Flood Risk Assessment

254 Kilburn High Road

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Date: March 2015
Job No.: 22408

Revisions

Rev	Date	By	Notes
01	June 2014	LH	Update in accordance with Camden SFRA

Contents

Abbreviations

AOD	Above Ordnance Datum
BREEAM	Building Research Establishment Environmental Assessment Methodology
CfSH	Code for Sustainable Homes
EA	Environment Agency
FRA	Flood Risk Assessment
PPS 25	Planning Policy Statement 25; Development & Flood Risk
SFRA	Strategic Flood Risk Assessment
NPPF	National Planning Policy Framework

1 Introduction

Price and Myers have been commissioned by Artich Group Ltd to undertake a Flood Risk Assessment (FRA) for the proposed redevelopment of the 254 Kilburn High Road, located within the London Borough of Camden. The flood risk classification of this site is based on the observations and the recommendations stated. This report is intended for the use of the developer of the site in support of their planning application for the site only.

This FRA has been carried out in accordance with:

- National Planning Policy Framework (NPPF),
- Planning Policy Statement (PPS) Statement 25 Technical Guidance,
- Advice and guidance from the Environment Agency (EA) and CIRIA documents,
- Information and recommendations within the London Borough of Camden Strategic Flood Risk Assessment (SFRA).

The NPPF states that an appropriate FRA will be required for all development proposals of 1 Ha or greater in Flood Zone 1, or for any development within Flood Zones 2 or 3. The site is within Flood Zone 1 and is less than 1 Ha; although a FRA is not required in this case it is required for compliance with the Code for Sustainable Homes (CSH) and Building Research Establishment Environmental Assessment Methodology (BREEAM) purposes. At the request of the Local Planning Authority this FRA also includes a SUDS assessment.

2 Site Description and Location

The site is located on Kilburn High Road in Kilburn. The site coordinates are at grid ref. OS 524992/184221 and the postcode is NW6 2BS. The site is situated to the west of Kilburn Grange Park within an urban area of London and has a vehicular entrance from Kilburn High Road. The entire site covers an approximate area of 0.203 Ha.

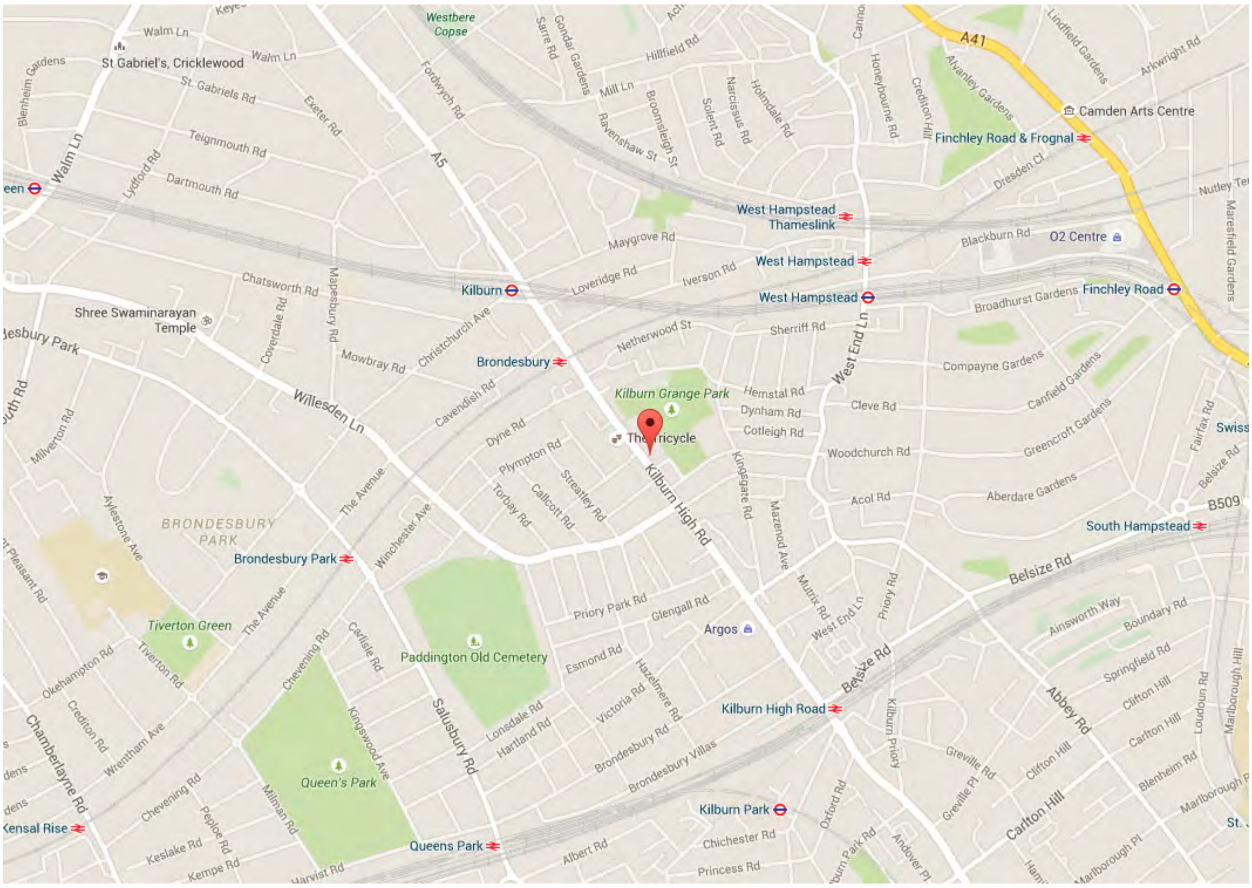

Figure 1 - Site Location Map

Figure 2 - Existing Development

3 Development Proposal

The proposed works comprise the demolition of the existing buildings and redevelopment of the site to provide a mixed use four/five storey building with commercial space at ground level and 60 residential units above. The proposals will have minor effect to the external areas and access to the proposed development will remain via Kilburn High Road.

