Brill Place Limited

BRILL PLACE

Flood Risk Assessment and Drainage Strategy

7370-WSP-00-ZZ-RP-D-520101
OCTOBER 2019

PUBLIC

Brill Place Limited

BRILL PLACE

Flood Risk Assessment and Drainage Strategy

PUBLIC

PROJECT NO. 70057370

OUR REF. NO. 7370-WSP-00-ZZ-RP-D-520101

DATE: OCTOBER 2019

Brill **Place Limited**

BRILL PLACE

Flood Risk Assessment and Drainage Strategy

WSP

WSP House
70 Chancery Lane
London
WC2A 1AF

Phone: +44 20 7314 5000

Fax: +44 20 7314 5111

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	First Issue	Second Issue		
Date	11/12/2019	11/03/2020		
Prepared by	Bryony Bennett	Bryony Bennett		
Signature				
Checked by	Rebecca Wilson	Rebecca Wilson		
Signature				
Authorised by	Lakhpal Chera	Lakhpal Chera		
Signature		Chera, Lakhpal (UKLSC006) Digitally signed by Chera, Lakhpal (UKLSC006) DN: cn=Chera, Lakhpal (UKLSC006), ou=London (Chancery Lane), email=Lakhpal.Chera@wsp.com Date: 2020.03.11 14:00:11		
Project number	70057370			
Report number	7370-WSP-00-ZZ-RP-D-520101			
File reference				

CONTENTS

1. INTRODUCTION 7

1.1. APPOINTMENT AND BRIEF 7

1.2. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 28: SUDS 7

1.3. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 35: FLOOD RISK ASSESSMENT - PLOT 7 8

1.4. OBJECTIVE OF STUDY 8

1.5. STUDY METHODOLOGY 8

2. EXISTING SITE 10

2.1. SITE LOCATION 10

2.2. SITE DESCRIPTION 10

2.3. GEOLOGY AND HYDROGEOLOGY 11

2.4. EXISTING WATERCOURSES, FLOOD DEFENCES AND STRUCTURES 13

2.5. EXISTING ARTIFICIAL WATERCOURSES/ WATERBODIES 13

2.6. EXISTING SEWERS/ DRAINAGE 13

3. PROPOSED DEVELOPMENT 15

3.1. DEVELOPMENT PROPOSALS 15

3.2. VULNERABILITY CLASSIFICATION 16

3.3. SEQUENTIAL ACCEPTABILITY AND EXCEPTION TEST 16

4. PLANNING POLICY AND GUIDANCE 17

4.1. INTRODUCTION 17

4.2. NATIONAL PLANNING POLICY FRAMEWORK 2018 17

4.3. RELEVANT LOCAL POLICY 17

4.4. THE LONDON PLAN & SUSTAINABLE DESIGN AND CONSTRUCTION SUPPLEMENTARY PLANNING GUIDANCE 19

5. DEFINITION OF FLOOD HAZARD 20

5.1. SOURCES AND MECHANISMS OF FLOODING 20
5.2. TIDAL AND FLUVIAL FLOODING 20
5.3. GROUNDWATER FLOODING 21
5.4. SURFACE WATER FLOODING 22
5.5. SEWER FLOODING 23
5.6. RESERVOIR AND ARTIFICIAL SOURCES OF FLOODING 24

6. CLIMATE CHANGE 25

6.1. BACKGROUND INFORMATION 25
6.2. DEVELOPMENT LIFESPAN 25
6.3. IMPACT OF CLIMATE CHANGE ON THE DEVELOPMENT 26

7. SURFACE WATER DRAINAGE STRATEGY 27

7.1. GENERAL COMMENTS 27
7.2. PROPOSED SURFACE WATER DRAINAGE STRATEGY 27
PROPOSED SURFACE WATER DISCHARGE METHOD 27
SOAKAWAY 28
WATERCOURSE 28
SEWER 28
7.3. EXISTING SURFACE WATER RUNOFF RATES 28
GREENFIELD RUNOFF RATES 28
BROWNFIELD RUNOFF RATES 29
ESTIMATION OF TOTAL SITE EXISTING SURFACE WATER RUNOFF 29
7.4. PROPOSED SURFACE WATER DISCHARGE RATES 30
LONDON BOROUGH OF CAMDEN LEAD LOCAL FLOOD AUTHORITY (LBC LLFA) CONSULTATION 30
THAMES WATER CONSULTATION 30
7.5. SURFACE WATER MODELLING AND RESULTS 31
DESIGN PRINCIPLES 31
PROPOSED DRAINAGE NETWORK RESULTS 31

OVERLAND FLOW / EXCEEDANCE 33
OFFSITE IMPACTS 34
8. RESIDUAL FLOOD RISK 35
8.1. OVERVIEW 35
9. PROPOSED FOUL WATER DRAINAGE STRATEGY 36
9.1. OVERVIEW 36
THAMES WATER FOUL WATER CALCULATOR METHOD 36
SEWERS FOR ADOPTION 7 METHOD 36
10. SURFACE WATER AND FOUL WATER DRAINAGE MAINTENANCE AND MANAGEMENT STRATEGY 38
10.1. OVERVIEW 38
11. BREEAM 39
11.1. OVERVIEW 39
12. EVIDENCE SUBMITTED TO DISCHARGE LONDON BOROUGH OF CAMDEN PLANNING CONDITIONS NO 28 & 35 41
12.1. OVERVIEW 41
12.2. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 28: SUDS 41
12.3. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 35: FLOOD RISK ASSESSMENT - PLOT 7 43
12.4. SUMMARY 43
13. CONCLUSIONS 44
13.1. REMARKS 44

TABLES

Table 1 - Summary of Geological Strata 11

Table 2 - Summary of Groundwater Information 12

Table 3 - Thames Water Sewer Summary 13

Table 4 – Schedule of Accommodation 16

Table 5 – Estimation of Greenfield Runoff Rate 29

Table 6 – Estimation of Brownfield Runoff Rate 29

Table 7 – Total Existing Surface Water Runoff Rate 29

Table 8 – Comparison between Existing and Proposed Surface Water Runoff Rates 32

Table 9 - Drainage Maintenance Requirements 38

Table 10 – BREEAM Pol 03 Surface Water Run-Off Credit Summary 39

FIGURES

Figure 1 - Indicative Site Location Plan 10

Figure 2 - Extract from DEFRA Ground Source Protection Zone Mapping (Site in blue) 12

Figure 3 - Central Somers Town: Community Facilities Project Masterplan 15

Figure 4 - Extract from EA's 'flood map for planning' 20

Figure 5 - Extract from Camden SFRA 'Increased Susceptability to Elevated Groundwater Figure 4e' 21

Figure 6 - SWMP 'Figure 3.8.1 - Critical Drainage Areas and key Local Flood Risk Zones' 22

Figure 7 - Extract from EA Surface Water Risk Flood Map 23

Figure 8 - Extract from EA mapping 'Flood risk from reservoirs' 24

Figure 9 - Snapshot of Proposed Development 32

APPENDICES

APPENDIX A SITE LOCATION

APPENDIX B THAMES WATER TOPO SURVEY & SEWER RECORD

APPENDIX C DEVELOPMENT PROPOSALS

APPENDIX D LBC CORRESPONDENCE

APPENDIX E EA CORRESPONDENCE

APPENDIX F ESTIMATION OF EXISTING GREENFIELD & BROWNFIELD RUNOFF

APPENDIX G THAMES WATER HISTORIC CORRESPONDENCE

APPENDIX H WSP SURFACE WATER DRAINAGE STRATEGY, MODELLING & CAMDEN SUDS PROFORMA

APPENDIX I THAMES WATER FOUL WATER CALCULATOR

APPENDIX J PUBLIC HEALTH ENGINEER PROPOSED ABOVE GROUND DRAINAGE

APPENDIX K WSP BASEMENT UNDERSLAB DRAINAGE

1. INTRODUCTION

1.1. APPOINTMENT AND BRIEF

1.1.1. WSP has prepared this Flood Risk Assessment (FRA) and Drainage Strategy on behalf of LBS Properties Ltd (the Client), to support the discharge of London Borough of Camden Planning Conditions Number 28 “SuDS” and Condition 35 “Flood Risk Assessment - Plot 7” associated with Planning Application Reference 2015/2704/P, for the re-development of the land at Brill Place, Kings Cross, Camden, London.

1.1.2. Plot 7 is located within the wider Central Somers Town Masterplan Project covering Land at Polygon Road Open Space, Edith Neville Primary School, 174 Ossulston Street and Purchese Street Open Space.

1.1.3. The proposed development of Plot 7 (the Site) will be for a tower building that will comprise commercial units on the ground floor, residential units from levels one to 22 and a single level of basement for cycle storage, refuse storage and mechanical plant.

1.1.4. This report is intended for the sole benefit of the parties named above and shall not be capable of reassignment, WSP shall not be liable for any use of the report for any reasons other than that for which the report was originally prepared and provided.

1.1.5. Although this report was prepared using the degree of skill and care ordinarily exercised by engineers practicing under similar circumstances please note that WSP cannot take responsibility for errors in the information provided by third parties.

1.2. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 28: SUDS

1.2.1. Prior to commencement of the relevant part of the development, details of a sustainable urban drainage system shall be submitted to and approved by the local planning authority in writing. Such details shall include details of the following features:

- *Permeable surfacing to all hard-standing areas, with a minimum 250mm sub-base, totalling 390m3 attenuation discharging to the public sewer at a reduced rate.*
- *Details of any weirs required within the sub-base to ensure that the full storage volume is utilised and to avoid lower areas becoming overwhelmed.*
- *Details of how rainfall falling on impermeable pathways or roads is shed and attenuated in adjacent grassed or planted areas to include swales or bio-retention / rain gardens and details of how these are connected to the sub-base of the paving areas to provide an even greater storage volume.*
- *A network of perforated pipes collecting the filtered runoff and conveying it to the public sewer.*
- *Details of permeable surfacing to all play areas.*
- *Full details of wetland areas*

SuDS will be implemented prior to the opening of the relevant parts of the development.

1.2.2. Reason: To reduce the rate of surface water run-off from the buildings and limit the impact on the storm-water drainage system in accordance with policies CS13 and CS16 of the London Borough of

Camden Local Development Framework Core Strategy and policies DP22, DP23 and DP32 of the London Borough of Camden Local Development Framework Development Policies.

1.3. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 35: FLOOD RISK ASSESSMENT - PLOT 7

1.3.1. Prior to commencement of development a Flood Risk Assessment shall be submitted to the local planning authority and approved in writing.

1.3.2. Reason: To reduce the rate of surface water run-off from the buildings and limit the impact on the storm-water drainage system in accordance with policies CS13 and CS16 of the London Borough of Camden Local Development Framework Core Strategy and policies DP22, DP23 and DP32 of the London Borough of Camden Local Development Framework Development Policies.

1.4. OBJECTIVE OF STUDY

1.4.1. This Report investigates flood risk in the vicinity of the Site from the various potential sources to ensure the sustainability and safety of the proposed development over its lifetime. Furthermore, this Report outlines the proposed Surface Water and Foul Water Drainage Strategy for the proposed development.

1.4.2. This FRA and Drainage Strategy has been produced in line with the requirements of the National Planning Policy Framework (NPPF 2018) and the Environment Agency's (EA) Standing Advice, in addition to consultation with the EA, Thames Water (TW) and the London Borough of Camden Council (LBC) who act as both the Drainage Authority and Lead Local Flood Authority (LLFA) within this area.

1.5. STUDY METHODOLOGY

1.5.1. The appraisal process has comprised of a desktop study, data research and consultation with regulatory bodies and in accordance with third party standing advice.

