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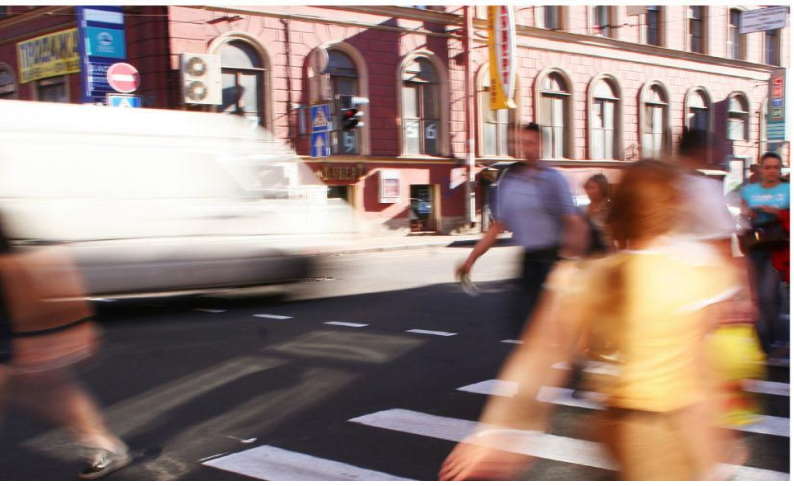
PROJECT CENTRE

Flood Risk Assessment

St Giles Circus, Camden

Engenuiti and Consolidated Developments

September 2012



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Report Reference	Issue	Description	Originator	Checked	Authorised
	01	Draft	ILW	ECW	ECW
	02	Draft	ILW	ECW	ECW
	03	Final Draft	ILW/ECW	ECW	ECW
	04	Final Issue	ILW/ECW	ECW	ECW

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1. CLIENT REQUIREMENTS

1.1 Consolidated Developments proposes to redevelop St Giles Circus (the site) to provide a mixed use development. The location of the site is shown by Figure 1.

1.2 To support the planning application, Consolidated Developments require the preparation of a flood risk assessment (FRA) to confirm the flood risk to the site and to provide mitigation measures where necessary to ensure the development is safe and does not increase flood risk elsewhere.

1.3 The FRA is to be prepared in accordance with the National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012) and the accompanying Technical Guidance (TG), and consultation with the Environment Agency (EA), Camden Council (CC) and Thames Water (TW).

1.4 The findings, recommendations and conclusions of this report are based on information obtained from a variety of external sources which are understood to be reputable. However, Project Centre cannot guarantee the authenticity or reliability of any data from third parties and no liability can be accepted for any erroneous information or the conclusions drawn from it.

2. DEVELOPMENT DESCRIPTION AND LOCATION

2.1 Location and development proposals:

What type of development is proposed and where will it be located?

2.1.1 The proposed mixed use redevelopment of St Giles Circus, Camden is located at National Grid Reference (NGR) TQ298812 as shown by Figure 1.