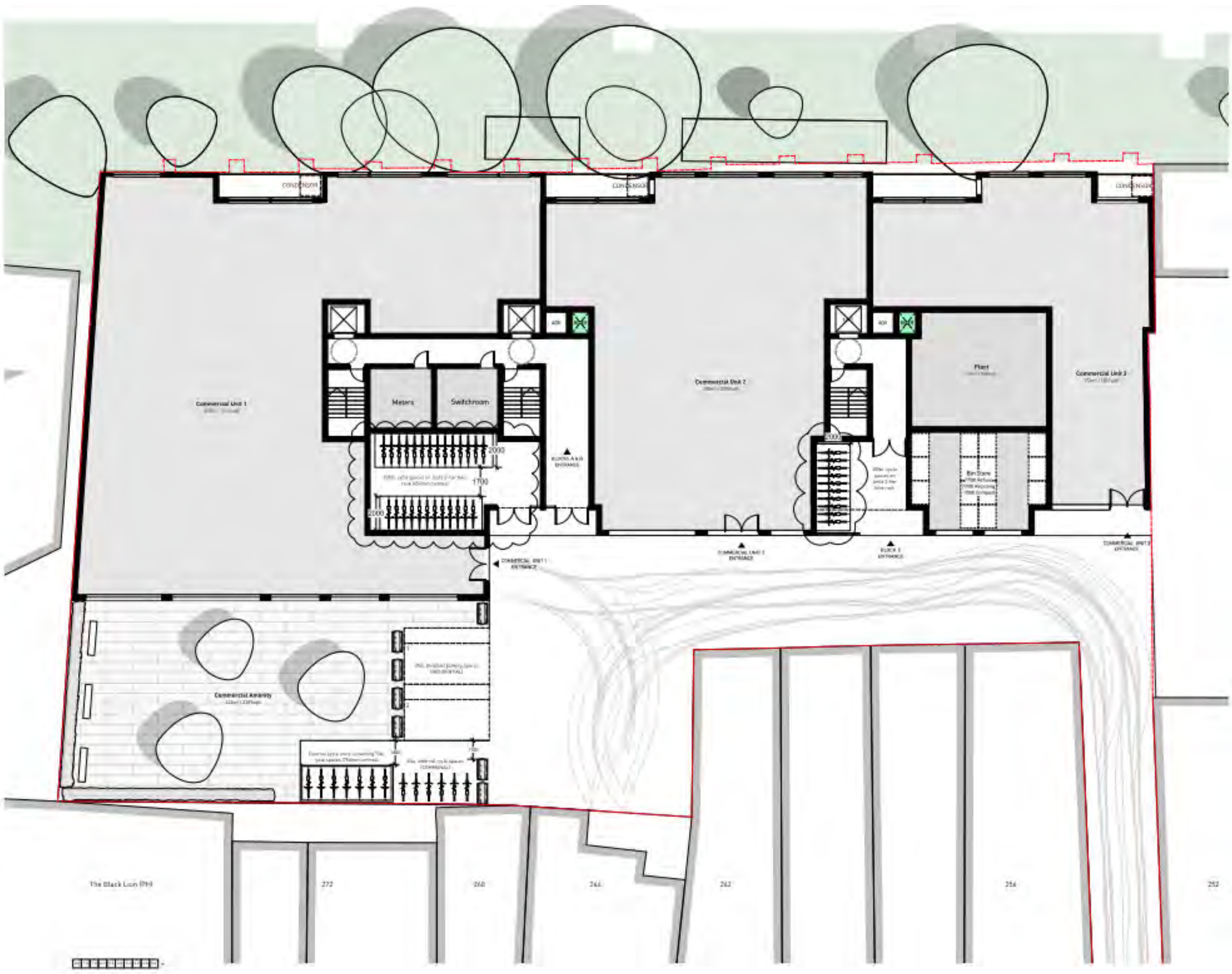

Figure 3 – Proposed ground floor plan

4 Flood Risk Assessment

4.1 Flood Risk from Watercourses (Fluvial/Tidal)

There is no risk of flooding from rivers and sea as identified on the Environment Agency (EA) indicative flood outline map. The map shows that the site lies within Flood Zone 1.