1.5.2. The following documents, policies and resources have been used to produce this FRA and Drainage Strategy:

- Camden Local Plan 2017
- Camden Core Strategy 2010-2025 Local Development Framework;
- Camden Development Policies 2010-2025 Local Development Framework;
- London Borough of Camden Strategic Flood Risk Assessment (2014);
- London Borough of Camden: Surface Water Management Plan (2013);
- Local Flood Risk Management Strategy (2013);
- Preliminary Flood Risk Assessment (2011) and addendum (2017);
- Managing flood risk in Camden: The London Borough of Camden flood risk management strategy (2013);
- Camden Planning Guidance: Water and Flooding (2019);
- GLA and Camden SuDS pro-forma;
- The London Plan (2016);

- Sustainable Design and Construction Supplementary Planning Guidance, The London Plan 2011 (2014);
- Thames Water Sewer Asset Records;
- British Geological Society (BGS) Online Viewer, 1:50,000 Bedrock and Superficial deposits; and
- Defra's Online Magic Map

1.5.3. This study contains Environmental Agency information © Environment Agency and database right.

1.5.4. This study contains public sector information licensed under the Open Government Licence v3.0.

2. EXISTING SITE

2.1. SITE LOCATION

2.1.1. The Site is located to the north of Brill Place within the Purchese Street Open Space area and opposite the Francis Crick Institute (FCI). The Site is bounded by Brill Place to the south and Purchese Street Open Space to the west, north and east. Further east of the Site is King's Cross St Pancras Station.

2.1.2. The Site is situated at:

- National Grid Reference: TQ 29870 83127.
- Easting, Northing: 529870, 183127
- Nearest Postcode: NW1 1EY

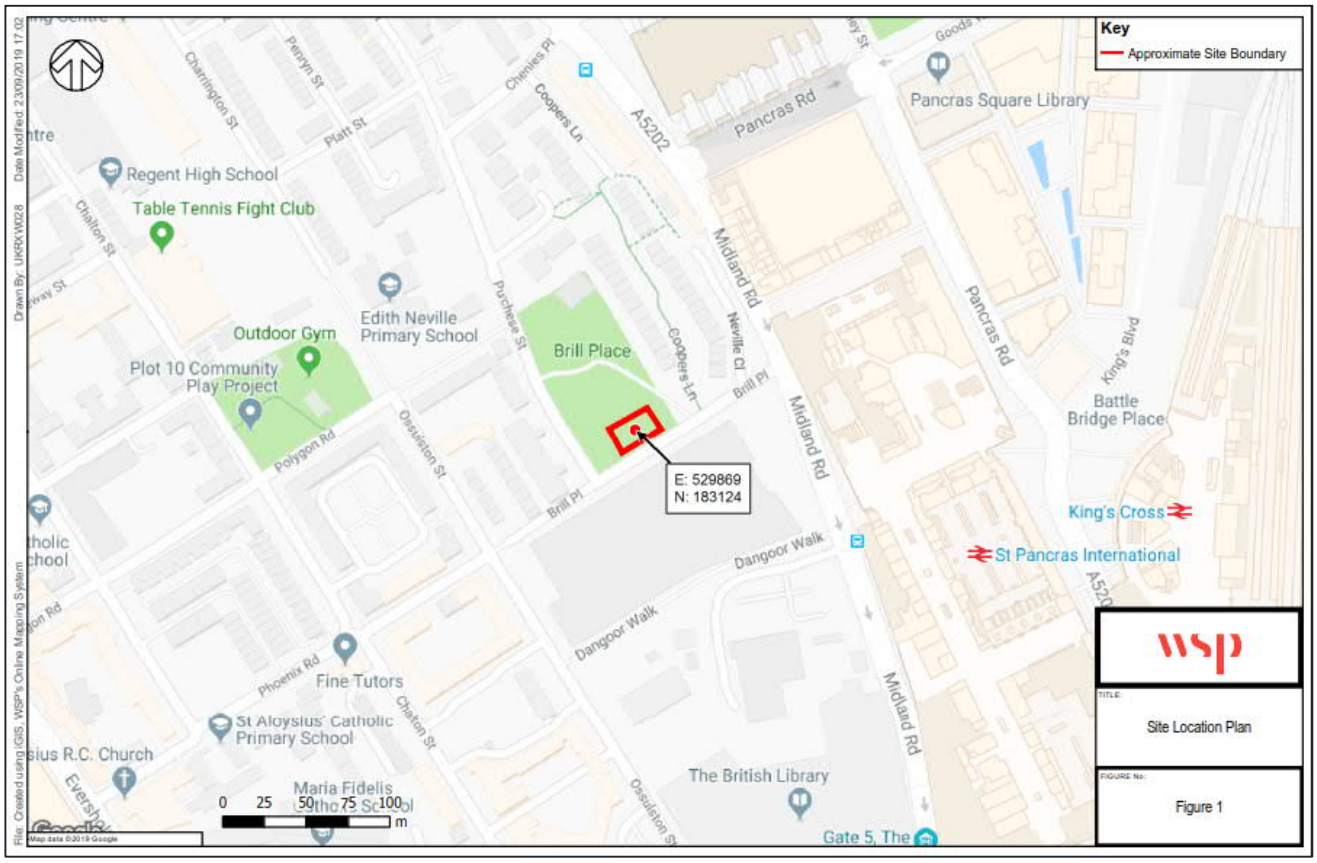

Figure 1 - Indicative Site Location Plan

2.1.3. Refer to Figure 1 above and to the location plan in Appendix A for more details of the extent of the site.

2.2. SITE DESCRIPTION

2.2.1. The existing development site in the majority is made up of open parkland with trees, however, there is a small area to the southwest and through the centre of the proposed development made up of impermeable paving.

2.2.2. Based on a copy of Thames Water's Drawing Fleet Storm Relief Sewer (Main Line) Line and Level Survey included in Appendix B, which depicts the topography of the Site, existing Site levels are elevated between approximately 19.47m AOD and 18.74m AOD sloping with a gradient of approximately 1:22 towards Brill Place. Top of kerb highway levels in Brill place immediately fronting the Site range between approximately 18.81m AOD and 18.51m AOD, with carriageway channel line levels elevated between approximately 18.69m AOD and 18.40m AOD sloping easterly towards Midland Road.

2.2.3. According to the Phase 1 Geotechnical and Geo-Environmental Desk Study produced by Buro Happold Engineers, dated 18th September 2015, the site has historically had many uses including; housing, a coal depot and a temporary 'Euston Air Terminal' which was demolished and replaced by the current parkland area in 1988. Notably, the site was also subject to substantial damage caused by bombing in World War II. As the site is currently undeveloped, it is considered as being Greenfield.

2.3. GEOLOGY AND HYDROGEOLOGY

2.3.1. This section of the report has been informed by mapping from the British Geological Survey (BGS) Geology of Britain viewer, the SFRA and a site investigation carried out by Ground Engineering Ltd on behalf of WSP in June 2019.

2.3.2. The likely geological strata at the site based on BGS historical borehole data is summarised in Table 1. This correlates with findings from the June 2019 site investigation that identified Made Ground to a depth of 2.5mbgl and London Clay to a depth of 6mbgl.

Table 1 - Summary of Geological Strata

Stratum	Depth to top of stratum mbgl [approximate thickness]	Aquifer Designation
Made Ground	Surface [<5m]	-
London Clay	1-5 mbgl [~25m]	Unproductive
Woolwich and Reading Beds (Lambeth Group)	21 mbgl [~14m]	Secondary A Aquifer
Thanet Sand	34mbgl [~8.5m]	Secondary A Aquifer
White Chalk	42mbgl [>100m]	Principal

BGS Reference Boreholes: TQ28SE1982, TQ28SE568, TQ28SE12, TQ28SE1953

2.3.3. Based on DEFRA's Magic Maps, the site is located on unproductive strata, meaning that the London Clay is a low permeability strata that has a negligible significance for water supply or river base flow. The London Clay Formation is likely to act as an aquitard to prevent vertical movement of groundwater between the White Chalk/Thanet Sand aquifers and the Made Ground. There are no superficial deposits recorded at the site.

2.3.4. The made ground is not classified by the EA, but groundwater may be present as a perched water body. The report 'Ground Investigation Summary and Preliminary Environmental Review' document prepared by WSP in June 2019 detailed borehole investigations made at the site, confirming that groundwater was only identified in borehole WS103 at 3.80mbgl within the London Clay.

2.3.5. DEFRA's Magic Maps 'Groundwater Vulnerability Zone' mapping, shown in Figure 2, indicates that the site is not located within a Groundwater Vulnerability Zone (GVZ).

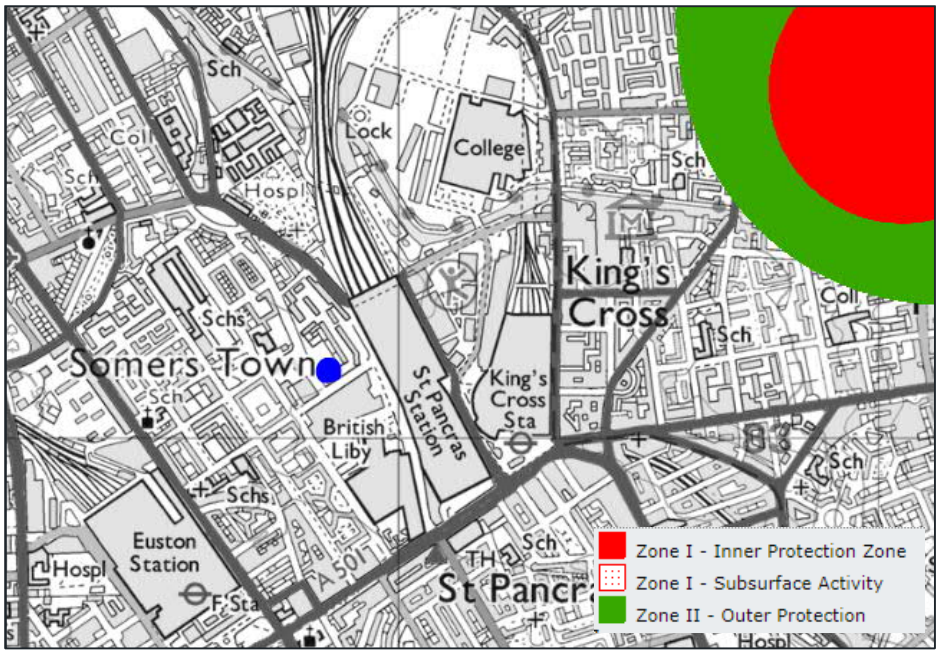

Figure 2 **- Extract from DEFRA Ground Source Protection Zone Mapping (Site in blue)**

2.3.6. Based on available online mapping the following information is understood in relation to the site:

Table 2 - Summary of Groundwater Information

Consideration	Detail
Groundwater Source Protection Zone	Not located within a Source Protection Zone (Figure 2)
BGS Aquifer Designation Maps -Bedrock	Unproductive – The EA classified Bedrock Strata as unproductive
Groundwater Vulnerability Zones (GVZ)	Not in a GVZ
Groundwater Source Protection Zone	Not located within a Source Protection Zone (Figure 2)
BGS Aquifer Designation Maps -Bedrock	Unproductive – The EA classified Bedrock Strata as unproductive

2.4. EXISTING WATERCOURSES, FLOOD DEFENCES AND STRUCTURES

2.4.1. The River Thames is located approximately 2.6km southeast of the site and runs from west to east.

2.4.2. The nearest flood defence, which is associated with the River Thames, is also located approximately 2.6km southeast of the Site.

2.4.3. There are no other watercourses in the vicinity of the Site.

2.5. EXISTING ARTIFICIAL WATERCOURSES/ WATERBODIES

2.5.1. The Regent's Canal is located approximately 320m north-east of the Site at its closest point and this is managed by the Canal and River Trust (C&RT).

