Section 19 Flood Investigation Report

South Tottenham, London Borough of Haringey

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Abbreviations used within the report

CDA	Critical Drainage Area
DWMP	Drainage and Wastewater Management Plan
FEH	Flood Estimation Handbook
FWMA	Flood and Water Management Act 2010
LLFA	Lead Local Flood Authority
mAOD	Metres Above Ordnance Datum
RMA	Risk Management Authority
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
TW	Thames Water

CONTENTS

1 INTRODUCTION

1.1 Terms of Reference

McCloy Consulting have been instructed on behalf of Haringey Council to undertake an investigation into flooding, in accordance with Section 19 of the Flood and Water Management Act, 2010.

1.2 Legislative background

Where a significant flood event has occurred and the responsibility for managing the future risk is unclear, Haringey Council may conduct a formal flood investigation, under Section 19 of the Flood and Water Management Act, 2010. The aim of this investigation is to identify which authority has responsibilities and whether they are proposing to respond. The results of the investigation will be published.

As the Lead Local Flood Authority (LLFA) for the study area, Haringey Council has a duty to investigate flood incidents as set out in Section 19 of the Flood and Water Management Act, 2010 (the Act). The Act states:

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

a. Which risk management authorities have relevant flood risk management functions, and

b. Whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

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

a. Publish the results of its investigation, and

b. Notify any relevant risk management authorities.

Section 1 of the Flood and Water Management Act (FWMA) (2010) defines a flood as *'any case where land not normally covered by water becomes covered by water'….*

It does not matter for the purposes of subsection (1) whether a flood is caused by:

a. Heavy rainfall

b. A river overflowing or its banks being breached

c. A dam overflowing or being breached

d. Tidal waters

e. Groundwater, or

f. Anything else (including any combination of factors).

But "flood" does not include

g. flood from any part of a sewerage system, unless caused by an increase in the volume of rainwater, entering or affecting the system, or

h. a flood caused by a burst water main

1.3 Defining the study extents

Two flood events were experienced in July 2021.

- 31 reports of flooding to Haringey Council recorded following rainfall events on 12th July 2021.
- 47 reports of flooding to Haringey Council recorded following rainfall events on 25th July 2021.

Widespread flooding was experienced across Haringey for both rainfall events. Haringey Council has proposed that reported flood incidents be split into three geographic areas of Wood Green, Hornsey Crouch End and South Tottenham. These areas describe the main concentrations of flood reports across the catchment taking into account both dates. This report covers the **South Tottenham** geographic area.

2 STUDY AREA

2.1 Study Location and Context

South Tottenham is located in the east of the London Borough of Haringey. It borders the London Borough of Waltham Forest to the east. Figure 2-1 below shows the extent of the study area. Bounding areas of north Tottenham and Wood Green are included in this report for the purposes of the investigation.

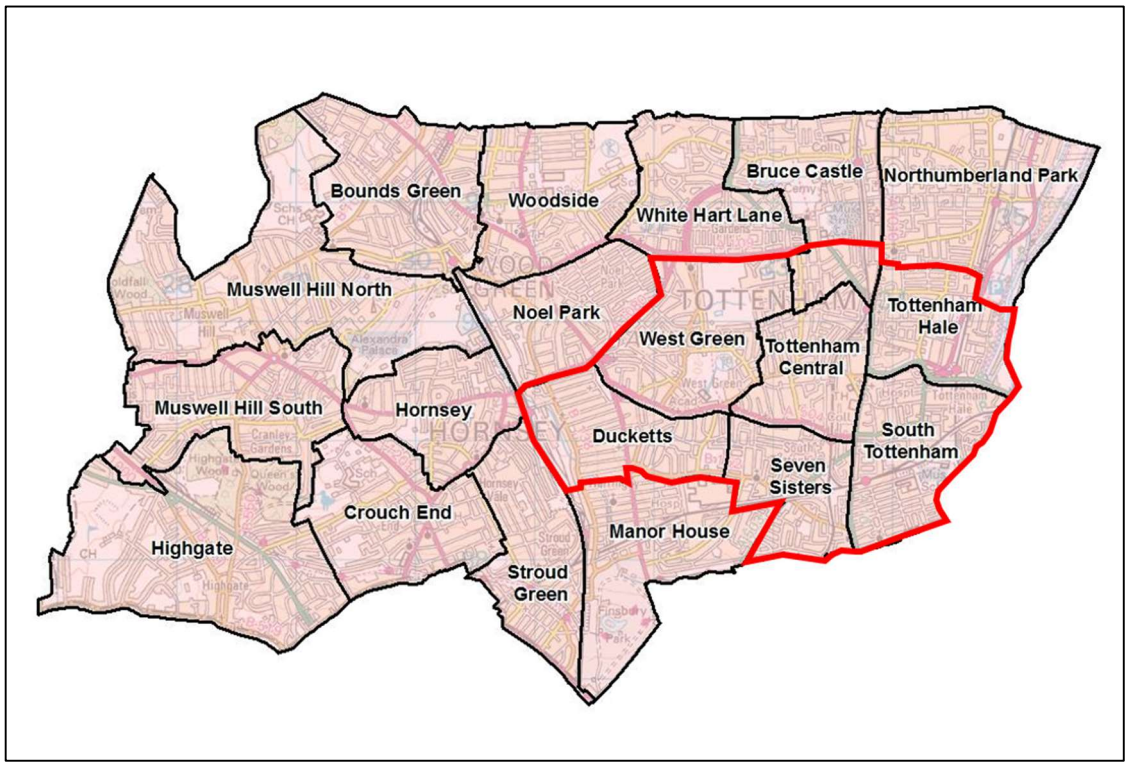


Figure 2-1 Map of Haringey showing study area extents

Tottenham has been identified in the London Plan and Haringey's Strategic Policies Local Plan[1] as a key regeneration area within London capable of accommodating significant growth.

South Tottenham is served by two underground stations, three overground stations and one national railway stations, which are located at Bruce Grove, Seven Sisters, South Tottenham and Tottenham Hale. The area is served by strategic roads including the A10, High Road and Seven Sisters Road.

2.2 Topography

Tottenham in general falls eastward towards the River Lea. The mainline railway through Wood Green in the west forms higher ground with White Hart Lane and Tottenham Recreation Ground in the north, with elevations ranging from 34m Above Ordnance Datum (AOD) to 40mAOD here. Land closer to the River Lea in the east ranges from 8mAOD to 10mAOD. There is a local high point in the residential area between Lordship Recreation Ground and Downhills Park, circa 30mAOD at its highest elevation.

[1] Haringey Strategic Policies Local Plan, 2013, Haringey Council:UK

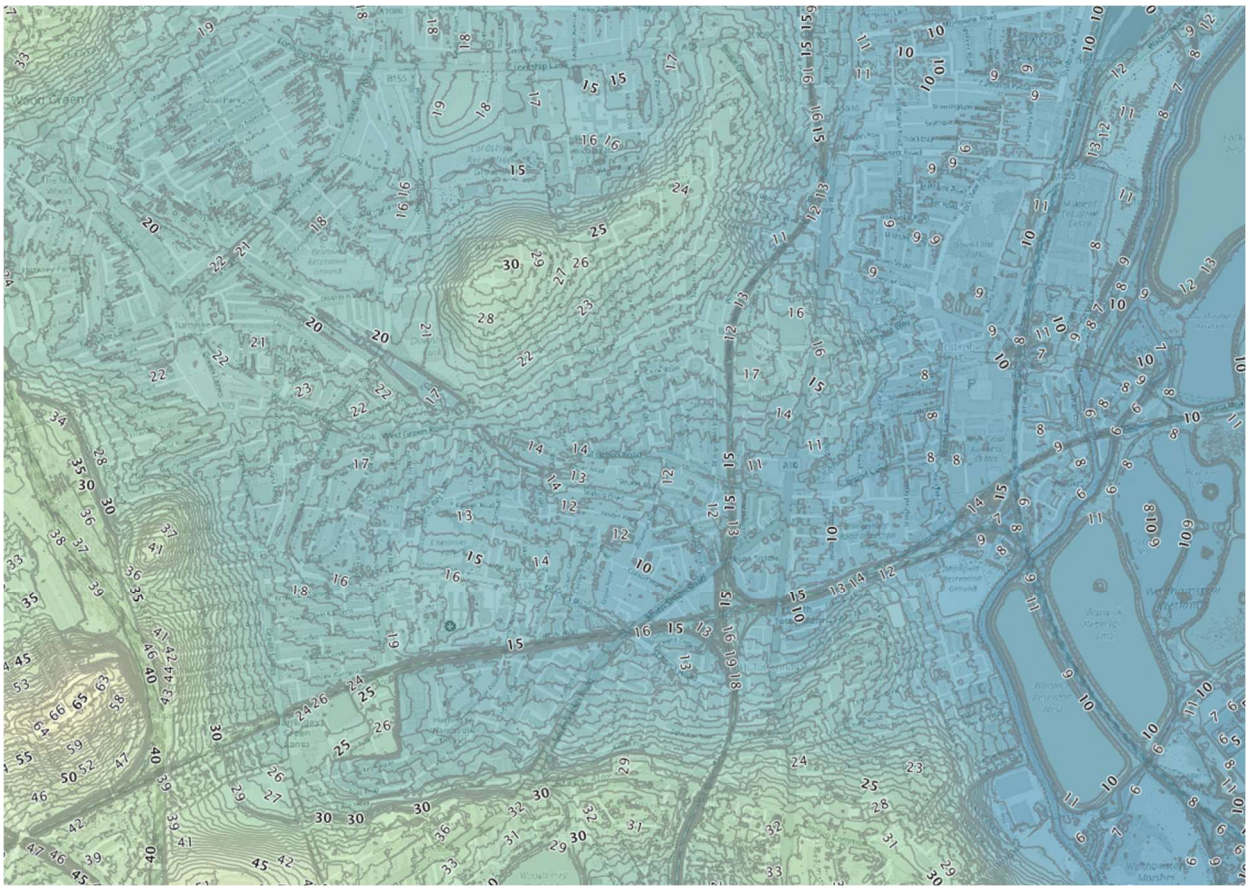


Figure 2-2 Topography of South Tottenham within London Borough of Haringey

2.3 Geology and Soils

Historic borehole logs within the study area were reviewed using British Geological Survey (BGS) database[2].

Borehole Grid References TQ39SW115/B, TQ38NW250 and TQ38NW76 identified similar ground conditions generally described as follows;

Topsoil and Made Ground (silty clay with fragments of brick, concrete, rootlets and ash) was encountered to up to 1.0m below ground level (bgl), with London Clay (stiff brown, occasionally grey silty and sandy clay) encountered beyond that to over 40m bgl. The BGS database indicates that areas of Taplow Gravel, Kempton Park Gravel, Enfield Silt and Alluvium may be present within Bruce Grove and eastern parts of Tottenham Hale.

2.4 Watercourses

South Tottenham lies within the Thames Catchment, and in particular drains to the Lower Lee.

Haringey's Strategic Flood Risk Assessment (SFRA)[3] details how a number of watercourses within the borough are culverted and commonly described as 'lost'.

The currently known alignment of watercourses local to South Tottenham is shown in Figure 2-3. Note that the New River is a controlled waterway with Thames Water having responsibility under the FWMA.