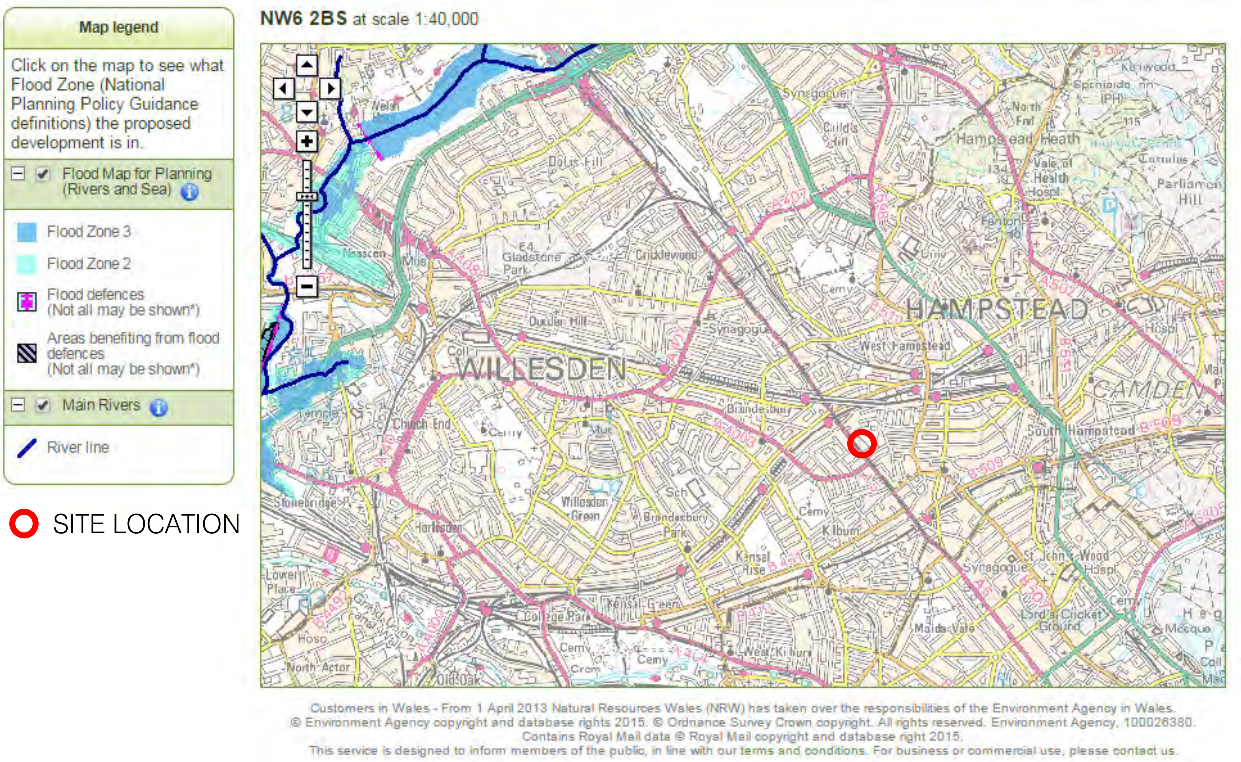

Figure 4 - Environment Agency indicative floodplain map

4.2 Flood Risk from Groundwater

The EA's groundwater source protection zones confirm that the site is not located within a source protection zone and is not underlain by an aquifer. Therefore, the proposed development will not affect the local hydrology.

