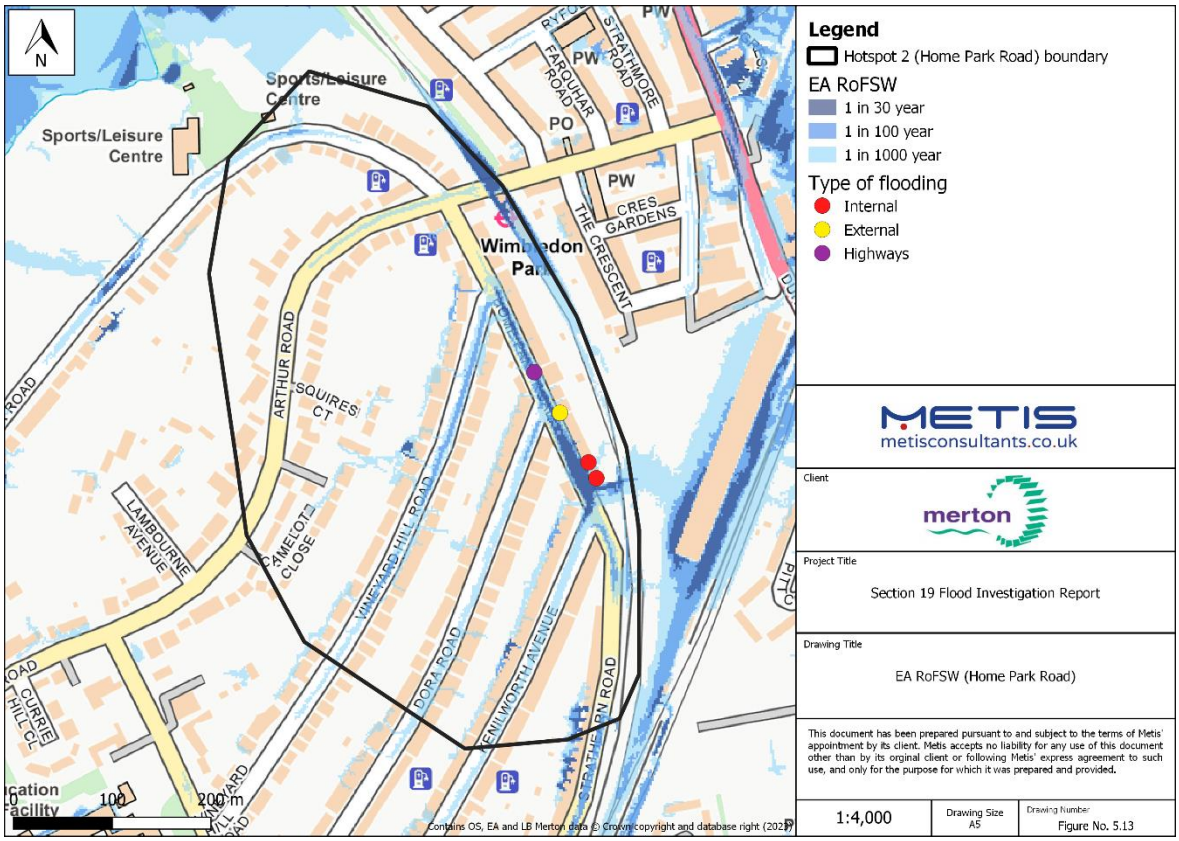

Figure 5.13: EA RoFSW (Home Park Road)

Ordinary Watercourse Flood Risk

There are no EA-designated ordinary watercourses located within this hotspot according to EA DRN data, and there is therefore no risk of flooding from ordinary watercourses to any location within this hotspot.

Fluvial Flood Risk

According to the EA'S Flood Map for Planning, this hotspot is situated wholly within Flood Zone 1 and therefore has a low probability of flooding from rivers and the sea.

Groundwater Flood Risk

The EA'S AStGWF dataset that uses a 1km^2 grid to show the proportion of each grid square that is susceptible to groundwater flooding emerging shows that groundwater flood risk in this hotspot is split into three areas of approximately equal size. *Fig 5.12* shows that the areas situated within the northern third of this hotspot are most susceptible to groundwater flooding, being located where >= 50% < 75% of land is susceptible to groundwater flood emergence. Areas situated within the south-eastern third of this hotspot are located where >= 25% < 50% of land is susceptible to groundwater flood emergence, whilst this figure is lowest for the hotspot's south-eastern third at <25%. *Figure 5.14* shows the EA AStGWF map for this hotspot. Despite part of this hotspot being located within an area where much of the land is relatively highly susceptible to groundwater flooding, there is no indication that groundwater played a role in the flooding that occurred to this location during this flood incident.

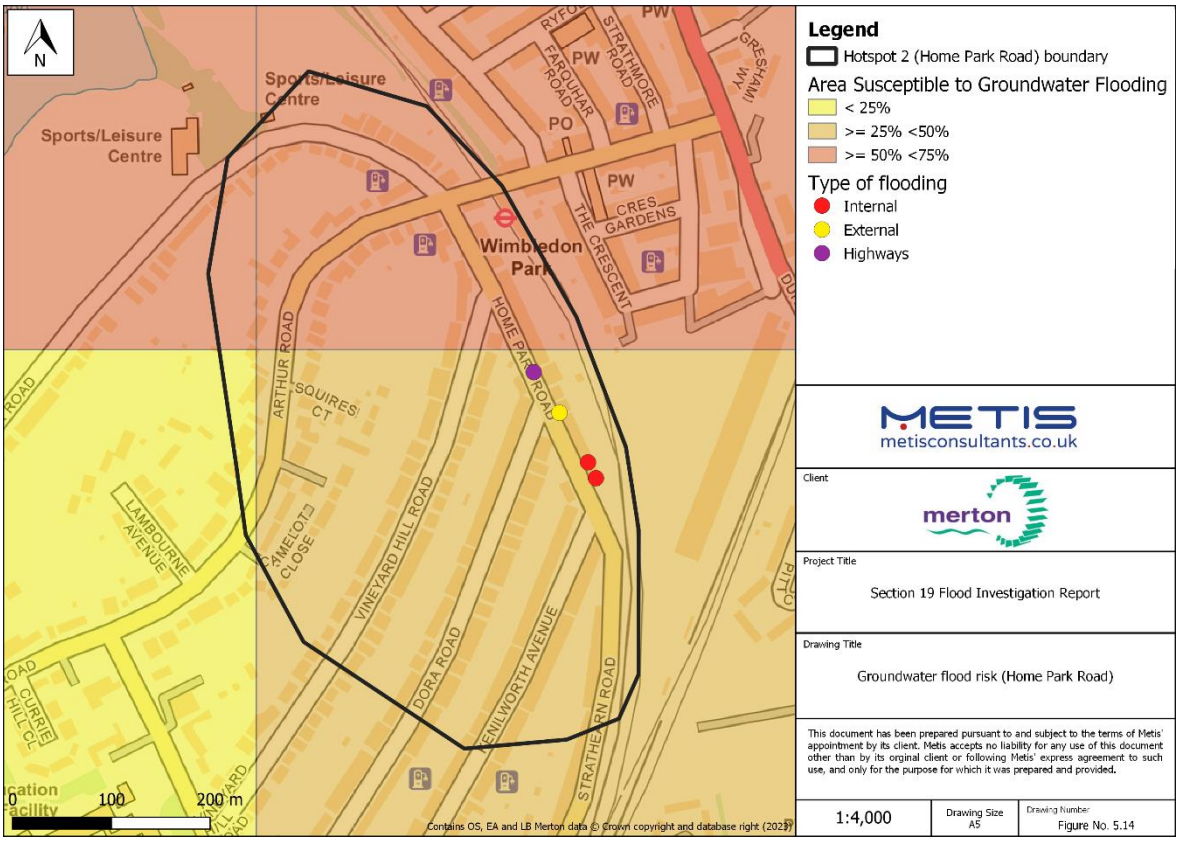

Figure 5.14: Groundwater flood risk (Home Park Road)

Sewer Flood Risk

Home Park Road's sewer network, shown in *Figure 5.12*, is comprised of several surface water and combined sewers flowing towards the eastern end of Home Park Road from both adjacent streets and from further west portions of Home Park Road. These surface water and combined sewers converge onto Home Park Road before flowing away towards the railway track located immediately behind properties. When considering the area's topography whereby the eastern end of Home Park Road is substantially lower in elevation than the adjacent roads, additional surface runoff towards this location would attempt to flow towards the gullies and into the sewer network. However, extreme rainfall events that exceed the design capacity of the local sewer network could result in surcharging of sewers which would thus render the gullies unsuitable for taking in additional surface water runoff. Likewise, as the surface water sewer main line is restricted under the railway, the system is likely unable to effectively direct high flows underneath the railway and away from Home Park Road during extreme rainfall events.