2.5.2. There are no other artificial watercourses or waterbodies in the immediate vicinity of the Site.

2.6. EXISTING SEWERS/ DRAINAGE

2.6.1. Based on Thames Water (TW) Sewer Asset Records, included in Appendix B, the Site appears to have no positive drainage infrastructure within the Purchese Street Open Space.

2.6.2. The Thames Water Fleet Storm Relief Sewer runs in a north to south direction and this is located approximately 7m away from the north-eastern boundary of the Site. The Storm Relief Sewer has a diameter of 2134mm and an approximate invert level of 3.3m AOD and is, therefore, approximately 15.5m deep. This sewer was built in the 1870's and provides relief to the Fleet Sewer Main Line.

2.6.3. LBC is served entirely by public combined water sewers. The nearest sewers include a public combined sewer in Brill Place and along Purchese Street . Table 3 below summarises the TW public sewers that are in proximity to the site.

Table 3 - Thames Water Sewer Summary

Location	Type	Size (mm)	Nearest Manhole Reference	Cover Level (mAOD)	Invert Level (mAOD)
Brill Place	Combined	1270 x 813	9144	Unknown	Unknown
Phoenix Court / Purchese Street	Combined	1245 x 813	721A	Unknown	Unknown
Along north-east edge of the Brill Place park	Storm relief	2134	N/A	N/A	3.36-3.20

2.6.4. A drainage survey will be commissioned by the Client to accurately locate the public sewers and identify the location and condition of the public sewer network along Brill Place for which it will be proposed to discharge both foul and surface water flows originating from the proposed development.

3. PROPOSED DEVELOPMENT

3.1. DEVELOPMENT PROPOSALS

3.1.1. Plot 7 is located within the wider Central Somers Town Masterplan Project (Figure 3), which aims to provide a new primary school, community facilities, affordable homes and a public park, as well as a small number of private homes.

Figure 3 - Central Somers Town: Community Facilities Project Masterplan

3.1.2. The proposed development at Brill Place will provide the affordable housing for the masterplan development. The proposed 22-storey tower will comprise of a contemporary park side building of 54 private residential apartments with flexible floor space and a café at ground level. A copy of the architect's development plans prepared by Stiff & Trevillion is included in Appendix C.

3.1.3. The proposed development will be a slender 22-storey tower occupying a small building footprint of 0.02ha within the existing Purchese Street Open Space, however, the development will have a surface water catchment area of approximately 0.04ha, as the proposed building will cantilever outwards from level one and above to form an undercroft at ground level i.e. the external area at ground floor will be open to the sides, however, will be covered by the building above.

3.1.4. The proposed building extent at roof level is edged in red in Figure 3. The proposed roof will comprise of two 45 degrees glazed sloping roofs, sloping in opposite directions. The option for green, blue or brown roofs for the proposed building will therefore not be viable.

3.1.5. The development will also incorporate a single level of basement for cycle storage, refuse storage and mechanical plant and the extent of the proposed basement is edged in blue in Figure 3. The land above the basement (excluding the tower building), however, will remain in the ownership of LBC and the responsibility for surface water drainage above the basement will lie with LBC.

3.1.6. The proposed development will have thresholds and finished floor levels of 18.90m AOD, 18.75m AOD and 18.60m AOD. The ground levels surrounding the building will be designed by LBC as part of LBC's wider Landscaping Masterplan for the Purchese Street Open Space area. Contact has not yet been made with the Landscape Architect for the Purchese Street Open Space area, however, in accordance with best practice and as part of the larger Landscape Masterplan designed by DSDHA on behalf of LBC, ground levels should fall away from the building, especially at thresholds and should fall towards the wider soft landscaping surrounding the proposed building.

Table 4 – Schedule of Accommodation

1 bed	2 bed	3 bed	Total
27	24	3	54
50%	44.4%	5.6%	100%

3.2. VULNERABILITY CLASSIFICATION

3.2.1. In accordance with the NPPF (2018) and associated flood risk and coastal planning practice guidance (2014) (Table 2: Flood risk vulnerability classification) the proposed development usage is classified as a more vulnerable development.

3.3. SEQUENTIAL ACCEPTABILITY AND EXCEPTION TEST

3.3.1. As stated in the NPPF, a sequential risk-based approach to determine the suitability of land for development in flood risk areas should be applied at all stages of the planning process giving precedence to low flood risk areas wherever possible.

3.3.2. Based on the Flood Map for Planning, the Site is located within Flood Zone 1 and deemed to be sequentially acceptable in accordance with the NPPF and the exception test need not be applied.

4. PLANNING POLICY AND GUIDANCE

4.1. INTRODUCTION

4.1.1. This section of the report summarises local policy and guidance relevant to this Flood Risk Assessment and Drainage Strategy.

4.2. NATIONAL PLANNING POLICY FRAMEWORK 2018

4.2.1. The National Planning Policy Framework (NPPF) was published in July 2018 with the aim of protecting the environment and to promote sustainable growth. There is an overarching presumption in favour of sustainable development that should be the basis of every plan and every decision.

4.2.2. The following paragraphs/policies within the NPPF are considered relevant to this assessment:

- Paragraph 155: Requires that "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.";
- Paragraph 158: Explains that "the aim of the Sequential Test is to steer development to areas with the lowest probability of flooding";
- Paragraph 163: Explains that "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere […];
- Paragraph 165: Recommends that "major development should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

a) take account of advice from the lead local flood authority;

b) have appropriate proposed minimum operational standards;

c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and

d) where possible, provide multifunctional benefits"

4.3. RELEVANT LOCAL POLICY

4.3.1. The London Borough of Camden (LBC) has a number of Drainage Policies which have been consulted in preparing this FRA and Drainage Strategy and these are referenced in Section 1.5 of this Report.

4.3.2. **Camden Local Plan 2017**

<u>Policy CC3 Water and Flooding</u>
The council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

This policy will require development to:

- Incorporate water efficiency measures;

- Avoid harm to the water environment and improve water quality;
- Consider the impact of development in areas at risk of flooding (including drainage);
- Incorporate flood resilient measures in areas prone to flooding;
- Utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
- Not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

Camden Core Strategy 2010-2025 Local Development Framework

- CS13: Tackling climate change through promoting higher environmental standards
  - This Policy states that the council will make Camden a water efficient borough and minimise the potential for surface water flooding by protecting existing drinking water and foul water infrastructure, making sure developments incorporate efficient water and foul water infrastructure and requiring developments to avoid harm to the water environment, water quality or drainage systems and prevent or mitigates local surface water and downstream flooding, especially in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross.
- CS16 – Improving Camden's health and well-being
  - Policy stating the council will seek to improve health and well-being in Camden.

Camden Development Policies 2010-2025 Local Development Framework

- DP22: Promoting sustainable design and construction
  - Policy stating that the council will require development to be resilient to climate change by ensuring schemes include appropriate climate change measures, such as limiting run-off and including pervious surfaces to enable water to infiltrate the ground.
- DP23: Water
  - Requires developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by limiting the amount and rate of run off and waste water entering the combined storm water and sewer network through capturing, retaining and re-using surface water and grey water on-site as well as other methods.
- DP27: Basements and lightwells
  - In determining proposals for basement and other underground development, the Council will require an assessment of the scheme's impact on drainage, flooding, groundwater conditions and structural stability, where appropriate. The council will only permit basement and other underground development that does not cause harm to the built and natural environment and local amenity and does not result in flooding or ground instability. The council will not permit basement schemes which include habitable rooms in areas prone to flooding.

4.3.3. A copy of correspondence from London Borough of Camden is included in Appendix D.

4.4. THE LONDON PLAN & SUSTAINABLE DESIGN AND CONSTRUCTION SUPPLEMENTARY PLANNING GUIDANCE

4.4.1. The London Plan, Policy 5.13, states developments should utilise SuDS to achieve greenfield runoff rates and to ensure that surface water runoff is managed as close to source as possible in line with the “drainage hierarchy”.

5. DEFINITION OF FLOOD HAZARD

5.1. SOURCES AND MECHANISMS OF FLOODING

5.1.1. Reference to gov.uk 'Flood Map for Planning' and 'Long term flood risk information' maps (which makes use of EA data) is made where appropriate, along with reference to the London Borough of Camden documents referenced in Section 1.5 of this Report.

5.1.2. Reference to consultation with the EA is included in Appendix E.

5.2. TIDAL AND FLUVIAL FLOODING

5.2.1. Fluvial flooding is caused by rivers, watercourses or ditches overflowing. Tidal flooding is caused by elevated sea levels or overtopping by wave action. In London, flooding may arise from either fluvial or tidal flooding, or a combination of the two.

The EA's 'Flood Map for Planning' confirms that the site is located in Flood Zone 1.

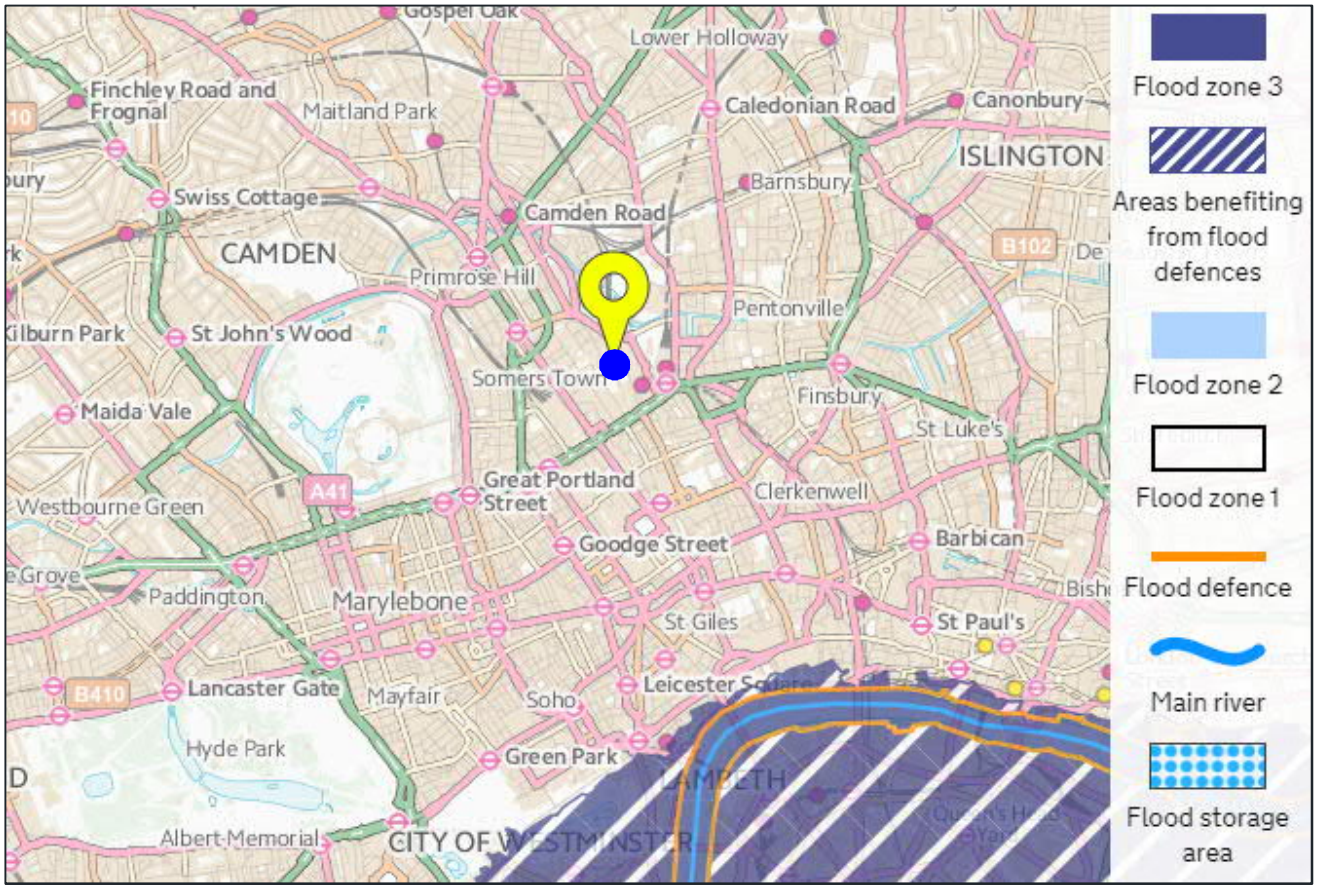

Figure 4 - Extract from EA's 'flood map for planning'

5.2.2. Flood Zone 1 is classified as land having a less than 0.1% annual probability of river (fluvial) or sea (tidal) flooding (1 in 1000-year return period event). In consistency with the above, the site is classified as having a 'very low' probability of flooding from fluvial or tidal sources.