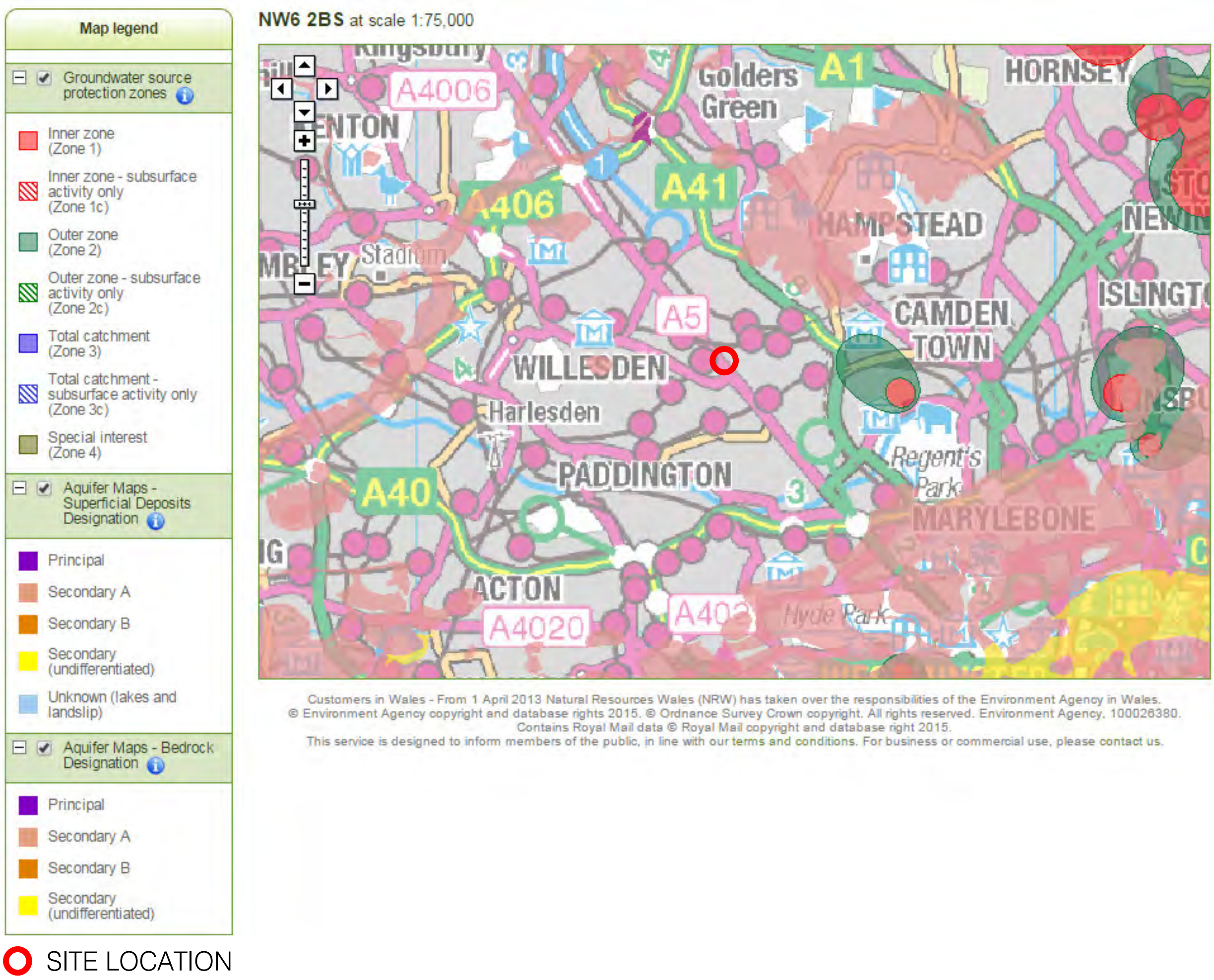

Figure 5 - Environment Agency Groundwater Source Protection Zones Map

A geotechnical site investigation was not available at the time this study was undertaken. However, the British Geological Survey map (Figure 6) for the site location confirms that the area is entirely underlain by London Clay Formation. This confirms that the flood risk from ground water is low as the London Clay is impermeable, preventing the groundwater from rising near the ground surface in this area.

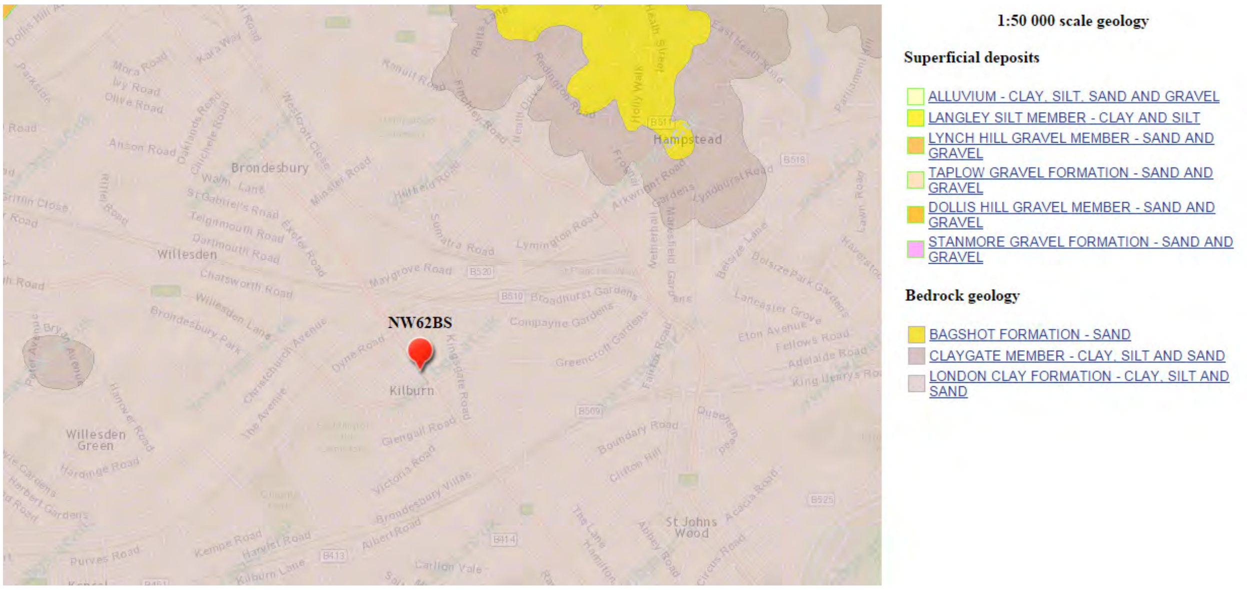

Figure 6 - British Geological Survey Map of the Site

This is in agreement with information provided in the SFRA. Figure 7 shows the results of mapping carried out to identify areas with increase potential for elevated groundwater and locations which have sufferance from groundwater flooding in the past. The maps indicated that the site is not at risk of groundwater flooding and that there have been no recorded incidents of groundwater flooding in the vicinity of the site. Furthermore, the proposals do not include any basements or lower ground floors (which are more susceptible to this type of flooding). Therefore the flood risk from groundwater is considered low.