The four instances of sewer flooding within Home Park Road's postcode area during this event that were reported to TWUL (and discussed in *Section 5.2.1*) further suggest that sewer flooding is a key flood source to this hotspot. However, as Home Park Road's postcode area covers locations outside of this hotspot, sewer flooding may have occurred elsewhere within the postcode area.

Flood Risk from other sources

EA Risk of Flooding from Reservoirs data show that the predicted reservoir flooding extent does not cover any location within this hotspot, and there is therefore no risk of flooding from other sources in this hotspot.

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

This location was not affected during the previous flood events that impacted LB Merton during 2016 and 2017. Nevertheless, several actions have been taken by TWUL and Merton Council following the flooding that occurred to this location on 12th July 2021, detailed in *Table* 5.2.

Table 5.2: RMA Actions taken at the Home Park Road hotspot

Authority	Authority Contributing Action to Flooding Incident
Merton Council	***Before*** ✓ Re-benching of highway drainage including new pipework along Home Park Road around late 2019-early 2020 ✓ Installation of 4G gully sensors and inclusion of the gullies on the high-risk cleaning programme ***During*** *No known actions taken* ***After*** ✓ Successfully bid for TWUL Surface Water Management Programme (SWMP) funding to aid construction of a pocket park, rain garden, and attenuation solutions in Kenilworth Green.
Thames Water	***Before*** ✓ Inspected sewer system of a flooded property in May 2021 ***During*** *No known actions taken* ***After*** ✓ Repair of collapsed surface water sewer along Home Park Road at junction with Dora Road in July 2021 ✓ July 2021 inspection of the surface water sewer running along Home Park Road, identifying that it is fully operational and defect-free ✓ Survey completed of the main line below the railway to inspect condition, with a fracture identified under this line. Permission to repair this line as appropriate is still in progress.

5.2.6 Source and Cause

The primary flood source in this hotspot during the rainfall event that occurred on 12th July 2021 was sewer flooding. Flood reports to Merton Council and on social media show that the sewer system at Home Park Road was unable to cope with the increased flows that occurred during this event, with flows collecting at the eastern end of Home Park Road. A combination of the main line surface water sewer being restricted below the railway alongside the configuration of the surface water sewer system that merges at the junction of Home Park Road and Kenilworth Avenue means that the system is at high risk of surcharging during extreme rainfall events. Moreover, the surface water sewer along Home Park Road at the junction with Dora Road partially collapsed during this rainfall event, with any defects to the system limiting the efficacy of the sewer system to manage increased flows. Flood reports indicate that gullies outside properties at the primary affected location on the eastern end of Home Park Road were blocked during this event, exacerbating the sewer system's reduced ability to manage surface runoff and worsening the impacts of flooding to Home Park Road.

Surface water flooding was a secondary flood source in this hotspot due to the area's topography (detailed in *Section 5.2.3*) encouraging surface runoff to flow from the higher-elevation adjacent streets towards the low point at the eastern end of Home Park Road. This surface water can subsequently collect in this low point and flow through gaps between properties and into their rear gardens while travelling towards the railway tracks located immediately behind these properties that are of an even lower elevation to the low point on Home Park Road. If the surface water sewer systems at this location are already overwhelmed during a heavy rainfall event, their capacity to deal with excess surface runoff will be limited and thus could be conducive to further flooding.

5.2.7 Recommendations

- Merton Council and TWUL should use TWUL SWMP funding to utilise the green space at the eastern-most extremity of Home Park Road (Kenilworth Green) for attenuation and pumps.
- Merton Council should use TWUL SWMP funding to install SuDS features, including rain gardens, to help remove flows from the surface water sewer network.
- TWUL and NR should work collaboratively to undertake investigation of defects (and repairs if required) within the main surface water sewer line running below the railway behind Home Park Road.
- TWUL and NR should investigate upgrading the main surface water sewer line running below the railway to ensure that it can effectively manage surface water flows. TfL should facilitate the early review of proposals for the sewer network upgrade.
- Ensure that gullies along Home Park Road are included in Merton Council's high-priority cleansing programme for each future works programme year.
- TWUL should continue to progress the permissions with NR to repair the main line below the railway.
- Merton Council should investigate increasing thresholds to at-risk properties through providing localised property-level protection, increasing resilience to basements and ground floors.

5.3 Hotspot 3 – West Barnes

The West Barnes hotspot is located in the south-west of LB Merton as shown in *Figure 4.9*, and is situated within the West Barnes ward. This hotspot is located within DC29 and DC30 as defined on the Surface Water Flooding tab of the LB Merton 2020 Level 1 SFRA mapping tool.

Despite instances of flooding occurring throughout this hotspot on 12th July 2021, reports to Merton Council and social media indicate that this flooding did not meet Section 19 threshold criteria as defined in Figure 5-2 of the 2015 LB Merton LFRMS. Therefore, this chapter provides a higher-level overview of flooding to locations within this hotspot during the 12th July rainfall event. The primarily-affected locations within this hotspot are Westway, West Barnes Lane, and the Burlington Road and Shannon Corner junction.

5.3.1 Non-Section 19 location investigation: Westway and West Barnes Lane

Westway and West Barnes Lane correspond to locations 6 and 7 respectively within *Table* 4.5 and have been grouped together into this sub-chapter due to the similar sources and mechanisms responsible for flooding at these locations during the 12th July 2021 incident. The flood reports received suggest that flooding occurred solely to highways and external areas of properties throughout these locations, aside from one instance of internal flooding to a garage outbuilding within a residential property on Linkway (situated adjacent to Westway). As two or more residential properties were not flooded internally and this singular instance of internal flooding did not involve foul water, flooding within this hotspot did not meet the "Risk to loss of life" or "Risk to residential property" Merton Council Flood Investigation Criteria. Likewise, although highway flooding occurred along Westway and West Barnes Lane, access to emergency vehicles was still possible and so flooding to these locations did not meet the "Risk to transport" criteria.

Hydromaster data indicate that these locations experienced a rainfall event with a maximum return period of between 1 in 20 and 1 in 30 years, whilst TWUL FEH13 data indicate a maximum 1 in 1121-year return period.

TWUL local sewer network data show that surface water sewers on West Barnes Lane take runoff from perpendicular roads before travelling in a north-easterly direction and into the culverted section of the Pyl Brook. Gully cleansing information is not available for gullies along West Barnes Lane as they are non-programmed gully assets. Westway's combined sewer and main surface water sewer both receive runoff from perpendicular roads and flow in a north-westerly direction towards Linkway. Map16 gully sensor data provided by Merton Council show that Westway's gullies were included within Merton Council's high-priority cleansing programme in 2018/19, 2019/20, and 2020/21, and prior to this event had most recently been cleaned in September 2020. West Barnes Lane's gullies are not on the current cleansing programme and so historical cleansing information is not available on Map16. CAF modelling data within TWUL's DWMP show that there is a high risk of main sewer surcharges along the northern areas of West Barnes Lane. LiDAR data show that elevation within these locations is relatively uniform, although topography slopes towards the low points along West Barnes Lane and Westway from perpendicular roads of higher elevation.

The EA's RoFSW map shows that parts of Westway, Linkway, and West Barnes Lane are at a high risk of surface water flooding. The entire section of West Barnes Lane that runs parallel to Westway is at a medium risk of surface water flooding, with this risk extending into properties located within Westway, West Barnes Lane, and Linkway. EA AStGWF mapping shows that much of these locations

are situated within a 1km^2 grid where >=50% <75% of land is susceptible to groundwater flooding, whilst the eastern-most portions of Westway are located in an area where <25% of land is susceptible to groundwater flooding. The EA's Flood Map for Planning shows that many properties along Westway, West Barnes Lane, and Linkway are at a high risk of fluvial flooding, being located within Flood Zone 3 and above a culverted section of the Pyl Brook which has been designated as a main river by the EA. There is no risk of flooding from reservoirs within these locations.

