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Temporary Store Drainage Strategy (Condition 47A)

Morrisons Superstore and Petrol Filling Station
Full Planning Permission Application ref: 2017/3847/P
Updated Non-Material Amendment Application ref: 2019/0153/P

St George Homes

January 2020

Quality information

Prepared by	Checked by	Verified by	Approved by
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Revision History

Revision	Revision date	Details	Authorized	Name	Position
P01	24/01/2020	DISCHARGE CONDITION 47A	Barry Pegg	Barry Pegg	Project Manager

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1. INTRODUCTION

1.1 Background Information

The site is located in Camden adjacent to Chalk Farm Road and approximately 3.26Ha in size. The site area is spilt between two separate parcels of land, Petrol Filling Station (PFS) and the Main Site (MS). The site development boundary is shown in Figure 1 below.

The proposal for this development comprises of the demolition of the existing buildings and the construction of a mixed use development with associated landscaping and public realm improvements. Reference can be made to the approved Camden Goods Yard Flood Risk Assessment and Drainage Strategy document (See **Appendix A**), Chapter 2 for a more detailed site description.

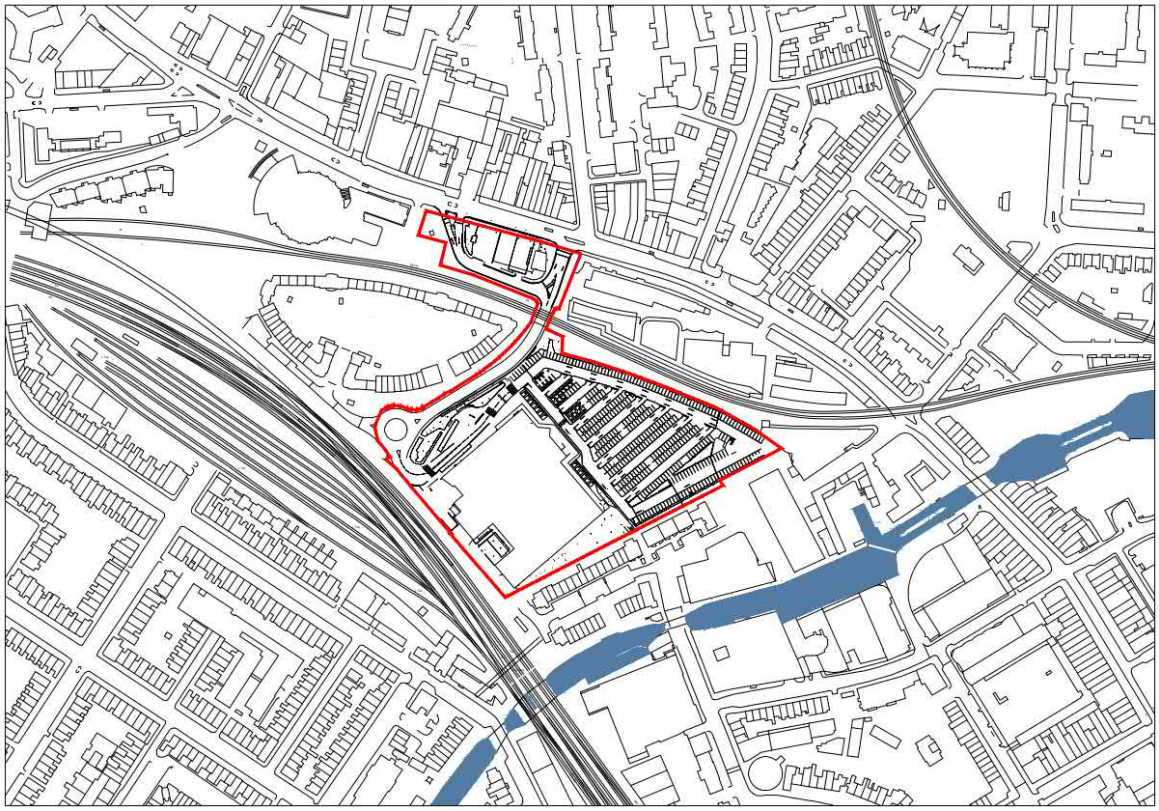

Figure 1 Site Boundary

The original Full Planning Permission was granted on 15th June 2018 (Ref: 2017/3847/P), and the Non-material Amendments to planning permission was granted on 09th Jan 2019 (Ref: 2019/0153/P).

1.2 Brief

AECOM have been appointed by St George Homes (the 'Client') to prepare a Drainage Strategy to discharge Non-Material Amendments to planning permission Replacement Condition 47A (see below) for the Temporary Store in the PFS Site.

"REPLACEMENT CONDTION 47
Drainage strategy

A. Prior to commencement of development on the PFS land parcel a drainage strategy for that parcel of land detailing any on and/or off site drainage works shall be prepared in consultation with the sewerage undertaker and submitted to and approved in writing by the local planning authority.

The drainage strategy for the relevant parcel of land shall include details of:

a. a sustainable urban drainage system (SUDs) which is based on a 1 in 100 year event with 40% provision for climate change demonstrating attenuation to support no more than three times greenfield runoff rate.

b. Goods Yard raingarden and any other SUDs features within the public realm including a plan of maintenance.

The drainage works and features approved for the relevant parcel of land shall be implemented in full prior to first discharge of foul or surface water from the relevant parcel of land into the public system.

Reason: To ensure reduce the rate of foul and surface water run-off from the buildings and limit the impact on the storm-water drainage system in accordance with Policy CC3 of the Camden Local Plan 2017."

This Drainage Strategy considers development of the Temporary Store only. The Drainage Strategy for the Main Site will be submitted during a later development phase.

This report should be read alongside the approved Flood Risk Assessment (FRA) and Drainage Strategy produced by AECOM in June 2017 contained in **Appendix A** of this report.

2. SITE DESCRIPTION

The PFS Site is located on Chalk Farm Road, between The Roundhouse and Horse Hospital.

The initial PFS works comprises demolition of the existing PFS and provision of a single-storey Temporary Morrisons Store (14k sq ft gross internal area) shell located at ground level on the existing PFS Site, constructed to a shell specification complete with external works, drainage and incoming services together with all necessary off-site and highways works.

The site boundary for the Temporary Store is assumed in Figure 2 shown below. This includes private surface and foul water drainage in relation to the proposed building and private access road/loading bay/car parking.

The total area is approximately 0.277 ha. The existing highest point is at the Chalk Farm Road entrance at approximately 28.20mAOD and slopes south-east towards Juniper Crescent at approximately 26.91mAOD.A topographical survey can be found in **Appendix B.**

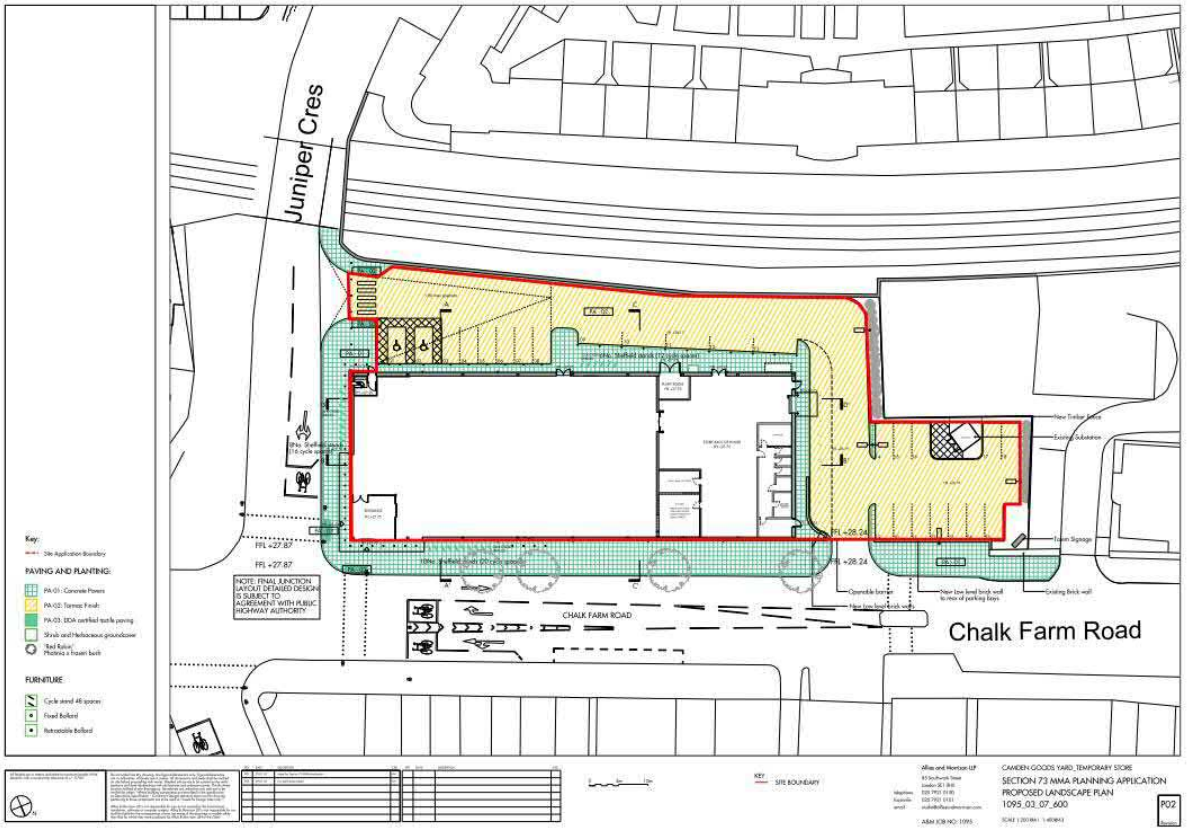

Figure 2 Temporary Store Layout

3. EXISTING DRAINAGE

The available Thames Water record plan (refer to **Appendix C**) indicates that there is an existing unknown diameter combined sewer in Juniper Crescent. A utility & drainage survey was carried out by E.L.S. Land Consultants in November 2019 (refer to **Appendix D**) and they confirmed the size of that existing combined sewer is DN250m, that sewer drain north into the DN1524mm combined sewer in Chalk Farm Road. The survey also identified there is an existing DN225mm surface water pipe discharging into that combined sewer. The existing outfalls will be reused and further investigation will be carried out to confirm he outfall conditions.

There does not appear to be any attenuation features or flow control devices that restrict discharge of surface water from the site.

4. DRAINAGE STRATEGY

4.1 Drainage Criteria

The surface water drainage system has been designed in accordance with the National Planning Policy Framework (NPPF) and the accompanying Guidance and Technical Standards for SuDS. The non-statutory technical standards for SuDS criteria recommends the following:

- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event

- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of the building

- The design of the site must ensure that, so far as is reasonable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

The drainage strategy also complies with the requirements under Building Regulations Part H and Sewers for Adoption 7th Edition. The drainage strategy for the temporary store was developed in consideration of the obligations within the planning permission.

Chapter 6 of the approved FRA provides details of the consented drainage strategy. The consented discharge rate for the PFS site is **14.1 l/s** (1 in 100 years) based on an effective runoff area of **0.357 Ha.**

The consented discharge rate is based on the obligation for the development to demonstrate sufficient attenuation to support no more than three times Greenfield run-off rate for the 1 in 100 year event with 40% provision for climate change, as stated in Condition 47.

4.2 Surface Water Drainage Strategy

The surface water runoff from the Temporary Store roof and private access road, loading bay and car parking spaces will discharge into the attenuation storage tank via gravity, prior connecting to the existing DN250 Thames Water combined sewer at Juniper Crescent.

The surface water runoff from the loading area and it's adjacent car parking area, which will be used for loading vehicle turning, will be routed through a petrol interceptor to provide a primary level of treatment prior to discharge into the attenuation tank. The remaining car parking spaces will not be routed through a petrol inceptor due to site level constraints and low pollution risk from this area.