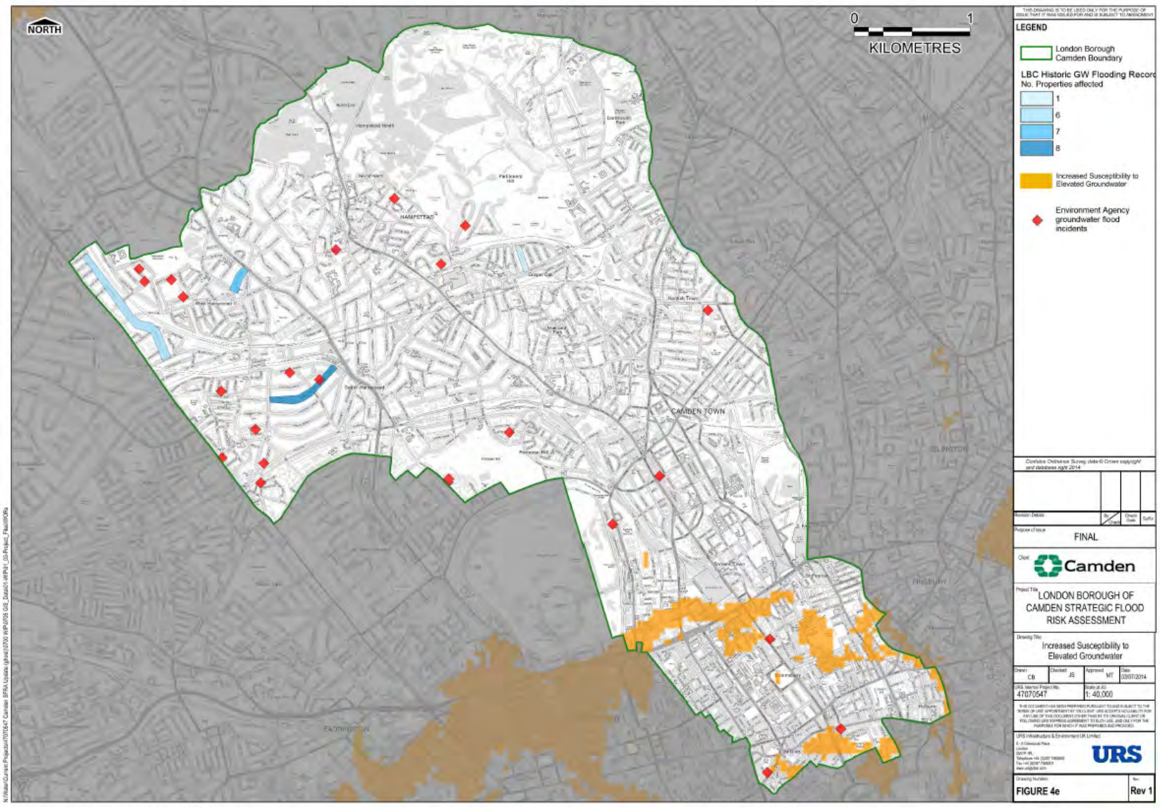

Figure 7 – Increase susceptibility to elevated groundwater (extract from SFRA)

4.3 Flood Risk from Overland Flows and Sewers

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter a drainage system due to blockages or the capacity of the system being exceeded. As part of the SFRA detailed modelling of surface water flows was carried out. Figure 8 shows that part of the site is located in an area that is at low to medium risk of surface water flooding although there are no historic records of any properties being flooding from surface water in this location.

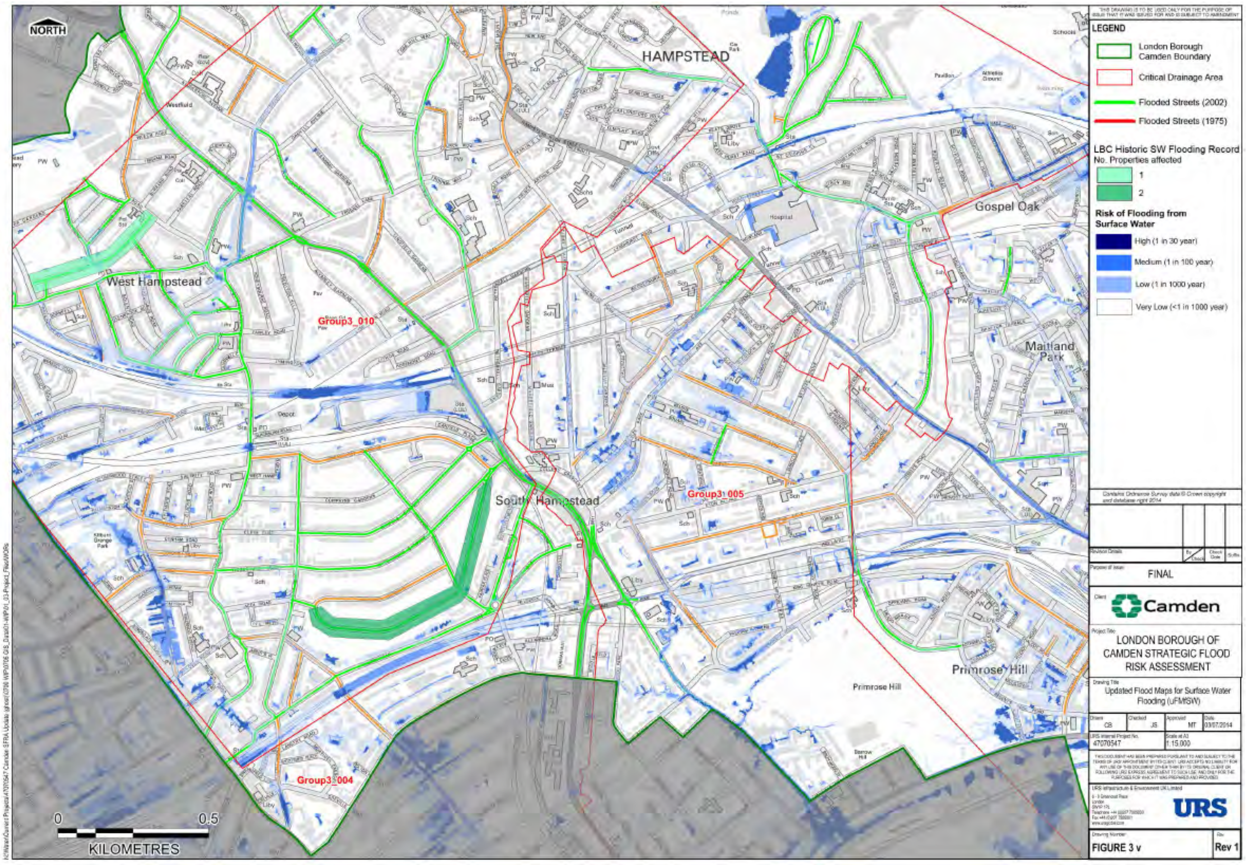

Figure 8 - Historical Flood Records (Extract from SFRA)

However, an extended topographical survey (Figure 9) shows that Kilburn High Road generally falls to the south-east. This indicates that surface water will flow to the south-east without ponding the local area. To further reduce the risk, a ramp can be implemented at the entrance to the site; this will create a natural barrier to overland flows and will prevent water from flowing into the site.