[2] Geology of Britain Viewer, 2021, British Geological Survey: UK. Available at Geology of Britain viewer | British Geological Survey (BGS) Access 30/11/2021

[3] Strategic Flood Risk Assessment, 2015, Haringey Council: UK. Available at: http://www.haringey.gov.uk/sites/haringeygovuk/files/2012s6315_haringeycouncil_sfra_v4.0_0.pdf Accessed on 30/11/2021

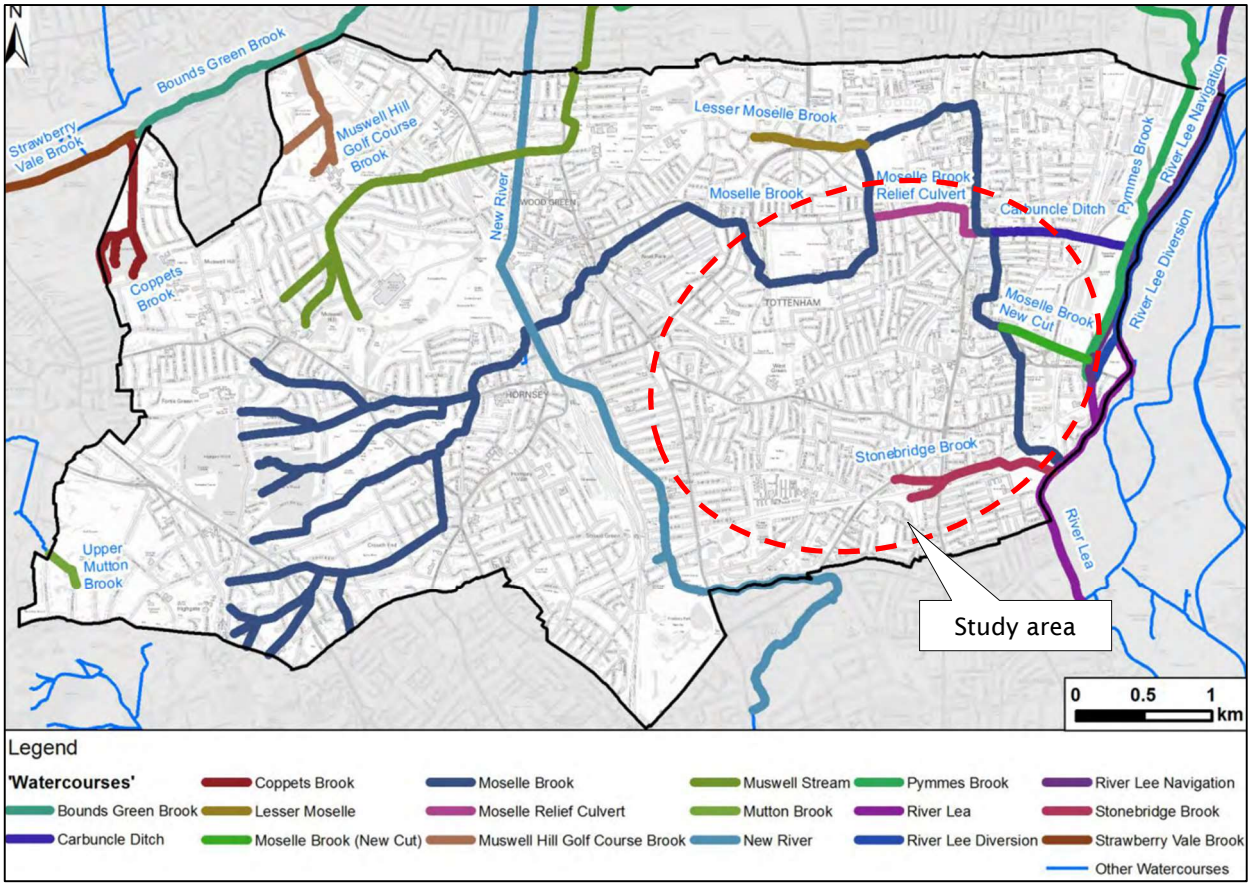


Figure 2-3 Overview of watercourses in Haringey and surrounding areas (from Haringey SFRA)

The following table indicates who is responsible for watercourses in Haringey;

Table 2-1 Watercourse responsibility in the London Borough of Haringey[4]

Watercourse	Classification	Responsibility under the FWMA
Moselle Brook	Main River	Environment Agency
Stonebridge Brook	Main River	
Pymmes Brook	Main River	
River Lee/River Lee Navigation	Main River	
Unnamed ditches	Ordinary Watercourse	Haringey Council
New River	Artificial Watercourse	Thames Water

[4] Surface Water Management Plan (SWMP), 2011, Haringey Council: UK. Available at: https://www.haringey.gov.uk/sites/haringeygovuk/files/dlt2_gp4_haringey_swmp_draft_v2.0_0.pdf Accessed on 02/11/21

2.5 Sewerage

The majority of South Tottenham is urban development of residential and commercial properties. The area therefore has a high percentage of impermeable area due to buildings, car parks, hard standings and highways.

The sewer network is separate, with a percentage of storm runoff known to contribute to the foul system. The public sewers are owned and maintained by Thames Water.

For the purposes of the Section 19 investigation, Thames Water has provided access to the Practitioner Portal of the Drainage and Wastewater Plan (DWMP). The DWMP portal provides modelling outputs from Thames Water's Capacity Assessment Framework, which includes identifying areas where sewers would be at capacity during a 2 year storm, where potential escapes from manholes would occur during a 30 year storm and the risk of flooding during a 50 year storm. This information has been used to further analyse the possible flood mechanisms across the study area.

2.6 Highway Drainage

The public highway generally drains to the public sewer network in this area via road gullies and pipework. The 'red routes' through Tottenham (the A10, Seven Sisters Road, Broad Lane and Monument Way) are maintained by Transport for London (TfL), with the remaining owned and maintained by Haringey Council as the local highway authority.

2.7 Flood Risk Mapping

The Environment Agency (EA) online maps provide readily available flood risk data within the study area. No new flood risk mapping has been produced to support this assessment.

2.7.1 Risk of Flooding from Rivers and Sea

Most of the entire study area is within Flood Zone 1 whereby the annual risk of flooding, from either rivers or the sea, is less than 0.1%. A section of Lordship Recreation Park and the eastern extents of Bruce Grove and Tottenham Hale are shown to be within Flood Zone 2, whereby the annual risk of flooding, from either rivers or the sea, is between 0.1 and 1.0%.

Figure 2-4 Flood Map for Planning

2.7.2 Risk of Flooding from Surface Water

The surface water Long-Term Flood Risk Map is shown in Figure 2-5. There are areas of high-risk flooding throughout the study area, notably High Road, Lordship Recreation Ground, Broad Lane, and residential areas north of St Ann's Road and Seven Sister Road. Areas of low to medium risk are indicated on the eastern extents of Bruce Grove and Tottenham Hale.

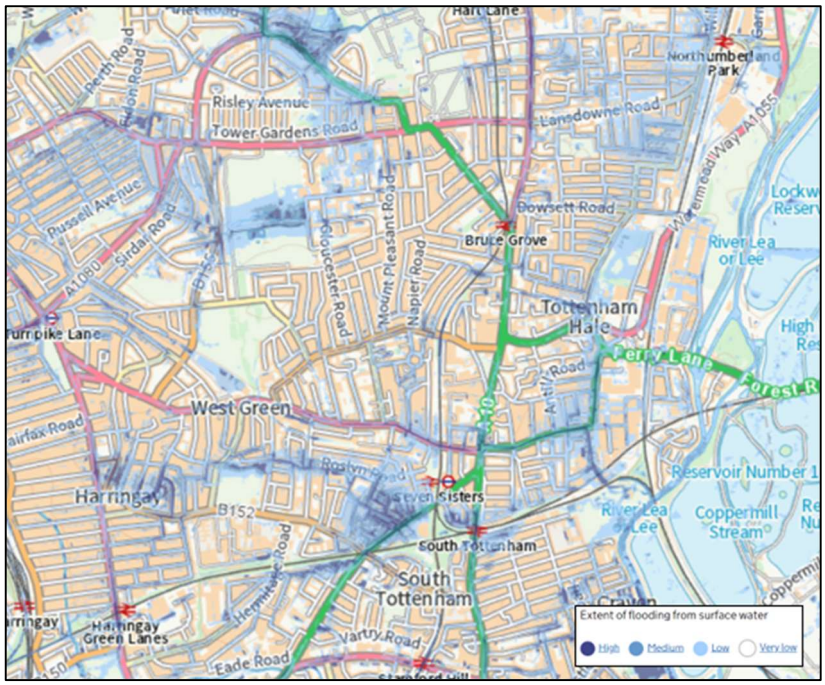


Figure 2-5 Surface Water Long Term Flood Risk Map

3 RISK MANAGEMENT AUTHORITIES

3.1 Haringey Council

Haringey Council is the LLFA for the area and the highway authority. The Flood and Water Management Act 2010 gives LLFAs powers and duties for the strategic overview of local flooding and for some flood risk management functions including:

- A duty to investigate flooding;
- A duty to maintain a register of significant structures and features;
- Powers to regulate ordinary watercourses;
- A duty as a statutory consultee to review drainage strategies and surface water management provisions associated with applications for major development.

As the highway authority, Haringey Council is responsible for the maintenance and operation of drainage gullies and the pipework connecting these to the public sewers for the proper function of highways and safety of highway users.

Haringey Council has contracted Marlborough Highways to support it on all aspects of highway infrastructure including carriageway, footway and cycleway maintenance, junction improvements, traffic calming measures, gully, drainage works and sustainable drainage systems (SuDS). The five year contract began in 2020.

3.2 Environment Agency

The EA is responsible for taking a strategic overview of the management of all sources of flooding and coastal erosion. The EA also has responsibility for managing the risk of flooding from main rivers, reservoirs and estuaries.

3.3 Statutory Undertaker for Public Sewers

Thames Water has a duty as a sewerage undertaker under Section 94 of the Water Industry Act 1991, to provide and maintain sewers for the drainage of buildings and associated paved areas within property boundaries. It has responsibility for any flooding which is directly caused by its assets i.e. its water or sewerage pipes. It also has a duty to cooperate with other relevant authorities in the exercise of flood risk management functions, which may include the sharing of information with other relevant authorities.

3.4 Transport for London

Transport for London (TfL) is responsible for the primary roads, underground, rail networks (London Overground and TfL Rail), buses, taxis, trams and river services in London. In Haringey, the primary roads, or 'Red Routes' which TfL is responsible for include the A406, the A10, Broad Lane, Monument Way and parts of Archway Road and Seven Sisters Road.

3.5 Riparian Landowners

Private landowners have responsibilities for the maintenance and upkeep of ordinary watercourses, including any associated culverts, and the bed / banks of any watercourse adjacent to or within their land. They should clear away any debris from the watercourse or culvert even if it did not originate from their land.

3.6 Residents and Property Owners

Private landowners are responsible for the maintenance and operation of drainage assets and connecting pipework located on privately owned roads and footways, car parks and other hard standings and for building surface water drainage.

Residents and property owners who know they are at risk of flooding have responsibilities to mitigate the risk of flood damage to their property as far as is reasonably practicable[5]. They should take measures to protect themselves and their property when flooding is imminent. Residents and property owners have the right to defend their property as long as they do not subsequently increase the risk of flooding to other properties.

Business owners should make a flood plan for their business. There are measures that can be taken to reduce the amount of damage to business premises caused by flooding and properties at risk should be insured.

[5] Living on the Edge. Environment Agency, 2015, available at https://www.wlma.org.uk/uploads/EA_Guide_to_rights_and_responsibilities_of_riverside_ownership.pdfhttps://www.wlma.org.uk/uploads/EA_Guide_to_rights_and_responsibilities_of_riverside_ownership.pdf, accessed 15th November 2021

4 SUMMARY OF RAINFALL EVENTS

4.1 12th July 2021

At 10:04 on 11th July 2021 (and updated 08:54 on 12th July 2021), the Met Office issued a Yellow warning of Rain expected between 10:00 and 23:59 on 12th July 2021. The warning covered the East of England, London, South East England and South West England.

Rainfall data was obtained from the EA for review from gauges located in Hornsey (grid reference TQ30557 89795), Brent, (grid reference TQ20836 87013) and Wanstead (grid reference TQ 41544 88234).

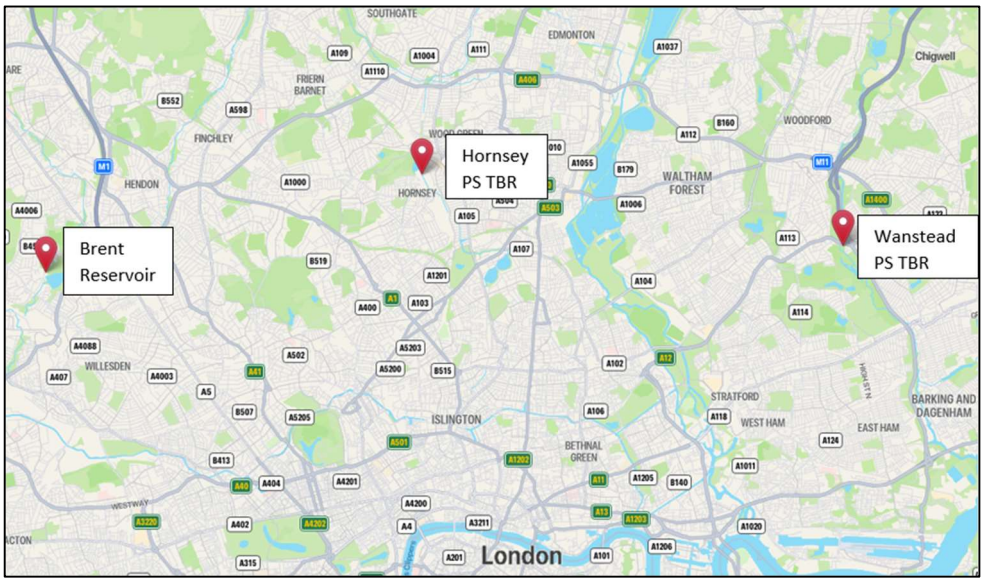


Figure 4-1 Locations of rainfall gauges

The most significant rain was recorded at Brent Reservoir between 17:00pm and 19:00pm, which recorded 7.6 mm of rainfall within this period. This rainfall is estimated as 1 in <2 year return rainfall event based on comparison of data obtained from the Flood Estimation Handbook. A total of 11.6mm was recorded for the whole day, with 10.2 mm of this falling over 3.5 hours. The rain gauge at Wanstead recorded 8mm over 24 hours, and the gauge and check gauge at Hornsey gave unreliable readings on the day due to apparatus blockages.