The final surface water runoff from above areas will be restricted at a limited flow rate in accordance with the consented flow rates from the FRA. To avoid surface water backflow into the petrol interceptor, we also proposed a flap valve at the final manhole prior connecting to the attenuation tank. Please refer to **Appendix E** for the proposed drainage layout.

Based on the consented discharge rates, we carried out a pro-rata calculation for the Temporary Store and the calculation results are shown in Table 1 below.

Storm Event	PFS Site (0.357 Ha) – Consented 3 Times Greenfield Rate (from Approved FRA)	PFS Site (0.277 Ha) – Consented 3 Times Greenfield Rate (proposed rate for Temporary Store)
1 in 100	14.1 l/s	**10.9 l/s**

Table 1 Temporary Store Surface Water Discharge Rates

The proposed Temporary Store surface water flow rate was calculated using a reduced area (0.277 Ha), and the consented 3 Times Greenfield rate (1 in 100 storm events) for the Temporary Store is **10.9 l/s.**

4.3 Surface Water Modelling

The hydraulic modelling of the surface water drainage was completed using MicroDrainage. All areas assed as contributing to the network were taken as 100% impermeable with a time of entry of 5 minutes.

The sizing of pipes and storage features was designed in accordance with no surcharging during a 1 in 1 year event, no flooding during a 1 in 30 year event and limited controlled flooding during the 1 in 100 year event (+40% CC).

Appendix F is attached to show MicroDrainage Summary of results and the Discharge Wizard result as evidence of the discharge rates achieved.

The attenuation storage tank provides a volume of 90m^3 and the results shows:

- No flooding for 1 in 1 year;
- No flooding and only allow surcharging for 1 in 30 years; and
- 3.3m^3 flooding for 1 in 100 years + 40% climate change across the site at a negligible depth of 0 m.

The surface water runoff rate is in accordance with the approved FRA and the surface water load on the public sewer will be reduced as a result of the proposed development. Therefore we do not envisage any capacity issues with the existing Thames Water DN250 combined sewer in Juniper Crescent.

A Section 106 Consent to Connect application will be submitted to Thames Water for the proposed connections to Thames Water sewers.

4.4 Foul Water Drainage Strategy

The total proposed foul water discharge rate for the Temporary Store is calculated as **1.6 l/s** by the Public Health Engineer. **(See Appendix G)**

In accordance with the overall site strategy, the foul water from the Temporary Store will be discharged via gravity prior connecting into the DN250mm combined sewer in Juniper Crescent.

As the proposed development will only be a single storey building, we consider there will be no sewer capacity issues due to the negligible flow rate and reduced surface water flow rate as mentioned above.

The foul water drainage strategy is shown in **Appendix E.**

A Section 106 Consent to Connect application will be submitted to Thames Water for the proposed connections to Thames Water sewers.

5. SCHEDULE OF MAINTENANCE

The maintenance of the SuDS features are to be as detailed below and in accordance with the CIRIA SuDS Manual C753. A specific management and maintenance plan will be produced at the detailed design phase, once details of the site specific sustainable drainage features to be incorporated have been finalised.

Along with the traditional pipes and manholes the designated SuDS features in this scheme are underground Geo-cellular storage and Petrol Interceptor. A flow control chamber with a Hydrobrake is also part of these works to restrict the discharge flow rate. Details of each system are provided below along with an associated maintenance schedule.

5.1 Drainage Pipes and Manholes

Drainage infrastructure covered in this section includes all privately owned manhole covers and surrounding pipework, gullies and drainage channels. Correct operation of this drainage infrastructure allows collection and transportation of water.

It is the responsibility of the Client to extend and maintain their drainage network.

Maintenance schedule	Required Action	Frequency
Before Start up	Removal of any inappropriate material from within the chamber and dispose off-site	At Start
	All pipe lines to be flushed with water to remove silt and check for blockages	At Start
Regular Maintenance	Removal of debris (which could include leaves, rubbish, branches) from areas served by drainage (where it may cause risk to performance)	Monthly
Remedial Actions	For blockages resulting in flooded manhole chambers, drain down manhole chamber and unblock	As required
	For pipe blockages, rod between access points to unblock	As required

Table 2: Maintenance Schedule for Drainage Pipes and Manholes

5.2 Geo-Cellular Storage Tank

The function of the Geo-Cellular attenuation storage is to collect and store water prior to discharging to the sewer off-site.

Table 3 refers to the maintenance procedure highlighted in the CIRIA SUDS Manual, table 21.3.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for three months, then annually
	Removal of debris from the catchment surface (where it may cause risk to performance)	Monthly
	Remove sediment from pre-treatment structures	Annually or as required
Remedial Actions	Repair of inlets, outlets, overflows and vents	As required
Monitoring	Inspect and check all inlets, outlets and vents to ensure that they are in good condition and operating as designed allowing surface water to be stored.	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Table 3: Maintenance Schedule for Geo-Cellular Attenuation Storage

5.3 Flow Control Chamber - Hydrobrake

The Hydrobrake is located at the end of the system to restrict flows surface water flows from the site.

Maintenance Schedule	Required Action	Frequency
Before Start	Removal of any inappropriate material from within the chambers and dispose off-site	At Start
Regular Maintenance (as per manufacturer's requirements)	Removal of debris (which could include leaves, rubbish and branches) from areas served by the drainage (where it may cause risk to performance)	Monthly
Remedial Actions	For blockages resulting in flooded manhole chambers, drain down manhole chamber and unblock	As required
Monitoring	Inspect unit and hose down is required	Monthly at the start for three months, then six monthly

Table 4: Maintenance Schedule for Hydrobrake Chamber

5.4 Petrol Interceptor

To prevent pollution, the petrol separators have been designed so that they are easily accessible and can be regularly maintained.

Every six months, or in accordance with the manufacturer's instructions, suitably experienced personnel should:

- Physically inspect the integrity of the separator and all mechanical parts
- Assess the depth of accumulated oil and silt
- Service all electrical equipment such as alarms and separator management systems
- Check the condition of any coalescing device and replace if necessary.

A detailed log of when the separator has been inspected, maintained, emptied or serviced should be kept. Specific records should be kept relating to the separator system including cleaning, repairs, accidents and incidents.

The separator should be emptied as soon as a significant quantity of oil and/or silt has built up. The retained waste, including the silt, must be removed and the separator refilled with clean water before being put back into service to prevent damage and to prevent oil passing through it.

In addition to the routine emptying of the separator, remedial emptying must be undertaken if oil or silt levels reach 90% of the storage volume and the alarm is activated.

Every five years the separators should be emptied and given a general inspection to test the integrity and performance of the system. The separator must be refilled with clean water following such an inspection.

Any material removed from the separator should be treated as waste and must be appropriately disposed of to ensure no pollution to the environment.

6. CONCLUSION

AECOM have prepared this Drainage Strategy to discharge Grant of Non-Material Amendments to planning permission Replacement Condition 47A for the Temporary Store in the PFS Site, set by London Borough of Camden. (Ref: 2019/0153/P).

The Drainage Strategy has been designed in accordance with best practice and only considers Temporary Store in the PFS Site. The Main Site of the development plot will be brought forward during a later development phase.

The surface water from the proposed development is discharged at a consented restricted flow rate prior to connecting the DN250Thames Water combined sewer.

The foul water from the Temporary will be discharged via gravity prior connecting into the DN250mm combined sewer in Juniper Crescent.

The maintenance of SuDS features is vital to ensuring they work as efficiently as they set out to do.

Appendix A Camden Goods Yard FRA & Drainage Strategy – June 2017

Camden Goods Yard

Flood Risk Assessment and Drainage Strategy

Safeway Stores Limited and BDW Trading Limited

Project Reference: 60493836

June 2017

Quality information

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1	2 June 2017	Draft for comment	MC	Barry Pegg	Technical Director
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4	29 June 2017	4th Draft	MC	Barry Pegg	Technical Director
5	29 June 2017	5th Draft	MC	Barry Pegg	Technical Director
6	5 October 2017	Amended following Consultee Comments	MC	Barry Pegg	Technical Director

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1. Introduction

AECOM Infrastructure & Environmental Limited (AECOM) was commissioned by Safeway Stores Ltd. and BDW Trading Limited ('the Applicant') to carry out a Flood Risk Assessment (FRA) and Drainage Strategy Report pertaining to the comprehensive redevelopment of the Morrisons supermarket and car park (MS parcel) and Petrol Filling Station (PFS parcel) (collectively known as 'the 'application site') situated off Chalk Farm Road in the London Borough of Camden (LBC).

The Applicant is seeking detailed planning permission for a residential led, mixed use development across the application site (hereafter referred to as the 'proposed development').

The overall proposed development would comprise residential units, a supermarket, petrol filling station, business & retail uses and associated landscaping and public realm improvements.

The quantum of proposed land uses is as follows:

MS parcel

- 573 residential units (ranging from studio to 4-bed units within private, affordable and accessible tenures) including 20 wheelchair accessible residential parking bays;
- 4,867 m^2 gross internal area (GEA) of office (B1) floorspace;
- 767 m^2 GEA workshop (B1c) floorspace;
- 565 m^2 GEA affordable workspace (B1c) floorspace;
- 19,963 m^2 GEA supermarket (A1) floorspace, including 300 parking bays and servicing space;
- 787 m^2 GEA retail (A1 and A3) floorspace;
- 86 m^2 GEA community centre (D2) floorspace;
- 1,298 m^2 GEA urban farm (sui generis) floorspace;
- 755 m^2 GEA of ancillary residential floorspace (gymnasium, concierge, community room, plant and parking); and
- 1,084 cycle parking bays.

PFS parcel

- 1,118 m^2 GEA petrol filling station (sui generis) floorspace;
- 1,627 m^2 GEA retail (A1, A3 and A4) floorspace inclusive of petrol filling station kiosk;
- 8,114 m^2 GEA office (B1) floorspace; and
- 329 m^2 GEA winter garden (sui generis) floorspace.

The application site covers an area of 3.26 hectares (ha) and is located in Flood Zone 1 and therefore has a low probability (less than 1 in 1000 year) of fluvial or tidal flooding.

As the application site is greater than 1 ha, a site specific FRA is required in line with the National Planning Policy Framework (NPPF) 2012[1] and accompanying Technical Guidance[2].

The FRA must assess all aspects of flood risk both to the proposed development itself and also in relation to the potential effect on people and property elsewhere within the surrounding catchment.

The proposed drainage strategy must assess the existing and proposed drainage at the application site and meet the requirements for surface run-off defined by the relevant legislation.

[1] National Planning Policy Framework, Department for Communities and Local Government (DCLG), 2012
[2] Technical Guidance to the NPPF, Department for Communities and Local Government (DCLG), 2012

1.1 Study Aims and Objectives

The overall objective of this study was to carry out a FRA and produce a Drainage Strategy Report that meets the requirements of the NPPF. The study is required to assess all aspects of flood risk to the proposed development, the potential impacts of the proposed development on people and property elsewhere within the catchment area and to identify possible mitigation measures to ensure that the development is safe in the event of a flood.

The study also assess the existing drainage conditions, the potential impacts of the proposed development on the existing drainage conditions, and identify Sustainable Drainage (SuDS) methods.

To achieve these aims, the following key actions were undertaken:

- Review topographical and flood risk data to identify the existing flood risk posed to the site from all sources;
- Assess the residual flood risk post-development;
- Assess the safety of the route of access/egress from the site in the event of any flood event;
- Identify suitable mitigation measures to protect the development site against flooding;
- Identify the existing drainage conditions; and,
- Propose a drainage strategy which provides betterment to the existing drainage conditions.