5.2.3. The site is located approximately 2.6km north of the River Thames, which is the nearest source of tidal and fluvial flooding. As the site is elevated at approximately +18.75m AOD it is significantly above flood levels expected from the River Thames.

5.2.4. The LBC SFRA states that "*all main rivers historically located within LBC are now culverted and incorporated into the TWUL sewer network and therefore there is no fluvial flood risk within LBC".*

5.2.5. Based on the above information, the Site has a very low to negligible probability of fluvial and tidal flooding.

5.3. GROUNDWATER FLOODING

5.3.1. Groundwater flooding occurs as a result of water rising up from underlying rocks, typically after long periods of sustanained rainfall. It is most likely to occur in low-lying areas underlain by aquifers.

5.3.2. The LBC's SFRA includes mapping for areas with 'Increased Susceptibility to Elevated Groundwater (Map 4e)', an extract of this plan is shown in Figure 5. This map does not indicate that the site has an increased susceptibility to groundwater nor are there any historic records of groundwater flooding.

5.3.3. Given that the site has been developed on historically, the presence of superficial permeable layers are likely to be limited as a result of historical subterranean development.

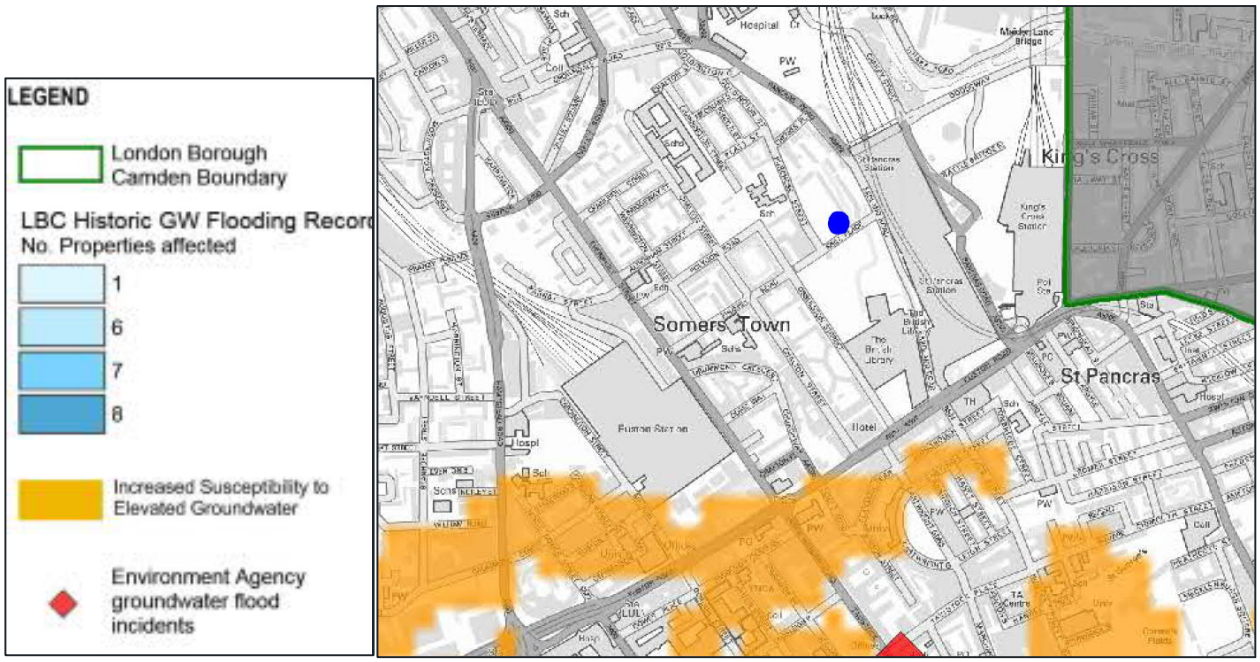

Figure 5 - Extract from Camden SFRA 'Increased Susceptability to Elevated Groundwater Figure 4e'

5.3.4. Considering the above information, the risk of groundwater flooding at the site has been assessed as very low.

5.4. SURFACE WATER FLOODING

5.4.1. The Camden SWMP identifies that the site lies within the Critical Drainage Area (CDA) 'Group 3_003 – River Fleet Catchment', with the cause of the CDA being the topography creating a basin. Despite being within the CDA, the site is not located in an area known to be a Local Flood Risk Zone (LFRZ) as indicated in figure 6.

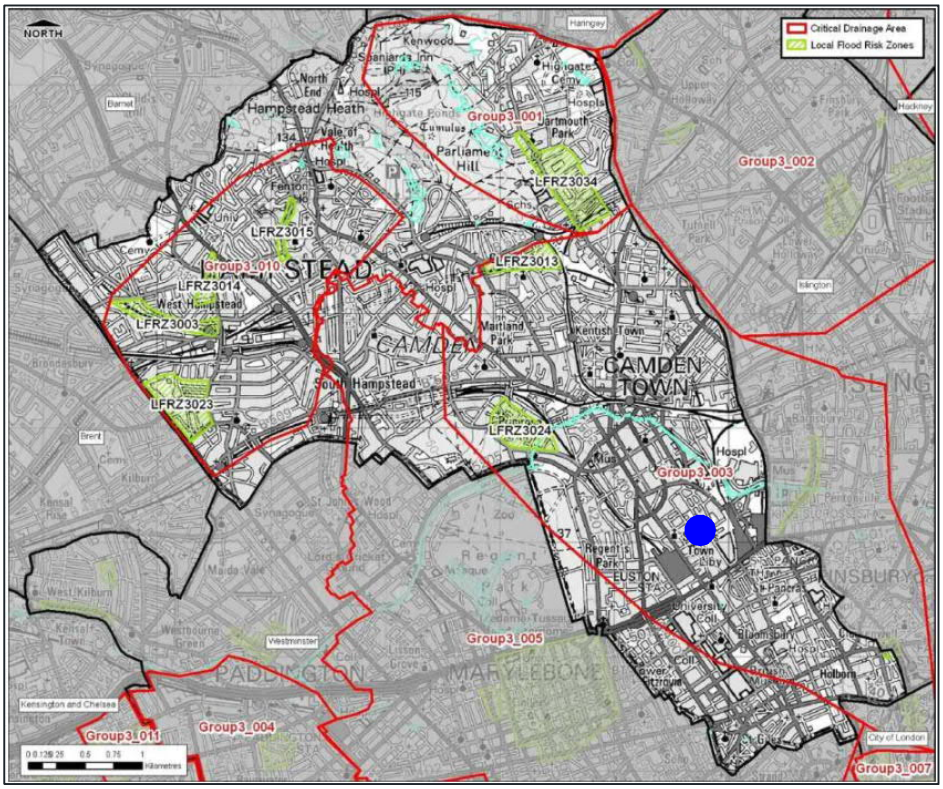

Figure 6 - SWMP 'Figure 3.8.1 - Critical Drainage Areas and key Local Flood Risk Zones'

5.4.2. Based on the Surface Water Flood Mapping (gov.uk) illustrated in Figure 7 ,the proposed development is generally at a very low risk of surface water flooding, with some small areas to the east of the proposed building and within Brill Place at a low risk of surface water flooding.

5.4.3. As these areas are localised, it is likely that these are topographical features where surface water ponding occurs during large duration storms. This is consistent with the lack of a formalised drainage network surrounding the Site. The larger Purchese Street Open Space area is to be developed by LBC as part of the Central Somers Town Masterplan Project and as such it is anticipated that this re-development of landscaping will remediate the topography causing ponding.

5.4.4. There is also ponding experienced along Midland Road to the east of the site. The SWMP indicated that LBC experiences surface water issues resulting from runoff of the railway embankments. It is considered that due to topography there is not a flow route from this area to the site.

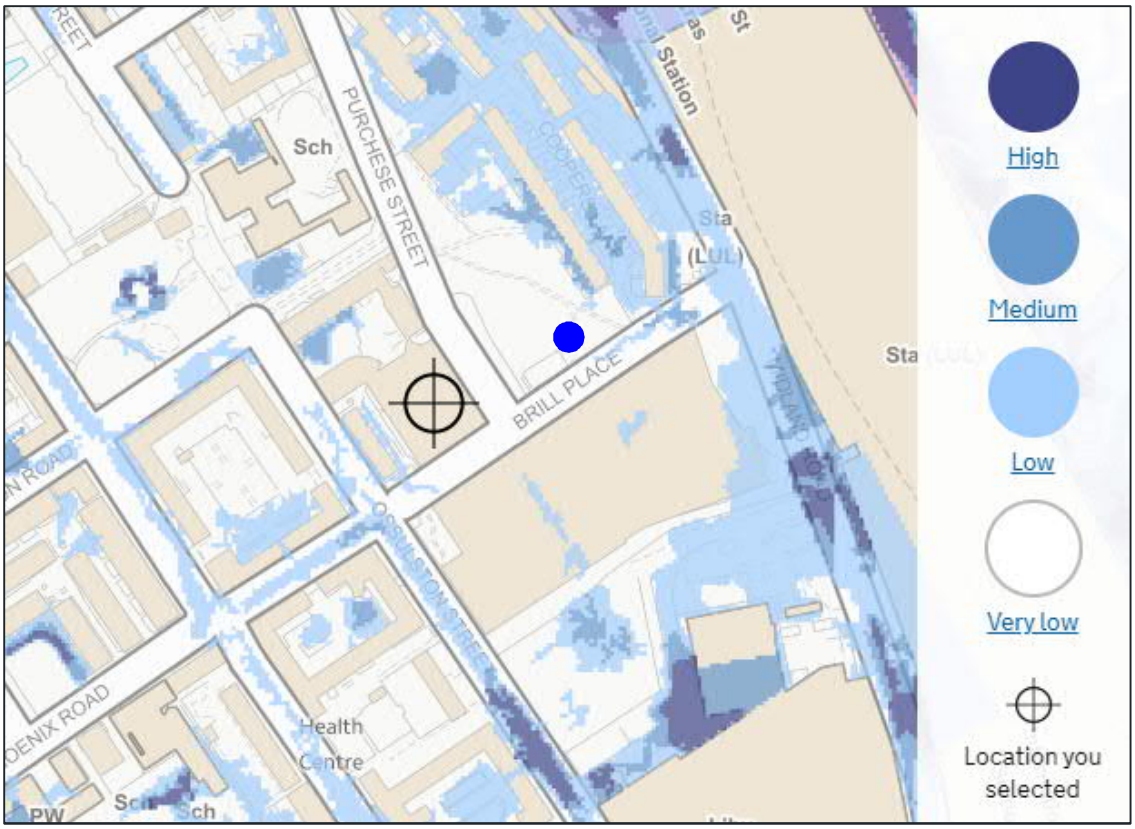

Figure 7 - Extract from EA Surface Water Risk Flood Map

5.4.5. The risk of flooding from surface water has therefore been assessed as very low based on the available information.