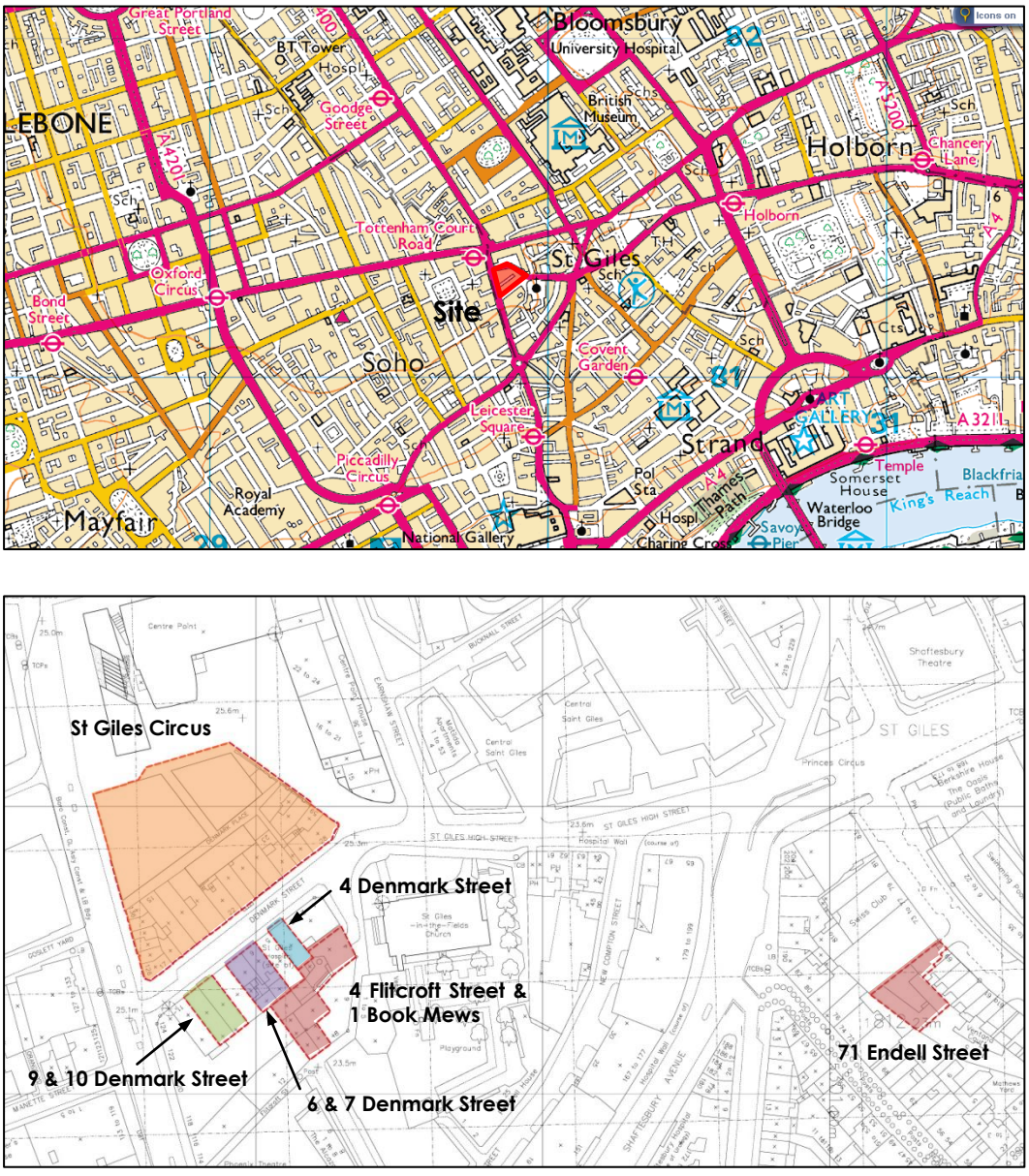

Figure 1 – Site Location Plan

2.1.2 St Giles Circus site is bounded by Charing Cross Road, Andrew Borde Street, St Giles High Street and Denmark Street. The development proposals also include No. 4 Flitcroft Street, Nos. 4, 6, 7, 9 and 10 Denmark Street, No. 1 Book Mews and No. 71 Endell Street.

2.1.3 The St Giles Circus site extends to some 0.37ha in a busy urban area, currently occupied by a mix of uses including offices, shops and other businesses, some residences, and cultural and civic buildings. The site itself contains a concentration of music shops and businesses, with an important music industry-related cultural history. In the north-east corner of the site, buildings have been demolished as part of the Crossrail / London Underground station construction works. The rest of the site is largely occupied by four-six storey Victorian buildings.

2.1.4 The site South of Denmark Street occupies approximately 0.11ha, and is currently made up of a mix of uses including shops, restaurants and bars, and office spaces. The shops and some of the associated offices to Denmark Street are again music oriented, and there is also a mix of small creative businesses in the offices situated on the upper floors of the buildings, and two residential studios/flats.

2.1.5 The buildings on Flitcroft Street and Book Mews are divided into multi-occupancy office space. These buildings also benefit from access to a rear open courtyard space between Flitcroft Street and Denmark Street, and part of the rear of properties facing Charing Cross Road.

2.1.6 Of the buildings in Consolidated's ownership, no's 6, 7 9 and 10 Denmark Street are Grade II listed. These are typically four storey terraced buildings with basements, constructed in the 1680's. In between these buildings no.s 5 and 8 Denmark Street are later 1920s developments and are typically 5 storey buildings with some rooftop additions.

2.1.7 4 Denmark Street and 4 Flitcroft Street are themselves not Listed, but are considered as positive contributors within the conservation area. 4 Denmark Street is a 5 storey building with basement, originally constructed in the 1680's but later redeveloped in the 1920's. 4 Flitcroft Street is a 3 storey building with a half-basement, dating from 1903 with a front façade designed in the Queen Anne Style.

2.1.8 71 Endell Street occupies approximately 0.039 hectares. The existing commercial office buildings are housed in a 4 storey late Victorian building. This will be converted into residential accommodation.

2.1.9 A site investigation completed by STATS confirms the site is underlain by a variable depth of made ground that overlies a superficial deposit of River Terrace Deposits (Lynch Hill Gravel Member) which in turn overlays the London Clay Formation.

2.1.10 A topographic survey of the site was completed by 3sixtymeaurement and indicates that there is a slight fall across the site from north to south; the pavement level at the junction of Charring Cross Road and St Giles High Street is approximately 25.5m above Ordnance Datum (AOD) falling to a level of

approximately 23.5m AOD in Book Mews. A copy of the topographic survey is enclosed at **Appendix A**.

2.1.11 St Giles Circus is intending to be a mixed use development with a focus on culture, creativity and information. The proposals include provision of two new buildings on St Giles High Street, Andrew Borde Street and Charing Cross Road, plus two smaller buildings on Denmark Place, with routes into, through and around the site, and associated infrastructure and landscaping. The proposals include an Events Galley at basement level to provide a new entertainment venue, hotel and residential properties. A detailed description of the proposed development is given at Section 6.0 and a copy of the proposed layout plan is enclosed at **Appendix B**.

2.1.12 The extract of the flood map published on the Environment Agency's web site shown below by Figure 2 identifies the site as lying within a Zone 1 - low probability flood risk area (Flood Zone 1) as defined by Table 1: Flood zones of the TG. Flood Zone 1 is defined as land that has less than a 1 in 1,000 (0.1%) annual probability of fluvial or tidal flooding.

Figure 2 – Extract of the Environment Agency's flood map

2.2 Vulnerability classification:

What is its vulnerability classification?

2.2.1 With reference to TG Table 2: Flood risk vulnerability classification, the residential elements of the proposed development and the hotel would be considered a

'More' vulnerable use. The remaining commercial and other uses would be considered a 'Less' vulnerable use.

2.3 Local Development Documents

Is the proposed development consistent with the Local Development Documents?

2.3.1 Camden Borough Council's Core Strategy and Development Policies were adopted on 8 November 2010 and form a key part of the Local Development Framework (LDF). The Core Strategy and Development Policies set out detailed planning criteria that are used to determine applications for planning permission in the Borough.