Merton Council have confirmed that the main river Pyl Brook culvert running between Westway and West Barnes Lane is in a good condition with no defects identified during a January 2021 survey in response to flooding that occurred in August 2020. Merton Council have also stated that the primary cause of flooding to Westway is believed to have been due to siltation and insufficient pipe capacity of the TWUL main surface water sewer at Westway that resulted in backflows. Surface water flooding is also likely to have been a contributory factor to flooding to Westway and West Barnes Lane, with extreme rainfall increasing surface runoff. Further actions recommended at this location include:

- TWUL should ensure that the main surface water sewer at Westway is inspected at an increased frequency and its size is increased to limit backflows and increase capacity.
- Merton Council should investigate the benefit of introducing a highway SuDS retrofit such as permeable paving along West Barnes Lane and Westway to improve the infiltration capacity during instances of extreme rainfall that may increase surface runoff into the area.

5.3.2 Non-Section 19 location investigation: Burlington Road and Shannon Corner junction

Burlington Road and Shannon Corner junction is location 8 within *Table* 4.5. Reports to Merton Council and on social media indicate that flooding to this location during the 12th July 2021 event was constrained solely to highways along the eastern end of Burlington Road near the Shannon Corner roundabout. Nevertheless, access to emergency vehicles was still possible and so the "Risk to transport" Section 19 threshold criteria were not met at this location.

Hydromaster data indicate that this location experienced a rainfall event with a maximum return period of between 1 in 2 and 1 in 5 years, whilst TWUL FEH13 data indicate a maximum 1 in 122-year return period.

TWUL local sewer network data show that surface water sewers on Burlington Road near the Shannon Corner Roundabout junction run in a westerly direction away from the roundabout and into a culverted section of the Beverley Brook. Historical Map16 gully cleansing information is not available for this location as the gully assets in this location are non-programmed, although Merton Council's previous Section 19 report confirms that gullies in this location were included within Merton Council's high-priority cleansing programme as recently as 2016/17 and 2017/18. LiDAR data show that this location is a local low point.

The EA's RoFSW map shows that the area of Burlington Road near the Shannon Corner junction is at a high risk of surface water flooding. EA AStGWF mapping shows that this location is situated within a 1km^2 grid where >=50% <75% of land is susceptible to groundwater flooding. The EA's Flood Map for Planning shows that this location is situated within Flood Zone 2 and is therefore at medium risk of fluvial flooding, being located to the east of the Beverley Brook which has been designated as a main river by the EA. There is no risk of flooding from reservoirs within this location.

This location is known to flood regularly, having flooded during the three previous rainfall incidents in 2016 and 2017 that were covered in Merton Council's previous Section 19 report in 2018. The likely cause of flooding during previous events was a combination of the Burlington Road surface water sewer's limited gradient alongside heavy siltation of the Shannon Corner surface water sewers, meaning that this location is susceptible to sewer surcharges and backflows. It is likely that these factors were also responsible for flooding during the 12th July 2021 event, especially when considering that TWUL confirmed in January 2023 that their local operations team were unaware of issues at this location. Surface water flooding is also likely to have been a contributory factor to flooding at this location given its high surface water flood risk, which would be compounded if sewer networks were not running efficiently. Further actions recommended at this location include:

- Merton Council and TfL should investigate introducing a highway SuDS retrofit such as permeable paving at this junction or within the Shannon Corner roundabout in order to improve the area's infiltration capacity during instances of extreme rainfall and increased surface runoff.
- Merton Council should ensure engagement with TfL regarding potential SuDS measures within the Shannon Corner roundabout, as these could impact traffic flow on the A3 flyover (a TfL red route) which can be accessed directly from slip roads at the roundabout.
- At Burlington Road, TWUL should make improvements to the surface water sewer network capacity and Merton Council should increase gully cleaning frequency.

5.4 Other flooded locations on 12th July 2021

Several other locations across LB Merton other than those within the three aforementioned hotspots experienced flooding during the rainfall event on 12th July 2021. However, flooding to these locations was not sufficiently extensive to trigger a full Section 19 investigation, or a higher-level analysis.

One of these locations is Hotspot 4 (Marina Avenue & Sir Joseph Hood) within *Table* 4.5, which experienced a return period of between 1 in 2 and 1 in 5 years according to Hydromaster data. However, flood extent at this location was limited to external areas of properties during this event and thus did not meet the Section 19 threshold criteria. Nevertheless, this hotspot experienced substantial flooding in the subsequent rainfall event on 25th July 2021; the specific flood mechanisms and sources at this hotspot are discussed in detail within *Section 6.1.*

Additional impacted locations include:

- Cannon Hill Lane and Northway (Cannon Hill ward, south-central area of LB Merton)
- Leafield Road (Merton Park ward, south-central area of LB Merton)
- Crooked Billet (Village ward, north-western area of LB Merton)
- Elsrick Avenue (St. Helier ward, southern area of LB Merton)

6 25TH JULY EVENT

6.1 Hotspot 4 – Marina Avenue & Sir Joseph Hood

The Marina Avenue & Sir Joseph Hood Hotspot is located in the south-west of LB Merton as shown in *Figure 4.10*, and is situated within the West Barnes ward. This hotspot is located within DC30 as defined on the Surface Water Flooding tab of the LB Merton 2020 Level 1 SFRA mapping tool.

6.1.1 Areas affected

On the 25th July 2021, flooding at this location began following rainfall that started at approximately 14:10 according to Hydromaster hotspot location gauges. *Figure 6.1* shows the affected locations within this hotspot according to flood reports to Merton Council. Marina Avenue and Sir Joseph Hood (locations 9 and 10 within *Table* 4.5) are the impacted areas in this hotspot, with Marina Avenue being located to the north of Sir Joseph Hood (which includes the sports/leisure centre shown in *Figure 6.1* and the adjacent playing fields).

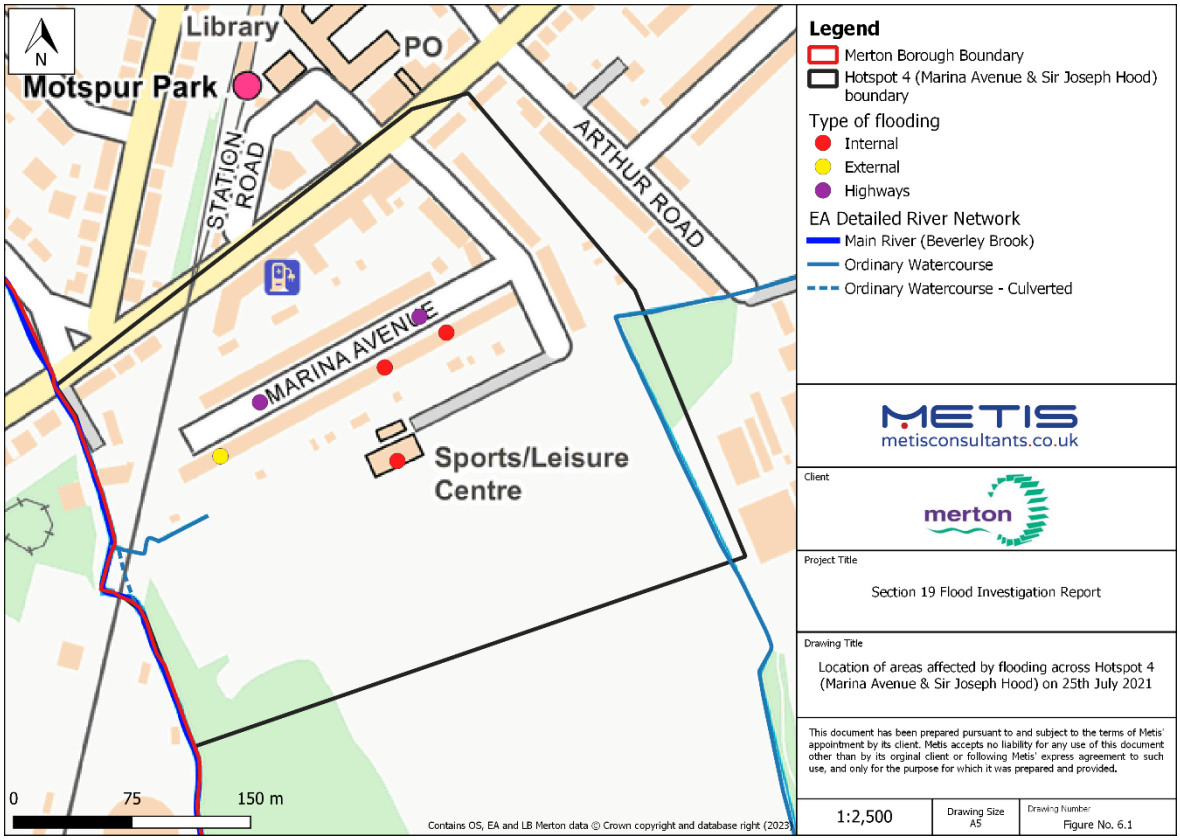

Figure 6.1: Location of areas affected by flooding across Hotspot 4 (Marina Avenue & Sir Joseph Hood)