5.5. SEWER FLOODING

5.5.1. The SFRA notes that the majority of LBC is served by public combined surface water and foul water sewer systems designed to accommodate rainfall events up to 3.3% AEP (1 in 30-year rainfall event). Therefore, rainfall events with return periods of frequency greater than 3.3% AEP would expect to result in surcharging of some of the sewer system. The sewer network in Camden is known to be particularly old with some sections identified as only being able to convey storms up to the 10% AEP event (1 in 10-year rainfall event).

5.5.2. The Fleet Storm Relief Sewer runs approximately 7m to the east of the proposed building and is approximately 15.5m deep. It is noted in the Camden Flood Risk Management Strategy that over loading of this sewer could occur during an event with a 3.3% chance of happening in any one year. Overloading of the Fleet Sewer has potential to cause flooding in Primrose Hill Park in the LBC.

5.5.3. Camden's SWMP does not list the Central Somers Town area as being at high risk of sewer flooding incidents in the Borough.

5.5.4. Based on this information, the risk of flooding from sewers has been assessed as being low.

5.6. RESERVOIR AND ARTIFICIAL SOURCES OF FLOODING

5.6.1. Based on the gov.uk online maps, seen in Figure 8, the site has not been identified as within the extent of flooding from reservoirs.

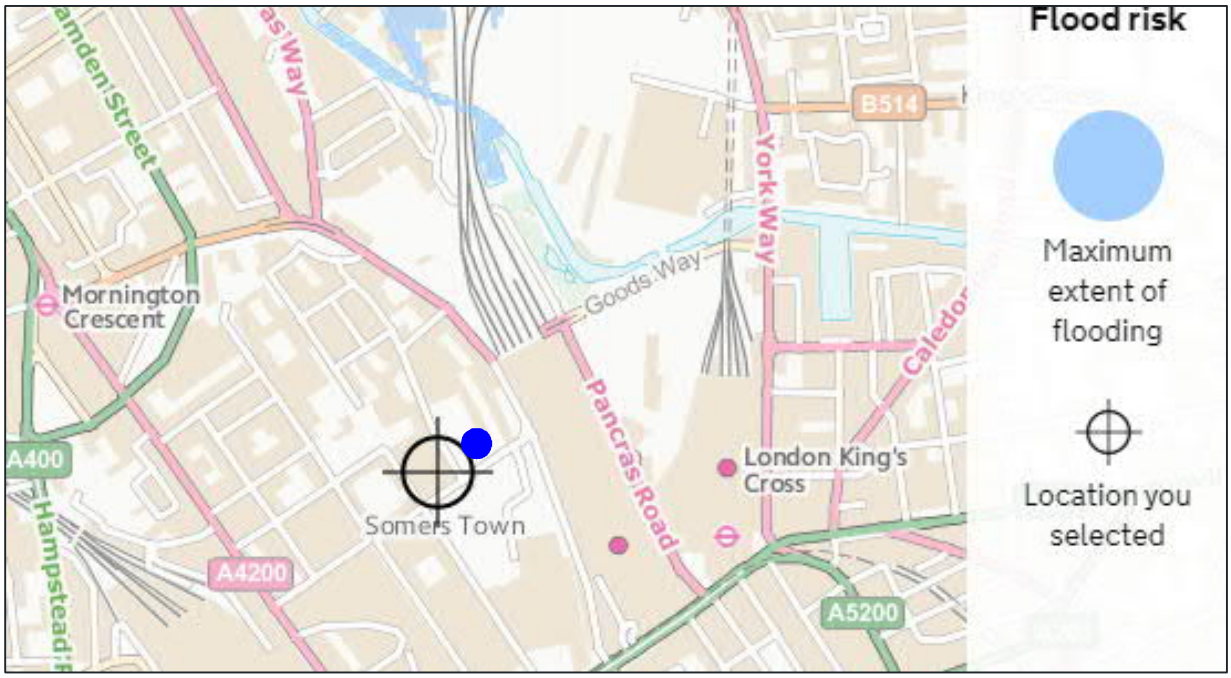

Figure 8 - Extract from EA mapping 'Flood risk from reservoirs'

5.6.2. The C&RT confirmed in the SFRA that there are no recorded incidents of overtopping or breaches of the Regent's Canal in or within 500m of LBC. As stated in Camden's SWMP, "*the water levels within the Regents Canal are controlled by British waterways and for this reason they are considered to pose a minimal risk of flooding*".

5.6.3. Based on the information available, the probability of flooding from reservoir and artificial watercourses at the site is considered to be negligible.

6. CLIMATE CHANGE

6.1. BACKGROUND INFORMATION

6.1.1. As explained in the Climate Change Adaptation Sub-Committee Progress Report 2014, increased flood risk is the greatest threat to the UK from climate change. Models of the climate system suggest floods of the type experienced in England and Wales in autumn 2000, and between December 2013 and February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

6.1.2. More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

6.1.3. New EA guidance “Flood risk assessments: climate change allowances” issued on the 19th February 2016 (and subsequent minor updates) provides up to date information on expected changes in rainfall, river flows and sea level rise as a consequence of climate change.

6.1.4. A key change from the previous guidance is that the climate change allowances for peak river flows now are shown as variable on a regional basis; allowances are also now based on percentiles, whereby a percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level (e.g. a 50% percentile means that the allowance has 50% chances of not being exceeded).

6.1.5. Sea levels allowances reflect the previous guidance and vary on a regional basis and for each epoch as shown in Table 3 of the EA guidance.

6.1.6. The EA have provided guidance to assess the impact of climate change on fluvial flooding. Technical assessment of climate change impacts on fluvial flooding appropriate for new developments depending on their scale and location (see following section).

6.1.7. For peak rainfall the EA Guidance provides an upper end and central allowance depending on epoch; the guidance recommends assessing both the central and upper end allowances to understand the range of possible impacts. These allowances are detailed in Table 2 (Peak rainfall intensity allowance in small and urban catchments) of the EA guidance.

6.2. DEVELOPMENT LIFESPAN

6.2.1. A typical lifespan for a residential development is 100 years.

6.2.2. Based on this, the contingency peak rainfall allowances for climate change that are potentially applicable to this Site are as set out in Table 2 of the EA’s “Flood risk assessments: climate change allowances” advice are:

- Upper End – 40% increase in peak rainfall by 2115;
- Central – 20% increase in peak rainfall by 2115.

6.2.3. When undertaking the Surface Water Drainage Strategy, the surface water attenuation calculations will be determined using the Upper End estimates to be precautionary and to prevent potential exceedance of flows off site.

6.3. IMPACT OF CLIMATE CHANGE ON THE DEVELOPMENT

6.3.1. Surface water runoff could in theory represent a risk to the Site, especially when the effects of climate change are considered. The Surface Water Drainage Strategy produced as part of this study takes into account the potential impacts of climate change.

6.3.2. The Surface Water Drainage Strategy demonstrates that the surface water drainage provision for the Site will be designed to accommodate surface water run-off for all events up to and including the 100-year return period plus 40% climate change allowance.

7. SURFACE WATER DRAINAGE STRATEGY

7.1. GENERAL COMMENTS

7.1.1. The risk to the Site from all sources of flooding has been demonstrated to be negligible to low, therefore, there are no site-specific flood mitigation measures required on-site apart from adhering to best practice measures such as:

- Ground levels should fall away from building entrances/thresholds in order to mitigate against surface water runoff entering the ground floor during extreme storm events.
- Raised thresholds should be implemented where possible.

7.2. PROPOSED SURFACE WATER DRAINAGE STRATEGY

7.2.1. A Surface Water Drainage Strategy is important for any new development to ensure that surface water is managed effectively limiting the risk off-site as well as on-site and ensuring compliance with local and national policy and best practice.

7.2.2. As discussed in the previous Chapters of this Report, no significant sources of flood risk for the Site have been identified, although surface water flooding of the surrounding Brill Place cannot be excluded in extreme rainfall events.

7.2.3. This section of the report discusses the principles of the proposed surface water drainage discharge strategy with appropriate design calculations and drainage maintenance requirements provided thereafter. The general principles of the Surface Water Drainage Strategy and drainage calculation methodology for the Proposed Development are also discussed.

7.2.4. All proposed drainage will be designed in accordance with local policy, local SuDS guidance, national standards and best practice where applicable during detailed design stages. This Surface Water Drainage Strategy identifies the principles of drainage management at the site and all agreements, permits and applications for connections to the public sewer network will be made post discharge of the Planning Conditions through engagement with the Thames Water.

PROPOSED SURFACE WATER DISCHARGE METHOD

7.2.5. Best practice for the management of surface water, based on best practice and Building Regulations 2010 Part H (2015 Version) states that surface water runoff from a site shall discharge to one of the following in order of priority:

- An adequate soakaway or some other adequate infiltration system;
- A watercourse; and
- Sewer.

SOAKAWAY

7.2.6. The use of infiltration techniques at the site is limited due to its location and the immediate areas surrounding the building footprint being outside of the Client's control.

7.2.7. In addition, the use of infiltration is not considered viable due to a requirement for infiltration devices to be at least 5m away from permanent structures and the uncertainties in terms of a perched groundwater levels in the 2.5mbgl-6mbgl recorded clay strata.

7.2.8. Furthermore, porous surface systems (such as permeable paving) are not considered to be viable due to the limited external areas for locating such systems i.e. the majority of the Site's footprint is comprised entirely of the main building that will sit above the basement as a podium slab.

WATERCOURSE

7.2.9. The potential for discharge via a watercourse has also been considered, however, the nearest watercourse is the Regents Canal that is located approximately 320m away from the proposed building and on the other side of King's Cross St Pancras International Railway Station. Surface water discharge into the watercourse is therefore not considered viable for the site.

SEWER

7.2.10. In the absence of any other suitable means of drainage discharge, it is therefore proposed to discharge surface water to the existing 1270mm X 813mm combined sewer located in Brill Place.

7.2.11. It will be proposed to attenuate rainwater by storing in a below ground tank for gradual release with a sustainable gravity discharge to the Thames Water public sewers.

7.3. EXISTING SURFACE WATER RUNOFF RATES

7.3.1. The existing development site in the majority is made up of 87% of open parkland with trees, however, there is a small area to the southwest and through the centre of the proposed development made up of 51m^2 (13%) of impermeable paving.

7.3.2. The land within the existing Purchese Street Open Space area does not appear to have any formal positive drainage. Surface water currently either infiltrates to ground, or during storm events when grass/vegetation will be too saturated to accept flows, surface water will flow overland following the natural topography of the Site towards Brill Place, where it would be captured in the Brill Place highway drainage system and ultimately the Thames Water Public Sewer Network.

GREENFIELD RUNOFF RATES

7.3.3. In consideration of FEH 2013-point rainfall data and the total proposed building roof catchment area of 0.04ha, the Site's greenfield runoff rate has been calculated using the online HR Wallingford Greenfield Runoff Rate Estimation Tool located on www.uksuds.com website.

A copy of the greenfield runoff calculation is included in Appendix F, with the results summarised in Table 5 below.