It is also important to note that the proposal does not include any lower ground floors which are particularly susceptible to this type of flooding. The ground floor will be mainly used for commercial and storage purposes which are classified a "less vulnerable" in accordance with the NPPF. All residential units, which are classified as "more vulnerable" will be located on the upper floors, further reducing the flood risk.

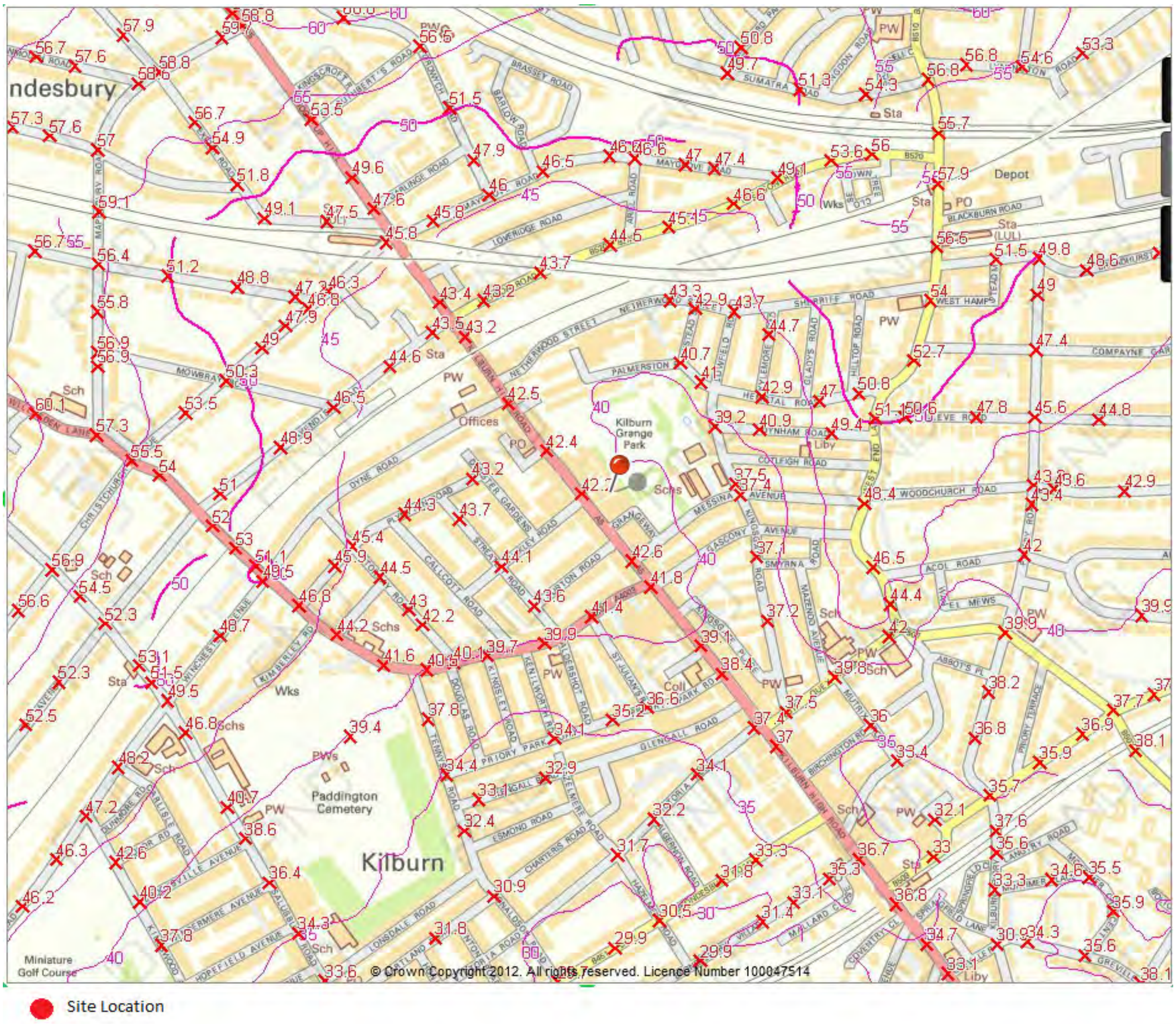

Figure 9 - Contours and Spot Heights (extract from FIND maps, 2014)

5 Run-off and SUDS Assessment

Existing Run-off

The impermeable areas currently cover the entire site area of approximately 0.203 Ha. It is thought that these areas currently drain to the public sewers. The existing run-off rate for the 1 in 100 year storm event was estimated based on the modified rational method:

Q_{100} = 2.78 x A x i (where "A" is the catchment area in Ha and "i" is the rainfall intensity in mm/hr. as estimated from WinDes Software).

Q_{100} = 2.78 x 0.203 x 105 = 59.3 l/sec.

5.2 Proposed Run-off

The development proposals will not increase the impermeable areas on site as the entire site area is currently impermeable. Therefore the run-off rate and surface water volumes to the public sewers will remain the same and there will be no increase in flood risk from surface water on site or elsewhere.