2.3.2 It is noted that the site lies within the Tottenham Court Road Growth Area and is included as one of the Proposals Sites (*Site 9 - St Giles Circus/Denmark Place, (including 126-140 Charing Cross Road)*).

2.3.3 The policies that relate to surface water drainage and flooding are discussed below.

2.3.4 Core Strategy Policy '*CS13 – Tackling climate change through promoting higher environmental standards*' in relation to water and surface water flooding states

> *'We will make Camden a water efficient borough and minimise the potential for surface water flooding by:*
>
> *g) protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;*
>
> *h) making sure development incorporates efficient water and foul water infrastructure;*
>
> *i) requiring development to avoid harm to the water environment, water quality or drainage systems and prevents 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 (see Map 5).'*

2.3.5 Development Policy '*DP22 – Promoting sustainable design and construction*' states:

> *'The Council will require development to incorporate sustainable design and construction measures. Schemes must:*

a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5 below, have been incorporated into the design and proposed implementation; and

b) incorporate green or brown roofs and green walls wherever suitable.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;

g) limiting run-off;

h) reducing water consumption;

i) reducing air pollution; and

j) not locating vulnerable uses in basements in flood-prone areas.'

2.3.6 Development Policy '*DP23 – Water*' states:

'The Council will require developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by:

a) incorporating water efficient features and equipment and capturing, retaining and re-using surface water and grey water on-site;

b) limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network through the methods outlined in part a) and other sustainable urban drainage methods to reduce the risk of flooding;

c) reducing the pressure placed on the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment and shown on Map 2 as being at risk of surface water flooding are designed to cope with the potential flooding;

d) ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and

d) encouraging the provision of attractive and efficient water features.'

2.3.7 It should be noted that Map 5 referred to in the Core Strategy and Map 2 referred to in the Development Policies are identical and provide an overview of the

streets that were flooded in 2002 and 1975 (mainly in the north of the Borough) and areas with the potential to be at risk of surface water flooding.

2.3.8 With reference to Maps 2 and 5 and the North London Strategic Flood Risk Assessment, the site does not lie on, or adjacent to, a street that has a history of flooding, or within an area identified to be at risk of surface water flooding.

2.3.9 The measures set out in Section 8.0 of this assessment will demonstrate how the proposed development will be consistent with the Core Strategy and Development Policies.

2.4 Sequential Test and Exception Test

Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type.

Sequential Test

2.4.1 The NPPF requires that at all stages of planning a Sequential Test is completed with the aim of steering new development to areas at the lowest probability of flooding.

2.4.2 NPPF Paragraph 101 advises that the aim the Sequential Test is to '*steer new development to areas with the lowest probability of flooding*'. Furthermore it states '*Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding*.'

2.4.3 As confirmed in Sections 3.0 and 4.0, the site lies within Flood Zone 1 and therefore the Sequential Test does not have to be applied.

Exception Test

2.4.4 TG Table 3: Flood risk vulnerability and flood zone 'compatibility' advises that 'More' and 'Less' vulnerable uses would be considered appropriate forms of development in Flood Zone 1 and as such the Exception Test does not have to be applied.

3. DEFINITION OF THE FLOOD HAZARD

3.1 Sources of flooding:

What sources of flooding could affect the site?

3.1.1 There are a number of potential sources of flooding and these include:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal flooding;
- Flooding from land;
- Flooding from groundwater;
- Flooding from sewers; and
- Flooding from reservoirs, canals, and other artificial sources.

Flooding from rivers or fluvial flooding

3.1.2 The site is approximately 1km from the River Thames at an elevation of approximately 25m AOD and is not therefore at risk of fluvial flooding. This is confirmed by the extract of the Environment Agency's flood map reproduced as **Figure 2**.

3.1.3 Flooding from rivers or fluvial sources has not therefore been considered further.

Flooding from the sea or tidal flooding

3.1.4 The site is approximately 1km from the River Thames at an elevation of approximately 25m AOD and is not therefore at risk of tidal flooding. This is confirmed by the extract of the Environment Agency's flood map reproduced as **Figure 2.**

3.1.5 Flooding from the sea or tidal flooding has not therefore been considered further.

Flooding from land

3.1.6 A site visit completed on 12 June 2012 confirmed that the land in the vicinity of the site falls from north to south. In particular, there is notable fall away from the site to the south along Charing Cross Road. To a lesser extent, there is a fall away from the site to the east along St Giles High Street. There is no notable fall towards the site from the north or west. This is shown by the topographic survey enclosed at **Appendix A**.

3.1.7 Therefore, the local topography would not allow any surface water runoff from the surrounding area to accumulate in the vicinity of the site to any significant depth.

3.1.8 This is confirmed by Maps 5 and 2 enclosed with Camden Borough Councils Core Strategy and Development Policies respectively that show there is no history of surface water flooding in the vicinity of the site and that the site does not lie within an area considered to be at risk of surface water flooding.

3.1.9 In response to a formal data request, the Environment Agency has provided a copy of their 'Surface Water Flood Map centered on St Giles Circus Created 23 July 2012 [Ref:NE31292MR]' that suggests only minor surface water flooding would be expected for a '1 in 200 chance rain' event at the western end of Denmark Street. It should be noted that these maps are indicative only having been prepared at a national scale and should therefore be treated with caution.

3.1.10 As noted at 3.1.6, it is clear from a site inspection and with reference to the topographic survey that surface water is unlikely to accumulate to any significant depth in Denmark Street due to the fall away from the site to the south along Charing Cross Road.