Table 5 – Estimation of Greenfield Runoff Rate

Return Period	Greenfield Runoff Rate (l/s)
Qbar (1 in 2.3 Years)	0.064
1 in 1 Year	0.056
1 in 30 Year	0.148
1 in 100 Year	0.204

BROWNFIELD RUNOFF RATES

7.3.4. An estimate of the development site existing brownfield runoff rate from the 51m^2 of impermeable paving has been calculated with reference to the rational method brownfield runoff calculation, i.e. Q=2.78CiA, the existing brownfield runoff for the Site has been calculated using FEH rainfall intensities, generated from average rainfall profiles using MicroDrainage software, for the 1 in 2 year, 1 in 30 year and 1 in 100 year 15 minute storm events. A copy of the MicroDrainage average rainfall intensities is also included in Appendix F. An assessment of the existing brownfield runoff rate is tabulated in Table 6 below.

Table 6 – Estimation of Brownfield Runoff Rate

Return Period	Average Intensity (mm/hr)	Brownfield Runoff Rate (l/s)
1 in 2 Year*	37.471	0.531
1 in 30 Year	96.890	1.374
1 in 100 Year	128.333	1.820

* Note: MicroDrainage software cannot generate FEH rainfall intensities for storm events less than the 1 in 2 year

ESTIMATION OF TOTAL SITE EXISTING SURFACE WATER RUNOFF

7.3.5. An estimation of the total existing surface water runoff is tabulated in Table 7 below.

Table 7 – Total Existing Surface Water Runoff Rate

Return Period	Greenfield Runoff Rate (l/s)	Brownfield Runoff Rate (l/s)	Total Existing Surface Water Runoff (l/s)
Qbar / 2 Year*	0.064	0.531	0.595
1 in 30 Year	0.148	1.374	1.522
1 in 100 Year	0.204	1.820	2.024

* Note: MicroDrainage software cannot generate FEH rainfall intensities for storm events less than the 1 in 2 year, therefore, estimation is made with existing Qbar (1 in 2.3 Years).

7.4. PROPOSED SURFACE WATER DISCHARGE RATES

7.4.1. According to The Sustainable Design and Construction Supplementary Planning Guidance, The London Plan 2011 (2014) Paragraph 3.4.10: *…"All developments on greenfield sites must maintain greenfield runoff rates. On previously developed sites, runoff rates should not be more than three times the calculated greenfield rate. The only exceptions to this, where greater discharge rates may be acceptable, are where a pumped discharge would be required to meet the standards'…*

LONDON BOROUGH OF CAMDEN LEAD LOCAL FLOOD AUTHORITY (LBC LLFA) CONSULTATION

7.4.2. The original planning documents relating to the outline surface water discharge strategy submitted to LBC as part of the Central Somers Town Masterplan Project under Planning Application Reference 2015/2704/P, proposed for a minimum flow rate of 5 l/s, to limit the risk of blockages, to be adopted for all outfalls from the wider development. LBC LLFA were consulted to establish if a discharge of 5l/s would still be permitted for Plot 7, which is located within the larger Masterplan.

7.4.3. LBC LLFA replied to indicate:

> *…'It is expected nowadays that correct design and maintenance can permit design rates as low as approximately 2 l/s. A higher rate of 5 l/s is occasionally accepted in exceptional circumstances but this would normally be dependent on a full evaluation of the whole scheme, existing site characteristics and drainage evidence, submitted at pre-application or application stage'…*

7.4.4. A copy of correspondence from London Borough of Camden LLFA is included in Appendix D.

7.4.5. It is proposed, therefore, to limit surface water discharge from the proposed development to 2 l/s for all storm events up to and including the 1 in 100 Year plus 40% climate change storm event, which will mimic the existing 1 in 100 Year storm event scenario. This proposed discharge will allow for surface water attenuation to be provided within the footprint of the proposed development and sustainably achieve a gravity discharge to the Thames Water Public Combined Sewer Network. A restriction of less than 2 l/s would result in a requirement for surface water flows to be pumped (due to proposed building constraints), which would not be sustainable and, in the case of surface water, should be avoided. Furthermore, less than 2 l/s could result in a high risk of blockages.

THAMES WATER CONSULTATION

7.4.6. A pre-development enquiry to identify if capacity is available within the existing public sewer network for the discharge of surface water flows from the Site has been submitted to Thames Water (TW) and WSP is currently awaiting feedback.

7.4.7. Notwithstanding this, based on the 5 l/s per outfall proposed under Planning Application Reference 2015/2704/P for the wider Central Somers Town Masterplan Project, Thames Water wrote to LBC Planning Authority to confirm they would have no objection to the planning application with regards to sewer infrastructure capacity. A copy of this historic correspondence is included in Appendix G.

7.4.8. As such, the Surface Water Drainage Strategy will seek to limit flows to 2 l/s for all storm events up to and including the 1 in 100 Year plus 40% climate change storm event, as indicated above.

7.5. SURFACE WATER MODELLING AND RESULTS

DESIGN PRINCIPLES

7.5.1. When undertaking the modelling for the proposed Surface Water Drainage Strategy, the following criteria have been used:

- Micro-Drainage Software has been used for all hydraulic design;
- 2013 Flood Estimation Handbook (FEH) rainfall data has been used;
- CV values are set at 0.95 (95%) within Micro-Drainage, for conservative measure;
- The proposed drainage network has been assessed for the 1 in 100 year plus 40% climate change event;
- A catchment area of 0.04ha is to be drained;
- A tank of depth 0.85m is incorporated above the B1 Basement Level;
- Limiting discharge rate of 2l/s for all storm events up to and including the 1 in 100 year + 40% climate change event;
- Flow control: Hydro-Brake with Linear Discharge Profile;
- 1 in 2-year return period event;
- 1 in 30-year return period event;
- 1 in 100-year return period plus 40% climate change event; and
- All agreements, permits and applications for connections to the public sewer network will be made post planning.

PROPOSED DRAINAGE NETWORK RESULTS

7.5.2. Based on the above parameters and results derived from MicroDrainage modelling, a volume of 26.2m^3 would be capable of accommodating the required attenuation volumes to limit flows 2l/s for the 1 in 100 year + 40% climate change event scenario.

7.5.3. Consultation with both the Architect and Structural Engineer has confirmed this required volume can be accommodated via an attenuation tank, which will be constructed as part of the proposed building structure and be suspended below the ground floor slab of the proposed building.

7.5.4. A copy of the proposed attenuation MicroDrainage calculations, WSP Surface Water Drainage Strategy Drawing and Camden SuDS Proforma is included in Appendix H.

7.5.5. The MicroDrainage calculations indicate that the proposed attenuation tank, which will have a total volume of 36m^3 based on a plan area of 42.5m^2 and depth of 850mm, will have a maximum water depth of 648mm during a 1 in 100 year + 40% climate change storm event. This, therefore, will provide 202mm freeboard. Furthermore, an upstream manhole will incorporate a silt trap and non-return valve, with the downstream manhole housing a HydroBrake flow control along with a high-level overflow pipe, which will drain surface water into the demarcation chamber in the unfortunate event of blockages of the flow control, or during a storm event exceeding a 1 in 100 year plus 40% climate change event. Both the upstream and downstream manhole chambers will be accessible at ground floor level from outside of the building footprint.

Table 8 – Comparison between Existing and Proposed Surface Water Runoff Rates

Return Period	Total Existing Surface Water Runoff (l/s)	Proposed Surface Water Runoff (l/s)	Variance (l/s)
Qbar / 2 Year*	0.595	0.9	+ 0.313
1 in 30 Year	1.522	1.4	- 0.122
1 in 100 Year	2.024	1.7	- 0.324
1 in 100 Year + 40% CC	N/A	2.0	

* Note: MicroDrainage software cannot generate FEH rainfall intensities for storm events less than the 1 in 2 year, therefore, estimation is made with existing Qbar (1 in 2.3 Years). Refer to Appendix H for a copy of the MicroDrainage calculations

7.5.6. The attenuation tank will discharge via gravity into the combined water sewer that runs east in Brill Place.

7.5.7. As mentioned in earlier chapters of this Report, the proposed development will be a slender 22-storey tower occupying a small building footprint of 0.02ha (edged in green in Figure 9) within the existing Purchese Street Open Space, however, the development will have a surface water catchment area of approximately 0.04ha (edged in red in Figure 9), as the proposed building will cantilever outwards from level one and above to form an undercroft at ground level i.e. the external area at ground floor will be open to the sides, however, will be covered by the building above.

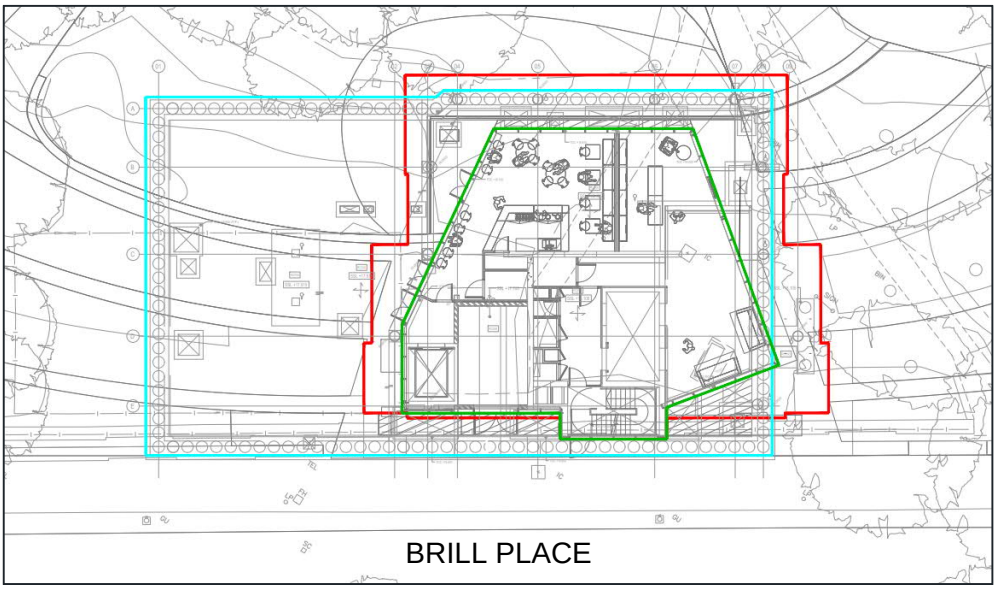

Figure 9 - Snapshot of Proposed Development

7.5.8. Furthermore, the development will also incorporate a single level of basement (edged in cyan in Figure 9). The land above the basement, excluding the proposed building edged in green and extent of the building overhang edged in red, however, will remain in the ownership of LBC and the responsibility for surface water drainage above the basement will lie with LBC.

7.5.9. Surface water generated from the proposed development building (edged in red in Figure 9) will be captured by the roof drainage system and be conveyed to the proposed attenuation tank located above Basement Level 1, prior to a controlled discharge from the Site. If any rainfall was to land on the external landscaped areas immediately adjacent to the building footprint at ground floor level (edged in green in Figure 9), this limited runoff would be wind driven rain that was able to get beneath the building undercroft.

7.5.10. This potential runoff would be nominal and as such it is not proposed to introduce a positive drainage collection system (i.e. linear drainage channels) at ground floor level as:

- The potential for runoff would be limited and negligible;
- It would be impractical to install a linear drainage channel system to follow the red outline edged in red in Figure 9, in terms of both engineering and aesthetics for the proposed Purchese Street Open Space external landscaping; and
- Introduction of a positive drainage collection system/linear drainage channels at ground floor level would result in a high risk of introducing pollution (silt / debris / cigarette butts / etc) to the proposed attenuation tank system serving the building, which would lead to a high risk of blockages of the proposed HydroBrake flow control.