5.3 SUDS Assessment

The London Plan states that new developments should aim to achieve Greenfield run-off rates and ensure that surface water run-off is managed as close to its sources as possible in line with the SUDS hierarchy. Sustainable Drainage Systems (SUDS) can reduce the impact of urbanisation on watercourse flows, ensure the protection and enhancement of water quality and encourage recharge of groundwater in a manner that mimics natural conditions. The SUDS hierarchy states that storing rainwater for reuse within the building should be prioritised, followed by infiltration techniques. However, published information confirms that the site is underlain by London Clay which is unsuitable for the use of infiltration techniques. Furthermore, the development proposals indicate that only a very small area of the site will not be occupied by buildings providing no sufficient area for infiltration techniques, considering that infiltration systems must be constructed at least 5m away from structures.

Therefore, in accordance with the London Plan, surface water should be attenuated to Greenfield run-off rates before draining to the public sewers. The Greenfield run-off rate for the site was estimated using the Greenfield run-off estimator tool (uksuds.com, Appendix A). The 1 in 100 year Greenfield run-off rate can be calculated by multiplying the 100 year growth curve factor by Q_{bar}:

Q_{100GF} = 3.19 x 0.97 = 3.09 l/sec

However, the joint Defra and EA R&D Technical Report (Preliminary Rainfall Runoff Management for Developments) states that the minimum limiting discharge for attenuation systems in 5 l/sec, as lower flow rates require small diameter flow control devices which are at risk of blockages. Therefore, surface water from the site will be attenuated to 5 l/sec before draining to the public sewers. Preliminary calculations show a volume of 100m^3 is required to attenuate surface water to 5 l/sec for the 1 in 100 year plus 30% (climate change) storm event.

It is important to note that whilst every effort will be made to incorporate rainwater harvesting into the final design, the attenuation tank will be designed to cope with surface water from all the roof and hardstanding areas (assuming no run-off reductions due to reuse of water onsite). This is because the amount of storage available within the rainwater harvester is dependent on the water demand from the building users. If a storm were to occur during a period when there was little water demand from the building users (and the harvester is full) the inflow to the harvester will be equal to the outflow, providing no attenuation benefits before entering the attenuation tank.

In accordance with the Local Planning Authority's requirements, a completed copy of the "Surface Water Drianage Pro-forma for new developments" form has been included in Appendix B.

6 Surface Water and Flood Risk BREEAM Assessment Criteria

The assessment criterion is split into three parts for which credits may be awarded.

6.1 Flood Risk

As stated in section 4 of this report. The EA's indicative flood map shows that the site lies in Flood Zone 1, an area with less than 0.1% annual probability of flooding by rivers and/or the sea. Therefore the proposed development can achieve two credits.

6.2 Surface Water Run-off

Section 5 analyses the surface water run-off of the proposed site. The surface water run-off rates were calculated.

BREEAM states that "where impermeable areas drainage to the watercourse (natural or municipal) has decreased or remains unchanged post-development, the peak and volume rate of run-off requirements for surface water run-off credits will be met by default." Therefore the development can achieve additional two credits.

6.3 Minimising watercourse pollution

Whilst the proposed development poses low risk of contamination to watercourses, surface water from all areas must pass through SUDS in order to meet BREEAM's requirements. The single credit which is available cannot be achieved as infiltration techniques cannot be used on site.

7 Conclusions & Recommendations

- In accordance with NPPF this site falls within Flood Zone 1, areas with little or no potential risk of flooding (annual probability less than 0.1% for fluvial flooding) which are already developed. Proposed Developments in these areas have no restrictions provided that the surface water drainage will not increase the flood risk on site and the surrounding areas.

- Information from the EA and SFRA shows that the site is at low risk of flooding from watercourses, ground water and overland flows.

- There will be no increase in impermeable areas on site and therefore no increase in the surface water run-off rates or peak volumes.

- Rainwater harvester for reuse will be prioritised. Surface water that is not reused within the building will drain to the public sewers via an attenuation tank. Preliminary calculations show a volume of 100m3 is required to attenuate to 5 l/sec for the 1 in 100 year plus 30% (climate change) storm event.

- The proposed development meets BREEAM's requirements and has the potential to achieve four credits for flood risk and surface water run-off.

- Therefore, the proposed redevelopment has an acceptable flood risk within the terms and requirements of NPPF.

APPENDIX A – Preliminary Calculations

Greenfield runoff estimation for sites

HR Wallingford
Working with water

Site name:	Kilburn High Road		
Site location:			

Site coordinates

Latitude:	51.54335° N
Longitude:	0.19919° W
Reference:	gcpv5rnvy8c5 / 0.2
Date:	15 Jun 2015

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Site characteristics

Total site area	0.2	ha
Significant public open space	0	ha
Area positively drained	0.2	ha

Methodology

Greenfield runoff method	FEH

Qmed estimation method	Calculate from BFI and SAAR	
BFI and SPR estimation method	Specify BFI manually	
HOST class	N/A	
BFI / BFIHOST	0.22	
Qmed	0.85	l/s
Qbar / Qmed Conversion Factor	1.136	

Hydrological characteristics

	Default	Edited	
SAAR	638	638	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.4	0.4	
FEH/FSR conversion factor	0.74	0.74	
Hydrological region	6	6	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.62	1.62	
Growth curve factor: 30 year	2.3	2.3	
Growth curve factor: 100 year	3.19	3.19	

Greenfield runoff rates

	Default	Edited	
Qbar	0.97	0.97	l/s
1 in 1 year	5.00	5.00	l/s
1 in 30 years	5.00	5.00	l/s
1 in 100 years	5.00	5.00	l/s