3.1.11 Furthermore, the Surface Water Flood Maps assume that any surface water drainage is nearing capacity and that only a nominal flow into the sewer occurs during the flood event. This nominal flow used has been estimated on a national basis and therefore is likely under-estimate the inflow into the extensive local sewer network.

3.1.12 These two factors, together with the lack of historic records of surface water or sewer flooding in the vicinity of the site, suggest that the surface water flood risk is overstated by the Surface Water Flood Risk map as is unlikely to be significant. A copy of the correspondence with the Environment Agency is enclosed at **Appendix C**.

3.1.13 In response to a formal data request, Camden Council advised that, based on Environment Agency modelling, there is a potential surface water flood risk in the vicinity of St Giles Circus and suggested that detailed hydraulic modelling of the sewers in the vicinity of the site should be completed to inform the flood risk assessment. However, as discussed above, the surface water flood risk does not appear significant and this conclusion is supported by the information contained in the Camden Borough Councils Core Strategy and Development Policies and the North London Strategic Flood Risk Assessment.

3.1.14 It is not therefore considered necessary to complete detailed hydraulic modelling of the combined sewers in the vicinity of the site to inform the flood risk assessment. A copy of the correspondence with Camden Council is enclosed at **Appendix D**.

3.1.15 It is therefore considered that there is no significant risk of flooding from the land (surface water flooding) and this has not therefore been considered further.

Flooding from groundwater

3.1.16 A site investigation completed by STATS confirms the site is underlain by a variable depth of made ground that overlies a superficial deposit of River Terrace Deposits (Lynch Hill Gravel Member) which in turn overlays the London Clay Formation. The investigation encountered a perched groundwater in the River Terrace Deposits at a depth of approximately 5.6m.

3.1.17 The risk of groundwater flooding to the proposed basement is addressed in the Basement Impact Assessment prepared by the project structural engineers, Engenuiti.

3.1.18 Flooding from groundwater has not therefore been considered further in this assessment.

Flooding from sewers

3.1.19 The risk of flooding from sewers is likely to be very similar to that of flooding from the land discussed above in that the local topography would tend to convey the flow from surcharging sewers away from the site. It is also the case that there is no history of sewer flooding in the vicinity of the site, whereas there is across other parts of the Borough.

3.1.20 On this basis Thames Water has not been commissioned to complete a hydraulic analysis of their sewer network in the vicinity of the site.

3.1.21 It is further noted that as discussed at Section 8.0, the redevelopment of St Giles Circus will **reduce** the inflow to the combined sewer network by **50ls^{-1}**. A copy of the correspondence with Thames Water is enclosed at **Appendix E**.

3.1.22 Flooding from sewers has not therefore been considered further.

Flooding from reservoirs, canals and other artificial sources

3.1.23 There are no reservoirs, canals and other artificial sources in the vicinity of the site that could give rise to a flood risk.

3.1.24 Flooding from reservoirs, canals and other artificial sources has not therefore been considered further.

3.2 Flooding mechanism:

For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available.

3.2.1 No significant sources of flooding have been identified.

3.3 Existing surface water drainage arrangements:

What are the existing surface water drainage arrangements for the site?

3.3.1 The site is currently developed and it is understood that surface water and foul flows drain to a combined public sewer.

3.3.2 Details of the combined sewer in the vicinity of the site are shown on Peter Brett Associates Drawing No. 22798/1/100/01 Rev D enclosed at **Appendix F.**

4. PROBABILITY

4.1 Flood Zone:

Which flood zone is the site within?

4.1.1 Reference to the extract of the Environment Agency's flood map illustrated by **Figure 2** indicates that the site falls within a Flood Zone 1.

4.1.2 This is defined as having an annual probability of flooding of less than 1 in 1,000 (1%) for fluvial and tidal sources.

4.2 Strategic Flood Risk Assessment:

If there is a Strategic Flood Risk Assessment (SFRA) covering this site, what does it show?

4.2.1 Although Camden has very low risk from flooding from fluvial and tidal sources, the North London Strategic Flood Risk Assessment identified several areas in the Borough, in particular West Hampstead, that have experienced surface water flooding when existing water infrastructure has not been able to cope with surface and foul water at the same time as the result of heavy rain.

4.2.2 As discussed at Section 3.1, the Environment Agency has developed a map showing areas with the potential to flood given the topography and depth of the site. A copy if this map is enclosed at **Appendix C**.

4.2.3 The site lies outside any areas considered to be at risk of surface water flooding.

4.3 Probability of the site flooding

What is the probability of the site flooding, taking into account the contents of the SFRA and of any further site-specific assessments?

4.3.1 As discussed at Sections 3.1 and 4.2, no significant sources of flood risk have been identified other than groundwater flooding of the basement that is addressed in a separate Basement Impact Assessment report.

4.4 Run-off:

What are the existing rates and volumes of run-off generated by the site?

4.4.1 The existing sites are virtually 100% impermeable comprising roofs, pavements, roads and areas of hardstanding. It is therefore appropriate to use the Modified Rational Method as detailed in Butler, D and Davies, J. (2006), Urban Drainage, 2nd ed., SPON.