Flood reports to Merton Council indicate that flooding within this hotspot resulted in internal flooding to two residential properties on Marina Avenue and one residential property within the pavilion inside Sir Joseph Hood Memorial Park, which is Merton Council-owned land. Flooding to external areas of properties also occurred within this hotspot, whilst *Figure 6.2* shows the extensive highway flooding to approximately 30m of the road and 65m of the footway in Marina Avenue during this event. Much of the Sir Joseph Hood Memorial Playing Fields also experienced flooding, particularly in areas situated closer to the river line to the west. The TWUL SFHD indicates that one

instance of sewer flooding occurred within postcode area KT3 6 during this event, in which this hotspot is situated.

Figure 6.2: Flooding to Marina Avenue on 25th July 2021 (Resident's photo submitted to Merton Council)

As a result of the internal flooding to residential properties within this hotspot, flooding that occurred at this location during the 25th July rainfall event reached the "Risk to residential property" Section 19 threshold criteria as defined by Merton Council in *Figure 1.1*. Thus, a full investigation into flooding within this hotspot is presented below.

Using Hydromaster data, the Motspur Park hotspot location gauge located 100m to the north-west of Marina Avenue's western end indicate that total 5-minute rainfall peaked at 2.45mm at 14:10, whilst hourly rainfall totals using 5-minute moving data peaked at 10.40mm at 15:05. Hydromaster datasets estimated rainfall to have had a maximum return period of between 1 in 2 and 1 in 5 years across this hotspot, whilst TWUL FEH13 data estimated a maximum return period of 1 in 76 years and 1 in 23 years at Marina Avenue and Sir Joseph Hood respectively.

6.1.2 Local drainage network

Figure 6.3 shows the local TWUL sewer networks within this hotspot using data obtained directly from TWUL. The sewer network within this hotspot is relatively small in comparison to those located in the aforementioned hotspots elsewhere in LB Merton. A 230mm diameter surface water sewer pipe flows in a westerly direction along Marina Avenue, after which it converges into a 300mm diameter surface water sewer pipe at the road's western end that discharges into the adjacent Beverley Brook. Marina Avenue's sewer network does not appear to receive flow from sewer networks located on adjacent streets, whilst there is no sewer network present in the Sir Joseph Hood location itself.

Map16 gully sensor data provided by Merton Council confirm that prior to the flooding incident, gullies in the Sir Joseph Hood pavilion area had been cleaned in December 2020. As gullies in this location were not cleaned again until October 2022, it is likely that they are not part of Merton Council's high-priority cleansing programme and are instead cleaned at least once every three years

as part of the standard programme. Gullies on Marina Avenue are not included in Merton Council's current programme, and so historical information on their cleansing programme priority is not available on Map16.

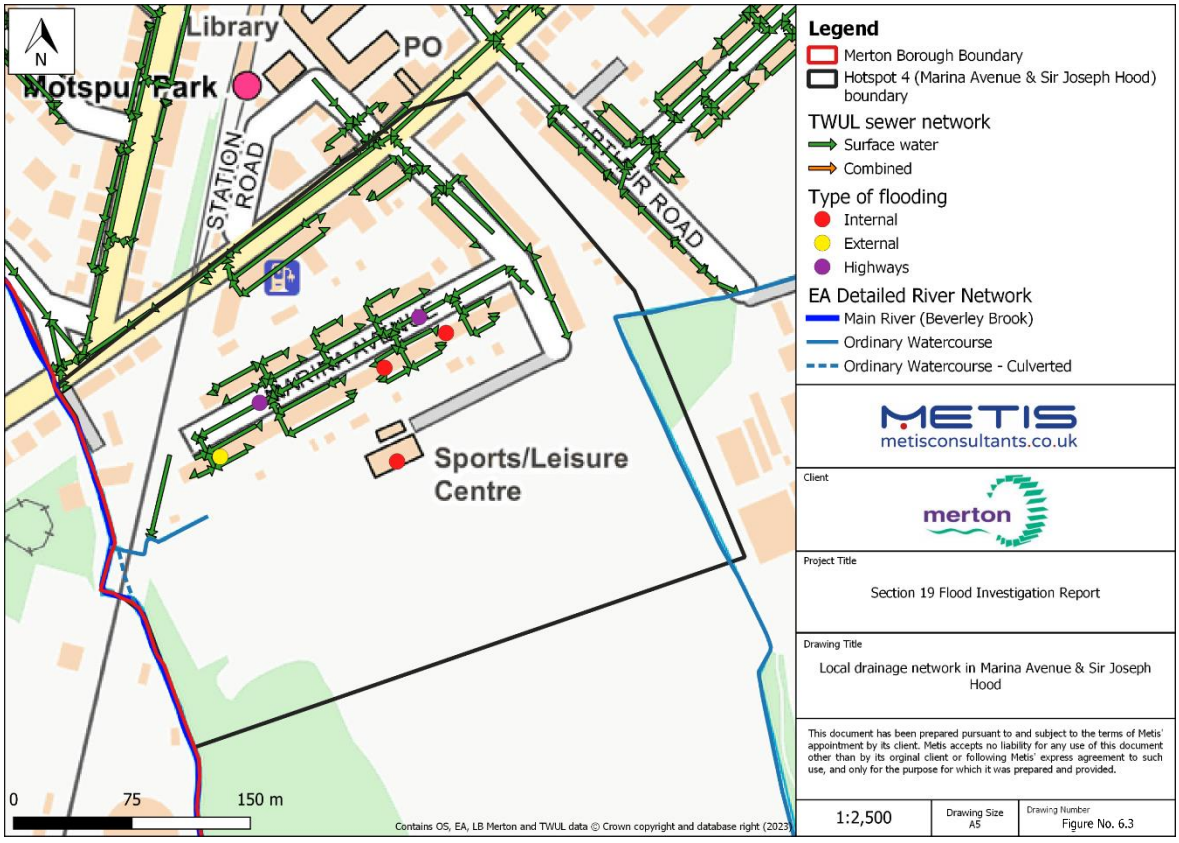

Figure 6.3: Local drainage network in the Marina Avenue & Sir Joseph Hood hotspot

6.1.3 Local flood mechanism

LiDAR data show that there is a reduction in elevation of approximately 4m between the Sir Joseph Hood Memorial Playing Fields and the residential properties on Marina Avenue, with the topography of Marina Avenue being relatively flat. Surface water that collects upon the playing fields is therefore likely to flow northwards towards Marina Avenue, where it would likely collect due to its flat topography. The Beverley Brook flows northwards from the southern end of Sir Joseph Hood Memorial Playing Fields.

6.1.4 Local flood risk

Identifying the potential risks of flooding from surface water, ordinary watercourses, main rivers, groundwater, sewers, and other potential sources is key in order to ascertain the specific flood sources within this hotspot that were likely to be responsible for flooding during the 25th July 2021 rainfall event.

Surface Water Flood Risk

The difference in elevation of approximately 4m between the Sir Joseph Hood Memorial Playing Fields and Marina Avenue could encourage surface runoff to flow towards the Sir Joseph Hood Memorial pavilion and Marina Avenue. This factor is compounded by Marina Avenue's flat topography also not being conducive to encouraging surface water runoff to flow away from the

area. *Figure 6.4* shows the EA RoFSW for this hotspot, with much of the area immediately adjacent to the pavilion within Sir Joseph Hood Memorial Park being at high risk of experiencing surface water flooding. The western half of Marina Avenue and the rear external areas of properties throughout the entire street are at a medium risk of surface water flooding, as is much of the northern portion of Sir Joseph Hood Memorial Park. Although internal areas of properties in this hotspot are not at a medium or high risk of experiencing surface water flooding, they are in immediate proximity to these medium-high risk areas.