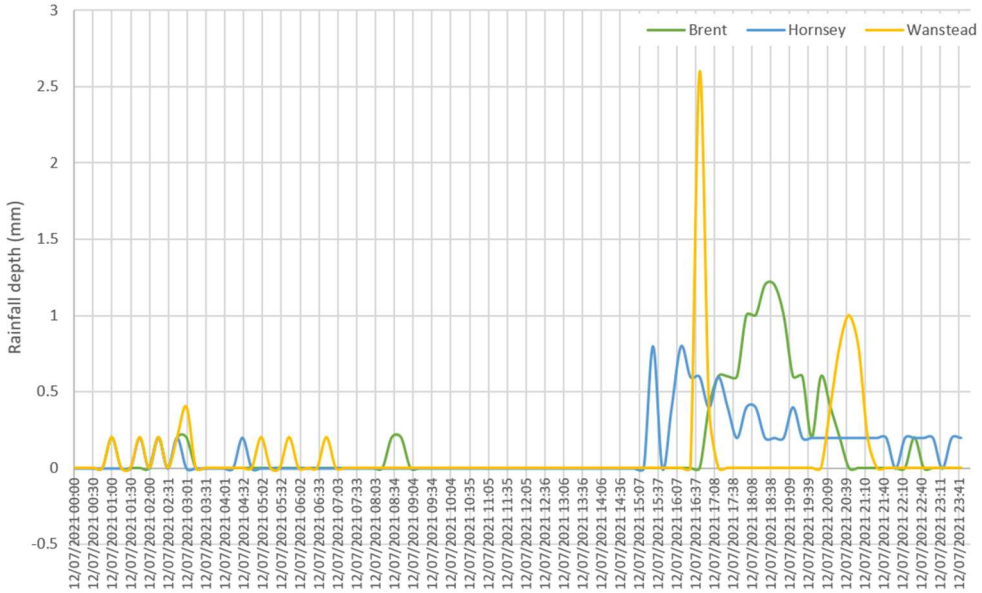


Figure 4-2 Rain gauge data, 12th July 2021

The relatively low rainfall recorded above is not consistent with the flood reports and anecdotal evidence provided from the area. The Hornsey gauges were blocked on retrieval of data and the recordings conflict with the Thames Water analysis of the rainfall event, which was presented at a recent workshop related to the floods[6], and indicated that the district received rainfall return periods ranging from a <5 year to a <20 year rainfall event. The areas in which the gauges are located in Brent (Borough) and Wanstead (London Borough of Redbridge) did not experience the same intensity of rainfall experienced elsewhere, which concurs with the relatively low estimated rainfall return period derived from the rain gauge data for these locations.

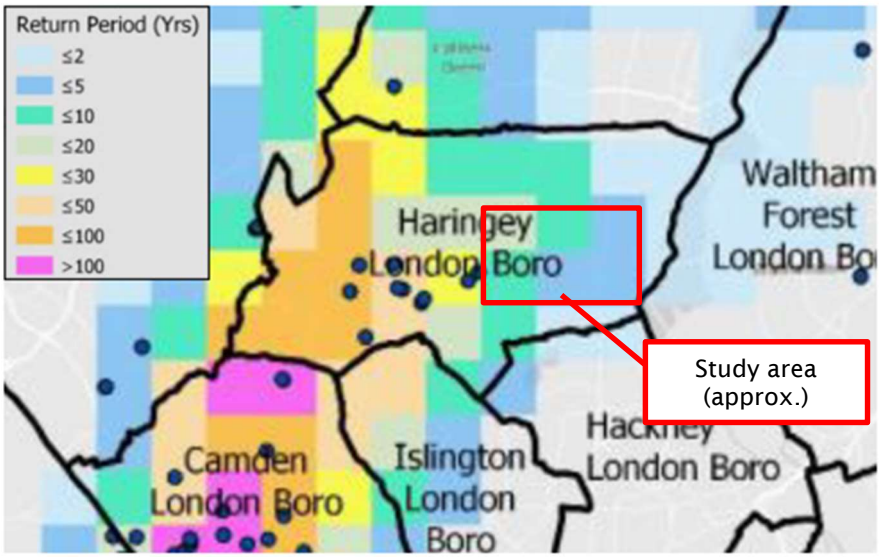


Figure 4-3 Rainfall Return Period and Report Flooding Incidents, 12th July 2021 (RaRa data using FEH99).

4.2 25th July 2021

The Met Office issued an Amber warning of Thunderstorm at 14:33 on 25 July 2021, expected between 14:33 and 19:00 on 25th July 2021, covering East of England, London and South East England.

The most significant rain being recorded at the selected gauges was between 14:15 and 15:45 at Wanstead. The rain gauge recorded 49 mm of rain within this time period, which was estimated to be a 1 in 70 year rainfall return event. A total of 54 mm was recorded for the whole day. The rain gauges at Brent Reservoir and Wanstead recorded 7.6mm and 22.8mm, respectively on this date.

[6] Supporting Section 19 Investigations, Workshop, 28th September 2021. Thames Water: UK

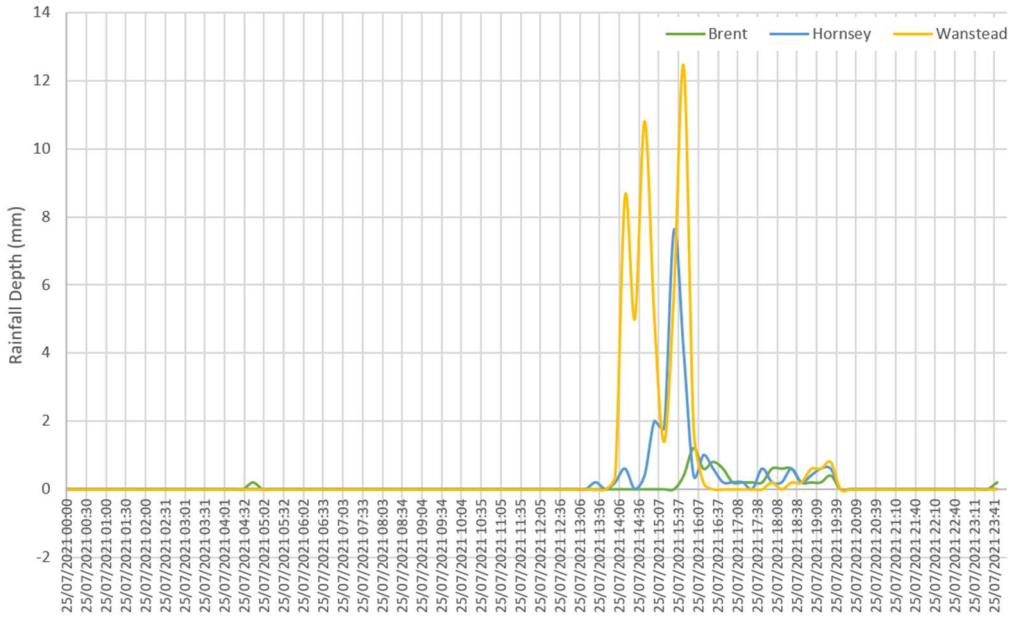


Figure 4-4 Rain gauge data, 25th July 2021

The Thames Water workshop data indicated that the district received rainfall return periods ranging from a <20 year to a <100 year rainfall event.

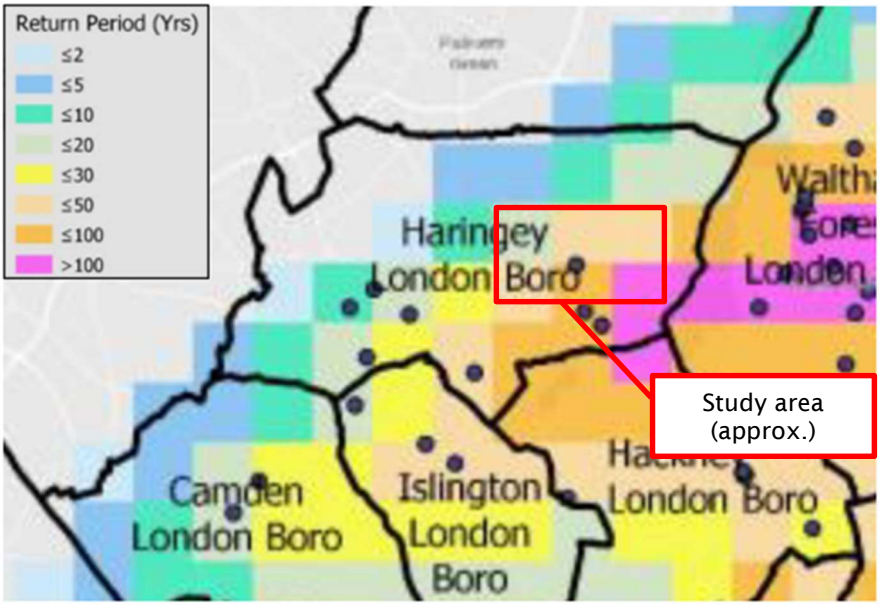


Figure 4-5 Rainfall Return Period and Report Flooding Incidents, 12th July 2021 (RARA data using FEH99).

5 ANALYSIS OF FLOOD EVENTS

5.1 Records of Incidents

Table 5-1 summarises the reports of flooding received by Haringey Council, and reactionary works that were undertaken by Haringey Council.

It is noted that the following have been screened out of further investigation;

- flood reports from single properties (not in proximity to other properties)
- locations where it is clear from the report that flooding was caused by internal drainage failure (for example a leaking roof).

Flood reports that have been screened out have been denoted by * beside the location name in the following table.

To support this investigation, Haringey Council has been provided with flood reports collated by London Fire Brigade (LFB) and Thames Water.

LFB received a total of 99 calls on 12th July 2021 and 58 calls on 25th July 2021 across the borough. Thames Water received 17 calls on 12th July 2021 and 13 calls on 25th July 2021 across the borough. LFB and Thames Water responses to individual flood locations are noted in the location specific sections of this report.

Table 5-1 Schedule of report flood incidents in South Tottenham

Location	Date of Report	Details of Flooding	Response to Flooding	Critical Drainage Area
Bruce Grove				
Dowsett Road	25/07/2021	Flooding	None recorded	None
Albion Road	25/07/2021	Flooding	None recorded	
High Road	25/07/2021	Minor flooding into c.10 businesses on High Road	None recorded	
500/508 High Road	26/07/2021	Flooding to business	None recorded	
Forster Road	25/07/2021	Flooding	None recorded	
South Tottenham / Broad Lane				
Lemsford Close, Rubner House	25/07/2021	Flooding	None recorded	None
Alan Barclay Close	26/07/2021	Garden flooded	None recorded	

Broad Lane	25/07/2021	None recorded	Clear gullies	
Markfield Road	25/07/2021	Flooding	Clear gullies	
High Cross Centre	25/07/2021	Flooding	None recorded	
Armadale Close*	25/07/2021	Loss of electricity	HFH to visit	
Armadale Close	25/07/2021	Flooding	None recorded	
Ferry Lane*	26/07/2021	Power outage	None recorded	
St Ann's / Seven Sisters				
Seven Sisters Road / St Ann's Road	25/07/2021	Flooding	None recorded	
Clarence Road	25/07/2021	Blown manhole cover and sewage in street	Thames Water visiting 27/07/21	
Henrietta House, Chisley Road*	26/07/2021	Communal balcony flooded	None recorded	Group 4_057
Culvert Road, backs onto Russell Road	25/07/2021	Minor flooding	Clear gullies	
Edgecot Grove	25/07/2021	Flooding	HFH / Haringey Council to review	
Milton Road Estate				
Milton Road Estate	25/07/2021	Flooding	HFH to check	
Willow Walk	25/07/2021	Flooding	None recorded	None
Langham Road	25/07/2021	Flooding	None recorded	
Broadwater Farm				

Willian Road	26/07/2021	Flooding report in houses	None recorded	Group 4_063
Broadwater Farm	25/07/2021	Flooding	None recorded	
Other Locations				
Larkspur Close	12/07/2021	Flooding in highway	Visited and no action taken due to water receded	Group 4_063
	25/07/2021	-	Extra check due to known flood risks	
West Green Road	26/07/2021	Heavy flooding	None recorded	None
Crowlands Primary School*	13/07/2021	Existing issue with pipe	Existing issue with pipe and not flooded by rainwater to best knowledge	Not applicable
The Grove School*	13/07/2021	Flooded rooms	None recorded	Not applicable
Green Lanes / Williamson Road	25/07/2021	Flooded and lifted manhole covers	None recorded	Group 4_057
66 Rothbury Walk*	26/07/2021	Flooded balcony	HFH to review	Not applicable
Park Lane*	25/07/2021	None recorded	None recorded	Not applicable
Philip Lane	25/07/2021	Minor flooding	Check gullies	Not applicable
Fairfax Road*	25/07/2021	Flooding	Clear gullies, cement	Not applicable
Lancaster Road*	25/07/2021	Flooded basement	None recorded	Not applicable

Figure 5-1 presents an overlay of flood reports from Haringey Council's Reported Flooding Impacts Mapping and highlights the areas of interest where an increased number of flood incidents were reported. Note that screened out locations also appear in this figure.