4.4.2 the surface water runoff for the existing site has therefore been calculated using the following equation:-

Q = C.i.A

Where: Q = maximum flow rate (ls^{-1})
C= PIMP/PR (Percentage of impermeable area/Percentage Runoff)
i= rainfall intensity (mm hr^{-1}),
A=area (ha)

A (drained area)	0.37ha	Estimated from the proposed development drawings.
PIMP (Percentage of impermeable area)	100	Estimated from the survey of the existing site and aerial photography
PR (Percentage Runoff)	100	Assumed 100% runoff from impermeable area
C	1	PIMP/PR
i (rainfall intensity)	50mm hr^{-1}	See Note 1

Note 1: It should be noted that a fixed rainfall intensity of 50mm hr^{-1} is used in this case as recommended by Butler & Davies (2006). This is to avoid using inappropriately high intensities for very low concentration times, i.e. small sites. For example, with reference to the Depth Duration Frequency model included on the Flood Estimation Handbook CD-ROM 3 (CEH, 2009), the 30 minute, 1 in 100 year rainfall depth is 49mm equating to an average intensity of 98mm hr^{-1}. The instantaneous peak intensity could be even higher, but would be attenuated by the drainage system.

4.4.3 Therefore Using the Modified Rational Method the maximum rate of runoff from the various elements of the scheme has been estimated as follows:

Element	Area (ha)	Estimated runoff (ls^{-1}).
St Giles Circus	0.37	51.5
71 Endell Street	0.040	5.6
9 and 10 Denmark Street	0.026	3.6
6 and 7 Denmark Street	0.025	3.5
4 Denmark Street	0.010	1.4
4 Flitcroft Street and 1 Book Mews	0.050	6.9

5. CLIMATE CHANGE

5.1 Climate change:

How is flood risk at the site likely to be affected by climate change?

5.1.1 The most recent advice on climate change is reported in TG Table 4: Recommended contingency allowances for net sea level rises and Table 5: Recommended national precautionary sensitivity ranges for peak rainfall intensities, peak river flows, offshore wind speeds and wave heights. This advice confirms that peak rainfall intensity, sea level, peak river flow, offshore wind speed and extreme wave heights are all expected to increase in the future. The TG recommends that considerations for future climate change are included in FRA's for proposed developments.

5.1.2 As such, in accordance with the advice contained within the TG, the site is likely to be subject to increases in rainfall intensity of 30% over the lifetime of the development taken to be 100 years

5.1.3 Increasing rainfall intensity will place additional pressure on the surface water drainage infrastructure over the lifetime of the development. It is therefore important that the proposed development has an effective surface water drainage system that will mitigate the predicted increase in rainfall intensity.

6. DETAILED DEVELOPMENT PROPOSALS

6.1 Development layout:

Please provide details of the development layout, referring to the relevant drawings

North of Denmark Street

6.1.1 The site North of Denmark Street occupies an irregular quadrilateral of land boarded by Denmark Street, Charing Cross Road, Andrew Borde Street and St Giles High Street. Denmark Place, a pedestrian alley cuts across the site from east to west dividing the site into two parts. The area of this part of the site is approximately 0.389ha, and is currently made up of a mix of uses including shops, restaurants and bars, residential and office spaces. The shops and some of the associated offices to Denmark Street are music oriented, and there is also a mix of small creative businesses in the offices situated on the upper floors of the buildings. The residential accommodation is predominantly above the retail units on St Giles High Street, with some accommodation in the listed buildings on Denmark Street.

6.1.2 Of the buildings in Consolidated's ownership, no's 20, 26 and 27 Denmark Street, no 17 Denmark Place and no 59 St Giles High Street are Grade II listed and the building at 22 Denmark Place is of local importance. With the exception of 22 Denmark Place which is a single storey building, these are typically three to four storey terraced buildings with basements, constructed in the 17th Century. In between these buildings no's 21 to 25 Denmark Street are later 1920s developments and are typically 5 storey buildings. York and Clifton Mansions on St Giles High Street are 5 storey Victorian buildings.

6.1.3 Much of the site is currently occupied by London Underground as a works site to deliver the new Tottenham Court Road Underground and Crossrail Stations. To accommodate the works site, many buildings fronting Charing Cross Road, Andrew Borde Street and Denmark Place have been demolished. The buildings at 1 to 6 and 17 to 21 Denmark Place will be also demolished and new buildings constructed behind a retained facade at 52 to 58 St Giles High Street.

6.1.4 The St Giles Circus redevelopment is defined by the creation of a covered plaza outside Tottenham Court Road station which can be used for a variety of events.

6.1.5 Below this a basement Events Gallery will provide a new facility for product launches, music and other cultural events.

6.1.6 Above the basement four new buildings will be constructed to house retail, a hotel and conferencing facilities (building A); a pub with bar, restaurant and roof

top terrace (building B); further hotel accommodation (building C); and the plant required to service the development (building D).

6.1.7 The existing buildings along the north side of Denmark Street will be retained with the upper floors of numbers 21 to 25 converted from the existing commercial office use to residential. A new mansard roof will be added to these buildings.

South of Denmark Street

6.1.8 The site South Denmark Street occupies approximately 0.11ha, and is currently made up of a mix of uses including shops, restaurants and bars, and office spaces. The shops and some of the associated offices to Denmark Street are again music oriented, and there is also a mix of small creative businesses in the offices situated on the upper floors of the buildings, and two residential studios/flats.

6.1.9 The buildings on Flitcroft Street and Book Mews are divided into multi-occupancy office space. These buildings also benefit from access to a rear open courtyard space between Flitcroft Street and Denmark Street, and part of the rear of properties facing Charing Cross Road.

6.1.10 Of the buildings in Consolidated's ownership, no's 6, 7 9 and 10 Denmark Street are Grade II listed. These are typically four storey terraced buildings with basements, constructed in the 1680's. In between these buildings no's 5 and 8 Denmark Street are later 1920s developments and are typically 5 storey buildings with some rooftop additions.

6.1.11 4 Denmark Street and 4 Flitcroft Street are themselves not Listed, but are considered as positive contributors within the conservation area. 4 Denmark Street is a 5 storey building with basement, originally constructed in the 1680's but later redeveloped in the 1920's. 4 Flitcroft Street is a 3 storey building with a half-basement, dating from 1903 with a front façade designed in the Queen Anne Style.