7.5.11. The ground levels surrounding the building will be designed by LBC as part of LBC's wider Landscaping Masterplan for the Purchese Street Open Space area. Contact has not yet been made with the Landscape Architect for the Purchese Street Open Space area, however, in accordance with best practice and as part of the larger Landscape Masterplan designed by DSDHA on behalf of LBC, ground levels should fall away from the building, especially at thresholds and should fall towards the wider soft landscaping surrounding the proposed building.

7.5.12. It is envisaged that proposed landscaping located above Basement Level 1 will incorporate a drainage board above the basement slab, with outfalls to relieve runoff into the wider surrounding landscaping. This is to be confirmed during the detailed design stages in consultation with LBC and their Landscape Architects, as the responsibility for surface water drainage above the basement will lie with LBC.

7.5.13. The specific details of the surface water drainage will be further developed during the detailed design stages and as part of this Drainage Strategy, the feasibility of the strategy principles have been assessed through appropriate drainage calculations to ensure there is sufficient space for surface water attenuation within the development site area.

OVERLAND FLOW / EXCEEDANCE

7.5.14. The design principles will aim for all landscaping to fall away from building entrances towards proposed soft landscaping surrounding the building. This will be further developed in consultation with LBC and their Landscape Architects during the detailed design stages.

7.5.15. Following this outline drainage strategy, detailed design stages will further assess the impact of temporary surface water flooding to minimise, where possible, potential conveyance off-site and flooding into the building thresholds during potential exceedance events, which will include detailed threshold level design to mitigate any risk of water ingress to the proposed development.

OFFSITE IMPACTS

7.5.16. This Surface Water Drainage Strategy demonstrates that the drainage network at the Site will be designed to accommodate runoff during all events up to and including the 100 year return period plus 40% climate change allowance pluvial event. As such, the Proposed Development will not have a negative impact on surface water flooding offsite.

8. RESIDUAL FLOOD RISK

8.1. OVERVIEW

8.1.1. Since the Site is located within Flood Zone 1, away from any floodplain, residual fluvial / tidal flood risk is considered to be negligible.

8.1.2. The Surface Water Drainage Strategy demonstrates that the drainage network at the site is designed to accommodate runoff during all events up to and including the 100 year plus 40% climate change allowance storm event.

8.1.3. Following the outline drainage strategy, detailed design stages will aim to include detailed threshold level design for slightly raised thresholds above the surrounding land, such that levels fall away from the building to ensure that any runoff would naturally flow away from the building; this will help in mitigating against any residual surface water flood risk or any risk of water ingress to the proposed development from runoff generated from external areas beyond the proposed building. The specific details of external levels will be further investigated and developed in consultation with LBC and their Landscape Architects during the detailed design stages.

9. PROPOSED FOUL WATER DRAINAGE STRATEGY

9.1. OVERVIEW

9.1.1. A pre-development enquiry to identify if capacity is available within the existing public sewer network for the discharge of foul water flows from the Site has been submitted to Thames Water (TW) and WSP is currently awaiting feedback.

9.1.2. Notwithstanding this, Thames Water wrote to LBC Planning Authority under Planning Application Reference 2015/2704/P to confirm they would have no objection to the planning application with regards to sewer infrastructure capacity. A copy of this historic correspondence is included in Appendix G.

9.1.3. As the site is currently undeveloped greenfield land, there is currently no foul water discharge from the development plot into the public sewers.

9.1.4. The proposed development will provide 54 residential apartments comprising of 27 x 1 bedroom, 24 x 2 bedroom and 3 x 3 bedroom apartment/flats. In addition, the development will include one level of basement that will house various mechanical plant, cycle storage and refuse storage facilities.

9.1.5. An estimate of the foul water flow that will be generated from the proposed building has been calculated based on using two methods: Thames Water's Foul Water Calculator; and Sewers for Adoption 7, which are shown below:

THAMES WATER FOUL WATER CALCULATOR METHOD

9.1.6. Based on occupancy rates from census 2011:

- 27 No x 1 Bed Flat = 35.1 People
- 24 No x 2 Bed Flat = 45.6 People
- 3 No x 3 Bed Flat = 7.2 People
- Total Proposed Occupancy = 87.9 People

9.1.7. Residential Use Wet Weather Flow

- General Housing Peak Flow = 990 l/day for first 200 occupants (WWF)
- = 990 x 87.9 / (24x60x60)
- = 1.01 l/s

9.1.8. Refer to Appendix I for a copy of the Thames Water Foul Water Calculator

SEWERS FOR ADOPTION 7 METHOD

- 4000 litres per unit per day for foul flow
- 54 units in total for Brill Place Tower.
- (54 * 4000) / (60*60*24) = 2.5 l/s

9.1.9. Based on the above calculations, there will be an estimated increase of between 1.01 l/s to 2.5 l/s of foul water flow compared to the existing situation.

9.1.10. Foul water flows generated from the 54 residential apartments in addition to the commercial uses at ground floor level shall be collected throughout the upper levels of the building and be conveyed to the boundary of the building adjacent to Brill Place, by pipework suspended below the ground floor slab, prior to a gravity discharge via a proposed demarcation chamber into the combined water sewer that runs east in Brill Place. Refer to Appendix J for a copy of the public health engineers proposed above ground drainage layout prepared by Hoare Lea.

9.1.11. There will also be a requirement, however, for foul water drainage to serve plant room / cycle store / refuse store gullies located at Basement Level 1 for wash-down/cleaning purposes. Foul water drainage from the proposed basement shall convey flows towards two GRP package pumping stations, which shall subsequently pump and convey flows to the above ground foul water drainage network, prior to discharging via gravity into the public combined sewer network. Refer to Appendix K for a copy of the WSP proposed below slab drainage layout.

9.1.12. To prevent any internal flooding, as a result of overloaded public sewers, non-return valves will be utilised to prevent sewer flooding entering the Site.

9.1.13. The private foul drainage network and confirmation of the demarcation arrangements/locations will be further developed during detailed design stages.

10. SURFACE WATER AND FOUL WATER DRAINAGE MAINTENANCE AND MANAGEMENT STRATEGY

10.1. OVERVIEW

10.1.1. The following drainage maintenance and management strategy (Table 9) has been produced and builds on information provided within the SuDS Manual; it is expected that the maintenance for the Proposed Development will be under the residential management company of the development, in which a suitably qualified maintenance specialist will undertake the work for the entire development.

Table 9 - Drainage Maintenance Requirements

Drainage Feature	Regular Maintenance	Occasional Maintenance	Monitoring
Attenuation Tank	Upstream / downstream inspection chambers will be checked every 6 months for the accumulation of debris and silt and cleaned as necessary.		Inspect every 6 months or after large storm.
Flow Control	Inspected every 3 months or as needed if problems occur		Inspect every 3 months
Manholes / Inspection Chambers	Inspection chambers will be checked every 6 months for the accumulation of debris and silt and cleaned as necessary.		Inspect every 6 months or after large storm.
Foul Water Pumping Stations	Checked every 3 months or as needed if problems occur and any debris or silt cleaned out as required.		Inspect if internal alarm is raised and/or every 6 months
Drainage Channels / Gullies (where required)	Inspections will be frequent and regular and will include gratings; covers including their locking bolts; sumps and sump buckets; exposed concrete surround and adjacent paving. Channels will be flushed with water or high-pressure jetting (no boiling water or cleaning agent will be used). All silt buckets and sumps will be cleaned out replaced back into the units ensuring they are correctly fitted.	All channel surfaces and joints will be checked and repaired as necessary.	Inspect every 6 months or after large storm.

11. BREEAM

11.1. OVERVIEW

11.1.1. The BREEAM credits expected to be achievable under BREEAM New Construction 2014 are summarised below; final assessment and confirmation on the credits achieved is the responsibility of the BREEAM assessor.

Table 10 – BREEAM Pol 03 Surface Water Run-Off Credit Summary

Pol 03 Credit	Relevant Criteria (summary)	Comments
Flood Resilience	**Two credits available (flood resilience):** 1) Where a site-specific flood risk assessment (FRA) confirms the development is situated in a flood zone that is defined as having a low annual probability of flooding (in accordance with current best practice national planning guidance). The FRA must take all current and future sources of flooding into consideration	**Expected to achieve two credits for flood resilience:** This FRA has identified that the development site is located within Flood Zone 1 and the development is at negligible risk of fluvial and tidal flooding. Other sources of flooding have been investigated. Surface water flooding is possible in the surrounding area; however, based on available information, this will not affect the Site the risk is classified as low.
Surface Water Run-off	**Pre-requisite:** An Appropriate Consultant is appointed to carry out, demonstrate and/or confirm the development's compliance with the following criteria. **One credit available (surface water management):** 1. Drainage measures specified to ensure that the peak rate of run-off from the site to the watercourses (natural or municipal) is no greater for the developed site than it was for the pre-development site. 2. Calculations for surface water runoff need to include an allowance for climate change, in accordance to best practice planning guidance. **One credit available (surface water resilience):** 1. Where flooding of property will not occur in the event of local drainage system failure (caused either by extreme rainfall or a lack of maintenance); AND EITHER 2. Drainage design measures are specified to ensure that the post development run-off volume, over the development lifetime, is no greater than it would have been prior to the assessed site's development for the 100-year 6-hour event, including an allowance for climate change. 3. Any additional predicted volume of run-off for this event is prevented from leaving the site by using infiltration or other Sustainable Drainage System (SuDS) techniques. OR (only where criteria 2 and 3 for this credit cannot be achieved): 4. Justification from the Appropriate Consultant indicating why the above criteria cannot be	**Pre-requisite expected to be achieved**: Refer to this Flood Risk Assessment and Drainage Strategy and associated appendices. **Expected to achieve one credit for surface water management**: Based on the surface water management strategy, surface water runoff from the site is proposed to be controlled and be managed for all events up to and including the 1 in 100 year + 40% climate change allowance event and will be no greater than the pre-development site**, (with appropriate supporting calculations and maintenance strategy provided). ** BREEAM New Construction 2014 defines 5l/s as the minimum discharge from the site to reduce the risk of blockages. The proposed development will discharge less than 5l/s for all storm events up to and including the 1 in 100 year + 40% climate change event. **Potential to achieve one credit for surface water resilience SUBJECT TO DETAILED DESIGN AND CONSULTATION WITH LBC AND THEIR LANDSCAPE ARCHITECTS**: The Site's external levels strategy should provide raised thresholds and external levels should fall away from the proposed building. Evidence to achieve this credit is subject to Stage 3/4 Detailed Design. TO BE CONFIRMED

	achieved, i.e. where infiltration or other SuDS techniques are not technically viable options. 5. Drainage design measures are specified to ensure that the post development peak rate of run-off is reduced to the limiting discharge. The limiting discharge is defined as the highest flow rate from the following options: a. The pre-development 1-year peak flow rate; OR b. The mean annual flow rate Qbar; OR c. 2L/s/ha. Note that for the 1-year peak flow rate the 1-year return period event criterion applies (as described in the peak run-off criteria above). 6. Relevant maintenance agreements for the ownership, long term operation and maintenance of all specified SuDS are in place. 7. For either option, above calculations must include an allowance for climate change; this should be made in accordance with current best practice planning guidance.	
Minimising Watercourse pollution	**One credit available for minimising watercourse pollution:** 1. There is no discharge from the developed site for rainfall up to 5mm (confirmed by the Appropriate Consultant). 2. In areas with a low risk source of watercourse pollution, an appropriate level of pollution prevention treatment is provided, using appropriate SuDS techniques. 3. Where there is a high risk of contamination or spillage of substances such as petrol and oil (see Compliance notes for a list of areas), separators (or an equivalent system) are installed in surface water drainage systems. 4. Where the building has chemical/liquid gas storage areas, a means of containment is fitted to the site drainage system (i.e. shut-off valves) to prevent the escape of chemicals to natural watercourses (in the event of a spillage or bunding failure). 5. All water pollution prevention systems have been designed and installed in accordance with the recommendations of documents such as Pollution Prevention Guideline 3 (PPG 3) 2 and/or where applicable the SuDS manual 3. For areas where vehicle washing will be taking place, pollution prevention systems must be in accordance with Pollution Prevention Guidelines 13 4. 6. A comprehensive and up to date drainage plan of the site will be made available for the building/site occupiers. 7. Relevant maintenance agreements for the ownership, long term operation and maintenance of all specified SuDS must be in place. 8. Where present, all external storage and delivery areas designed and detailed in accordance with the current best practice planning guidance.	**Expected to achieve one credit for minimising watercourse pollution**: Due to surface water runoff from the site discharging to the combined public sewer network surrounding the site and not to a watercourse. Surface water run-off will pass through silt traps and trapped gullies; however, as there is no option to infiltrate, this eliminates the opportunity of ensuring 'no discharge from the developed site for rainfall up to 5mm'. Notwithstanding this, the aim of interception of rainfall up to 5mm is to minimise the potential of polluted runoff from entering streams and rivers, particularly in summer periods when they have low flows and the water is warm, however, surface water discharge from the site will be to the combined public sewer network and not to watercourse.