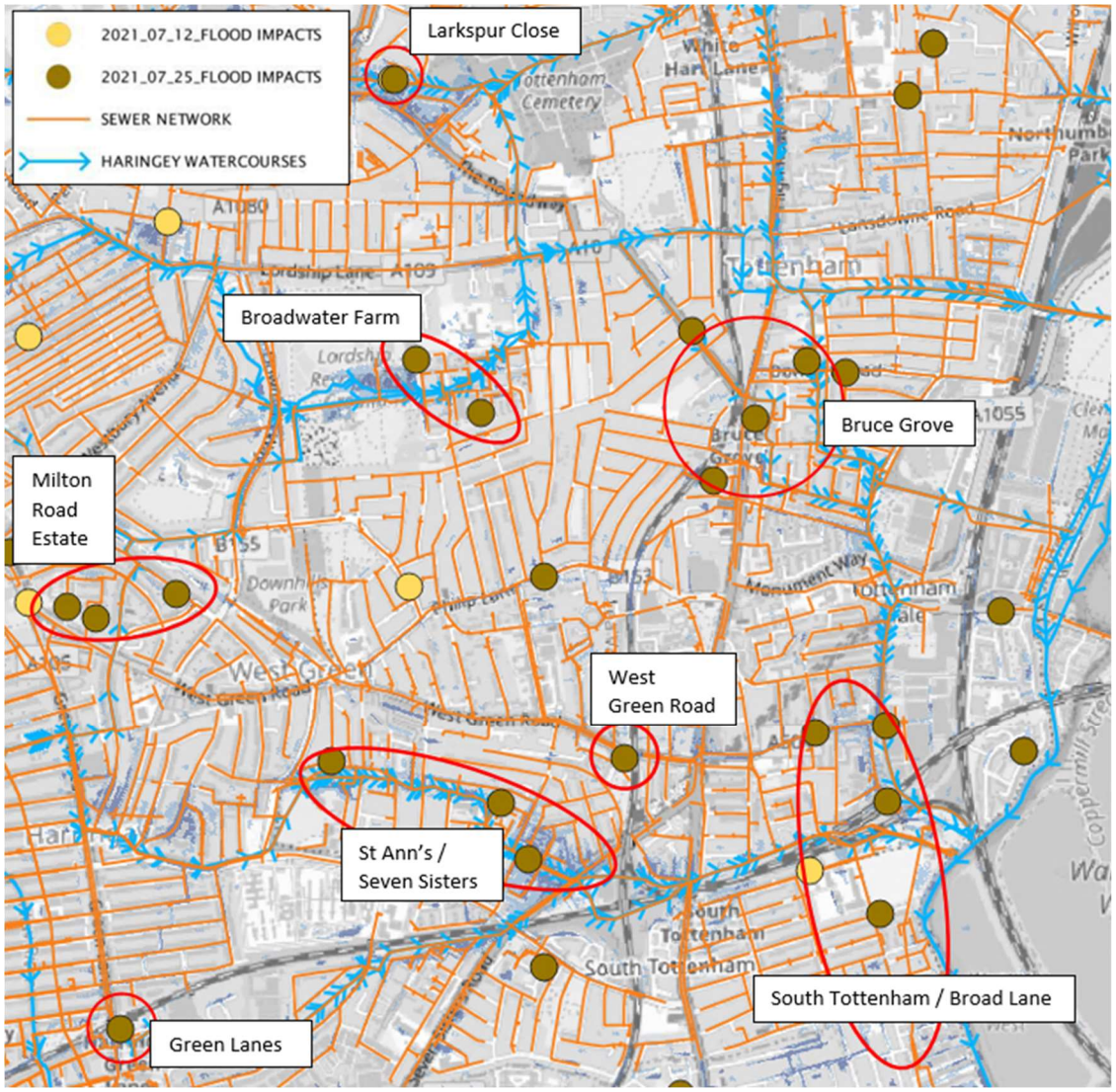


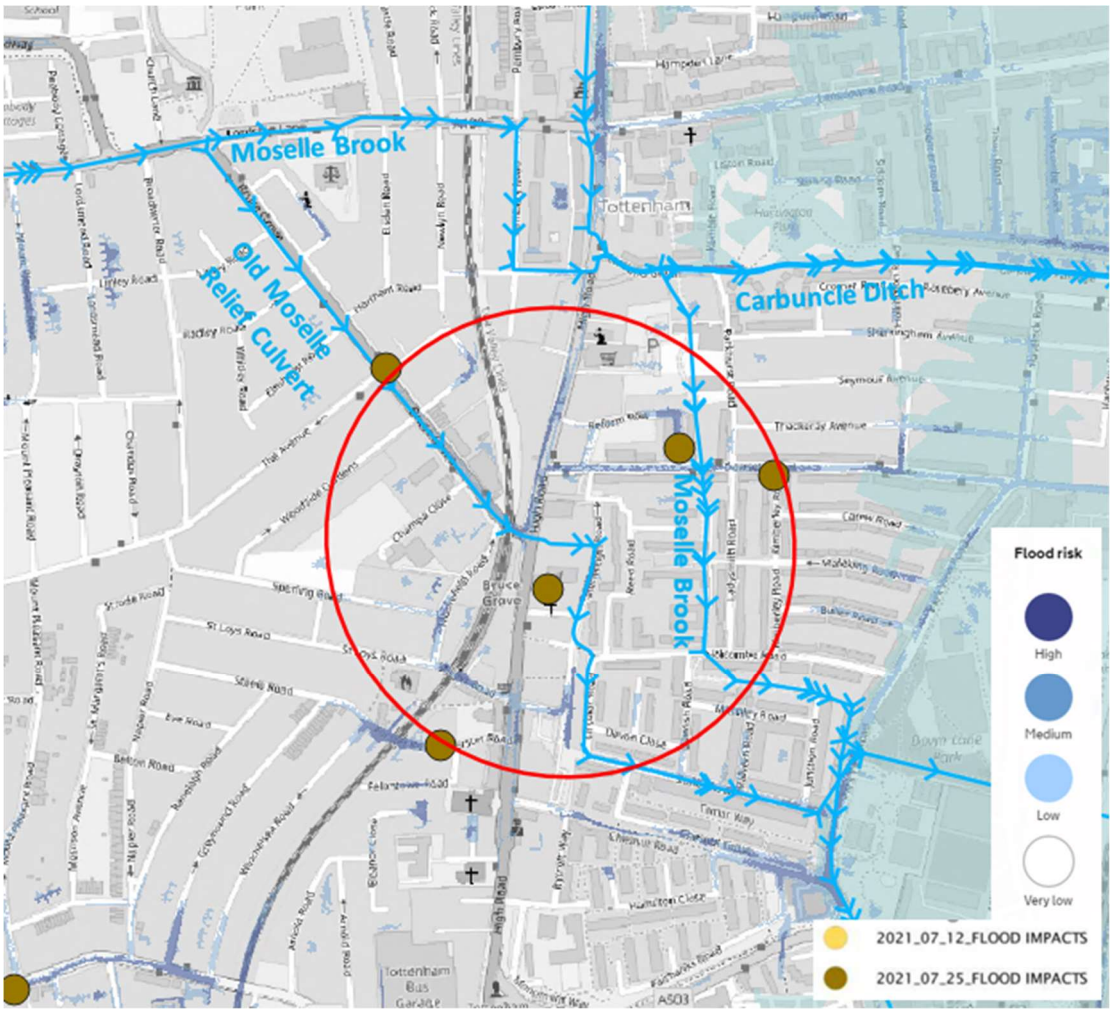
Figure 5-1 Recorded flood impacts and areas of interest in South Tottenham

5.2 Bruce Grove

Figure 5-2 Site Location

Location	Bruce Grove

Location Plan:



5.2.1 Summary of Impact

12th July 2021

There were no reports of flooding received on 12th July 2021.

25th July 2021

LFB received flood related emergency calls from 16:16pm. Calls were received from St Loys Road, Stoneleigh Road and Woodside Gardens. Both residential dwellings and business were affected. Haringey Council received further calls from properties on Albion Road, Dowsett Road and Forster Road. At least 10 businesses along High Road experienced minor flooding of their premises. During a site walkover visit on 28th October 2021, local business owners on Moorefield Road off High Road described flood waters covering the highway on the southern end of Moorefield Road and St Loys Road.

Figure 5-3 Flooding at Forster Road underpass, 25th July 2021

5.2.2 Site Context

Land falls from the west and southwest toward Bruce Grove and High Road, with streets such as A10, Sperling Road, St Loy's Road and Steele Road acting as valleys toward Moorefield Road and High Road. The LiDAR data shows that land falls toward the junction of Dowsett Road and High Road and continues to fall to the east toward the River Lead. The surface water flood risk areas in Figure 5-2 reflect this topography; higher risk areas are shown on Moorefield Road, the lowest part of St Loys Road, High Road between junctions with the A10 and Dowsett Road, Dowsett Road and Albion Road. Forster Road passes under the overground railway, forming a surface water flood risk area at the underpass. During a site walkover on 28th October 2021 it was noted that 2no. gullies are located in the Forster Road underpass.

5.2.3 Existing Drainage and Watercourses

Asset records indicate that the area is served by a network of surface water sewers. Surface water sewers range from 229mm to 900mm.

The DWMP model output indicates that some sections of sewer in the area are at risk of surcharging during a 1 in 2 year rainfall event. These include sewers at the junction of Bruce Grove and High Road, parts of Dowsett Road and roads and streets bounding Down Lane Park east of High Road.

A culverted section of the Moselle Brook flows south through residential streets east of High Road, crossing Mulberry Primary School grounds, Dowsett Road and Holcombe Road before turning toward Down Lane Park. The culvert diameter ranges from 1219mm to 4100 x 2500mm diameter. Asset records indicate that local surface water sewers connect into the culvert; the extent and nature of these would need further investigation. An old relief culvert of the Moselle Brook flows down the A10, crossing High Road and passing down Stoneleigh Road and Circular Road before joining the Moselle Brook at Down Lane Park.

5.2.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records 1 no. instance of flooding in the Bruce Grove area, on Park View Road at the bottom of Dowsett Road. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N17 0 postcode area, as of 2010.

5.2.5 Potential Flood Mechanisms

The site context and anecdotal evidence suggests that the primary cause of the flooding was excessive rainfall which exceeded the capacity of the drainage network in this area. The intensity of the rainfall meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low sections of Moorefield Road, St Loys Road and High Road. From here water levels were able to rise, encroaching into adjacent businesses and flowing into adjoining streets to the east. Surface water

accumulated in the localised low spots of Albion Road, Stoneleigh Road and Forster Road, causing flooding of the highway. The surcharging or flooding of the Moselle Culverts may have increased flooding on the carriageways and footways.

The DWMP data does not indicate when sewers would surcharge at events greater than the 1 in 2 year rainfall event. Therefore, further investigation would be required to identify whether the capacity issues were primarily due to the receiving capacity of the highway drains, the public sewer, the culverts or a combination. Other contributing factors to the extent (depth and magnitude) of flooding include:

- **Blocked gullies**

  A site walkover on 28th October 2021 showed that at least 2 no. gullies along a 100m stretch of the road were blocked. Any blockages would have reduced the capacity for surface water to enter reach the public sewer.

Figure 5-4 Blocked gully outside 490 High Road, 28th October 2021

- **Threshold Heights**

  During the site walkover it was noted that a number of businesses along High Road had flush front door thresholds. This arrangement would allow for surface water to quickly enter properties once the footway had been submerged.