1.2 Scope of Works

In order to meet the above objectives, the following scope of work and tasks were undertaken:

Task	Name	Description
1	Data Collection	AECOM collected relevant available information on the nature of flooding and drainage at the site. The Applicant and the Architect have provided information about the Proposed Development layout and design.
2	Identification of the Current and Post-Development Flood Risk and Drainage Strategy.	The flood risk at the Site was assessed from the data that was collected in Task 1. The assessment identified flood risk from all potential sources of flooding and considered the impact of climate change. The existing drainage on Site was evaluated and a strategy for the Proposed Development was created.
3	Assessment of Site Safety	AECOM considered whether flood resilience measures need to be undertaken, the safety of the route of access/egress from the site and the impacts of the drainage strategy.

1.3 Data Collected

Table 1 lists the data that has been collected as part of this assessment.

Table 1: Collected Data

Purpose	Data and Source	Comments
Identification of site location	Ordnance Survey Map	Identifies the position of the site and local hydrological features
Identification of flood risk	Topographical Survey	Existing site levels and topography
	Development details (Drawings for Existing and Proposed Buildings)	Information on the layout of the Proposed Development
	Environment Agency Flood Maps	Risk of flood from tidal, fluvial and surface water sources
	London Borough of Camden, Strategic Flood Risk Assessment (SFRA), 2014[3] London Borough of Camden, Flood Risk Management Strategy (FRMS), 2013[4]	Reports that identify existing flood risk information within the borough and considerations for development.
	Sirius Geotechnical and Environmental, Geoenvironmental Appraisal, June 2010[5] Ramboll Environ, Preliminary Risk Assessment, November 2016[6]	Site specific data including ground investigation
Identification of existing drainage network	Thames Water Asset Plan	Asset plans identify public sewers nearest to the site.
	The Survey Association, Topographical Survey, 2015 Tower Surveys, Topographical and Drainage Survey, 2010	Existing site levels and drainage network

2. Site Description

2.1 Proposed Development

The proposed development comprises of the demolition of the existing building structures on both the MS and PFS parcel which are to be replaced with a residential led development (573residential units), mixed use scheme which includes a supermarket, petrol filling station, business and retail uses, part basement carpark (approximately providing 300 parking spaces) and associated landscaping and public realm improvements. A plan of the proposed development is included in Appendix D.

2.2 Site Location

The application site is located adjacent to Chalk Farm Road in the LBC and is formed of two interconnected parcels of land. . Both parcels are predominantly rectangular in shape and have an approximate total size of 3.26ha. The application site has an approximate National Grid Reference (NGR) of 528469E and 184160N.

The application site is spatially separated by an elevated railway track but connected via an access road which runs underneath the railway line. The northern parcel of the application site, which lies at a lower topography, is occupied by a Morrison's Petrol Filling Station (PFS) with easy access for vehicles and pedestrians.

The southern parcel of the application site is currently occupied by a large Morrisons supermarket (MS parcel) and servicing car park, with postcode NW1 8AA, with only one road access point to the north and three pedestrian access points.

The application site is situated on a raised platform that is at the same topographic level as the surrounding railway lines and Gilbeys Yard (see Appendix A).

[3] London Borough of Camden, Strategic Flood Risk Assessment, 2014
[4] London Borough of Camden, Flood Risk Management Strategy, 2013
[5] Sirius Geotechnical and Environmental Ltd., Geoenvironmental Appraisal, 2010
[6] Morrisons Site Chalk Farm, Ground Contamination Interpretive Report, Ramboll Environ, 2016

Access to the application site is via Juniper Crescent, off Chalk Farm Road. This road passes underneath the railway line to the north east of the application site, under a bridge known as Southampton Bridge. The road then rises by approximately 6 meters (m) to reach the platform on which the proposed development would sit.

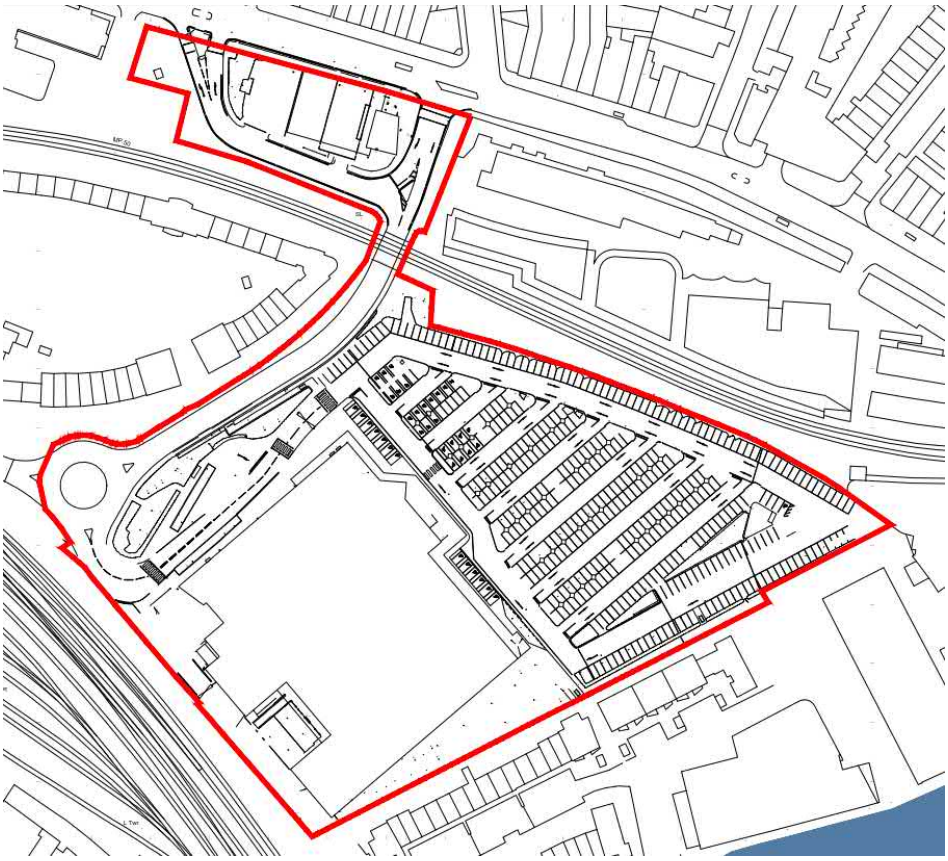

Figure 1. Plan of the Existing Site

The site is bound to the north-east and south-east by railway lines servicing London Euston to the east. Juniper Crescent, the access road serving the site, runs along the northwest boundary. Finally, the rear gardens of the houses on Gilbeys Yard and the Interchange building are located along the south-east boundary.

In addition, the eastern corner of the site abuts the Horse Tunnel Market. This section of the market is below ground level in this area and the MS parcel's car park extends over the roof of the market in this area.

Table 2: Summary of the application site boundaries and features.

Direction	Summary
North East	Railway lines on the Camden Road Station branch, sitting on top off the vaults forming part of the Stables Market.
East	Horse Tunnel Market (below ground).
South East	Rear gardens to houses on Gilbeys Yard, plus the Interchange Building.
South West	Main line railway lines into London Euston Station, together wind vaults under the railway lines at the southern end of this boundary.
North West	Juniper Crescent, with residential development beyond

2.3 Site Topography

The MS parcel is relatively flat with no clearly visible dips or hills. Elevations across the MS parcel ranges from approximately 32.82m to 34.21m Above Ordnance Datum (AOD) with a slope trending from the high point in the north-west to the low point in the south-east. The Juniper Crescent access road has an approximate elevation of 32.89m near the roundabout which falls down to approximately 27.15m near the railway overpass. This gives an approximate fall of 6m between the MS Parcel and the PFS.

The PFS parcel is relatively flat with no clearly visible dips or hills. Elevations range from 27.33m to 28.24m AOD with small gradient falling from the north-west to the south-east.

2.4 Site Geology and Hydrogeology

A Geoenvironmental Appraisal was undertaken in 2010 by Sirius Geotechnical and Environmental. A further investigation was undertaken by Ramboll Environ in 2016.

According to the Geoenvironmental Appraisal the application site lies above a layer of made ground with approximate depths of 1.1m - 8.1m below ground level (bgl). A layer of the London Clay formation was found under the layer of made ground with low to medium strength. This is confirmed by the Ramboll investigation which tested down to a maximum depth of 7m bgl and identified the made ground to be between 3m – 7m in thickness.

Sirius Geotechnical and Environmental supervised an intrusive ground investigation of the MS parcel for Wm Morrisons Supermarket Plc in 2010 and presented their results in the Geoenvironmental Appraisal. As part of the investigation, exploratory boreholes BH1, BH2 and BH3 where used to provide geotechnical parameters of the deeper soils. The locations and findings of these boreholes are presented in Appendix B.

The surface layer encountered during the intrusive investigation consisted of either hardstanding in the form of tarmac or concrete paving slabs to a maximum thickness of 0.4m. Underneath this surface layer, the remaining made ground consisted of a mixture of granular bricks, concrete, flint and slightly sandy slightly gravelly clay at depths of between 1.1m – 2.4m bgl at BH1 and between 6.75m – 8.1m bgl at BH2 and BH3.

Underlying this layer of made ground, the London Clay Formation was encountered of thickness greater than 35m. The London Clay consisted predominantly of stiff sandy clay with occasional gravel or flint. The London Clay formation is classed as a non-aquifer and as unproductive strata with low permeability. This layer is regarded as containing negligible amounts of groundwater.

These findings are confirmed by the borehole data provided by the British Geological Survey's (BGS) geology of Britain viewer[7]. The nearest BGS borehole is located south-west of the site near the railways. The borehole data indicates made ground with an approximate thickness of 5.5m bgl with underlying London Clay of approximate thickness 45m.

Reported in both the Geotechnical Appraisal and Ramboll investigation, groundwater was encountered at various depths with perched groundwater found at depths of 3m - 5m bgl rising to a maximum elevation of 2.7m bgl 20 minutes after being struck. Groundwater was also found at depths of 22.5m - 23.6m in the London Clay Formation.

The application site is not located in a groundwater Source Protection Zone (SPZ); with the closest being a SPZ 2 located approximately 400m south-west of the Site. SPZs typically are centred on boreholes which abstract groundwater for potable uses.

2.5 Site Hydrology

The closest water course to the application site is the Grand Union Canal (Regent's Canal) which is located approximately 125m to the south and runs in an east-west direction. The River Thames is located approximately 4.2km south-east of the application site at its closest proximity.

[7] British Geological Survey, Geology of Britain Viewer (Source: http://mapapps.bgs.ac.uk/geologyofbritain/home.html?)

The LBC Strategic Flood Risk Assessment (SFRA) indicates that the application site lies within a Critical Drainage Area (CDA) and adjacent to the Local Flood Risk Zone (LFRZ) of Primrose Hill, which are shown in Appendix C.

CDAs are defined as *"discrete geographic areas where multiple and interlinked courses of flood risk cause flooding in one or more Local Flood Risk Zones (LFRZ) during severe weather"*. A LFRZ is defined as *"a discrete area of flooding that does not exceed the national criteria for a 'Flood Risk Area' but still affects property"*.

3. Planning Policy

3.1 National Policies

3.1.1 National Planning Policy Framework and accompanying Technical Guidance

The National Planning Policy Framework (NPPF) sets out what needs to be taken into account by developers to assess whether a proposed development is likely to be at risk of flooding or has the potential to increase flood risk elsewhere.

The overall objective of the policy is to reduce flood risk through development opportunities. The policy aims to ensure that flood risk has been taken into account and appropriate measures put in place to ensure that:

- The development is safe;
- Where possible, the flood risk overall is reduced;
- Increased flood risk does not occur elsewhere; and
- Appropriate mitigation measures are employed to deal with these effects and risks.