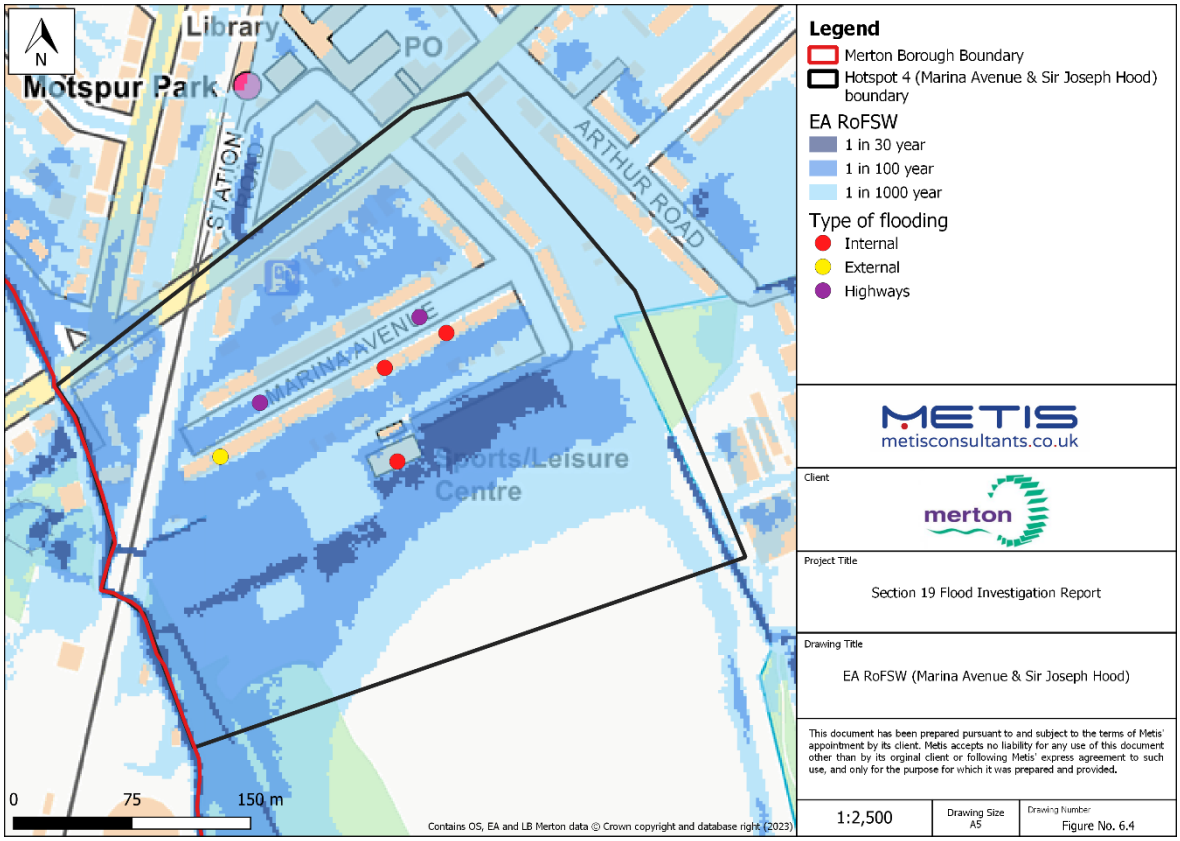

Figure 6.4: EA RoFSW (Marina Avenue & Sir Joseph Hood)

Ordinary Watercourse Flood Risk

According to EA DRN data, a drain connected to the Pyl Brook that is designated as an ordinary watercourse runs through the east of this hotspot. This drain also enters into a culvert through a trash screen in the north-eastern corner of the Sir Joseph Hood Memorial Playing Fields, with this culvert running behind properties located on the southern side of Marina Avenue. This channel turns into an ordinary watercourse once the culvert passes onto NR land at the western end of Marina Avenue, after which it undergoes a 90° bend and re-enters the culvert before joining the Beverley Brook. Despite these ordinary watercourses being a potential flood source within this hotspot, the limited reports of flooding associated with these ordinary watercourses during this event indicate that larger bodies of water are likely to have been of greater flood risk to this location.

Fluvial Flood Risk

The Beverley Brook is an EA-designated main river that is located along the western boundary of this hotspot, running immediately to the west of the Sir Joseph Hood Memorial Fields and Marina

Avenue. As demonstrated in *Figure 6.5*, much of this hotspot is located within Flood Zone 2 and Flood Zone 3 according to the EA's online Flood Map for Planning, and is thus at a medium-high risk of experiencing fluvial flooding. The property within the Sir Joseph Hood area alongside the rear external areas of residential properties along the south side of Marina Avenue are located in Flood Zone 3 and are thus subject to a high fluvial flood risk, whilst Marina Avenue itself and all of its properties are located within Flood Zone 2. The EA issued a fluvial flood warning at the Beverley Brook in West Barnes at approximately 15:00, and Merton Council have confirmed that fluvial flooding occurred within this hotspot during the flood event on 25th July 2021.

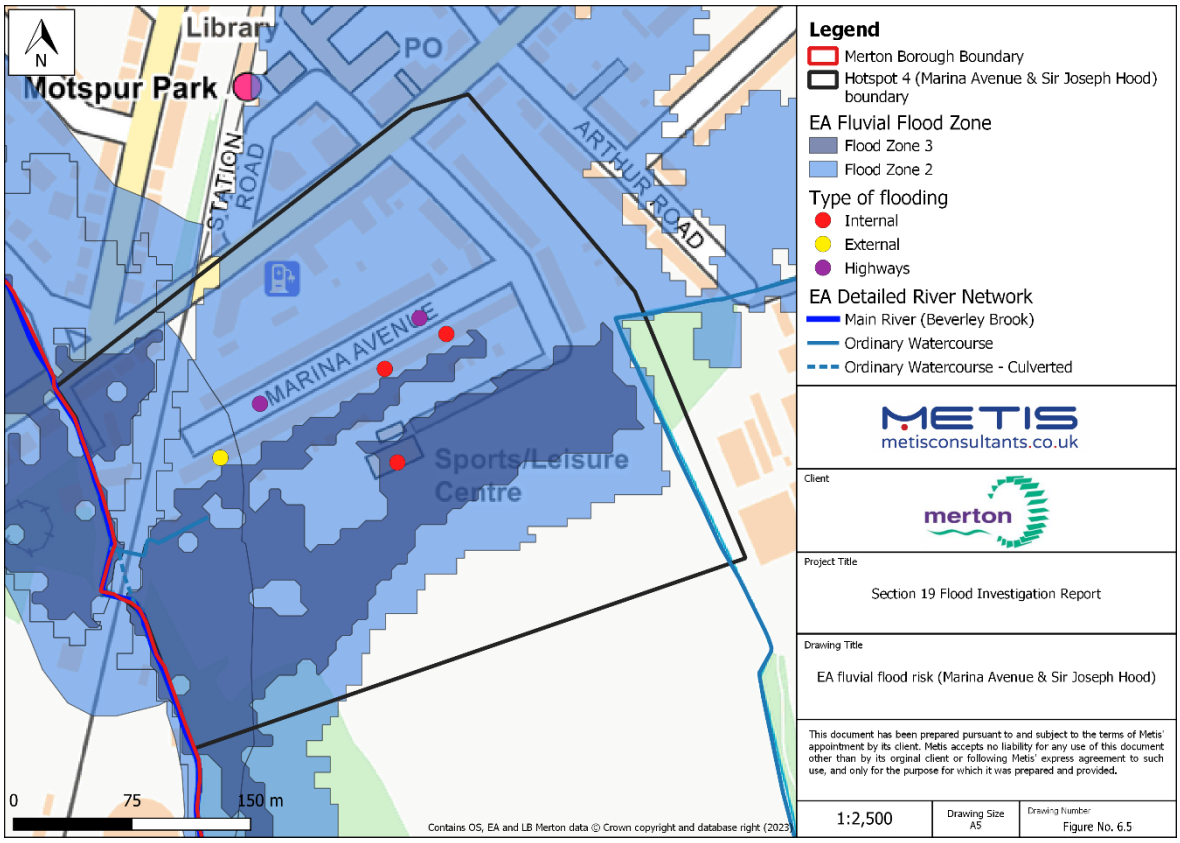

Figure 6.5: EA fluvial flood risk (Marina Avenue & Sir Joseph Hood)

Groundwater Flood Risk

The EA's AStGWF dataset shows that much of the land within this hotspot is susceptible to the emergence of groundwater flooding. Specifically, this hotspot is located wholly within an area where >= 50% < 75% of land is susceptible to groundwater flood emergence, depicted in *Figure 6.6.* However, there were no reports of groundwater flooding within this hotspot and so groundwater flooding is unlikely to have contributed to the flood incident in this location.