5.2.6 Responses to Flooding

Haringey Council:

- No response works are recorded in the flood report schedule.
- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- TfL confirmed via email on 4th November 2021 that no disruptions were recorded on the A10 due to flooding, and there were no London Underground line closures within Haringey as a result of the flooding.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- Attended flood related emergency calls at Stoneleigh Road, St Loys Road and Woodside Gardens. No details are given of the remedial works carried out.

5.2.7 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

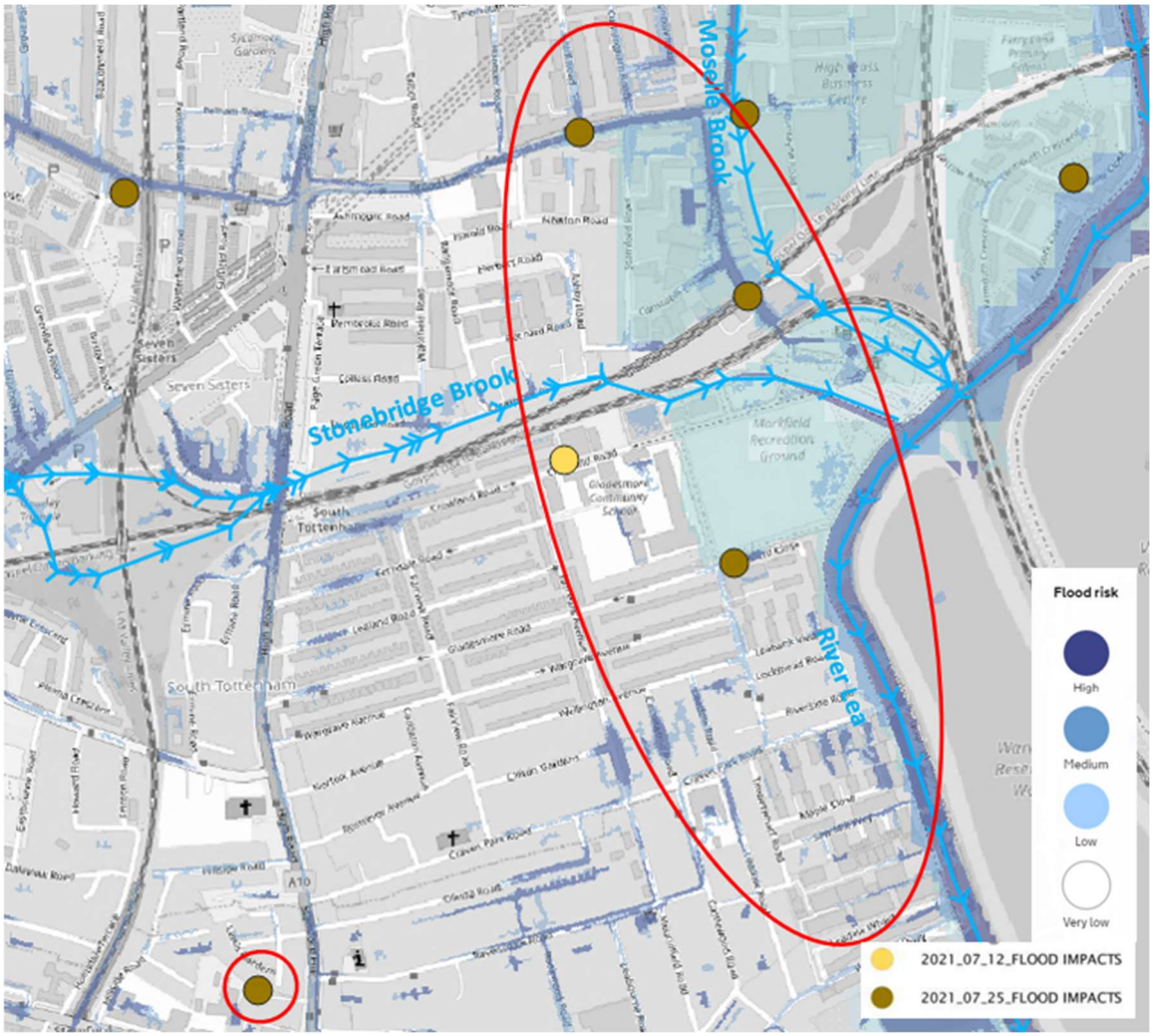
- Haringey Council to undertake increased frequency of gully pot cleaning along High Road.
- Haringey Council to consider construction of additional road gullies to increase inlet capacity, for example at the Forster Road underpass. Discussions with Thames Water would be required to confirm that there is sufficient capacity within in the receiving storm sewer network to facilitate additional inlet connections. Additional connections to the sewer would require the consent of Thames Water.
- Haringey Council to consider implementation of SuDS measures in the upslope catchment to reduce the amount of runoff reaching the location of flood risk.
- Affected businesses to consider installation of demountable flood gates. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Haringey / Environment Agency to consider inspection of the Moselle Brook culverted ordinary and main watercourses respectively to ensure they are operating at capacity.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.3 South Tottenham / Broad Lane

Figure 5-5 Site Location

Location	South Tottenham / Broad Lane

Location Plan:



5.3.1 Summary of Impact

12th July 2021

The only reported emergency call on 12th July, as shown in Figure 5-5, was from Crowlands Road Primary School. Haringey Council recorded that the cause of flooding was due to an issue with an existing pipe issue and not rainwater, therefore this location is screened out of the investigation.

River gauge data[7] indicates that flows in the River Lee at Lea Bridge rose on 25th July to 6.212mASD by 19:45PM, having ranged from 5.810mASD to 5.850mASD over the preceding two weeks.

[7] Shoothill Gauge Map, 2021, Available at https://www.gaugemap.co.uk/#!Map/Summary/1395/1545/2021-07-01/2021-08-01, [Accessed 03/12/2021]

Figure 5-6 Flooding in Broad Lane, South Tottenham, 25th July 2021

Figure 5-7 Flooding in Elm Park Avenue (L) and Lemsford Close, South Tottenham, 25th July 2021

25th July 2021

Emergency calls were made to LFB from 16:20pm citing flooding at properties in Wellington Avenue and Clifton Gardens (both intersected by Elm Park Avenue), with flooding also reported at a warehouse off Broad Lane. The photographs shown in Figure 5-6 and Figure 5-7 show flooding of footways and carriageways at the junction of Clifton Gardens and Elm Park Avenue, Lemsford Close and Broad Lane.

During a site walkover visit on 28th October 2021, users of Markfield Recreation Ground described flooding of the carriageways at Lemsford Close and Grovelands Road.

River gauge data[8] indicates that flows in the River Lee at Lea Bridge rose on 25th July to 6.094mASD by 17:45PM, having ranged from 5.800mASD to 5.820mASD over the preceding two weeks.

[8] Shoothill Gauge Map, 2021, Available at https://www.gaugemap.co.uk/#!Map/Summary/1395/1545/2021-07-01/2021-08-01, [Accessed 03/12/2021]

5.3.2 Site Context

Land falls from the west toward the topographically lowest areas in the study area at Broad Lane, Markfield Road, Markfield Recreation Ground and Grovelands Road. Streets such as Elm Park Avenue, Castlewood Road, Leadale Road and Grovelands Road run perpendicular to the fall of the land. Low points on these streets could therefore be prone to receiving and trapping surface water; this is reflected in the surface water flood risk mapping in Figure 5-2. The lowest part of St Loys Road, High Road between junctions with the A10 and Dowsett Road, Dowsett Road and Albion Road. Forster Road passes under the overground railway, forming a low spot at the underpass.

5.3.3 Existing Drainage and Watercourses

Asset records indicate stormwater sewers ranging from 229mm to 305mm diameter in residential streets around Elm Park Avenue. Stormwater is culverted within Broad Lane; the asset records indicate culvert diameters up to 660x1092mm and show a connection to the Moselle Brook Culvert on the eastern extent of Broad Lane. Sewers in Markfield Road are 229mm diameter.

The DWMP data indicates that surface water sewers on the eastern extent of Broad Lane, the northern half of Elm Park Avenue and all of Markfield Road, would surcharge during a 1 in 2 year storm. A risk of water escaping from manholes during a 1 in 30 year rainfall event is indicated at Clifton Gardens and Craven Park Road. A risk of sewer flooding during a 1 in 50 year rainfall event is indicated in streets served by Broad Lane, as well as in Elm Park Avenue and Wellington Avenue.

A section of the Lower Lee (Navigation) is located on the extern extent of the study area, flowing in a southerly direction. The Lower Lee catchment is heavily urbanised with large parts of the floodplain developed. The combination of impermeable surfaces and clayey catchment soils means the river responds rapidly to rainfall. Major flooding of the river up to 1947 led to the construction of the Lee Flood Relief Channel. Since completion there has been no major flooding of the river. Consequently, the principal flood risks are associated with the Lower Lee tributaries[9].

Two culverted tributaries of the River Lee pass through this area. The Stonebridge Brook runs adjacent to the Gospel Oak to Barking railway line in an easterly direction before crossing Markfield Recreation Ground and joining the Lee (Navigation). Asset records show the culvert to reach 2000x2400mm diameter. The Moselle Brook flows under Broad Lane and passes through industrial yards off Markfield Road before crossing Markfield Recreation Ground and joining the Lee (Navigation). Asset records show the culvert to reach 2000x3000mm diameter.

5.3.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records 3 no. instances of flooding in the South Tottenham area; on Broad Lane, Anthill Road off Broad Lane, and Tottenham Green. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N17 9 postcode area and up to 50 in the N15 4 area, as of 2010.

5.3.5 Potential Flood Mechanisms

In Broad Lane and Markfield Road, the topography, existing sewer and culvert network (and DWMP outputs) and connections to the River Lee suggests that the primary cause of flooding was excessive rainfall which exceeded the capacity of the drainage network in the area. The rise in water levels in the River Lee would have increased surcharging of the sewer and culvert network; this in combination with the intensity of the rainfall meant that it accumulated on the surface, flooding the carriageway.

In Elm Park Avenue and the neighbouring streets, the photographs and DWMP outputs strongly suggest that the primary cause of the flooding was the limited receiving capacity of the sewers. The intensity of the rainfall meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low sections of Elm Park Avenue, Clifton Gardens, Grovelands Road and Lemsford Close.

Other contributing factors to the extent (depth and magnitude) of flooding include:

[9] Lower Lee Flood Risk Management Strategy – SEA Addendum, 2008, Environment Agency : UK

- **Blocked gullies**

  Haringey Council raised an order for gullies to be cleared on Broad Lane and Markfield Road. Any blockages would have reduced the capacity for surface water to enter reach the public sewer.

5.3.6 Responses to Flooding

Haringey Council:

- Raised an order for crew to attend Broad Lane and Markfield Road to unblock gullies. It is not stated in the flood report schedule how many gullies were cleaned.
- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this area.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- Attended flood related emergency calls at Wellington Avenue and Clifton Gardens. No details are given of the remedial works carried out.

5.3.7 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

- Haringey Council to undertake increased frequency of gully pot cleaning along Broad Lane.
- Haringey Council to consider implementation of SuDS measures in the upslope catchment to reduce the amount of runoff reaching the location of flood risk.
- Haringey Council to consider implementation of flood storage features to ease pressure on adjacent stormwater drainage and culverts adjacent the River Lee.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Environment Agency to consider inspection of the Moselle Brook and Stonebridge Brook Culverts to ensure they are operating at capacity.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.4 St Ann's / Seven Sisters

Figure 5-8 Site Location

Location	St Ann's / Seven Sisters

Location Plan:

5.4.1 Summary of Impact

12th July 2021

No flooding is recorded by Haringey Council on 12th July for this area.

Figure 5-9 Flooding on Seven Sisters Road (L) and Black Boy Road, 25th July 2021

25th July 2021

LFB starting receiving flood related emergency calls from 17:47pm. Calls were received from properties on Seven Sisters Road, St Ann's Road, Kerswell Close, Culvert Road and Edgecot Grove. Haringey Council recorded calls from Culvert Road Seven Sisters Road / St Ann's Road, Clarence Road, Culvert Road and Edgecot Grove. Photographic footage was received of Seven Sisters Road and Black Boy Road near its

junction with Clarence Road. The footage shows the highway and part of the adjacent footways inundated with water. Vehicles are shown passing through the area. At Clarence Road, it was reported that a manhole cover had been blown and water was reported flowing from the sewer into the street.