Paragraph 103 states that:

> *"A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding."*

The EA Flood Map shows the Proposed Development to be located within Flood Zone 1. As the site is larger than 1 hectare in area, a FRA is required to demonstrate that the Proposed Development is safe and that it will not increase flood risk in the surrounding area.

The NPPF considers the vulnerability of different forms of development to flooding; in this case, the Proposed Development is classified as 'More Vulnerable'. Being in Flood Zone 1; under NPPF guidelines the Proposed Development is considered appropriate.

The Technical Guidance to the NPPF states:

> *"For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless the factors above or other local considerations require particular attention."*
>
> *"In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems."*

3.1.2 Climate Change

The ''Flood risk Assessments: Climate Change Allowances Guidance[8]'' published in February 2016 by the EA indicates that climate change is currently expected to result in increased peak rainfall and rising sea levels. Table 3 shows anticipated changes in extreme rainfall intensity in small and urban catchments within England. One hundred years is an appropriate design life for residential developments which corresponds to the year 2115 in the Table below.

Table 3: Peak Rainfall Intensity Allowance in Small and Urban Catchments.

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

3.2 Regional Policies

3.2.1 The London Plan

The London Plan is a strategic plan for London which sets out an integrated economic, environmental, transport and social framework for developments over the next 20-25 years[9]*."*

The London Plan, 2016[10][11] contains the following relevant policies to flood risk:

3.2.1.1 Policy 5.11 – Green Roofs and Development Site Environs

Planning Decision

> *"A Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:*
>
> *a. Adaptation to climate change (i.e. aiding cooling);*
>
> *b. Sustainable urban drainage;*
>
> *c. Mitigation of climate change (i.e. aiding energy efficiency);*
>
> *d. Enhancement of biodiversity;*
>
> *e. Accessible roof space;*
>
> *f. Improvements to appearance and resilience of the building;*
>
> *g. Growing food."*

3.2.1.2 Policy 5.12 – Flood Risk Management

Strategic

> *A. "The Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way"*

[8] Flood risk assessments: climate change allowances Guidance, 2016 (Source: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)
[9] What is the London Plan (Source: https://www.london.gov.uk/what-we-do/planning/london-plan/current-london-plan/london-plan-overview-and-introduction)
[10] The London Plan: Spatial Development Strategy for Greater London, Greater London Authority (GLA), 2015
[11] The London Plan: The Spatial Development Strategy for London Consolidated with Alternation since 2011, Greater London Authority (GLA), 2016

Planning Decision

B. "Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated Technical Guidance on Flood Risk over the lifetime of the development and have regards to the measures proposed in the Thames Estuary 2100 and Catchment Flood Management Plans."

C. "Developments which are required to pass the Exceptions Test set out in the NPPF and the Technical Guidance will need to address flood resilient design and emergency planning by demonstrating that:

a. The development will remain safe and operational under flood conditions

b. A strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions

c. Key services including electricity, water etc. will continue to be provided under flood conditions

d. Buildings are designed for quick recovery following a flood."

D. "Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way."

3.2.1.3 Policy 5.13 - Sustainable Drainage

"Development should utilise SuDS [Sustainable Drainage Systems] unless there are practical reasons for not doing so and should aim to achieve Greenfield run-off rates and ensure that surface water runoff is managed as close to its source as possible in line with the following drainage hierarchy:

- *Store rainwater for later use;*
- *Use infiltration techniques, such as porous surfaces in non-clay areas;*
- *Attenuate rainwater in ponds or open water features for gradual release;*
- *Attenuate rainwater by storing in tanks or sealed water features for gradual release;*
- *Discharge rainwater direct to a watercourse;*
- *Discharge rainwater to a surface water sewer/drain; and*
- *Discharge rainwater to the combined sewer."*

3.2.1.4 Policy 5.14 - Water Quality and Wastewater Infrastructure

Strategic

A. "The Mayor will work in partnership with the boroughs, appropriate agencies within London and adjoining local planning authorities to:

a. Ensure that London has adequate and appropriate wastewater infrastructure to meet the requirements placed upon it by population growth and climate change

b. Protect and improve water quality having regard to the Thames River Basin Management Plan."

Planning Decisions

B. "Development proposals must ensure that adequate wastewater infrastructure capacity is available in tandem with development. Proposals that would benefit water quality, the delivery of the policies in this Plan and of the Thames River Basin Management Plan should be supported while those with adverse impacts should be refused.

C. *Development proposals to upgrade London's sewage (including sludge) treatment capacity should be supported provided they utilise best available techniques and energy capture.*

The development of the Thames Tideway Sewer Tunnels to address London's combined sewer overflows should be supported in principle".

3.2.2 The Mayor's Water Strategy

The Mayor's Water Strategy, 2011[12] details ways in which present water resources could be used more effectively in order to tackle problems such as water supply, wastewater generation and flood risk across London. 'Actions' of relevance to water resource and flood risk issues are:

- Action 5 aims to make properties more water efficient. The strategy aims to raise awareness of efficient commercial (non-domestic) water use and encourages commercial users to set internal targets and best practice benchmarks for water use reduction. Thames Water estimates that, overall, commercial demand will grow by 8% over the next 25 years. The policy recognises that a significant proportion of commercial water use is from the services sector (for example 16% from hotels, bars and restaurants) and it therefore holds significant potential to save water. A number of water saving technologies are outlined, such as the replacement of urinals with waterless varieties; and
- Action 18 encourages the use of green roofs, rainwater harvesting, grey water recycling and sustainable drainage to relieve pressure on drainage systems, thereby reducing flood risk and water demand.

3.2.3 Thames Catchment Flood Management Plan

The Thames Catchment Flood Management Plan (CFMP), 2009[13] provides an overview of the flood risk across the Thames catchment and provides relevant policies regarding flood management. As identified within the CFMP, the application site is located in Sub-area 9 'London catchments'. To be consistent with the visions of the CFMP, the proposed actions and policies for this sub-area relevant to the proposed development are:

- *"We will continue to make sure the recommendations in Strategic Flood Risk Assessments and Local Development Framework policies create the potential to reduce flood risk through regeneration.*
- *We will play our part in adopting a strategic approach to planning so that wider community objectives as well as flood risk objectives can be met.*
- *We will develop our emergency response planning to deal with extreme floods, including raising public awareness and working with key partners to identify critical infrastructure at flood risk.*
- *We want to continue to maintain the existing flood defences and when redevelopment takes place, replace and improve them so that they are more effective against the impacts of climate change. We will be looking to remove culverts and other structures that cause significant conveyance problems. An example of this is our work in the Ravensbourne catchment.*
- *With our partners, we will look for opportunities to reduce flood risk by recreating river corridors in urban areas. We will influence people who shape the urban environment and harness these opportunities, allowing space for water, habitat, wildlife and recreation."*

3.2.4 Sustainable Design and Construction, Supplementary Planning Guidance

The Greater London Authority has produced the Sustainable Design and Construction, Supplementary Planning Guidance (SPG), 2014[14] which offers recommendations to developers and sets expectations to incorporate Sustainable Urban Drainage Systems (SuDS) as a means to reduce flood risk and mitigate increases in surface water run-off.

[12] Securing London's Water Future - The Mayor's Water Strategy, Greater London Authority (GLA), 2011
[13] Thames Catchment Management Plan, Her Majesty's Stationery Office, 2009
[14] Supplementary Planning Guidance – Sustainable Design and Construction, Greater London Authority (GLA), 2014

The following clauses provide relevant information regarding flooding and surface water:

Clause 3.4.2

> *"It is important to incorporate sustainable drainage in all developments to prevent the increasing volume of surface water runoff during heavy rainfall. Surface water flooding is the most likely form of flooding that development may be exposed to. Surface water flooding is likely to increase due to the anticipated increased intensity in rainfall events as well as the continuing urbanisation of London. For small developments, including those that do not require planning permissions, simple measures can include draining impervious surfaces to a landscaped area of the garden or to a soak away or installing a water butt to collect water from an existing or new impervious roof. It is essential to consider how SuDS measures will be incorporated at the initial design stage, especially when the National Standards for SuDS are introduced."*

Clause 3.4.12

> *"The capture and storage of rainwater for later use is always the priority in order to also meet the objective of making efficient use of water resources. Where there are no opportunities to collect and reuse rainwater, the site, where practical should drain to the ground to recharge groundwater resources. Where infiltration is not possible, surface water should be stored on-site in open water features such as ponds and wetlands and then released at a controlled rate. The final option is to store surface water in tanks or cellular storage before it is released at a controlled rate. This is the least preferable storage option as it does not provide wider sustainability benefits such as habitat provision or water quality improvements."*

Clause 3.4.13

> *"Development should utilise SuDS unless there are practical reasons for not doing so. The aspiration is to deliver SuDS schemes that provide multiple benefits, in addition to reducing flood risk. The most beneficial schemes will successfully contribute to the delivery of the Water Framework Directive by reducing water pollution and providing additional valuable habitat to improve the status of our water bodies. SuDS schemes should also aim to improve amenity, and therefore the quality of life of Londoners, as well as contribute to the wider goals relating to green infrastructure, biodiversity, water efficiency and recreation."*

Clause 3.4.18

> *"Drainage designs incorporating SuDS measures should include details of how each SuDS feature, and the scheme as a whole, will be managed and maintained throughout its lifetime. When published the National Standards for sustainable drainage systems should be followed with additional consideration given to the issues associated with the constrained nature and abundance of below ground services on London sites. These SuDS will be reviewed by, and require permission from SuDS Approval Bodies administered by the boroughs."*

3.3 Local Policies

3.3.1 Strategic Flood Risk Assessment

LBC produced a Strategic Flood Risk Assessment (SFRA) in 2014 with the most up-to-date information regarding the risk the LBC faces from flood sources, including tidal and fluvial, surface water, sewer, groundwater and artificial.

According to the SFRA, the entirety of LBC is located within Flood Zone 1 which indicates the flood risk from tidal and fluvial sources is less than a 0.1%(1 in 1000) chance of occurring each year.

The SFRA states that for all proposed developments greater than 1 ha in size and located within Flood Zone 1, a site specific FRA is required to ensure that surface water generated by the proposed development is managed in a sustainable manner and does not increase the burden on the existing infrastructure and/or flood risk to neighbouring properties.

3.3.2 Camden Core Strategy

The LBC has produced a Core Strategy which helps define and plan the future of the borough by providing a vision and objective for developers as well as balancing the social and environmental needs of residents, businesses and future generations.

Policy 'CS13 – Tackling climate change through promoting higher environmental standards'[15] deals with 'Water and surface water flooding' and states:

> *"We will make Camden a water efficient borough and minimise the potential for surface water flooding by:*
>
> *1. Protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;*
>
> *2. Making sure developments incorporate efficient water and foul water infrastructure;*
>
> *3. Requiring development to avoid harm to the water environment, water quality or drainage system and prevent or mitigate local surface water and downstream flooding, especially in areas uphill 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."*

3.3.3 Draft Camden Local Plan

The LBC have produced a draft Local Plan[16] which sets out the planning policies which will replace the current 2010 Core Strategy and Development Policies planning documents. The Local Plan is still a draft and is due to be adopted in the summer of 2017. The following policies within the plan are relevant to flood risk and drainage.

> "Policy CC2 Adapting to climate change*The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:*
>
> *a. The protection of existing green spaces and promoting new appropriate green infrastructure;*
>
> *b. Not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;*
>
> *c. Incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and*
>
> *d. Measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.*
>
> *Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.*
>
> ***Sustainable design and construction measures***
>
> *The Council will promote and measure sustainable design and construction by:*
>
> *e. Ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;*
>
> *f. Encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;*
>
> *g. Expecting developments (conversions/extensions) of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and*
>
> *h. Expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019."*

[15] Camden Core Strategy 2010-2025, Local Development Framework, 2010
[16] Camden Local Plan, Submission Draft, 2016

"Policy CC2 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a. Incorporate water efficiency measures;

b. Avoid harm to the water environment and improve water quality;

c. Consider the impact of development in areas at risk of flooding (including drainage);

d. Incorporate flood resilient measures in areas prone to flooding;

e. Utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy, unless inappropriate, to achieve a greenfield run-off rate where feasible; and

f. Not locate vulnerable development (such as basement dwellings) 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."