Please note that a minimum flow of 5 l/s applies to any site

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 180 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.525	0.525	0.0	3.7	3.7	49.9	O K
30 min Summer	0.658	0.658	0.0	4.1	4.1	62.5	O K
60 min Summer	0.761	0.761	0.0	4.5	4.5	72.3	Flood Risk
120 min Summer	0.808	0.808	0.0	4.6	4.6	76.8	Flood Risk
180 min Summer	0.806	0.806	0.0	4.6	4.6	76.5	Flood Risk
240 min Summer	0.793	0.793	0.0	4.5	4.5	75.4	Flood Risk
360 min Summer	0.760	0.760	0.0	4.5	4.5	72.2	Flood Risk
480 min Summer	0.723	0.723	0.0	4.3	4.3	68.7	Flood Risk
600 min Summer	0.687	0.687	0.0	4.2	4.2	65.2	O K
720 min Summer	0.651	0.651	0.0	4.1	4.1	61.9	O K
960 min Summer	0.588	0.588	0.0	3.9	3.9	55.9	O K
1440 min Summer	0.486	0.486	0.0	3.6	3.6	46.1	O K
2160 min Summer	0.375	0.375	0.0	3.1	3.1	35.6	O K
2880 min Summer	0.297	0.297	0.0	2.8	2.8	28.2	O K
4320 min Summer	0.195	0.195	0.0	2.3	2.3	18.5	O K
5760 min Summer	0.120	0.120	0.0	2.1	2.1	11.4	O K
7200 min Summer	0.097	0.097	0.0	1.9	1.9	9.2	O K
8640 min Summer	0.085	0.085	0.0	1.6	1.6	8.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	136.659	16
30 min Summer	88.315	31
60 min Summer	54.281	60
120 min Summer	32.230	116
180 min Summer	23.456	144
240 min Summer	18.621	176
360 min Summer	13.418	244
480 min Summer	10.633	312
600 min Summer	8.872	380
720 min Summer	7.649	448
960 min Summer	6.048	578
1440 min Summer	4.339	836
2160 min Summer	3.108	1212
2880 min Summer	2.451	1584
4320 min Summer	1.752	2296
5760 min Summer	1.379	2952
7200 min Summer	1.145	3672
8640 min Summer	0.983	4408

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	0.076	0.076	0.0	1.4	1.4	7.3	O K
15 min Winter	0.589	0.589	0.0	3.9	3.9	56.0	O K
30 min Winter	0.740	0.740	0.0	4.4	4.4	70.3	Flood Risk
60 min Winter	0.861	0.861	0.0	4.7	4.7	81.8	Flood Risk
120 min Winter	0.924	0.924	0.0	4.9	4.9	87.8	Flood Risk
180 min Winter	0.916	0.916	0.0	4.9	4.9	87.0	Flood Risk
240 min Winter	0.900	0.900	0.0	4.8	4.8	85.5	Flood Risk
360 min Winter	0.853	0.853	0.0	4.7	4.7	81.0	Flood Risk
480 min Winter	0.800	0.800	0.0	4.6	4.6	76.0	Flood Risk
600 min Winter	0.747	0.747	0.0	4.4	4.4	71.0	Flood Risk
720 min Winter	0.697	0.697	0.0	4.3	4.3	66.3	O K
960 min Winter	0.608	0.608	0.0	4.0	4.0	57.8	O K
1440 min Winter	0.469	0.469	0.0	3.5	3.5	44.5	O K
2160 min Winter	0.329	0.329	0.0	2.9	2.9	31.2	O K
2880 min Winter	0.238	0.238	0.0	2.5	2.5	22.6	O K
4320 min Winter	0.112	0.112	0.0	2.0	2.0	10.6	O K
5760 min Winter	0.086	0.086	0.0	1.6	1.6	8.2	O K
7200 min Winter	0.074	0.074	0.0	1.4	1.4	7.0	O K
8640 min Winter	0.066	0.066	0.0	1.2	1.2	6.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Summer	0.864	5136
15 min Winter	136.659	16
30 min Winter	88.315	30
60 min Winter	54.281	60
120 min Winter	32.230	116
180 min Winter	23.456	164
240 min Winter	18.621	186
360 min Winter	13.418	262
480 min Winter	10.633	338
600 min Winter	8.872	410
720 min Winter	7.649	482
960 min Winter	6.048	618
1440 min Winter	4.339	880
2160 min Winter	3.108	1256
2880 min Winter	2.451	1640
4320 min Winter	1.752	2252
5760 min Winter	1.379	2936
7200 min Winter	1.145	3672
8640 min Winter	0.983	4392

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	0.061	0.061	0.0	1.0	1.0	5.7	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
10080 min Winter	0.864	5104

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.600	Shortest Storm (mins)	15
Ratio R	0.437	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.203

Time (mins)	**Area (ha)**
0-1	0.203

Model Details

Storage is Online Cover Level (m) 1.000

Cellular Storage Structure

Invert Level (m) 0.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	**Area (m²)**	**Inf. Area (m²)**
0.000	100.0	100.0

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md7 Invert Level (m) 0.000
Design Flow (l/s) 5.0 Diameter (mm) 87

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	1.9	1.200	5.5	3.000	8.8	7.000	13.4
0.200	2.3	1.400	6.0	3.500	9.5	7.500	13.9
0.300	2.8	1.600	6.4	4.000	10.1	8.000	14.3
0.400	3.2	1.800	6.8	4.500	10.7	8.500	14.7
0.500	3.6	2.000	7.2	5.000	11.3	9.000	15.2
0.600	3.9	2.200	7.5	5.500	11.9	9.500	15.6
0.800	4.5	2.400	7.8	6.000	12.4		
1.000	5.1	2.600	8.2	6.500	12.9		