6.1.12 On the south side of Denmark Street the buildings at numbers 4, 6, 7, 9 and 10 will be refurbished with a new mansard added to the building at No'4.

6.1.13 The existing half basement at number 4 Flitcroft Street will be excavated to form a single storey basement that will link to the existing basement at 4 Denmark Street and to a new basement below 1 Book Mews, this new basement will extend under the existing yard. A new single storey restaurant will be constructed above this basement in part of the yard.

71 Endell Street

6.1.14 The site 71 Endell Street occupies approximately 0.039 hectares. The existing commercial office buildings are housed in a 4 storey late Victorian building. This will be converted into residential accommodation.

6.1.15 Development proposals are contained within **Appendix B**.

6.2 Sequential Test within site layout:

Where appropriate, demonstrate how land-uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding.

6.2.1 As discussed at Sections 4.0 and 5.0, the site is entirely within Flood Zone 1 and therefore there are no sequentially preferable locations for the proposed development.

6.2.2 However, it noted that there are no 'More' vulnerable uses (residential accommodation and hotel bedrooms) to be provided at basement level.

7. FLOOD RISK MANAGEMENT MEASURES

7.1 Flood risk management measures:

How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?

7.1.1 As discussed in Sections 3.0, 4.0 and 5.0, no significant sources of flood risk have been identified beyond the potential for groundwater flooding of the basement. This is addressed specifically in a separate Basement Impact Assessment.

7.1.2 As will be discussed in Section 8.0, a gravity connection to the combined sewer will required for the surface water drainage system serving the proposed development and there will also be a gravity and pumped foul drainage connection. Care should therefore be taken to protect against any potential flood flow path into the basement due to surcharging of the combined sewer through the installation of suitable non-return valves.

7.1.3 Proposed external pavement levels are shown by Peter Brett Associates Drawing No. 22798/1/112/01 Rev B enclosed at **Appendix F**.

7.1.4 The proposed means of managing surface water runoff from the proposed development is discussed in Section 8.0.

8. OFF SITE IMPACTS

8.1 Flood risk elsewhere:

How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?

8.1.1 Development has the potential to increase the flood risk elsewhere through the reduction of floodplain storage and obstruction of flood flows.

8.1.2 However, as set out in Section 3.0, the proposed development is located in Flood Zone 1 and as such will not have an impact on the flood risk elsewhere as there will be no reduction of floodplain storage or obstruction of flood flows.

8.2 Surface water management:

How will you prevent run-off from the completed development causing an impact elsewhere?

Policy

8.2.1 Policy 5.13, '*Sustainable drainage*' of the London Plan (Greater London Authority, July 2011) requires that:

> *'a development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:*
>
> *1 store rainwater for later use*
>
> *2 use infiltration techniques, such as porous surfaces in non-clay areas*
>
> *3 attenuate rainwater in ponds or open water features for gradual release*
>
> *4 attenuate rainwater by storing in tanks or sealed water features for gradual release*
>
> *5 discharge rainwater direct to a watercourse*
>
> *6 discharge rainwater to a surface water sewer/drain*
>
> *7 discharge rainwater to the combined sewer.'*

Greenfield runoff rate

8.2.2 As recommended by the SuDS Manual, CIRIA Report C697 (CIRIA, 2007) the 'greenfield' (undeveloped) run-off from the site has been estimated in accordance with IH Report 124, Flood estimation for small catchments (Marshall and Bayliss, 1994). The pro-rata method on the size of catchment detailed in Table 4.2 in The SuDS Manual, CIRIA C697 (2007) has been used for the 0.37ha site.

8.2.3 The analysis has been completed using the Source Control module of WinDes Version W.12.5 using the following parameters:

Area (drained area)	50ha	Recommended the SuDS Manual. Pro-rata flows by area of the site
SAAR (Standard Average Annual Rainfall)	622mm	Obtained from the FEH CD-ROM
SOIL (parameter representing the permeability of the sub soils)	0.30	This has been taken to reflect the underlying River Terrace Gravels and assumes that no made ground is present
Region (FSR Region representing regional growth curve)	7	The site lies within Region 6

8.2.4 The analysis provides an estimate for QBAR (the mean annual flood) of 79.4ls^{-1} for a 50ha site. Therefore QBAR for an undeveloped site is estimated to be **1.6ls^{-1}ha^{-1}**

8.2.5 Therefore the estimated 'Greenfield' runoff, QBAR, from the various elements of the proposed development based on a runoff rate of **1.6ls^{-1}ha^{-1}** has been estimated as follows.

Element	Area (ha)	Estimated runoff (ls^{-1}).
St Giles Circus	0.375	0.60
71 Endell Street	0.040	0,06
9 and 10 Denmark Street	0.026	0,04
6 and 7 Denmark Street	0.025	0.04
4 Denmark Street	0.010	0.02
4 Flitcroft Street and 1 Book Mews	0.050	0.08

8.2.6 Details of the analysis are enclosed at **Appendix G**.

Surface Water Management

8.2.7 The applicability to the proposed development of the options for the management of surface water runoff set out in Policy 5.13 of the London Plan have been considered and are discussed below:

- Store rainwater for later use. Rainwater harvesting is to be included as part of the proposed development and will be used to service the toilets in the hotel and Events Gallery. However, to take a robust approach to the management of surface water runoff, the benefit this might provide has been discounted as the harvesting tanks may be full at the time the storage is required during the peak of a storm.