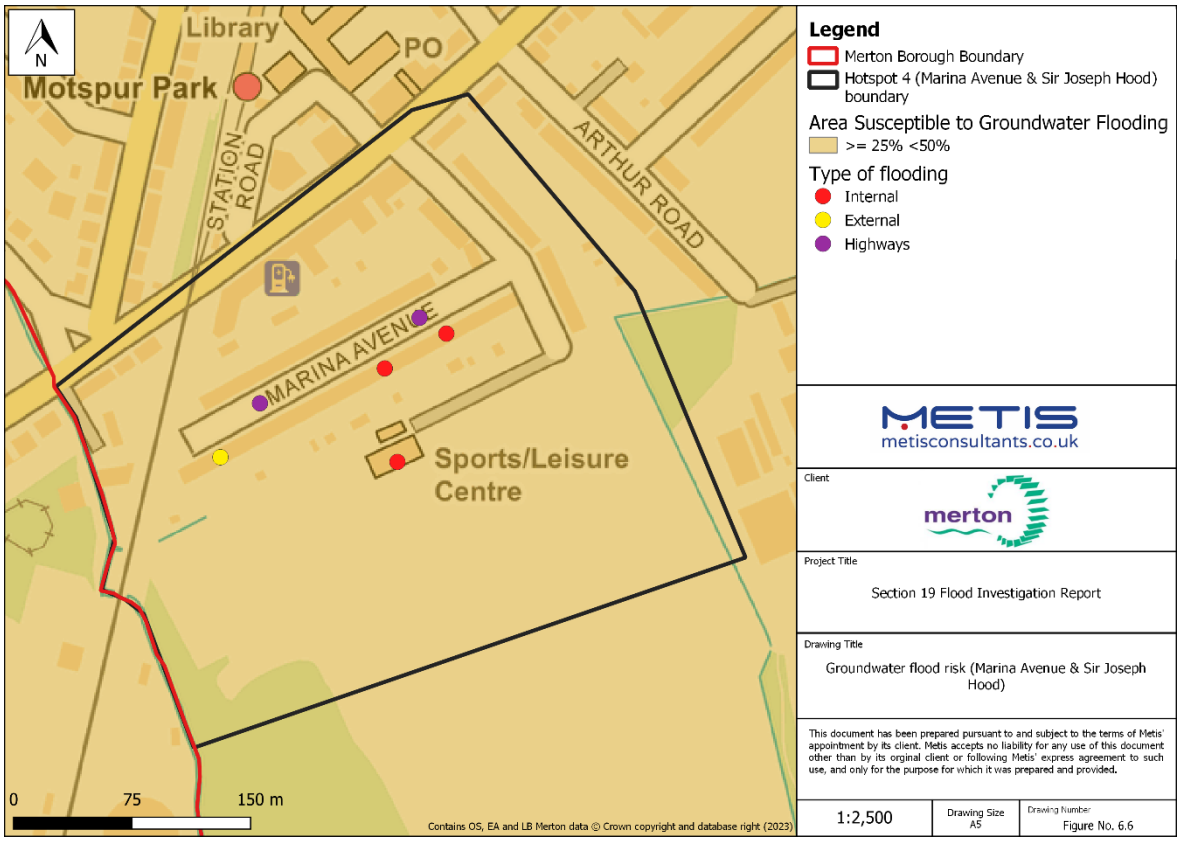

Figure 6.6: Groundwater flood risk (Marina Avenue & Sir Joseph Hood)

Sewer Flood Risk

As this hotspot's sewer network is relatively small with no inflows from networks on adjacent roads and has a direct route into the Beverley Brook, sewer flood risk in this hotspot is likely to not be a primary flood source. Nevertheless, sewer flooding could be an additional flood source in this location if gully blockages limit the sewer network's ability to manage additional flows entering the network during extreme rainfall events and causing flooding to the western half of Marina Avenue, although there is limited evidence to suggest that this was the case during the 25th July 2021 incident. The aforementioned TWUL-reported sewer flooding within this hotspot's postcode area (discussed in *Chapter 6.1.1*) suggests that sewer flooding could be a risk factor at this location; however, this is unlikely as there was only a singular instance of sewer flooding according to TWUL in this postcode area and it is unclear whether this sewer flooding occurred within this hotspot or elsewhere in the postcode area.

Flood Risk from other sources

There is no risk of flooding from other sources in this hotspot since predicted reservoir flooding extent does not cover any location within this hotspot according to EA Risk of Flooding from Reservoirs data.

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

Table 6.1: RMA Actions taken at the Marina Avenue & Sir Joseph Hood hotspot

Authority	Authority Contributing Action to Flooding Incident
Merton Council	***Before*** ✓ Clearance, strimming and inspections of the ordinary watercourses around Sir Joseph Hood, Marina Avenue, and Arthur Road as part of the council's annual ditching programme. ***During*** *No known actions taken* ***After*** ✓ Culvert running behind properties on the southern end of Marina Avenue surveyed in February-March 2022, with a generally good condition identified aside from a few obstructions. ✓ During culvert survey, some intruding connections and tree roots were identified and subsequently cut back. ✓ Annual ditching works carried out each winter, with silt/debris and vegetation being cleared from the ordinary watercourses around Sir Joseph Hood. ✓ October 2022 gully inspection at Sir Joseph Hood, with silt cleared but a blocked outlet identified. ✓ Ditch clearance undertaken during Winter 2022-2023.
Thames Water	***Before*** *No known actions taken* ***During*** *No known actions taken* ***After*** *No known actions taken*

6.1.6 Source and Cause

Fluvial flooding was the primary flood source in this hotspot during the 25th July 2021 event. The heavy rainfall that occurred during this event was conducive to increased river levels along the

Beverley Brook (located along the western border of this hotspot), which was issued with a flood warning by the EA during this event. The Beverley Brook's relatively small channel capacity is unfavourable for successfully managing increased flows in-channel, thus encouraging out-of-bank flows. The EA confirmed that fluvial floodwaters entered the area from the south, with the increased river volumes overflowing the channel banks and causing flooding to the Sir Joseph Hood and Marina Avenue area. The topography of Sir Joseph Hood Memorial Playing Fields also meant that some fluvial floodwaters could not return into the channel following the event peak, resulting in areas of standing floodwater within this hotspot.

Surface water flooding was likely to have been a secondary flood source in this hotspot on the 25th July 2021. The poor drainage within the Sir Joseph Hood Memorial Playing Fields would have increased the volume of surface water runoff during the heavy rainfall that occurred to this location. With topographic factors encouraging this runoff to flow towards Marina Avenue and collect within this location, surface water flooding is likely to occur to this hotspot during extreme rainfall such as that which occurred on 25th July 2021. As the affected properties are located immediately adjacent to locations of medium and high surface water flood risk as detailed in *Section 6.1.4* and *Figure 6.4*, it is likely that increased surface water runoff could have expanded further onto these properties during extreme rainfall. Moreover, one property affected by internal flooding was undergoing renovations during this incident and had its ground floor threshold levels lowered by approximately 600-900mm, thus increasing its susceptibility to flooding from both fluvial and surface water sources.

6.1.7 Recommendations

- EA should request access from NR to survey the section of main river culvert at the western edge of the hotspot that is located below the railway line to enable a full survey to be undertaken, thus helping to identify any potential issues that could be causing or compounding flooding to this location.
- Merton Council should improve the sports pitch drainage within the Sir Joseph Hood Memorial Playing Fields to reduce the runoff of surface water onto Marina Avenue, whilst being mindful to not increase flows to the Beverley Brook or downstream.
- Merton Council should ensure that the blocked outlet at Sir Joseph Hood is cleared, and gullies are inspected more frequently to ensure that outlets do not become frequently blocked.

6.2 Hotspot 5 – Lower Morden

The Lower Morden hotspot is located in the far south-west of LB Merton as shown in *Figure 4.10*, and is situated within the Lower Morden ward. This hotspot is located within DC33 according to the Surface Water Flooding tab of the LB Merton 2020 Level 1 SFRA mapping tool.