12. EVIDENCE SUBMITTED TO DISCHARGE LONDON BOROUGH OF CAMDEN PLANNING CONDITIONS NO 28 & 35

12.1. OVERVIEW

12.1.1. This Flood Risk Assessment and Drainage Strategy has been prepared on behalf of LBS Properties Ltd to provide evidence to support the discharge of London Borough of Camden Planning Conditions Number 28 “SuDS” and Condition 35 “Flood Risk Assessment - Plot 7” associated with Planning Application Reference 2015/2704/P, for the re-development of the land at Brill Place, Kings Cross, Camden, London.

12.1.2. Plot 7 is located within the wider Central Somers Town Masterplan Project covering Land at Polygon Road Open Space, Edith Neville Primary School, 174 Ossulston Street and Purchese Street Open Space.

12.2. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 28: SUDS

Prior to commencement of the relevant part of the development, details of a sustainable urban drainage system shall be submitted to and approved by the local planning authority in writing. Such details shall include details of the following features:

- *Permeable surfacing to all hard-standing areas, with a minimum 250mm sub-base, totalling 390m3 attenuation discharging to the public sewer at a reduced rate.*

12.2.1. Porous surface systems (such as permeable paving) are not considered to be viable due to the limited external areas for locating such systems i.e. the majority of the Site’s footprint is comprised entirely of the main building that will sit above the basement as a podium slab and the immediate areas surrounding the building footprint are outside of the Client’s control. In addition, the majority of hardstanding/landscaped areas surrounding the Plot 7 will be covered by the building above, due to the undercroft formed by the proposed tower.

12.2.2. Notwithstanding this, the statement ‘*minimum 250mm sub-base, totalling 390m3 attenuation’* is very precise and is considered to refer to other specific areas of the wider Central Somers Town Masterplan Project and is not considered relevant to Plot 7.

- *Details of any weirs required within the sub-base to ensure that the full storage volume is utilised and to avoid lower areas becoming overwhelmed.*

12.2.3. This is considered to refer to the first feature of *‘minimum 250mm sub-base, totalling 390m3 attenuation’* and is not considered relevant to Plot 7.

- *Details of how rainfall falling on impermeable pathways or roads is shed and attenuated in adjacent grassed or planted areas to include swales or bio-retention / rain gardens and details of how these are connected to the sub-base of the paving areas to provide an even greater storage volume.*

12.2.4. Porous surface systems (such as permeable paving) are not considered to be viable due to the limited external areas for locating such systems i.e. the majority of the Site’s footprint is comprised entirely of

the main building that will sit above the basement as a podium slab and the immediate areas surrounding the building footprint are outside of the Client's control. In addition, the majority of hardstanding/landscaped areas surrounding Plot 7 will be covered by the building above, due to the undercroft formed by the proposed tower and any limited runoff generated from below the undercroft would be due to wind driven rain.

12.2.5. Introduction of a positive drainage collection system/linear drainage channels located at ground floor level around the proposed building is considered impractical in terms of both engineering and aesthetics for the proposed Purchese Street Open Space external landscaping and this would also result in a high risk of introducing pollution (silt / debris / cigarette butts / etc) to the proposed attenuation tank system serving the building, which would lead to a high risk of blockages of the proposed HydroBrake flow control.

12.2.6. The ground levels surrounding the building will be designed by LBC as part of LBC's wider Landscaping Masterplan for the Purchese Street Open Space area. Contact has not yet been made with the Landscape Architect for the Purchese Street Open Space area, however, in accordance with best practice and as part of the larger Landscape Masterplan designed by DSDHA on behalf of LBC, ground levels should fall away from the building, especially at thresholds and should fall towards the wider soft landscaping surrounding the proposed building.

12.2.7. It is envisaged that proposed landscaping located above Basement Level 1 will incorporate a drainage board above the basement slab, with outfalls to relieve runoff into the wider surrounding landscaping. This is to be confirmed during the detailed design stages in consultation with LBC and their Landscape Architects, as the responsibility for surface water drainage above the basement will lie with LBC.

12.2.8. On this basis, this feature is not considered relevant to Plot 7.

- *A network of perforated pipes collecting the filtered runoff and conveying it to the public sewer.*

12.2.9. This feature is considered relevant to the wider Landscape Masterplan and is not considered relevant to Plot 7.

- *Details of permeable surfacing to all play areas.*

12.2.10. This feature is not considered relevant to Plot 7.

- *Full details of wetland areas*

12.2.11. This feature is not considered relevant to Plot 7.

SuDS will be implemented prior to the opening of the relevant parts of the development.

12.2.12. The four pillars of SuDS include: Amenity; Biodiversity; Quality; and Quantity.

12.2.13. The proposed Plot 7 "Brill Place Tower" will provide surface water attenuation for all storm events up to and including the 1 in 100 year plus 40% climate change allowance storm event and will limit runoff to 2l/s to mimic the existing greenfield/brownfield scenario to address the SuDS Quantity pillar and to support the management of flood risk.

12.2.14. Furthermore, the proposed surface water drainage system will incorporate silt traps to assist in providing water treatment to address the SuDS Quality pillar.

12.2.15. The proposed tower associated sloping roofs and land immediately surrounding the building footprint being outside of the Client's control make it unfeasible to incorporate the remaining SuDS pillars within the Plot 7 development site. The Land immediately surrounding Plot 7, that is the Purchese Street Open Space that is part of the wider Central Somers Town Masterplan Project, however, will be able to provide the Amenity and Biodiversity SuDS pillars.

12.2.16. Given the very small footprint and constraints of Plot 7 within the wider Central Somers Town Masterplan and the features relating to Planning Condition Number 28 not being considered relevant to Plot 7, WSP request London Borough of Camden to discharge this Planning Condition relating to Plot 7.

12.3. LONDON BOROUGH OF CAMDEN PLANNING CONDITION NUMBER 35: FLOOD RISK ASSESSMENT - PLOT 7

Prior to commencement of development a Flood Risk Assessment shall be submitted to the local planning authority and approved in writing.

12.3.1. A number of Drainage Policies have been consulted in preparing this Flood Risk Assessment and Drainage Strategy, including policies CS13 and CS16 of the London Borough of Camden Local Development Framework Core Strategy and policies DP22, DP23 and DP32 of the London Borough of Camden Local Development Framework Development Policies. A full list of LBC Drainage Policies consulted to prepare this Report are referenced in Section 1.5 of this Report.

12.3.2. The proposed Surface Water Drainage Strategy demonstrates that the proposed development will reduce the rate of surface water run-off from the proposed building and will limit the impact on the public sewer network. Furthermore, the proposed surface water drainage will minimise the potential for surface water flooding by including drainage systems that will prevent or mitigate local surface water flooding and downstream flooding, in addition to being resilient to climate change.

12.3.3. WSP are of the view this Flood Risk Assessment and Drainage Strategy will be to the approval of London Borough of Camden to discharge Planning Condition Number 35.

12.4. SUMMARY

12.4.1. The evidence submitted to discharge these two planning conditions is contained within this Report, associated Appendices and in the above statements.

12.4.2. WSP are of the opinion that this Flood Risk Assessment and Drainage Strategy submitted to support the discharge of London Borough of Camden Planning Conditions Number 28 "SuDS" and Condition 35 "Flood Risk Assessment - Plot 7" will be to the satisfaction and approval of London Borough of Camden to successfully discharge the drainage related planning conditions for Plot 7 associated with Planning Application Reference 2015/2704/P.

13. CONCLUSIONS

13.1. REMARKS

13.1.1. WSP has prepared this Flood Risk Assessment and Drainage Strategy on behalf of LBS Properties Ltd to support the discharge of London Borough of Camden Planning Conditions Number 28 “SuDS” and Condition 35 “Flood Risk Assessment - Plot 7” associated with Planning Application Reference 2015/2704/P, for the re-development of the land at Brill Place, Kings Cross, Camden, London.

13.1.2. Plot 7 is located within the wider Central Somers Town Masterplan Project covering Land at Polygon Road Open Space, Edith Neville Primary School, 174 Ossulston Street and Purchese Street Open Space.

13.1.1. The Site is shown in the EA Flood Maps as being located within Flood Zone 1, which based on the NPPF, is classified as having a ‘low’ probability of tidal and fluvial flooding. Other potential sources of flooding have been investigated and the probability of flooding has also been assessed as low to negligible.

13.1.1. The Drainage Strategy has been developed to manage surface water runoff within the Proposed Development, taking into account potential climate change impact with the overall aim to reduce the rate of surface water run-off from the proposed building and limit the impact on the public sewer network in line with policy and practice.

13.1.2. The Proposed Development will mimic the existing greenfield/brownfield runoff rate and limit surface water flows to 2 l/s for all storm events up to and including the 1 in 100 year plus 40% climate change allowance storm event via a HydroBrake flow control device set with “linear discharge profile” and this will achieve discharge flow rates less than 2 l/s for storm events less than the 1 in 100 year plus 40% climate change event.

13.1.3. Development constraints have made providing below ground attenuation difficult; the proposed solution relies on accommodating attenuation as part of the main building structure, i.e. suspended below the ground floor level and above basement level 1 to achieve a gravity discharge to the public sewer network.

13.1.4. The expected increase in foul and surface water discharge from the Site has been investigated through a pre-development enquiry with Thames Water (TW). WSP are currently awaiting feedback from TW for confirmation that both attenuated surface water flows and foul water flows can be accommodated from the Proposed Development within the public sewer network. Notwithstanding this, TW historically wrote to LBC Planning Authority under Planning Application Reference 2015/2704/P to confirm they would have no objection to the planning application with regards to sewer infrastructure capacity.

Appendix A

SITE LOCATION

Appendix B

THAMES WATER TOPO SURVEY & SEWER RECORD

Appendix C

DEVELOPMENT PROPOSALS

Appendix D

LBC CORRESPONDENCE

Appendix E

EA CORRESPONDENCE

Appendix F

ESTIMATION OF EXISTING GREENFIELD & BROWNFIELD RUNOFF

Appendix G

THAMES WATER HISTORIC CORRESPONDENCE

Appendix H

WSP SURFACE WATER DRAINAGE STRATEGY, MODELLING & CAMDEN SUDS PROFORMA

Appendix I

THAMES WATER FOUL WATER CALCULATOR

Appendix J

PUBLIC HEALTH ENGINEER PROPOSED ABOVE GROUND DRAINAGE

Appendix K

WSP BASEMENT UNDERSLAB DRAINAGE

WSP House
70 Chancery Lane
London
WC2A 1AF

wsp.com