3.3.4 Draft Camden Goods Yard Planning Framework

The LBC has also produced a Draft Planning Framework, for the Camden Goods Yards, 2017[17], which not only includes the existing Morrisons supermarket but also Gilbeys Yard, Juniper Crescent and the Network Rail land to the east of the application site. The draft planning framework is due to be adopted in the summer of 2017 and sets out the LBC council's visions and key objectives in this area with input from the public and local stakeholders.

It is stated in the draft report that new developments should use the SuDS hierarchy to try and achieve greenfield run-off rates and also to be designed to address the areas of flood risk identified in the LBC SFRA. Changes in level across the applications site should be designed to minimise the risk of increased surface water run-off.

It is also stated that the Council will support green infrastructure such as green roofs and drought resistant planting that mitigates flood risk, improves biodiversity and provides shade.

4. Existing Flood Risk

This section of the report identifies the potential sources of flooding at the application site.

4.1 Fluvial and Tidal Flooding

The SFRA states that the entirety of LBC is located within Flood Zone 1 which is defined as having an annual chance of flooding from tidal and fluvial sources as less than 0.1 % (1 in 1000).

The closest source of fluvial or tidal flooding to the application site is the River Thames, approximately 4.2km to the south of the application site, whose extents of flooding do not pose a threat to the application site.

According to the SFRA, the Environment Agency's (EA) Historic Flood Map shows no flooding has occurred in the LBC from fluvial or tidal sources. Therefore, the flood risk from fluvial and tidal sources to the application site is assessed as low.

4.2 Surface Water Flooding

Surface water flooding typically occurs after periods of intense rainfall that is not able to infiltrate to the ground or enter a drainage system which can result in localised flooding / pooling of rainwater.

[17] Camden Goods Yard, Draft Planning Framework, 2017

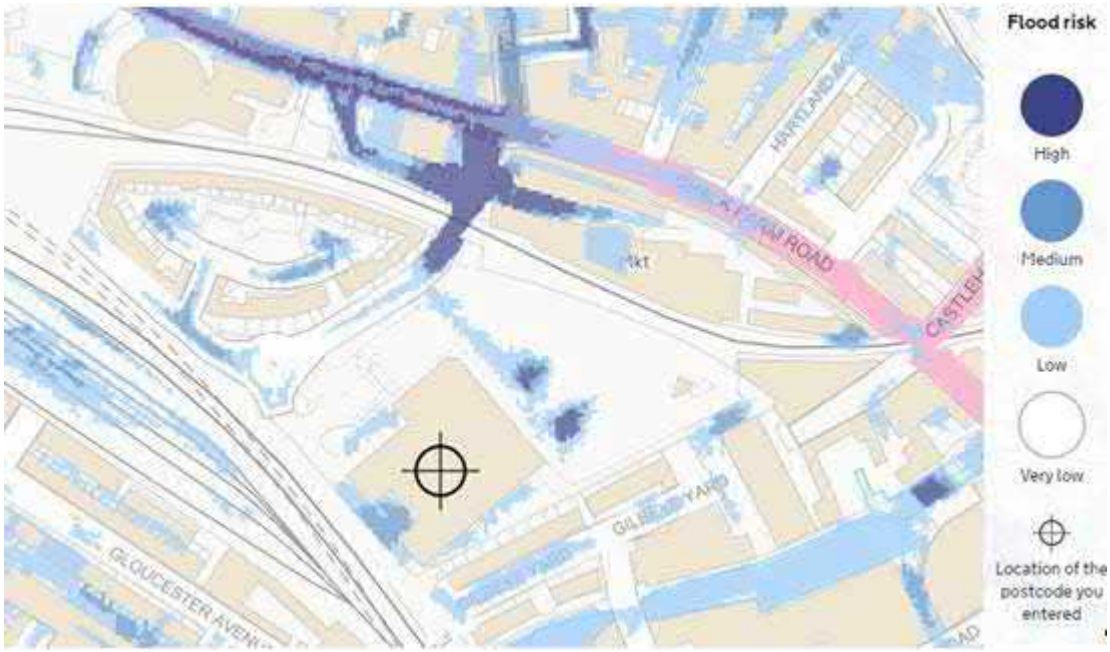

Figure 2. Map Showing Flood Risk from Surface Water

The EA flooding map (Figure 2) indicates the extents of potential surface water flooding at the application site as follows:

- High risk flooding as shown along Juniper Crescent access road and in the centre of the application site occurs as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%);
- Medium risk flooding as shown along Juniper Crescent access road and to the south of the MS parcel occurs as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year; and
- Low risk flooding as shown in the centre of the MS parcel and PFS parcel occurs as a result of rainfall of between 1 in 1000 (0.1%) and 1 in 100 (1%) chance in any given year.

Figure 2 indicates a limited amount of surface water pooling in the existing MS parcel during medium and low risk events. The lower section of the access road underneath the overhead railway bridge floods during high risk (1 in 30 year) rainfall events.

The high risk areas of surface water flooding are linked to the highway underbridge and pooling affects both the access road to and areas on the PFS parcel.

The flood risk from surface water is assessed to be medium.

4.3 Sewer Flooding

The application site is currently served by combined sewers which run across the application site from the south-west and east which eventually merge and run below the access road towards Chalk Farm Road. This is a Thames Water Utilities Ltd (TWUL) sewer of ranging dimensions from 610 x 457mm to 1524 x 914mm. The TWUL Assets Plans are included in Appendix E.

The risk of sewer flooding is difficult to predict and is dependent on the localised conditions during storm events that that result in high intensity rainfall where sewer capacity is exceeded and when there are blockages within the sewer system. Sewer flooding can result in short term localised flooding.

The Water Services Regulation Authority (OFWAT) regulates water companies who operate sewerage systems in England and Wales. As part of the regulation process water companies report on specific aspects of their performance. One of these is the Director General of Water Services DG5 list which records internal and external flooding of property from sewers over the preceding decade.

The DG5 records, provided by Thames Water, shown in the LBC Surface Water Management Plan (SWMP)[18], 2011, identify areas at the highest risk of sewer flooding. The records show a significant number of sewer flooding incidents in Camden Town and the Hampstead Area. The application sites postcode of NW1 8AA falls within an area at higher risk of sewer flooding with more than 51 recorded sewer flooding incidents and 190 individual properties affected within the NW1 8 area in the decade prior to 2011.

The DG5 External and Internal Sewer Flooding maps shown in Appendix F indicate that the application site does not have a recorded historic event of sewer flooding, either internally or externally.

Therefore the flood risk from sewers is assessed to be low.

4.4 Groundwater Flooding

Groundwater flooding typically occurs when the groundwater levels rise above the ground level due to prolonged rainfall events. Groundwater flooding mostly occurs in low lying areas with underlying permeable geology and the effects can be long lasting.

The application site strata consists of a layer of made ground (with no underlying superficial deposits) above the London Clay Formation which has low permeability and is typically associated with low risk of ground water flooding.

In the majority of groundwater flooding incidents, the soil strata is not uniform and may contain gravelly deposits which act as conduits for groundwater movement.

The SFRA indicates that there have been no historical groundwater flooding events near the application site. The Flood Risk Management Strategy (FRMS) states that the overall risk of groundwater flooding is low for the LBC. The groundwater flood risk map for the Borough from the FRMS is included as Appendix G.

The flooding risk from groundwater is assessed to be low.

4.5 Flooding from Artificial Sources

Artificial sources of flooding include raised channels such as canals, or storage features such as ponds and reservoirs. The closest artificial source to the application site is the Grand Union Canal (Regent's Canal) located approximately 50m to the south-east of the Site.

The water levels in the Regents Canal are controlled by the Canal and River Trust and for this reason they are considered to pose a minimal risk of flooding. The closest reservoirs to the application site are the interlinked ponds at Hampstead Heath approximately 2km to the north. No reservoir flood extents affect the application site.

Therefore the flood risk from artificial sources is assessed to be low.

4.6 Summary of Existing Flood Risk

The existing flood risk from all sources to the Proposed Development has been summarised in Table 4.

Table 4: Summary of Existing Flood Risk to the Proposed Development

Type of Flooding	Source of Flooding	Existing Flood Risk
Tidal	River Thames	Low
Fluvial	Fluvial watercourses	Low
Surface water	Runoff from surrounding land	Medium
Sewers	Surrounding TWUL combined drainage systems	Low
Groundwater	Underlying geology and groundwater levels	Low
Reservoir	Grand Union Canal (Regent's Canal)	Low

[18] Surface Water Management Plan, London Borough of Camden, 2011

5. Future Flood Risk

This section of the FRA identifies the sources of flood risk both to and from the application site after the proposed development has been constructed and is operational.

The overall proposed development would comprise residential units, a supermarket, petrol filling station, business & retail uses and associated landscaping and public realm improvements.

The quantum of proposed land uses is as follows:

MS parcel

- 573 residential units (ranging from studio to 4-bed units within private, affordable and accessible tenures) including 20 wheelchair accessible residential parking bays;
- 4,867 m^2 gross internal area (GEA) of office (B1) floorspace;
- 767 m^2 GEA workshop (B1c) floorspace;
- 565 m^2 GEA affordable workspace (B1c) floorspace;
- 19,963 m^2 GEA supermarket (A1) floorspace, including 300 parking bays and servicing space;
- 787 m^2 GEA retail (A1 and A3) floorspace;
- 86 m^2 GEA community centre (D2) floorspace;
- 1,298 m^2 GEA urban farm (sui generis) floorspace;
- 755 m^2 GEA of ancillary residential floorspace (gymnasium, concierge, community room, plant and parking); and
- 1,084 cycle parking bays.

PFS parcel

- 1,118 m^2 GEA petrol filling station (sui generis) floorspace;
- 1,627 m^2 GEA retail (A1, A3 and A4) floorspace inclusive of petrol filling station kiosk;
- 8,114 m^2 GEA office (B1) floorspace; and
- 329 m^2 GEA winter garden (sui generis) floorspace.

5.1 Fluvial and Tidal Flooding

The application site is located within Flood Zone 1 as defined by the EA, which is equivalent to an annual flood risk from fluvial and tidal sources of less than 0.1% (1 in 1000).

The risk imposed by the proposed development will not affect the existing flood risk for fluvial and tidal sources in the surrounding area and therefore the flood risk from fluvial and tidal sources remains low.

5.2 Surface Water Flooding

In accordance with Policy 5.13 of the London Plan, development should provide betterment to potential flood risk deriving from surface water runoff by implementing the use of SuDS.

The Drainage Strategy (refer to Section 6 of this FRA) for the proposed development shows that surface water runoff from the application site would be restricted to the 3 times Greenfield runoff rate, providing betterment compared to the existing peak surface water runoff rate.

There would be a residual risk of surface water flooding at the application site if the surface water drainage network is not maintained correctly. The on-site drainage would be managed by a dedicated management company who will be responsible for maintaining all on-site services including drainage. To comply with the Flood

and Water Management Act 2011[19] any off-site drainage will be put forward for adoption by TWUL. A maintenance regime is presented in Appendix H.

Considering the appropriate surface water drainage measures to be implemented, the proposed development would provide betterment to the existing risk of flooding from surface water. The risk of surface water flooding once the proposed development is operational is assessed as low.

5.3 Sewer Flooding

Sewer flooding can occur as a result of blocked sewers or failed pumping stations. The Site is served by TWUL combined sewers for the discharge of both surface and foul water.