Despite instances of flooding occurring throughout this hotspot on 25th July 2021, reports to Merton Council and social media indicate that this flooding did not meet Section 19 threshold criteria as defined in Figure 5-2 of the 2015 LB Merton LFRMS. Therefore, this chapter provides a higher-level overview of flooding to locations within this hotspot during this rainfall event. The primarily affected locations within this hotspot are locations 11-14, shown within *Table* 4.5.

6.2.1 Non-Section 19 location: Lynmouth Avenue, Kingsbridge Road, and Garth Road

Lynmouth Avenue, Kingsbridge Road and Garth Road are locations 11, 12, and 13 respectively within *Table* 4.5, and have been grouped together within this sub-chapter due to their similar flood mechanisms and sources during the flood incident on 25th July 2021. The flood reports received by Merton Council and on social media suggest that flooding occurred solely to highways and external areas of properties throughout these locations, aside from one instance of internal flooding to an extension within a residential property on the southern end of Garth Road. As two or more residential properties were not flooded internally and access to emergency vehicles to highways across the hotspot was still possible during the event, flooding to these locations did not meet the Merton Council Flood Investigation Criteria.

Hydromaster data indicate that these locations experienced a rainfall event with a maximum return period of between 1 in 2 and 1 in 5 years, whilst TWUL FEH13 data show return periods of between 1 in 78 years and 1 in 84 years.

All gullies in this location drain into the TWUL sewer network, which flows into the Pyl Brook. Specifically, TWUL local sewer network data show that surface water sewers on Lynmouth Avenue take runoff from surface water sewers along Kingsbridge Road and generally flow into a northerly direction before making a 90° turn westwards into the Pyl Brook through a number of outfalls. Surface water sewers on the southern end of Garth Road flow southwards and discharge into the Pyl Brook, whilst surface water sewers within the northern half of Garth Road flow northwards and eventually flow into the Pyl Brook after reaching Lower Morden Lane. LiDAR data show that land along the Pyl Brook, including portions of Lynmouth Avenue and Garth Road, is a local low point, with the higher elevation of adjacent streets including Kingsbridge Road meaning that topography slopes towards the Pyl Brook. Map16 gully sensor data provided by Merton Council show that the highway gullies in these locations were part of Merton Council's high-priority cleansing programme (whereby they are cleaned at least once annually and on an ad hoc basis following reports of blocked gullies) during 2019/20 and 2020/21. However, Map16 data also show that vehicular obstructions meant that some gullies could not be cleaned during recent inspections and thus gullies in this location had most recently been cleaned at varying times between January 2019 and March 2021 prior to the July 2021 flooding incident. CAF modelling data within TWUL's DWMP show that there is a high risk of main sewer surcharges along the entirety of Garth Road, most of Lynmouth Avenue, and parts of Kingsbridge Road.

The EA's RoFSW map shows that surface water flood risk is high to much of Lynmouth Avenue's central portion and parts of Garth Road and Kingsbridge Road, with some properties in Lynmouth Avenue and Garth Road being at high risk of surface water flooding. Larger areas within these locations have a medium risk of surface water flooding that extends onto some additional properties, with surface water running between properties from Kingsbridge Road to Lynmouth Avenue. EA AStGWF mapping shows that most of these locations are located within a 1km^2 grid where <25% of land is susceptible to the emergence of groundwater flooding, although the northernmost areas of Lynmouth Avenue and Kingsbridge Road are located where >=25% <50% of land is susceptible to groundwater flooding. The EA's Flood Map for Planning shows that some properties on Lynmouth Avenue and Garth Road are at a high risk of fluvial flooding given their location within Flood Zone 3, whilst additional properties on Garth Road Lynmouth Avenue are located within Flood Zone 2 and are therefore at a medium risk of fluvial flooding. This is because

the Pyl Brook, an EA-designated main river, runs directly through these locations below Garth Road and parallel to Lynmouth Avenue. There is no risk of flooding from reservoirs within this hotspot.

As this location's local sewer network flows into the Pyl Brook, high river levels during this flood incident that were confirmed by Merton Council resulted in a backflow and capacity issue, with the outfalls located along the river channel being surcharged. In September 2021, Merton Council undertook extensive investigations and high-pressure jetting of the local highway drainage system, confirming that there were no defects within the sewer system. Therefore, it is clear that a combination of high river levels and limited sewer network capacity alongside intense rainfall which increased surface runoff rates into the local sewer network were the primary causes of flooding to this location, with floodwaters collecting in the local topographic low points along Garth Road and Lynmouth Avenue. Further actions recommended at this location include:

- TWUL and Merton Council should expand the use of Lynmouth Gardens, located between Garth Road and Lynmouth Avenue, as a flood storage area to limit the risk of fluvial flooding.
- Merton Council should investigate introducing SuDS retrofits in the affected areas to maximise attenuation capacity of surface runoff.

6.2.2 Non-Section 19 location: Wydell Close, Rosebery Close, Essex Close, Garth Close

These roads form location 14 within *Table* 4.5. Flood reports received suggest that flooding occurred solely to highways and external areas of properties throughout the hotspot. As Merton Council have confirmed that no internal property flooding was recorded and access to emergency vehicles to highways was still possible during the event, flooding at this location did not meet the Merton Council Flood Investigation Criteria.

Hydromaster data show that these locations experienced a rainfall event with a return period of between 1 in 2 and 1 in 5 years, whilst maximum TWUL FEH13 data indicate a return period of 1 in 78 years.

TWUL local sewer network data show that surface water sewers on each of the four roads within this location flow in an easterly direction into the Pyl Brook. LiDAR data show that land along the Pyl Brook, including the roads within this location, is a local low point, with the rest of the hotspot's topography sloping towards the Pyl Brook on either side of the river from higher elevations. Each of these roads within this location run in a west-east orientation with the adjacent Garth Road located immediately to their west. As each of these roads are situated at a lower elevation than Garth Road, surface water runoff is encouraged to flow from Garth Road onto the roads within this location during rainfall events. Map16 gully sensor data show that gullies in this location were not regularly cleaned each year and thus were likely part of Merton Council's standard cleansing programme whereby gullies are cleaned at least once every three years. Map16 data also show that prior to the flooding incident, most gullies in this location had last been cleaned in January 2018 and September 2020, although some had not been cleaned since March 2017. CAF modelling data within TWUL's DWMP show that there is a high risk of main sewer surcharges within each of the roads at this location.

The EA's RoFSW map shows that surface water flood risk is high to parts Wydell Close, although no properties are included within this high-risk area. Some properties on each of the four roads within

this location are at a medium risk of surface water flooding. EA AStGWF mapping shows that Essex Close and Garth Close are located within a 1km^2 grid where <25% of land is susceptible to the emergence of groundwater flooding, while Wydell Close and Rosebery Close are located where >=25% <50% of land is susceptible to groundwater flooding. The EA's Flood Map for Planning shows that most properties in Wydell Close and Rosebery Close are located within Flood Zone 3, whilst Flood Zone 2 extends to the remainder of properties on these roads and to some properties on Essex Close and Garth Close. This is because the Pyl Brook, an EA-designated main river, runs directly adjacent to the roads within this location. There is no risk of flooding from reservoirs to this location.

Reports received by Merton Council and subsequent investigations indicate that a combination of sewer and surface water flooding were the sources of flooding to this location during the 25th July 2021 storm event. Specifically, reports included a dislodged manhole cover on Lower Morden Lane, foul water surcharges from Garth Road that flowed down to each of the roads in this location due to local topography, and sewer surcharges within the location's roads. The high river levels of the Pyl Brook during this event likely reduced the capacity of the local sewer network as it is directly connected to the Pyl Brook. Gullies across this location were inspected and cleared shortly after the flood event in August and September 2021, with siltation of up to 60% identified but no defects found. Further actions recommended at this location include:

- TWUL should ensure that the surface water sewer network along Garth Road and within this location is inspected and cleared at an increased frequency to limit surcharges.
- Merton Council should investigate introducing SuDS retrofits to properties and highways across the location's roads to maximise attenuation of runoff from Garth Road.

6.3 Other flooded locations on 25th July 2021

Several other locations across LB Merton other than those within the two aforementioned hotspots experienced flooding during the rainfall event on 25th July 2021. However, flooding reports to these locations were few and flood extent was not sufficiently extensive to trigger a full Section 19 investigation, or a higher-level analysis.