5.4.2 Site Context

Seven Sisters Road falls to the north east from a high point at the boundary of Finsbury Park (39m AOD) to its junction with High Road (11m AOD). A low spot on Seven Sisters Road is shown along the road north of Gourley Park and adjacent to the junctions of Seven Sisters Road with Culvert Road, Victoria Crescent and Elizabeth Road (10mAOD). St Ann's Road falls from its junction with Green Lanes (20mAOD) to its junction with Seven Sisters Road (11mAOD). From the junction with Seven Sisters Road (at the railway bridge) it rises to its junction with High Road at 16mAOD. The residential areas to the north of St Ann's Road fall to the east, forming a valley which follows the approximate alignment of the Stonebridge Brook culvert and encompass the low spot on Seven Sisters Road. The surface water flood risk map reflects this topography, with higher risk areas shown through the valley alignment and in adjacent residential streets.

5.4.3 Existing Drainage and Watercourses

Asset records indicate a network of stormwater sewers in the area, ranging from 150mm diameter pipes in residential streets to 1325 x 500mm culverts on St Ann's Road. The asset plans indicate that the stormwater sewers eventually drain to the culverted Stonebridge Brook or Hermitage Brook.

The DWMP model indicates that sewers on the throughout most of St Ann's Road would surcharge during a 1 in 2 year storm, and a risk of water escaping from manholes during a 1 in 30 year rainfall event is indicated at its junctions with Green Lanes, Kimberly Gardens, St Ann's General Hospital, Latimer Road and Howard Road. The DWMP indicates that sewers on Seven Sisters Road between its junction with St Ann's Road and High Road, would surcharge during a 1 in 2 year storm, and a risk of water escaping from manholes during a 1 in 30 year rainfall event is indicated at its junctions with Culvert Road and Victoria Crescent. Other areas shown a risk of 1 in 30 year stormwater manhole escape, including Clarence Road, Ida Road and Seaford Road.

There two culverted watercourses identified in this area. The Stonebridge Brook flows under St Ann's Road from Green Lanes. The watercourse continues east along St Ann's Road to Chestnuts Recreation Ground, at which point it crosses the park in a north easterly direction, passing through the residential area north of St Ann's Road. The Stonebridge Brook crosses Seven Sisters Road, converging with the Hermitage Brook before crossing High Road. The Hermitage Brook flows south of the Gospel Oak to Barking railway line, before converging with the Stonebridge Brook. Further investigation is required as to the extent of stormwater connectivity with the brooks.

5.4.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP does not show any flooding records in the area. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N15 3 and N15 5 postcode areas, as of 2010. The SWMP cites anecdotal evidence from Haringey Council confirming that flooding has occurred at the lowest part of Culvert Road.

5.4.5 Previous flood studies

The area falls within CDA Group 4_057 ("Seven Sisters Road, South Tottenham"). The CDA analysis states that surface water follows a natural valley, with no clear outfall due to the presence of railway embankments. Surface water is observed to pond in low lying areas such as those around Culvert Road and Seven Sisters Road. Ponding in these areas is estimated in the CDA analysis to reach up to 0.5m depth throughout the natural valley.

5.4.6 Potential Flood Mechanisms

The photographs, flood reports and DWMP output strongly suggest that the primary cause of the flooding was an exceedance of the capacity of the drainage network and culverts in this area, caused by the excessive rainfall which fell on the day. The intensity of the rainfall meant that surface water was unable to enter the sewers and culverted watercourses fast enough and accumulated in the topographical low points, flooding the highways and adjacent properties. The DWMP model outputs suggest that the limited receiving capacity

of the sewers would have exacerbated the flooding. This is supported by evidence from the Haringey flood report schedule which describes a manhole cover being blown and discharging onto Clarence Road. Further investigation would be required to identify whether the capacity issues were primarily due to the receiving capacity of the public sewer, the culverts, the highway drains or a combination. Other contributing factors to the extent (depth and magnitude) of flooding include:

- **Blocked gullies**

  The flood report schedule indicates that Haringey Council cites a possible need for unblocking of gullies on Culvert Road in response to the flooding. Any blockages would have reduced the capacity for surface water to enter the public sewer.

5.4.7 Responses to Flooding

Haringey Council:

- Instructed Marlborough Highways to unblock gullies on Culvert Road. It is not stated in the flood report schedule how many gullies were cleaned.
- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- The Haringey flood schedule report indicates that Thames Water were to visit the site of the blown manhole cover in Clarence Road on 27th July 2021. No further details of this visit are available.

London Fire Brigade

- Attended properties at Seven Sisters Road, St Ann's Road, Kerswell Close, Culvert Road and Edgecot Grove. No details are given of the remedial works carried out.

5.4.8 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

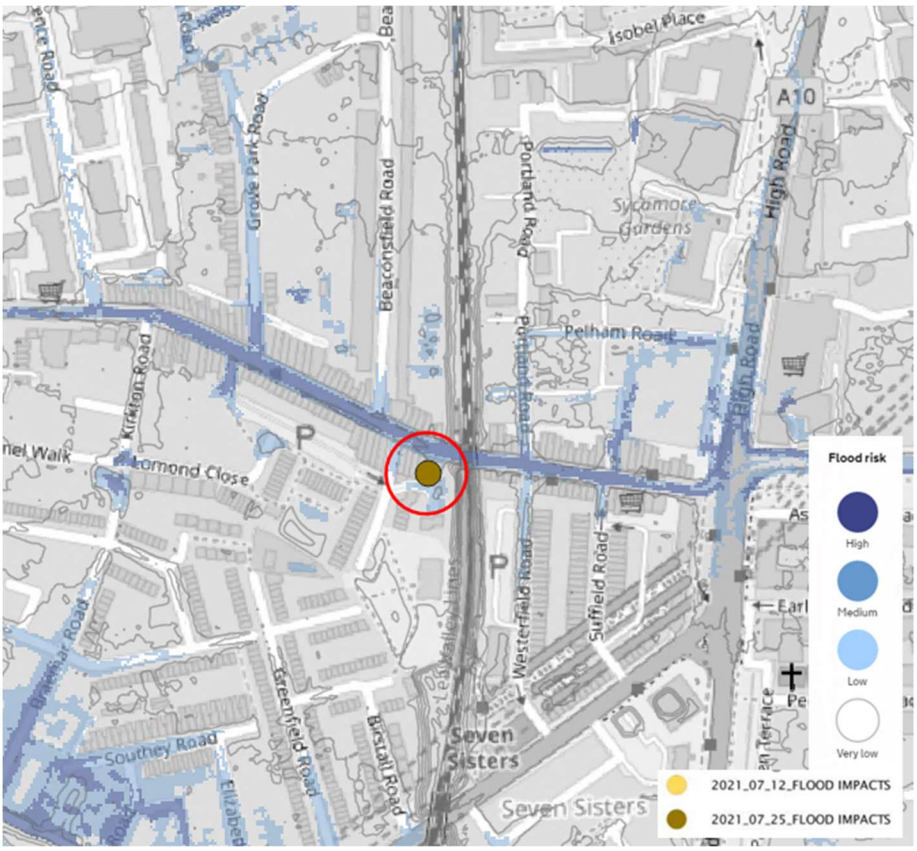
- Haringey Council to consider implementation of SuDS measures in the upslope catchments, particularly within the natural valley north of St Ann's, to reduce the amount of runoff reaching the location of flood risk.
- Affected property owners throughout the higher flood risk area (i.e. the natural valley) to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.5 West Green Road

Figure 5-10 Site Location

Location	West Green Road

Location Plan:



5.5.1 Summary of Impact

12th July 2021

No flooding was reported on 12th July at this location.

25th July 2021

Haringey Council received a flood related emergency call from a business on West Green Road citing heavy flooding on the road either side of the Chestnut to Seven Sisters railway bridge. Figure 5-11 shows the flooding east of the bridge, where water has submerged the highway and pedestrians can be seen walking on flooded footways. Flood waters appear to have reached as far as the thresholds of businesses along West Green Road. Vehicles are still passing through the road.

Figure 5-11 Flooding on West Green Road, 25th July 2021

5.5.2 Site Context

The eastern extent of West Green Road, between the junctions with Lawrence Road and High Road, is the lowest section along the road at approximately 11mAOD. West Green Road falls from circa 22mAOD at its junction with Green Lanes in the west to this point. Adjoining streets from the north and south, as well as part of High Road fall toward West Green Road. The surface water flood map indicates the risk in this area is due to the flow routes converging in this area, with limited ability for the water to flow away over the ground. During a site walkover on 28th October 2021, it was noted that there is a total of 14no. gullies along the carriageway under the bridge, over a distance of circa 12m.

5.5.3 Existing Drainage and Watercourses

Asset records indicate that this part of West Green Road is served by a series of large stormwater culverts ranging from 606mm diameter to 1524mm diameter.

The DWMP model indicates that sewers to the west of the bridge underpass would surcharge during a 1 in 2 year storm, and there would be a risk of water escaping from manholes there during a 1 in 30 year event.

There are no watercourses identified in close proximity to this location.

5.5.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records no instances of flooding on West Green Road. Appendix D, Figure 9 of the SWMP records up to 50 instances of flooding in the N15 4 postcode area, as of 2010.

5.5.5 Potential Flood Mechanisms

The photos and site evidence strongly suggest that the primary cause of the flooding was exceedance of the capacity of the surface water sewers in West Green Road. Surface water was unable to enter the sewer network fast enough and accumulated in the low-lying area along West Green Road, which reached sufficient depths to flood the highway and enter property. The DWMP model outputs suggest that the limited receiving capacity of the sewers would have been the primary cause of flooding. Observations during the site walkover support this; frequent gully positions were identified at the low spot of the railway underpass (14 no. across 12m of carriageway) but flooding was not prevented. Further investigation would be required throughout this low lying section of West Green Road to identify whether the capacity issues were entirely due to the receiving capacity of the public sewer or whether the capacity of the highway drains was a contributing factor. Other contributing factors to the extent (depth and magnitude) of flooding include:

- **Bow wave effect**

  The photographs from the flooding along West Green Road shows vehicles moving through the flood water, which in other instances across Haringey during the July floods, have caused a bow wave effect. This could have led to further movement of water onto the footway and into properties.

- **Threshold Heights**

  During the site walkover it was noted that a number of properties in the affected area had flush front door thresholds. This arrangement would allow for surface water to quickly enter properties once the footway had been submerged.

5.5.6 Responses to Flooding

Haringey Council:

- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No information of response works was provided for this location.

5.5.7 Next Steps

The EA surface water flood maps indicate that West Green Road is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

- Haringey Council to consider implementation of SuDS measures in the upslope catchment to reduce the amount of runoff reaching the location of flood risk.
- Haringey Council to consider localised temporary road closures or diversions in high-risk areas with low profile kerbs to reduce ingress of floodwaters onto footways and into properties where risk of internal flooding is caused by bow wave affect from the movement of vehicles through flood waters.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.6 Green Lanes

Figure 5-12 Site Location

Location	Green Lanes

Location Plan:

5.6.1 Summary of Impact

12th July 2021

There were no emergency calls received on 12th July 2021.

25th July 2021

LFB received flood related emergency calls from business on Green Lanes from 17:16pm. Haringey Council also received calls reporting flooding of the highway and lifted manhole covers. Figure 5-13 shows the flooding at the junction of Green Lanes and Williamson Road, where water has submerged the highway and footways. Vehicles are still passing through the road.

Figure 5-13 Flooding at Green Lanes, 25th July 2021

5.6.2 Site Context

This section of Green Lanes gently falls northwards toward the underpass of the Barking to Gospel Oak overground railway. LiDAR data indicates a low area around the junction of Green Lanes and Williamson Road, to which the adjoining Lothair Road North and Endymion Road fall at approximate gradients of 1 in 40. Further east the road rises again to the junction with Westbury Avenue, Green Lanes and High Road. The surface water flood map shows flow routes north and south of the railway underpass converging along this section of Green Lanes, with limited ability for the water to flow away over the ground.

5.6.3 Existing Drainage and Watercourses

Asset records indicate 152mm and 229mm diameter stormwater sewers north of the Green Lanes/Williamson Road junction, and a 610mm diameter sewer south of the junction.

The DWMP model does not indicate any risk of surcharging in a 2 year rainfall event south of the junction. The model indicates that sewers within the Arena Shopping Park and north of the railway underpass would surcharge during a 1 in 2 year storm, and there is a risk of water escaping from manholes during a 1 in 30 year event through Green Lanes between the railway junction and the Green Lanes / Salisbury Road junction.

The New River passes within 215m of the area. A culverted section of the Hermitage Brook is located within the Arena Shopping Park off Williamson Road, and flows eastward.

5.6.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records no instances of flooding in this section of Green Lanes. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N4 1 postcode area, as of 2010.

5.6.5 Previous flood studies

Green Lanes falls within CDA Group 4_057 (“Seven Sisters Road, South Tottenham”). The CDA analysis shows the highest surface water flood risk at the railway underpass, with ponding estimated to reach up to 0.5m depth.