Although foul water production would increase once the proposed development is operational, this is compensated for by a greater reduction in the peak surface water run-off rate. Therefore there would be a significant reduction in the peak combined flow rate off the application site which offers a benefit to the receiving Thames Water combined sewers in the locality (including Juniper Crescent, Chalk Farm Road and within the application site itself).

It is recommended that the proposed development should utilise water efficient fixtures and fittings to reduce the effect on the TWUL combined sewer network by reducing the volume of discharged flow.

In the long-term, it is the responsibility of TWUL to extend and maintain the drainage network and sewage treatment works to cope with additional demand as a result of the proposed development. TWUL implements a five year development plan to maintain and enhance the sewer network and treatment process to incorporate any future development needs based upon the approved development plans presented by LBC.

Considering the appropriate drainage measures to be put in place, the risk of sewage flooding to the proposed development once operational is assessed to remain low.

5.4 Groundwater Flooding

Groundwater flooding occurs when groundwater levels rise above the ground level. The application site is underlain by made ground and the London Clay Formation which is classed as a non-aquifer and defined as unproductive strata with low permeability.

The site-specific ground investigation completed by Sirius Geological and Environmental states that the groundwater levels measured on the application site are approximately 20.8m bgl within the London Clay, with perched groundwater seepage measured at approximately 4.6m bgl within the made ground.

The 2016 Ramboll Environ Preliminary Risk Assessment established that groundwater was encountered at between 4.40m and 5.00m bgl within the Made Ground and between 22.50m and 23.60m bgl within the London Clay. Subsequent groundwater monitoring visits recorded groundwater levels of between 1.15m and 20.80m bgl.

The deep groundwater poses no future risk to the proposed development.

The Proposed Development would include basement levels 1 and 2, with the finished floor level of basement level 2 proposed to be +24m AOD, approximately 9m below existing ground level.

The existing Morrisons supermarket is at an elevation approximately 8m above the Regents Canal and 6m above the ground levels at the railway underbridge on Juniper Crescent. Therefore the shallow perched groundwater recorded on site is not in hydraulic connectivity with the wider catchment.

The proposed basement would be waterproofed to the appropriate standard specified within BS 8102:2009[20]. Any interaction between the proposed basement and the perched groundwater is assessed to be both minor and temporary resulting in a negligible effect.

Therefore, it is assessed that the proposed development would not affect the existing risk of groundwater flooding at the application site, which remains low.

[19] Flood and Water Management Act 2010, Her Majesty's Stationery Office, 2010
[20] Ref 14. BS 8102:2009 Code of practice for protection of below ground structures against water from the ground

5.5 Flooding from Artificial Sources

The proposed development will not affect the existing flood risk from artificial sources which remains low due to the distance to the nearest recognised reservoir.

5.6 Summary of Future Flood Risk

Table 5 summarises the potential impact of the proposed development on the risk of flooding and indicates whether any mitigation is required.

Table 5: Summary of Future Flood Risk.

Type of Flooding	Source of Flooding	Flood Risk as a Result of the Propose Development	Mitigation required?
Tidal	River Thames	None – located in Flood Zone 1	No
Fluvial	Fluvial watercourses	None – located in Flood Zone 1	No
Surface water	Runoff from the Site and surrounding land	Additional runoff due to climate change	Yes, surface water attenuation required
Sewers	TWUL combined drainage systems	Increase in flow to sewer system	Yes, peak combined flow is reduced. A maintenance regime for private sewers will be implemented
Groundwater	Underlying geology and groundwater levels	None	Basement waterproofing in accordance with BS 8102
Canal	Grand Union Canal (Regent's Canal)	None	No

This flood risk assessment identifies a low risk of flooding from all sources once the proposed development is complete and operational. This includes both the flood risk to other off site areas as a result of the proposed development as well as the risk to the completed development itself.

6. Drainage Strategy

6.1 Existing Drainage

The application site is served by a combined TWUL sewer network (refer to Appendix E for TWUL Asset Plan).

The TWUL Asset Plans show that a combined sewer with a diameter of 1143 x 762mm runs beneath the application site from the south-west, beneath the railway tracks, and onto the application site in a north-easterly direction which combines with lateral drains, before changing to a diameter of 1524 x 914mm.

A second TWUL combined sewer is located to the east of the application site which runs under the Gilgamesh restaurant and the railway track and has a diameter of 450mm. This sewer then continues to the west with a diameter of 1372 x 914mm and merges with the 1524 x 914mm sewer. This sewer also receives flow from a 610 x 457mm combined sewer which is believed to have formerly served the adjacent plot at Gilbeys Yard.

Once the two combined sewers have merged, the sewer then continues west beneath the access road and then runs north under Southampton Bridge to discharge to an 1855 x 1804mm combined sewer at Chalk Farm Road.

There are various manholes and existing connections along the run of TWUL sewers beneath the application site, as indicated by the numerous site drainage plans assessed.

6.1.1 Existing Surface Water Discharge

The proposed development has an approximate total area of 3.26ha. The existing application site consists mostly of an area of hardstanding with minimal areas of soft landscaping. Both of these areas contribute to the total amount of surface water run-off and are presented in Table 6.

Table 6: Existing Equivalent Runoff Area

Site	Area Type	Existing Area (m^2)	Runoff Coefficient	Equivalent Runoff Area (m^2)
MS parcel	Impervious Roof & Hardstanding	24,502	0.95	23,277
	Green Roof	0	0.8	0
	Other Semi-Pervious Surfaces	0	0.8	0
	Soft Landscaping	2,722	0.25	681
	TOTAL	**27,224**	**-**	**23,957**
PFS parcel	Impervious Roof & Hardstanding	3,930	0.95	3,734
	Green Roof	0	0.8	0
	Other Semi-Pervious Surfaces	0	0.8	0
	Soft Landscaping	0	0.25	0
	TOTAL	**3,930**	**-**	**3,734**

The current design standard set within the Building Regulations Part H[21] is for no flooding during a 1 in 30 year rainfall event. This relates to a 50mm/hr rainfall event for the south-east of England, and approximately equates to 0.014l/s/m².

For the MS parcel, with an equivalent runoff area of 23,957m², the existing peak surface water run-off rate is approximately **335.4l/s**, and for the PFS Parcel, this equates to approximately **52.3l/s**. Therefore, the total existing approximate surface water run-off rate for the application site is **387.7l/s**.

6.1.2 Existing Foul Water Discharge

The application site is currently served by a TWUL combined sewer which predominantly runs underneath the carpark of the MS parcel to the north-east, where it then continues beneath the access road past the PFS parcel and onto Chalk Farm Road.

The existing Morrison supermarket has an area of approximately 7,225m² and the existing PFS store has an approximate footprint of 125m². The CIRIA C657 Water Key Performance Indicators and Benchmarks for Offices and Hotels[22] provide a benchmark of 2.4l/m²/day of foul water that office/retail/commercial areas typically discharge. This value corresponds to a peak foul discharge rate of **0.9l/s** for the Morrison supermarket and **0.01l/s** for the PFS. This provides a total estimate of **0.91l/s** of existing foul discharge for the entire site.

6.2 Proposed Drainage Strategy

The proposed surface water drainage is based on the principles of integrated Construction Industry Research and Information Association (CIRIA) C753 SuDS[23] and source control methods.

6.2.1 Proposed Surface Water Drainage Strategy

The London Plan sets an ideal target to achieve Greenfield run-off rates. The Sustainable Design and Construction SPG to the London Plan indicates a minimum ‘expectation’ of a 50% reduction in the existing peak run-off rate. Following an assessment of the development proposals, it is proposed that the peak runoff rate for the proposed development will be limited to the 3 times Greenfield runoff rate, which provides notable betterment to the existing conditions on the application site.

The proposed drainage strategy will implement the use of SuDS to attenuate and reduce the surface water runoff through the use of underground attenuation tanks which have been determined as the most suitable SuDS for the

[21] Approved Document Part H of the Building Regulations, Drainage and Waste Disposal, 2006
[22] Water Key Performance Indicators and Benchmarks for Offices and Hotels, CIRIA C657, 2006
[23] SUDS Manual C753, CIRIA, 2015

proposed development. There is a substantial amount of roofing space in the proposed development which will be utilised for green roofs that would provide a reduction in the peak rate of surface water runoff.

The proposed drainage strategy utilises the existing TWUL combined sewers which run beneath the application site. The 610 x 457mm sewer, which is believed to serve Gilbeys Yard, will be abandoned and replaced with a new sewer to serve Gilbeys Yard which will be located adjacent to the eastern Site boundary. The proposed drainage layout for both foul and surface water is included as Appendix I.

The drainage strategy for surface water has been completed in accordance with BS EN 752 (2008) 'Drain and Sewer Systems Outside Buildings'[24] and the NPPF which states that for surface water sewers:

- Drainage surcharge with no flooding for a 1 in 30 year rainfall event is permissible; and,
- Drainage can flood provided it does not flood any buildings or flow offsite for a 1 in 100 year rainfall event with a climate change factor.

The London Plan drainage hierarchy is assessed for the Proposed Development within Table 7.

Table 7: Drainage Hierarchy Assessment for the Proposed Development

Rank	Discharge Type	Solution	Comments
1 (most preferred)	Store rainwater for later use	Recommended	Reuse portions of stored rainwater, e.g. for irrigation
2	Use infiltration techniques	Not Recommended	Due to underlying London Clay, infiltration is not viable
3	Attenuate rainwater for gradual release	Recommended	No land footprint available for basins or ponds. Underground attenuations tanks recommended
4	Discharge rainwater directly to a watercourse	Not Recommended	No watercourse within locality of the Site
5	Discharge rainwater to a surface water sewer/drain	Not Recommended	Surrounding sewers are all part of a combined network
6 (least preferred)	Discharge rainwater to a combined sewer	Recommended	Discharge of flow to combined sewer on and adjacent to the Site

Due the underlying London Clay and proposed basement, disposal of runoff via infiltration techniques is not a viable solution for the proposed development.

Discharging to a surface water sewer or to a watercourse is also not a viable option as there are no outfall locations within the vicinity of the application site.

The proposed surface water drainage strategy is to attenuate and limit surface water discharge rate by using underground attenuation tanks. There is no available space on-site for other attenuating features such as basins or ponds.

The Proposed Development aims to maximise the use of open green spaces on the application site for amenity and community uses. The use of permeable paving has been discounted due to maintenance concerns. Raised planters that are provided to terraces with resident access will be irrigated. Traditional green roofs provided with no resident access will not be irrigated with potable water (solely via rainfall).

The completed development site areas are detailed in Table 8.

[24] British Standard 'Drain and Sewer Systems Outside Buildings', BS EN 752: 2008

Table 8: Proposed Equivalent Runoff Area

Site	Area Type	Proposed Area (m^2)	Runoff Coefficient	Proposed Equivalent Runoff Area (m^2)
MS parcel	Impervious Roof & Hardstanding	15,161	0.95	14403
	Green Roof	330	0.8	264
	Other Semi-Pervious Surfaces i.e. Roof Gardens, Amenity Spaces and Courtyards	6,231	0.8	4985
	Soft Landscaping	5,502	0.25	1376
	TOTAL	27,224	-	21027
PFS parcel	Impervious Roof & Hardstanding	3,211	0.95	3050
	Green Roof	596	0.8	477
	Other Semi-Pervious Surfaces i.e. Roof Gardens, Amenity Spaces and Courtyards	19	0.8	15
	Soft Landscaping	104	0.25	26
	TOTAL	**3,930**	**-**	3568

The Proposed Development will contribute a lower equivalent run-off area than the existing by approximately 9% and 4% for MS parcel and the PFS parcel respectively.