Two of these locations are located within Hotspot 3 (West Barnes): West Barnes Lane, and the Burlington Road and Shannon Corner junction location. These sites experienced rainfall return periods of between 1 in 2 years and 1 in 20 years according to Hydromaster data, although the number of flood reports at these locations were few on 25th July 2021. Nevertheless, these locations experienced more substantial flooding during the rainfall event of 12th July 2021 as aforementioned (although Section 19 threshold criteria were still not met), with their specific flood sources and mechanisms at these locations discussed within *Section 5.3*.

Additional impacted locations include:

- Lower Morden Lane (Lower Morden ward, south-western area of LB Merton)
- Rustington Walk (St. Helier ward, southern area of LB Merton)
- Crown Lane and Stratton Road (Merton Park ward, south-central area of LB Merton)
- Rostrevor Road (Hillside Ward, north-central area of LB Merton)
- Hawthorne Avenue (Lavender Fields Ward, eastern area of LB Merton)

7 Conclusions and Recommendations

7.1 Conclusions

This Section 19 investigation for Merton Council was triggered as a result of two extreme rainfall events that occurred on the 12th July 2021 and the 25th July 2021, each of which resulted in flooding across the borough. Specifically, a total of 75 reports of flooding incidents were recorded during the 12th July event, whilst 37 reports of flooding incidents were recorded during the 25th July event. A total of nine and four incidents of internal flooding were reported to Merton Council during the 12th July and 25th July events, respectively. Flooding during the 12th July 2021 event resulted in closure of access to several roads across Raynes Park, disrupting the responses of emergency responders.

A total of five hotspots across LB Merton where reports of flooding were highly concentrated were selected for analysis within this investigation in order to assess the specific flood mechanisms and sources that resulted in flooding to these locations.

This investigation identified that LB Merton is primarily at risk of sewer flooding and surface water flooding. Parts of Hotspot 3 (West Barnes), Hotspot 4 (Marina Avenue & Sir Joseph Hood), and Hotspot 5 (Lower Morden) are also at a high risk of fluvial flooding from the Beverley Brook or the Pyl Brook. Additionally, groundwater flooding may be a further cause of flooding within parts of Raynes Park due to the high susceptibility to emergence of groundwater flooding in this location. Various topographical factors exacerbate flood risk at certain locations throughout LB Merton, encouraging floodwaters to flow towards and collect within local low spots. A further source of flooding to Abbott Avenue (located within the Raynes Park hotspot) is the continuing operation of its pumping station during extreme rainfall events, which can increase flow into the road's sewer network and result in gully surcharging.

7.2 Hotspot-specific recommendations

Within each chapter of this report, recommendations have been provided in order to help reduce the risk of flooding within the five hotspots investigated during any future rainfall events. This is especially important when considering that climate change is expected to increase the frequency and intensity of extreme rainfall events, which will likely raise both the severity of flooding and the number of flood events experienced across LB Merton.

These recommendations are summarised below for each hotspot:

Hotspot 1 (Raynes Park)

- TWUL and Merton Council should continue their collaborative working on the Raynes Park Flood Alleviation Scheme and investigate the feasibility and potential locations of additional resilience measures and SuDS to the Coombe Lane area and Abbott Avenue.
- TWUL should monitor the Abbott Avenue attenuation tank and the Worple Road Combined Sewer Overflow to limit flooding and liability to backflows within properties in future.
- TWUL should investigate whether the Abbott Avenue pumping station pumps can be switched off during high-magnitude rainfall events and provide additional storage upstream of the pumping station in order to only allow flows from Worple Road into manholes, thus keeping extreme flows away from the western end of Abbott Avenue.

- Merton Council should ensure routine highway drainage gully cleaning, whilst TWUL should undertake routine monitoring of sewer networks and the upgraded pumping station below the railway at Approach Road to ensure optimal performance levels.
- TWUL should investigate upgrading surface water sewer network capacity along Lower Downs Road to limit gully surcharging and ensure that surface water flows can be managed effectively at the local low point below the railway.
- Merton Council should work collaboratively with stakeholders to consider implementing SuDS elsewhere in the catchment closer to runoff sources to reduce flows towards the town centre.
- TWUL, alongside Merton Council, NR and the EA should continue collaborative drainage modelling of the Apostles area to identify specific issues and locations within the sewer network that cause flooding, from which a programme to identify means of resolving issues in the problematic areas could be created.

Hotspot 2 (Home Park Road)

- Merton Council and TWUL should use TWUL SWMP funding to utilise the green space at the eastern-most extremity of Home Park Road (Kenilworth Green) for attenuation and pumps.
- Merton Council should use TWUL SWMP funding to install SuDS features, including rain gardens, to help remove flows from the surface water sewer network.
- TWUL and NR should work collaboratively to undertake investigation of defects (and repairs if required) within the main surface water sewer line running below the railway behind Home Park Road.
- TWUL and NR should investigate upgrading the main surface water sewer line running below the railway to ensure that it can effectively manage surface water flows. TfL should facilitate the early review of proposals for the sewer network upgrade.
- Ensure that gullies along Home Park Road are included in Merton Council's high-priority cleansing programme for each future works programme year.
- TWUL should continue to progress the permissions with NR to repair the main line below the railway.
- Merton Council should investigate increasing thresholds to at-risk properties through providing localised property-level protection, increasing resilience to basements and ground floors.

Hotspot 3 (West Barnes)

- TWUL should ensure that the main surface water sewer at Westway is inspected at an increased frequency and its size is increased to limit backflows and increase capacity.
- Merton Council should investigate the benefit of introducing a highway SuDS retrofit such as permeable paving along West Barnes Lane and Westway to improve the infiltration capacity during instances of extreme rainfall that may increase surface runoff into the area.

- Merton Council and TfL should investigate introducing a highway SuDS retrofit such as permeable paving at the Burlington Road / Shannon Corner junction or within the Shannon Corner roundabout in order to improve the area's infiltration capacity during instances of extreme rainfall and increased surface runoff.
- Merton Council should ensure engagement with TfL regarding potential SuDS measures within the Shannon Corner roundabout, as these could impact traffic flow on the A3 flyover (a TfL red route) which can be accessed directly from slip roads at the roundabout.
- At Burlington Road, TWUL should make improvements to the surface water sewer network capacity and Merton Council should increase gully cleaning frequency.

Hotspot 4 (Marina Avenue & Sir Joseph Hood)

- EA should request access from NR to survey the section of main river culvert at the western edge of the hotspot that is located below the railway line to enable a full survey to be undertaken, thus helping to identify any potential issues that could be causing or compounding flooding to this location.
- Merton Council should improve the sports pitch drainage within the Sir Joseph Hood Memorial Playing Fields to reduce the runoff of surface water onto Marina Avenue, whilst being mindful to not increase flows to the Beverley Brook or downstream.
- Merton Council should ensure that the blocked outlet at Sir Joseph Hood is cleared, and gullies are inspected more frequently to ensure that outlets do not become frequently blocked.

Hotspot 5 (Lower Morden)

- TWUL and Merton Council should expand the use of Lynmouth Gardens, located between Garth Road and Lynmouth Avenue, as a flood storage area to limit the risk of fluvial flooding.
- TWUL and Merton Council should investigate introducing SuDS retrofits to properties and highways in the affected locations to maximise attenuation capacity and minimise surface runoff.
- TWUL should ensure that the surface water sewer network along Garth Road and within this location is inspected and cleared at an increased frequency to limit surcharges.

7.3 General recommendations

- Merton Council should engage with TfL on any future flood alleviation works and SuDS opportunities along its red route network (A3, A24, A297), particularly if these are part of greater scheme projects.

TWUL have specified the following additional recommendations that can be applied across LB Merton where appropriate:

- Flood RMAs including TWUL should adhere to the recommendations provided during the independent London Flood Review. These 28 recommendations are listed within Chapter 3 of the London Flood Review's Stage 4 Summary Report, and are discussed in detail within Chapter 4 of the full Stage 4 Technical Report.

- TWUL should finalise and publish their final DWMP, which investigates the current state of drainage and wastewater management whilst factoring in growth, urban creep, and climate change to provide long-term actions required for the DWMP areas. Further information can be accessed on TWUL's DWMP webpage.
- TWUL should consider the recommendations of the London Flood Review and continue to prioritise inspection and sewer cleaning based on the behaviour and impact of the operation of the sewer network at all sites. TWUL should prioritise sites where the sewer network is impacting residents.