- Use infiltration techniques, such as porous surfaces in non-clay areas. The site is underlain by made ground and, given the depth to the perched groundwater table, it would not be possible to achieve a sufficiently deep unsaturated zone to protect groundwaters. These factors, together with the potential risk to the existing basements, preclude the use of infiltration devices.

- Attenuate rainwater in ponds or open water features for gradual release. There is insufficient space within the very congested site to provide ponds or open water features.

- Attenuate rainwater by storing in tanks or sealed water features for gradual release. It is proposed to provide attenuation storage using a variety of means within the proposed development. These are discussed below, but include the substrates to green (intensive) and brown (extensive) roofs, open-graded sub-base to permeable paving within the development and a basement storage tank.

- Discharge rainwater direct to a watercourse. There are no watercourses to which a connection could be made.

- Discharge rainwater to a surface water sewer/drain. There is no dedicated surface water sewer/drain to which a connection could be made.

- Discharge rainwater to the combined sewer. The attenuated runoff from the proposed development will be discharged to a combined sewer. It is assumed that as the proposed redevelopment scheme will reduce the surface water runoff to the combined sewer there will be no issues with capacity.

Attenuation of surface water runoff

8.2.8 Guidance contained in the Code for Sustainable Home, Technical Guidance (DCLG, 2010) recommends that a minimum limiting discharge of $5ls^{-1}$ is adopted to minimise the risk of blockage. Therefore, as the estimated existing discharge rates for Nos. 4, 6 and 7 and 9 and 10 Denmark Street are less than $5ls^{-1}$, (paragraph 4.4.3) attenuation of surface water runoff is not considered appropriate.

8.2.9 The attenuation storage required for St Giles Circus, 71 Endell Street and 4 Flitcroft Street and 1 Book Mews has therefore been estimated assuming a permitted maximum discharge rate of $5ls^{-1}$.

8.2.10 A number of existing buildings will be retained as part of the redevelopment of the St Giles Circus and will utilise their existing connections to the combined sewer. These are shown by Drawing No.1793 PL005-RF enclosed at **Appendix H**. The 'new build' area of the proposed development has therefore been taken to be 0.29ha.

8.2.11 The attenuation storage has been estimated using the Quick Storage Estimate module of WinDes Version W.12.5 assuming the run-off from a 1 in 100 (1%) storm including a 30% allowance for climate change is attenuated to **$5ls^{-1}$.** A summary of the results is set out below:

Element	Area (ha)	Estimated attenuation volume (m^3).
St Giles Circus	0.290	119 to 168
71 Endell Street	0.040	6 to 12
4 Flitcroft Street and 1 Book Mews	0.050	9 to 17

8.2.12 It should be noted that this is a very conservative estimate of the storage required and is likely to be reduced through the detailed design process. It should also be noted that the reduction in runoff through evapotranspiration of the green and brown roofs has not been considered, nor the contribution of the rainwater harvesting system. However, for the purposes of this assessment, and to demonstrate the feasibility of the measures proposed, the upper end of the range of storage volumes has been adopted.

8.2.13 Details of the analysis are enclosed at **Appendix I**.

8.2.14 The total pre and post development runoff in response to a rainfall event with an annual probability of 1% (1 in 100) therefore be summarised as follows:

Element	Pre-development runoff (ls^{-1}).	Post-development runoff (ls^{-1}).
St Giles Circus (new build)	40.3	5.0
(refurbished)	11.2	11.2
71 Endell Street	5.6	5.0
9 and 10 Denmark Street	3.6	3.6
6 and 7 Denmark Street	3.5	3.5

4 Denmark Street	1.4	1.4
4 Flitcroft Street and 1 Book Mews	6.9	5.0
Totals	**72.5**	**34.7**

8.2.15 It should be noted that overall the proposed development meets the minimum requirement of a 50% reduction in surface water runoff required by the Local Planning Authority's EIA Scoping Response.

8.2.16 The proposed development discharges to a combined sewer and it is therefore appropriate to consider the impact on foul flows as well as surface water runoff. Using the Discharge Units method of analysis, peak foul flow from the existing properties on St Giles High Street, Denmark Place, Denmark Street within the footprint of the St Giles Circus development has been estimated as 24 ls^{-1}. The redevelopment of these properties will reduce the peak foul flow to some 13 ls^{-1}. The net reduction in peak foul flow to the combined sewer will therefore be **11 ls^{-1}**.

Attenuation storage volumes.

8.2.17 Set out below is a summary of the proposed means of providing the required attenuation storage volume for the St Giles Circus redevelopment:

- Green (intensive) roofs. With reference to Drawing No.1793 PL005-RF, the proposed green roof extents to an area of some 200m^2. Assuming a substrate depth of 300mm with a porosity of 0.2 and that 75% of the available storage could be mobilised, the potential storage volume is: **9m^3**

- Brown (extensive) roofs. With reference to Drawing No.1793 PL005-RF, the proposed brown roof extents to an area of some 250m^2. Assuming a substrate depth of 150mm with a porosity of 0.2 and that 75% of the available storage could be mobilised, the potential storage volume is: **6m^3**

- Permeable paving. It is understood that there is sufficient depth of construction to allow a permeable paving system to be installed along Denmark Place over a porous sub base depth of 0.3m. Denmark Place and the alley to the north extend to an area of some 400m^2. Assuming a substrate depth of 0.3m with a porosity of 0.3 and that 80% of the

available storage could be mobilised, the potential storage volume is: **29m³**.

- Storage tank. The balance of storage to provide the 168m³ estimated at 8.2.11 is therefore: **124m³**.