Applying the 3 times Greenfield runoff criteria, the surface water run-off rate will be limited to a maximum of **97.5l/s** for the MS parcel and **14.1l/s** for the PFS parcel which results in a total of **111.6l/s** for the entire application site.

The reasons why Greenfield runoff rates have not been achieved are as follows:

- The amount of attenuation required to limit the surface water discharge to greenfield rates would limit the degree of development viable for the Site;
- For the MS parcel, the extent of the proposed basement limits the possible locations of underground attenuation tanks to the periphery of the application site;
- Green roofs have been maximised at 926m² with an additional 6,250m² of surfaces of similar permeability. Additional roof space is required for PV panels and the proposed chilli farm;
- The public realm appearance is to be that of an urban setting as discussed between the Landscape Architect and LBC; and
- For the PFS parcel, there is a lack of underground space available due to fuel tanks, pipework and other service ducts.

The volume of surface water attenuation required to limit the peak discharge to 3 times Greenfield rates is summarised in Table 9.

Table 9: Attenuation Volumes Required

Return Period Event	Attenuation Required to limit to 3 times Greenfield rates (m^3)	
	MS parcel	PFS parcel
1 in 30 Year	347	63
1 in 100 Year + Climate Change (Additional Storage)	497	60
TOTAL	844	123

The Proposed Drainage Plans included in Appendix I show that the surface water attenuation tanks would provide, as a minimum, the 1 in 100 Year + 40% Climate Change volumes quoted in Table 9. The attenuation calculations are included as Appendix J.

Flood water from exceedance events will remain on site with pooling upon the podium and within the kerbs of the estate roads.

The completed LBC SuDS Proforma is included in Appendix K of this report.

6.2.2 Proposed Foul Water Drainage Strategy

The foul water drainage strategy will adhere to the standards set in BS EN 752 (2008) 'Drainage and Sewer Systems Outside Buildings'.

The Proposed Development will consist of 573 mixed housing units as well as office, retail and communal areas.

Sewers for Adoption 7th Edition[25] indicates a peak foul water discharge rate of 4000l/day/unit for dwellings which, for the Proposed Development, would correspond to a peak design flow rate of **26.5l/s**.

The non-residential uses of the site include the following:

- 12,469m³ retail (A1-A3) inclusive of 10,575m^2 for the Morrison supermarket;
- 5,147m² leisure (D1-D2); and
- 8,087m² business (B1) uses and workspace.

The CIRIA C657 Water Key Performance Indicators and Benchmarks for Offices and Hotels benchmark of 2.4l/m²/day. Applying an (average) 12 hour working day and a peak flow factor of 3, corresponds to a peak design flow rate of **4.3l/s** for the non-residential uses for the Proposed Development.

Therefore, the total proposed foul water to be discharged is initially estimated to be **30.8l/s**.

The existing foul water discharge from the Morrison supermarket equates to **0.9l/s**. This figure derives from an existing supermarket plan area of 7,225m², a 16 hour working day and a peak flow factor of 3.

The Proposed Development would result in a notable increase in foul water discharge compared to the existing rate. The increase in foul water discharge would be compensated for through the reduction in surface water peak rate to a maximum value of **193.8l/s** which would provide betterment to the overall discharge into the combined sewer network.

6.3 Drainage Strategy Summary

The proposed surface water drainage strategy for the proposed development is to provide underground attenuation tanks in Appendix I to limit the surface water discharge to a maximum of the 3 times Greenfield surface water runoff rate.

This restriction applies for all rainfall events up to the 1 in 100 year, plus climate change rainfall event. Flow will be discharged to the existing TWUL combined sewers located beneath and adjacent to the application site.

Additional benefits are to be provided in the form of:

- Irrigation of raised planters related to terraces with residents access using roof water;
- 926m² of green roofs; and
- 6,250m² of other semi-pervious areas such as roof gardens and courtyards.

The proposed drainage strategy will provide betterment to the existing surface water drainage by limiting the peak rate of surface water discharge rates in the TWUL sewers.

An increase in the peak foul water discharge rate will be mitigated by a greater reduction in the peak surface water rate discharged from the Site.

All necessary consents will be obtained from TWUL and meetings have already been held with regard to this aspect.

[25] WRc, Sewers for Adoption – A Design and Construction Guide for Developers, 7th Edition, 2012

7. Conclusions

The existing and future flood risks at the application site, both to and from the application site have been assessed from all sources.

The existing flood risk to the application site from surface water was assessed as medium and the flood risk from all other sources was assessed as low. The flood risk once the proposed development is completed has been assessed to reduce to low from all sources.

The Proposed Development would reduce the surface water runoff to a peak of 3 times Greenfield rates from the application site. This rate would be achievable whilst keeping the size of attenuation tanks within limits that do not compromise other aspects of the proposed development.

Underground attenuation tanks of a total capacity 967m³ across the entire site would be provided to limit the surface water discharge rate. Extensive areas of green roofs and roof gardens would also provide surface water attenuation and help limit the peak surface water discharge rate.

The notable increase in foul water discharge from the Proposed Development would be compensated for by the reduction in the existing peak surface water rate discharged from the application site. This will provide minor betterment to the existing flow conditions.

An existing sewer, which is believed to serve Gilbeys Yard, is to be abandoned, removed and replaced with a new sewer that would also service the completed development.

Appendix A Existing Site Plan

SL

MP 50

L Twr

Tunnel

Canal

Appendix B Borehole Plan And Results

KEY

BH1 Sirius cable percussive boreholes

WS1 Sirius window sample boreholes

REVISION	
0	>>
A	>>
B	>>
C	>>
D	>>

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CLIENT

WM MORRISON SUPERMARKETS PLC

SITE

CHALK FARM ROAD, CAMDEN

DRAWING TITLE

EXPLORATORY HOLE LOCATION PLAN

DRAWING NO.	REVISION NO.
C3821/04	0

DRAWN BY	APPROVED BY
SA	MB

DATE	SCALE	PAPER SIZE
June 2010	NTS	A3

project drawing original size passed

BOREHOLE RECORD

BH No. **BH1**
Sheet 1 of 2

Site: Chalk Farm Road, Camden

Contract No: C3821

Client: Wm Morrison Supermarkets Plc

Dates: 07/04/2010-08/04/2010

Method: Cable percussive rig with 150mm diameter tools and casing.

Scale 1:100

Logged By: JCC | Checked By: MB

Driller: SDS

SAMPLE DETAILS Type (Blows)	Depth From - To(m)	N (Cu)	Groundwater (Casing)	STRATA RECORD Description	Depth (m)	Level (m AOD)	Legend	Well
D	0.30			MADE GROUND: Tarmac.	0.10			
				MADE GROUND: Light grey sandy angular fine to coarse GRAVEL of limestone.	0.30			
D (75)	1.20		1		1.20			
U	1.20 - 1.65			MADE GROUND: Firm brown slightly sandy gravelly CLAY. Low plasticity (field test). Gravel is subangular to subrounded fine to coarse of siltstone, clinker and brick.				
D	1.45 - 1.70	(30)						
D	2.00		2					
S	2.20 - 2.65	N=8 (1,1,1,2,2,3)						
D	3.00		3	Stiff, locally firm, low strength brown fissured slightly sandy slightly gravelly CLAY. Very high plasticity. Gravel is subangular fine to coarse gravel of flint.				
U (35)	3.20 - 3.55							
D	3.55 - 3.60	(24)						
D	4.00		4					
S	4.20 - 4.50	N=7 (1,0,1,1,2,3)						
D	5.00		5					
U (38)	5.20 - 5.60			--- From 5.20m to 8.20m medium strength				
D	5.60 - 5.65	(74)						
D	6.00		6					
D	6.50							
S	6.70 - 7.15	N=15 (2,2,3,4,4,4)	7					
D	7.50							
			8					
U (60)	8.20 - 8.65			--- From 8.20m to 12.70m high strength				
D	8.65 - 8.70	(82)						
D	9.00		9					
S	9.70 - 10.15	N=21 (4,4,5,5,5,6)						
D	10.20		10					
			11					
D (80)	11.20							
U	11.20 - 11.65							
			12					
D	12.20							
S	12.70 - 13.15	N=33 (4,6,7,8,9,9)			12.70			
D	13.20		13	Stiff high and very high strength grey brown slightly sandy slightly gravelly CLAY. Very high, locally high, plasticity. Gravel is fine to coarse subrounded of flint.				
			14					
D (80)	14.20							
U	14.20 - 14.55							
D	14.55 - 14.70	(118)						
			15					
D	15.20							
S	15.70 - 16.15	N=33 (6,6,6,8,9,10)						
D	16.20		16					
			17					
D (100)	17.20							
U	17.20 - 17.58							
D	17.58 - 17.68	(112)						
D	18.00		18					
S	18.70 - 18.95	N=36 (6,6,7,9,10,10)						
D	19.00		19					

Continued next sheet

Remarks and Water Observations

1) Service inspection pit hand excavated to 1.20m.
2) Groundwater seepage at 23.60m bgl. No rise in the groundwater level recorded after 20 minutes.
3) Cable percussive boring complete at 35.00m.
4) Standpipe installed as detailed above.
5) Shear strengths given in ( ) show results of hand vane tests undertaken in U100's.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.
BH1

BOREHOLE RECORD

BH No. **BH1**
Sheet 2 of 2

Site: Chalk Farm Road, Camden

Contract No: C3821

Client: Wm Morrison Supermarkets Plc

Dates: 07/04/2010-08/04/2010

Method: Cable percussive rig with 150mm diameter tools and casing.

Scale 1:100

Logged By: JCC | Checked By: MB

Driller: SDS

SAMPLE DETAILS			Groundwater (Casing)	STRATA RECORD				
Type (Blows)	Depth From - To(m)	N (Cu)		Description	Depth (m)	Level (m AOD)	Legend	Well
D (100)	20.00			Stiff high and very high strength grey brown slightly sandy slightly gravelly CLAY. Very high, locally high, plasticity. Gravel is fine to coarse subrounded of flint.				
U	20.20 - 20.60							
D	20.60 - 20.65	(70)						
D	21.00		21					
S	21.70 - 22.15	N=35						
D	22.00	(5,5,7,9,9,10)	22					
D	23.00		23					
U (100)	23.20 - 23.60							
D	23.60 - 23.65	(92)						
D	24.00		24					
S	24.75 - 25.15	N=38						
D	25.20	(6,8,8,9,10,11)	25					
D (100)	26.20		26					
U	26.20 - 26.50							
D	26.50 - 26.55							
D	27.20		27					
S	27.70 - 28.15	N=46						
D	28.20	(7,8,10,10,12,14)	28					
D	29.20		29					
UF B								
D	30.20		30					
U (110)	30.70 - 30.95							
D	30.95 - 31.00	(>150)	31					
D	32.20		32					
S	32.20 - 32.65	50/195mm (8,11,14,19,17)						
D	33.20		33					
U (120)	33.70 - 33.95							
D	33.95 - 34.00		34					
D	35.00		35	End of Borehole at 35.00 m	35.00			
			36					
			37					
			38					
			39					

Remarks and Water Observations

1) Service inspection pit hand excavated to 1.20m.
2) Groundwater seepage at 23.60m bgl. No rise in the groundwater level recorded after 20 minutes.
3) Cable percussive boring complete at 35.00m.
4) Standpipe installed as detailed above.
5) Shear strengths given in ( ) show results of hand vane tests undertaken in U100's.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.
BH1

BOREHOLE RECORD

BH No. **BH2**
Sheet 1 of 2

Site: Chalk Farm Road, Camden

Contract No: C3821

Client: Wm Morrison Supermarkets Plc

Dates: 09/04/2010-13/04/2010

Method: Cable percussive boring rig with 200mm and 150mm diameter casing and tools.