5.6.6 Potential Flood Mechanisms

The photos and flood report schedule suggests that the primary cause of the flooding was exceedance of the capacity of the surface water sewers in Green Lanes. Surface water was unable to enter the sewer network fast enough and accumulated in the low-lying area along West Green Road, which reached sufficient depths to flood the highway and businesses. The DWMP model output shows a risk of surface water escaping from manholes during a 1 in 30 year event. This is supported by the flood report of manholes being lifted. Further investigation would be required in throughout the section of Green Lanes south of the underpass to identify whether the capacity issues were entirely due to the receiving capacity of the public sewer or whether the capacity of the highways was a contributing factor.

5.6.7 Responses to Flooding

Haringey Council:

- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- Attended 2 businesses on 25th July 2021. No details are given of the remedial works carried out.

5.6.8 Next Steps

The EA surface water flood maps indicate this section of Green Lanes is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

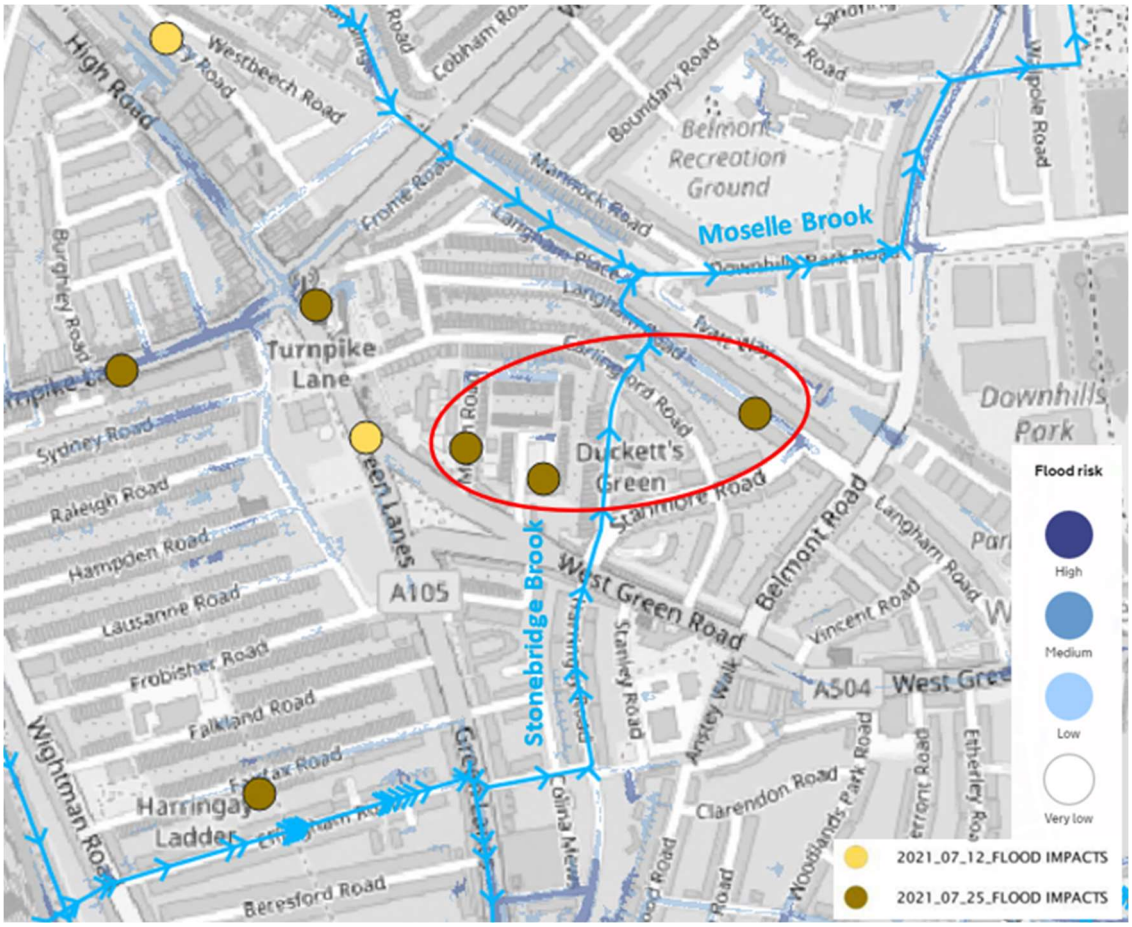
- Haringey Council to undertake increased frequency of gully pot cleaning along Green Lanes.
- Haringey Council to consider construction of additional road gullies to increase inlet capacity. Discussions with Thames Water would be required to confirm that there is sufficient capacity within in the receiving storm sewer network to facilitate additional inlet connections. Additional connections to the sewer would require the consent of Thames Water.
- Haringey Council to consider construction of below ground storage structures to reduce pressure on the existing sewer system. Discussions with Thames Water would be required to identify highest risk parts of the sewer network and suitable locations for connections.
- Haringey Council to consider implementation of SuDS measures in the upslope catchment to reduce the amount of runoff reaching the location of flood risk.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.7 Milton Road Estate

Figure 5-14 Site Location

Location	Milton Road Estate

Location Plan:



5.7.1 Summary of Impact

12th July 2021

There were no emergency calls received on 12th July 2021.

25th July 2021

Haringey Council recorded three incidents of flooding in this area on 25th July; two within Milton Road Estate and one in neighbouring Langham Road. A photo of the flooding is presented in Figure 5-15 and shows carriageways and parking areas within Milton Road Estate submerged in flood water. Haringey Council attended Milton Road Estate on the evening of the flooding; residents described how the rain was too fast for the drains.

Figure 5-15 Flooding on Milton Road Estate, 25th July 2021

5.7.2 Site Context

Milton Road Estate is accessed directly from West Green Road, and Langham Road is accessed from West Green Road via Waldeck Road; the land falls from West Green Road into the Milton Road Estate and Langham Road, where areas of flood risk are observed on the surface water flood maps, indicating low spots along the northern sections of Milton Road, Willow Walk and Langham Road.

5.7.3 Existing Drainage and Watercourses

Asset records indicate that Milton Road Estate and Langham Road is served by 229mm diameter pipes throughout. The sewers appear to drain to the Stonebridge Improvement culvert, which flows under Waldeck Road northward. The asset records indicate the culvert to be 1680mm diameter.

The DWMP model indicates that sewers throughout Milton Road Estate and Langham Road would surcharge during a 1 in 2 year storm, and a risk of water escaping from manholes during a 1 in 30 year rainfall event is indicated at the junction of Langham Road and Waldeck Road.

5.7.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records no instances of flooding in the area. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N15 3 postcode area, as of 2010.

5.7.5 Potential Flood Mechanisms

The photos, anecdotal evidence and output from the DWMP strongly suggest that the primary cause of the flooding was excessive rainfall which exceeded the capacity drainage network in this area. The intensity of the rainfall meant that surface water was unable to enter the sewer network fast enough and accumulated in the topographical low points, which flooded highways and properties. Further investigation would be required in the east of Langham Road to identify whether the capacity issues were primarily due to the receiving capacity of the highway drains, the public sewer or both.

5.7.6 Responses to Flooding

Haringey Council:

- Attended the area to check gullies within Milton Road Estate, all of which were found to be clear. This included newly installed drains.
- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year.

The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No information of response works was provided for this location.

5.7.7 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

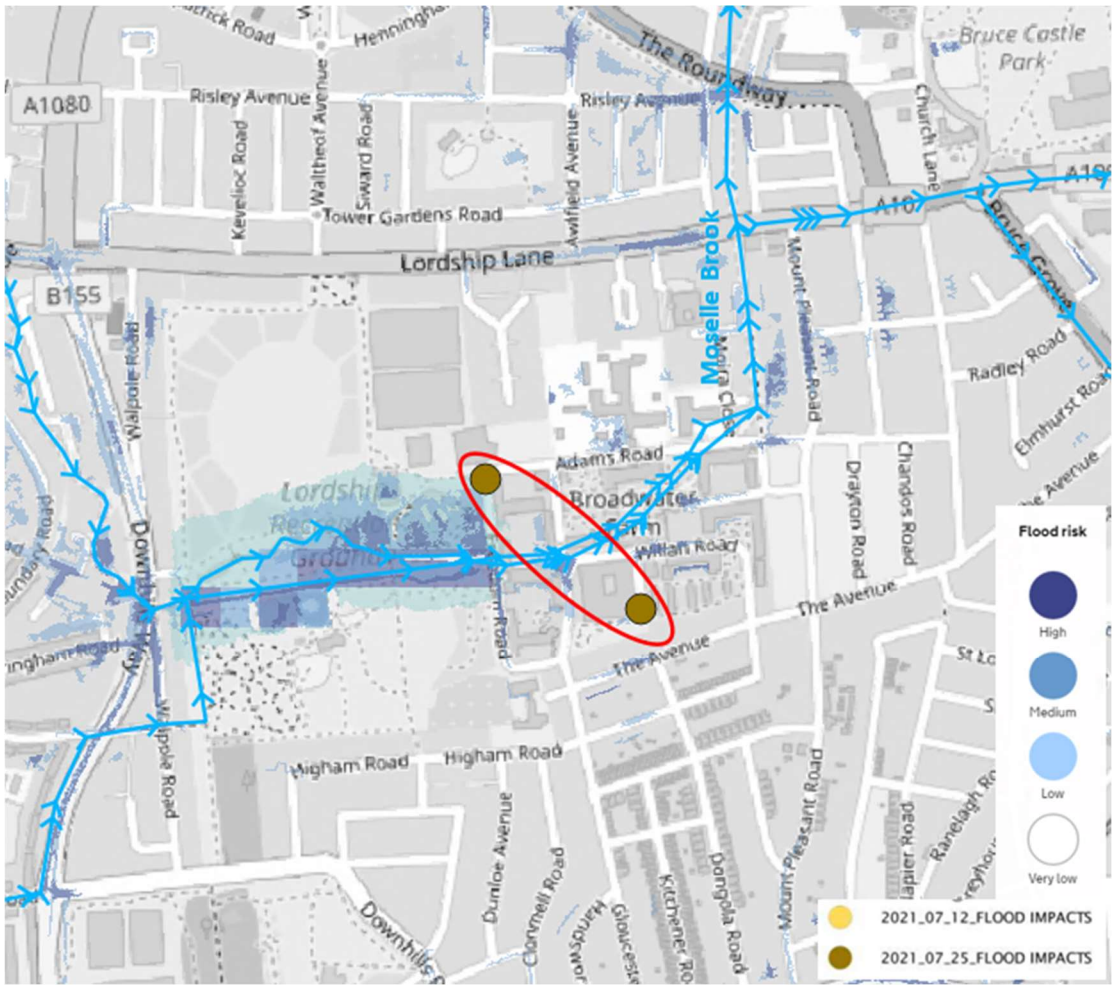
- Haringey Council to consider implementation of SuDS measures within the estate to reduce the amount of runoff reaching the location of flood risk.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.8 Broadwater Farm

Figure 5-16 Site Location

Location	Broadwater Farm

Location Plan:



5.8.1 Summary of Impact

12th July 2021

There were no emergency calls received on 12th July 2021.

25th July 2021

Haringey Council recorded flooding at Broadwater Farm Community Centre and Willan Road. Flooding of the highway and parking areas was observed at the community centre, and flooding reported in houses along Willan Road. No further details are giving of the extent of flooding in the houses.

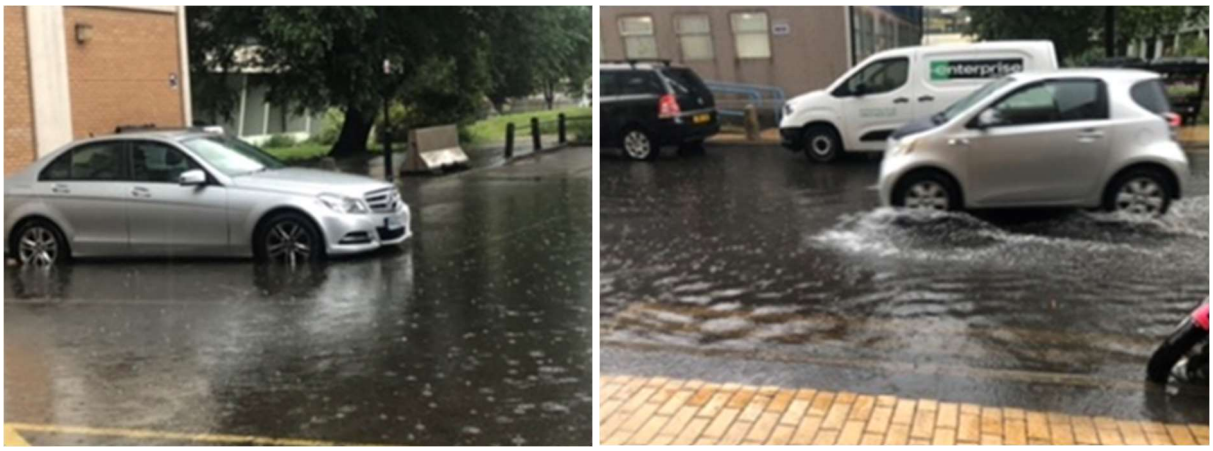


Figure 5-17 Flooding at Broadwater Farm, 25th July 2021

5.8.2 Site Context

Broadwater Farm is situated within a natural valley, with the higher land situated to the north west, south and south east along Lordship Lane (19mAOD) and Higham Road (23mAOD to 29mAOD). The valley extends from Lordship Recreation Ground in the west, and continues to the northeast toward Tottenham Cemetery. Surface water flood risk is indicated through the valley section of Lordship Recreation Ground.