The storage tank is to be located in the basement of 22 Denmark Street which extends to approximately 80m². Based on the details of the existing combined sewers in Denmark Street shown on Peter Brett Associates Drawing No. 22798/1/100/02 Rev D, it should be possible to make a gravity connection to the existing sewer in Denmark Street. A high level overflow from the tank to street level should be provided should the receiving sewer surcharge.

The provision of the required storage in 71 Endell Street and 4 Flitcroft Street and 1 Book Mews will be agreed as part of the detailed design of the refurbishment works. It is noted, however, that the redevelopment of 71 Endell Street will include a green or brown roof.

Flood Risk elsewhere

8.2.18 As shown by the analysis set out above, the surface water runoff from the development of St Giles Circus in response to 1 in 100 (1%) storm will be reduced from the current **72.5ls^{-1}** to **34.7ls^{-1}** post development. This represents a significant reduction in runoff from and therefore may contribute to a reduction in the flood risk elsewhere. A further reduction of flow to the combined sewer of **11ls^{-1}** will result from the reduced foul flow to the combined sewer from the redevelopment of St Giles Circus.

9. RESIDUAL RISKS

9.1 Residual flood risk

What flood-related risks will remain after you have implemented the measures to protect the site from flooding?

9.1.1 As reported at Sections 3.0, 4.0 and 5.0, the site is not considered to be at significant risk of flooding, even when considering the impact of climate change.

9.1.2 However, there is always a risk that events of a greater magnitude than those designed for will occur.

9.1.3 As discussed in Section 7.0, the detailed design of the development and drainage system will identify flood flow routes to cater for the surcharging of the local sewer network or surface water flood flows. Care will be taken to avoid low points within the development that could give rise to a localised flood risk.

9.2 Management

How, and by whom, will these risks be managed over the lifetime of the development?

9.2.1 The drainage systems serving the site will either be offered for adoption or managed by a suitably experienced management company. Appropriate activities will include periodic inspection and maintenance of the drainage system to ensure its continuing effectiveness.

10. CONCLUSIONS

10.1 Background

10.1.1 This report has been prepared to consider the risk of flooding to the proposed redevelopment of St Giles Circus and No. 4 Flitcroft Street, Nos. 4, 6, 7, 9 and 10 Denmark Street, No. 1 Book Mews and No. 71 Endell Street.

10.1.2 St Giles Circus is currently developed and extends to an area of some 0.37ha. No. 4 Flitcroft Street, Nos. 4, 6, 7, 9 and 10 Denmark Street, No. 1 Book Mews and No. 71 Endell Street are all existing properties.

10.1.3 The sites are located in Flood Zone 1 and no significant source of flood risk has been identified other than from groundwater flooding to the proposed basement to be constructed as part of the redevelopment of St Giles Circus. This is being addressed by a separate Basement Impact Assessment report.

10.1.4 The proposed mixed-use development comprises both 'More' and 'Less' vulnerable uses, although only the 'Less' vulnerable uses are proposed in the basement.

10.2 Sequential and Exception tests

10.2.1 The proposed development lies within Flood Zone 1 it therefore is not subject to either the Sequential or Exception Tests.

10.3 Flood risk management

10.3.1 No specific flood risk management measures are considered necessary other than to ensure that connections to the combined public sewer do not provide a flood flow path should it become surcharged.

10.4 Off site impacts

10.4.1 A sustainable surface water management system will be designed to significantly reduce the runoff the proposed development compared the existing site.

10.4.2 Therefore, there will be no increase in the risk of flooding elsewhere arising from the proposed development.

10.5 Residual risks

10.5.1 Measures are recommended to ensure the development would be protected from flooding should the capacity of the local drainage network be exceeded or flood flows develop from an exceptional storm event.

10.5.2 It will be important that the drainage system is regularly maintained to ensure its effective long-term operation.

11. REFERENCES

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Mouchel, 2008, *North London Strategic Flood Risk Assessment*.

Quality

It is the policy of Project Centre to supply Services that meet or exceed our clients' expectations of Quality and Service. To this end, the Company's Quality Management System (QMS) has been structured to encompass all aspects of the Company's activities including such areas as Sales, Design and Client Service.

By adopting our QMS on all aspects of the Company, Project Centre aims to achieve the following objectives:

- Ensure a clear understanding of customer requirements;
- Ensure projects are completed to programme and within budget;
- Improve productivity by having consistent procedures;
- Increase flexibility of staff and systems through the adoption of a common approach to staff appraisal and training;
- Continually improve the standard of service we provide internally and externally;
- Achieve continuous and appropriate improvement in all aspects of the company;

Our Quality Management Manual is supported by detailed operational documentation. These relate to codes of practice, technical specifications, work instructions, Key Performance Indicators, and other relevant documentation to form a working set of documents governing the required work practices throughout the Company.

All employees are trained to understand and discharge their individual responsibilities to ensure the effective operation of the Quality Management System.

APPENDIX A – TOPOGRAPHIC SURVEY

APPENDIX B – PROPOSED DEVELOPMENT DETAILS

APPENDIX C – CORRESPONDANCE WITH THE ENVIRONMENT AGENCY

APPENDIX D – CORRESPONDANCE WITH CAMDEN COUNCIL

APPENDIX E – CORRESPONDANCE WITH THAMES WATER

APPENDIX F – PETER BRETT ASSOCIATES DRAWINGS

APPENDIX G – ESTIMATION OF THE GREENFIELD RUNOFF RATE

APPENDIX H – PROPOSED DRAINAGE STRATEGY

APPENDIX I – ESTIMATION OF ATTENUATION STORAGE VOLUME

Accreditations

Memberships