5.8.3 Existing Drainage and Watercourses

Asset records indicate that the area is served by stormwater sewers ranging from 229mm to 305mm diameter.

The DWMP model indicates that surface water sewers on the western section of Willan Road would surcharge during a 1 in 2 year storm. No output is shown for the rest of Broadwater Farm.

The Moselle Brook passes through the area, following the alignment of the natural valley. The watercourse emerges from a culvert in the south west corner of Lordship Recreation Ground, crossing the park in an easterly direction as an open channel before entering another culvert near Freedom Road. The culverted watercourse then passes underneath Broadwater Farm and then north toward Tottenham Cemetery. A 2017 survey by the EA indicates that the culvert 1900mm x 2600mm diameter through this area. Further investigation is needed to ascertain the extent of connectivity between local stormwater sewers and the culvert.

5.8.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records no instances of flooding at Broadwater Farm. Appendix D, Figure 9 of the SWMP records no instances of flooding in the N17 6 postcode area, as of 2010.

5.8.5 Previous flood studies

The northern half of the Broadwater Farm area falls within CDA Group 4_063 (“The Roundway (A10) and Warkworth Road, Tottenham”). The CDA analysis shows scattered pockets of surface water flood risk within the area.

5.8.6 Potential Flood Mechanisms

The photos, topography and location of the watercourses suggests that the primary cause of the flooding was excessive rainfall which exceeded the capacity of the drainage network and/or culverted watercourse in this area. The intensity of the rainfall meant that surface water was unable to enter the sewers or culverts fast enough, resulting in an accumulation of water in the topographical low points, which reached sufficient depths to flood the carriageway and enter property. The DWMP model output suggests that the limited receiving capacity of the sewers on would have been the primary cause of flooding on Willan Road. Further investigation would be required to identify whether the capacity issues were primarily due to the receiving capacity of the highway drains, the public sewer, the culvert or a combination.

5.8.7 Responses to Flooding

Haringey Council:

- Provided a schedule of all gully cleaning works that have taken place in South Tottenham between 12th July and 30th September 2021 (Seven Sisters, West Green, Tottenham Hale and Tottenham wards). A total of 434 jobs were raised for gully clearance between these dates. Haringey Council confirmed via email that gully cleaning occurs on a cyclical basis, with reactive maintenance where required. The proposed cycle was to clean all the gullies in the borough once every two years and clean all gullies in Critical Drainage Areas every year. The Council has now increased its gully cleaning capacity to 2 No. cleaning machines. Its new cleaning programme started in first week of October and the aim is to have cleaned all the gullies in the borough by Summer 2022.
- Already proposing to implement a SuDS scheme upslope of Broadwater Farm to reduce the amount of runoff reaching the location of flood risk.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- Attended property on Willan Road on 25th July 2021 having received a call at 17:14pm. No details are given of the remedial works carried out.

5.8.8 Next Steps

The following measures may be considered to reduce the risk and impact of flooding.

- Haringey Council to consider construction of additional road gullies to increase inlet capacity. Discussions with Thames Water would be required to confirm that there is sufficient capacity within in the receiving storm sewer network to facilitate additional inlet connections. Additional connections to the sewer would require the consent of Thames Water.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.
- Environment Agency to consider inspection of the Moselle Brook Culvert to ensure it is operating at capacity.
- Thames Water to consider a review of the local sewer network to identify locations where surface water sewers have insufficient capacity and work with other RMAs to identify potential mitigation as appropriate.

5.9 Larkspur Close

Figure 5-18 Site Location

Location	Larkspur Close

Location Plan:

5.9.1 Summary of Impact

12th July 2021

Haringey Council received reports of flooding in the highway at Larkspur Close on 12th July. Haringey Council visited the area at 21:00pm, by which time the flooding had largely receded. It was confirmed to Haringey Council that the floodwaters reached kerb level. The rain stopped before property was flooded but residents had placed sandbags at their front doors in preparation. Responders from Haringey Council noted from their visit a build-up of vegetation at the culvert inlet of the Lesser Moselle watercourse.

Figure 5-19 Moselle Culvert at Larkspur Close, 12th July 2021

25th July 2021

There were no reports of flooding on 25th July at Larkspur Close, however Haringey Council attended the area due to the known flood risk at this location.

5.9.2 Site Context

Larkspur Close is situated in a lower topographical area (13mAOD) than the adjacent carriageways to the north (Jellicoe Road at 14mAOD) and south (The Roundway at 14mAOD). The surface water flood risk mapping shows high risk flood areas on The Roundway, Jellicoe Road, Fryat Road and Larkspur Close, suggesting flow routes potential reaching Larkspur Close from Fryatt Road. Informal flood brick and slab defence walls are present along the boundary of Larkspur Close and the Lesser Moselle watercourse.

5.9.3 Existing Drainage and Watercourses

Asset records show the culverted section of the Lesser Moselle passing under Larkspur Close. The asset records do not show any separate stormwater sewers, suggesting that surface water runoff on Larkspur Close drains directly to the culvert.

The DWMP model does not provide information on modelled capacity for the culvert in Larkspur Close, but it indicates that sewers on Jellicoe Road and The Roundway would surcharge during a 1 in 2 year storm. A risk of water escaping from manholes during a 1 in 30 year rainfall event is also indicated along both roads north and south of Larkspur Close.

5.9.4 Flood History

Appendix D, Figure 5 of the Haringey SWMP records no instances of flooding in the area but the CDA analysis within the SWMP states that previous flooding (date not indicated) of the sheltered housing in Larkspur Close affected 30-50 properties. Appendix D, Figure 9 of the SWMP records up to 5 instances of flooding in the N17 7 postcode area, as of 2010.

5.9.5 Previous flood studies

Larkspur Close area falls within CDA Group 4_063 ("The Roundway (A10) and Warkworth Road, Tottenham"). The CDA analysis output shows a surface water flow route along Rivolet Road and Jellicoe Road before entering the Moselle Brook. This location is at the headwaters of the Lesser Moselle and is one of the few locations where the watercourse is not culverted. Flooding has the potential to combine fluvial and surface water. Properties in this area are known to be at risk.

Previous flood studies confirm the presence of a flood protection wall located to the southern boundary of Larkspur Close. Previous studies have identified a combination of potential flood mechanisms including excess flows entering via site entrance at junction with Jellicoe Road and potential for reverse flows from Moselle Brook via existing road gully and pipes serving Larkspur Close.

5.9.6 Potential Flood Mechanisms

The site visit notes, flood report schedule and existing drainage arrangement strongly suggests that the primary cause of the flooding was exceedance of the capacity of the Lesser Moselle, caused by excessive rainfall. The intensity of the rainfall meant that capacity of the sewer network was overwhelmed and started to accumulate in the topographical low points, flooding the carriageways in Larkspur Close.

There is insufficient information to confirm whether there were any reverse flows via the road gully network.

The DWMP model outputs suggest that the limited receiving capacity of the sewers in neighbouring streets could have surcharged or flooded, allow surface water to escape and contribute to the flooding in the topographically lower Larkspur Close. Other contributing factors to the extent (depth and magnitude) of flooding include:

- **Blocked culvert inlet**

  Haringey Council visited the area on the evening of 12th July and noted heavy vegetation at the inlet of the Lesser Moselle Culvert inlet. Haringey Council has stated via email that at times of heavy rain debris from upstream reduces the capacity of the culvert inlet.

5.9.7 Responses to Flooding

Haringey Council:

- Visited Larkspur Close on 12th July, but no action was required as the water had receded. A second visit was made on 25th July to check the street due to the known flood risks, but there was no required for action on this date.
- Haringey Council is currently working on a flood alleviation scheme to help address flooding issues in the area. The scheme is currently at detailed design stage.

Transport for London

- No TfL assets were affected in this location.

Thames Water

- No information on response or remedial works undertaken by Thames Water was provided by Thames Water for this location.

London Fire Brigade

- No information of response works was provided for this location.

5.9.8 Next Steps

The EA surface water flood maps indicate that Larkspur Close is located in an area prone to surface water flooding. The following measures may be considered to reduce the risk and impact of flooding.

- Haringey Council to consider regular monitoring and clearance of vegetation from the Lesser Moselle culvert inlets at this location.
- Haringey Council to consider implementation of SuDS measures in the adjacent uphill streets to reduce the amount of runoff reaching the location of flood risk.
- Affected property owners to consider installation of demountable flood gates, flood doors and air vent covers. Properties should be surveyed by qualified professionals to ensure that all openings have been identified and defences properly specified.

- It is noted that Haringey Council is progressing a flood resilience / protection scheme at Larkspur Close which will comprise installation of rain gardens within existing green spaces within the Close, installation of a flood retention basin within the green space located at the junction of Fryatt Road and Jellicoe Road, installation of a demountable flood gate at the entry to Larkspur Close and installation of non-return valves at the gully outlet points from Larkspur Close to Moselle Brook along with other ancillary works. The scheme is currently at design stage and no defined date for installation has been provided.

6 SUMMARY

The flooding that occurred on 12th July and 25th July 2021 in South Tottenham was caused by storms ranging from a 1 in 5 to a 1 in 20 year rainfall event on 12th July, and on 25th July potentially up to a 1 in 100 year rainfall event. Traditional pipe and gully urban drainage is generally not designed to cope with rainfall of the intensity experienced.

It is understood that there are no programmes for Thames Water to invest in upscaling its local drainage networks to provide additional sewer capacity.

Other factors have been identified which may have caused flooding at the respective locations identified within this report, which include;

- Blocked gully pots observed during the site visits to the respective locations.
- Propagation of flood waters by passage of vehicles through flood waters causing bow waves.
- Watercourse culvert inlet becoming overgrown with vegetation.
- Lack of capacity within surface water sewers, as noted by recorded reports of flooding (Clarence Road, Green Lanes / Williamson Road and St Annes) and outputs from DWMP models.

Thames Water were unable to provide any location specific data or actions carried out in relation to flooding for a number of the locations considered by this Section 19 assessment.

Thames Water has undertaken an internal review, (which considers the wider London catchment) to identify the actions taken ahead of, during and after the July 2021 storm events. This review concluded that the two key areas in which customers were let down were the initial response on the ground and lack of Thames Water customer contact provision during the events.

A further Independent Review has been commissioned by Thames Water into the causes and impacts of flooding, with a detailed assessment of sewer performance, which is due to be completed by Spring 2022.

It is understood that there are no current programmes for Thames Water to invest in upgrading local drainage networks to provide additional sewer capacity in the South Tottenham area.

6.1 Next steps

Haringey Council has committed to programme and undertake future gully cleaning throughout Haringey which is proposed to be completed by Summer 2022. Haringey Council has also identified that it is progressing with a scheme to manage flood risk within Larkspur Close.

Other actions are recommended and are summarised below:

- The outcomes of the Thames Water independent review (due 2022) to be shared with other RMAs to ensure that mechanisms of flood can be better understood and any actions identified from the review can be developed jointly with other RMAs (as appropriate).
- Haringey Council to consider further retrofitting of SuDS and flood alleviation measures to manage excess storm runoff along predominant flow paths.
- Localised temporary road closures or diversions are recommended in high-risk areas with low profile kerbs to reduce ingress of floodwaters onto footways and into properties where risk of internal flooding is caused by bow wave effect from the movement of vehicles through flood waters.
- Homeowners and businesses should be aware of their risk of flooding and investigate flood resilience and resistant measures to protect affected properties. Haringey Council offers advice through its website[10]. This link also provides information on how to sign up for flood warnings.

[10] Be prepared for flooding. Haringey Council, 2021, available at https://www.haringey.gov.uk/environment-and-waste/major-emergencies/drainage-and-flooding/be-prepared-flooding, accessed 12th November 2021.

- EA / Haringey to consider inspection of main and ordinary watercourses at the areas affected to ensure culverts are operating at capacity.