Scale 1:100

Logged By: JCC | Checked By: MB

Driller: SDS

SAMPLE DETAILS			Groundwater (Casing)	STRATA RECORD				
Type (Blows)	Depth From - To(m)	N (Cu)		Description	Depth (m)	Level (m AOD)	Legend	Well
D	0.40			MADE GROUND: Tarmac.	0.20			
				MADE GROUND: Light grey sandy angular to subangular fine to coarse GRAVEL of limestone.	0.40			
D	1.00		1					
B	1.20 - 1.65	N=35 (2,5,8,10, 10,7)		MADE GROUND: Medium dense and dense brown clayey fine to coarse SAND and subangular to subrounded fine to coarse GRAVEL of sandstone, brick, flint, limestone, concrete and clinker.				
D	2.00		2					
B	2.20 - 2.65	N=27 (3,3,4,8,9 ,6)						
D	3.00		3					
B	3.20 - 3.65	N=16 (2,2,5,4,4 ,3)						
D	4.00		4					
B	4.20 - 4.65	62/225mm (10,12,30, 22,10)		From 4.20m: Low cobble and boulder content of concrete.				
D	5.00		5					
B	5.20 - 5.65	60/150mm (25,20,50, 10)		From 5.50 to 5.75m: Obstruction encountered.				
			6					
D	6.75				6.75			
U (45)	7.00 - 7.45		7	Stiff high strength brown fissured locally thinly laminated slightly sandy slightly gravelly CLAY. Very high plasticity. Gravel is subangular to subrounded fine to coarse gravel of flint.				
D	7.45 - 7.50	(98)						
D	8.00		8					
S	8.50 - 8.95	N=23 (4,4,5,5,6 ,7)						
D	9.00		9					
D (75)	10.00		10					
U	10.00 - 10.45							
D	10.45 - 10.50	(88)						
D	11.00		11					
S	11.50 - 11.95	N=29 (4,5,5,7,8 ,9)						
D	12.00		12					
D (80)	13.00		13					
U	13.00 - 13.45							
D	13.45 - 13.50	(44)		--- At 13.45m hand vane failed on fissures				
D	14.00		14					
S	14.50 - 14.95	N=35 (4,6,7,8,1 0,10)		Stiff high strength and very high strength grey brown fissured slightly sandy slightly gravelly CLAY. Very high plasticity. Gravel is subangular to subrounded fine to medium of flint.	14.30			
D	15.00		15					
D (100)	16.00		16					
U	16.00 - 16.40							
D	16.40 - 16.45	(98)		--- At 16.40m hand vane sheared on fissures.				
D	17.00		17					
S	17.50 - 17.95	N=37 (6,7,8,8,1 0,11)						
D	18.00		18					
D (100)	19.00		19					
U	19.00 - 19.30							
D	19.30 - 19.35							

Continued next sheet

Remarks and Water Observations

1) Service inspection pit hand excavated to 1.20m.
2)Groundwater encountered at 4.40m bgl, rising to 4.35m bgl after 15 minutes.
3) Chiselling hard strata from 5.50m to 5.75m bgl, 1 hour.
4) Casing reduced from 200m to 150mm at 6.75m.
5) Cable percussive boring complete at 35.00m.
6) Standpipe installed, as detailed above.
7) Shear strengths given in ( ) show results of hand vane tests undertaken in U100's.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.
BH2

BOREHOLE RECORD

BH No. **BH2**
Sheet 2 of 2

Site: Chalk Farm Road, Camden

Contract No: C3821

Client: Wm Morrison Supermarkets Plc

Dates: 09/04/2010-13/04/2010

Method: Cable percussive boring rig with 200mm and 150mm diameter casing and tools.

Scale 1:100

Logged By: JCC | Checked By: MB

Driller: SDS

SAMPLE DETAILS			Groundwater (Casing)	STRATA RECORD				
Type (Blows)	Depth From - To(m)	N (Cu)		Description	Depth (m)	Level (m AOD)	Legend	Well
D	20.00			Stiff high strength and very high strength grey brown fissured slightly sandy slightly gravelly CLAY. Very high plasticity. Gravel is subangular to subrounded fine to medium of flint.				
S	20.50 - 20.95	N=41 (6,8,10,10						
D	21.00	,10,11)	21					
D (100)	22.00		22					
U	22.00 - 22.20							
D	22.20 - 22.25							
D	23.00		23					
S	23.50 - 23.95	N=50 (7,8,10,12						
D	24.00	,12,16)	24					
D (100)	25.00		25					
U	25.00 - 25.30							
D	25.30 - 25.35	(>150)						
D	26.00		26					
S	26.50 - 26.95	N=68 (8,9,10,15						
D	27.00	,18,25)	27					
D (100)	28.00		28					
U	28.00 - 28.10							
D	28.20 - 28.25							
D	29.00		29					
S	29.50 - 29.90	50/235mm (7,9,11,14						
D	30.00	,16,9)	30					
D (100)	31.00		31					
U	31.00 - 31.25							
D	31.25 - 31.30							
D	32.00		32					
S	32.50 - 32.95	50/275mm (8,9,10,15						
D	33.00	,19,6)	33					
D (100)	34.00		34					
U	34.00 - 34.25							
D	34.35 - 34.40							
D	35.00		35	End of Borehole at 35.00 m	35.00			
			36					
			37					
			38					
			39					

Remarks and Water Observations

1) Service inspection pit hand excavated to 1.20m.
2)Groundwater encountered at 4.40m bgl, rising to 4.35m bgl after 15 minutes.
3) Chiselling hard strata from 5.50m to 5.75m bgl, 1 hour.
4) Casing reduced from 200m to 150mm at 6.75m.
5) Cable percussive boring complete at 35.00m.
6) Standpipe installed, as detailed above.
7) Shear strengths given in ( ) show results of hand vane tests undertaken in U100's.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.
BH2

BOREHOLE RECORD

BH No. **BH3**
Sheet 1 of 2

Site: Chalk Farm Road, Camden

Contract No: C3821

Client: Wm Morrison Supermarkets Plc

Dates: 14/04/2010-15/04/2010

Method: Cable percussive boring rig with 150mm diameter casing and tools.

Scale 1:100

Logged By: JCC | Checked By: MB

Driller: SDS

SAMPLE DETAILS Type (Blows)	Depth From - To(m)	N (Cu)	Groundwater (Casing)	STRATA RECORD Description	Depth (m)	Level (m AOD)	Legend	Well
D	0.30			MADE GROUND: Tarmac.	0.30			
				MADE GROUND: Light grey sandy angular to subangular fine to coarse GRAVEL of limestone.	0.40			
D	1.00		1					
B	1.20 - 1.65	N=18						
D	1.40	(1,2,4,5,5,4)						
D	2.00		2					
S	2.20 - 2.65	N=8 (1,2,2,2,2,2)		MADE GROUND: Medium dense brown clayey sandy GRAVEL. Medium cobble content. Gravel is subangular to subrounded fine to coarse of brick, clinker, sandstone and flint. Cobbles are angular to subrounded of brick, sandstone and concrete.	2.10			
D	3.00		3	MADE GROUND: Soft low and medium strength brown slightly sandy slightly gravelly CLAY. High Plasticity (field test). Medium subangular brick and concrete cobble content. Gravel is subangular to subrounded fine to coarse of brick, clinker, sandstone and flint.				
U (20)	3.20 - 3.65			--- from 3.00m very wet with strong sewage odour.				
D	4.00		4					
S	4.20 - 4.65	N=8 (1,1,2,2,2,2)						
D	5.00		5					
B	5.20 - 5.65							
UF								
D	6.00		6					
B	6.20 - 6.65	N=50						
D	6.20	(5,8,10,10,20,10)						
S	6.20 - 6.65			At 6.50m: Chiseling at 6.50m concrete/obstruction.				
D	7.00		7	From 6.50m: Obstruction. Assumed former concrete basement floor.				
B	7.70 - 8.15	N=28						
D	8.00	(10,10,8,7,7,6)	8		8.10			
U (50)	8.20 - 8.45			Stiff high and very high strength soft brown fissured slightly sandy slightly gravelly CLAY. Very high plasticity. Gravel is subangular to subrounded fine to coarse of flint.				
D	8.65 - 8.70	(88)						
D	9.00		9					
S	9.70 - 10.15	N=33						
D	10.20	(4,6,8,8,8,9)	10					
			11					
D	11.20							
U	11.20 - 11.65							
D	11.65 - 11.70	(86)						
D	12.00		12	--- At 12.00m orange brown and rare angular fine to coarse gravel of quartz.				
S	12.70 - 13.15	N=37						
D	13.20	(4,5,9,9,9,10)	13					
					13.60			
			14	Stiff very high strength orange brown fissured slightly sandy slightly gravelly CLAY. Very high, locally high, plasticity. Gravel is subangular to subrounded fine to coarse flint.				
D (88)	14.20							
U	14.20 - 14.65							
D	14.65 - 14.70	(88)						
			15					
D	15.20							
S	15.70 - 16.15	N=45						
D	16.20	(6,7,9,10,12,14)	16					
			17					
D (100)	17.20							
U	17.20 - 17.60							
D	17.60 - 17.65							
			18					
D	18.20							
S	18.70 - 19.15	N=49						
D	19.20	(5,8,12,10,12,15)	19					

Continued next sheet

Remarks and Water Observations

1) Service inspection pit hand excavated to 1.20m.
2) Groundwater encountered at 5.00m bgl, rising to 4.85m bgl after 20 minutes. Groundwater seepage at 22.50m bgl.
3) Chiselling hard strata from 6.50m to 8.00m bgl, 1 hour 20 minutes.
4) Cable percussive boring complete at 35.00m.
5) Standpipe installed, as detailed above.
6) Shear strengths given in ( ) show results of hand vane tests undertaken in U100's.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.
BH3

BOREHOLE RECORD

BH No. **BH3**
Sheet 2 of 2

Site: Chalk Farm Road, Camden

Contract No: C3821

Client: Wm Morrison Supermarkets Plc

Dates: 14/04/2010-15/04/2010

Method: Cable percussive boring rig with 150mm diameter casing and tools.

Scale 1:100

Logged By: JCC | Checked By: MB

Driller: SDS

SAMPLE DETAILS			Groundwater (Casing)	STRATA RECORD				
Type (Blows)	Depth From - To(m)	N (Cu)		Description	Depth (m)	Level (m AOD)	Legend	Well
D (100)	20.20			Stiff very high strength orange brown fissured slightly sandy slightly gravelly CLAY. Very high, locally high, plasticity. Gravel is subangular to subrounded fine to coarse flint.				
U	20.20 - 20.50							
D	20.50 - 20.55	(90)						
D	21.00		21					
S	21.70 - 22.15	N=40 (6,8,8,10,						
D	22.20	10,12)	22					
			23					
D (100)	23.20							
U	23.20 - 23.50							
D	23.50 - 23.55	(120)						
D	24.00		24					
S	24.70 - 25.15	N=46 (5,8,10,10						
D	25.20	,12,14)	25					
			26					
D (100)	26.20							
U	26.20 - 26.45							
D	26.45 - 26.50	(120)						
D	27.20		27					
S	27.70 - 28.15	N=50 (6,9,9,10,						
		16,15)	28					
			29					
D (100)	29.20							
U	29.20 - 29.50							
D	29.50 - 29.55	(87)						
D	30.00		30					
S	30.70 - 31.15	N=50 (7,9,11,13						
D (120)	31.20	,18,8)	31					
U	31.20 - 31.40							
D	31.40 - 31.45	(120)						
D	32.20		32					
S	32.70 - 33.15	N=70 (8,11,14,1						
D	33.20	9,17,20)	33					
			34					
D (120)	34.20							
U	34.20 - 34.50							
D	34.50 - 34.55	(120)						
D	35.00		35	End of Borehole at 35.00 m	35.00			
			36					
			37					
			38					
			39					

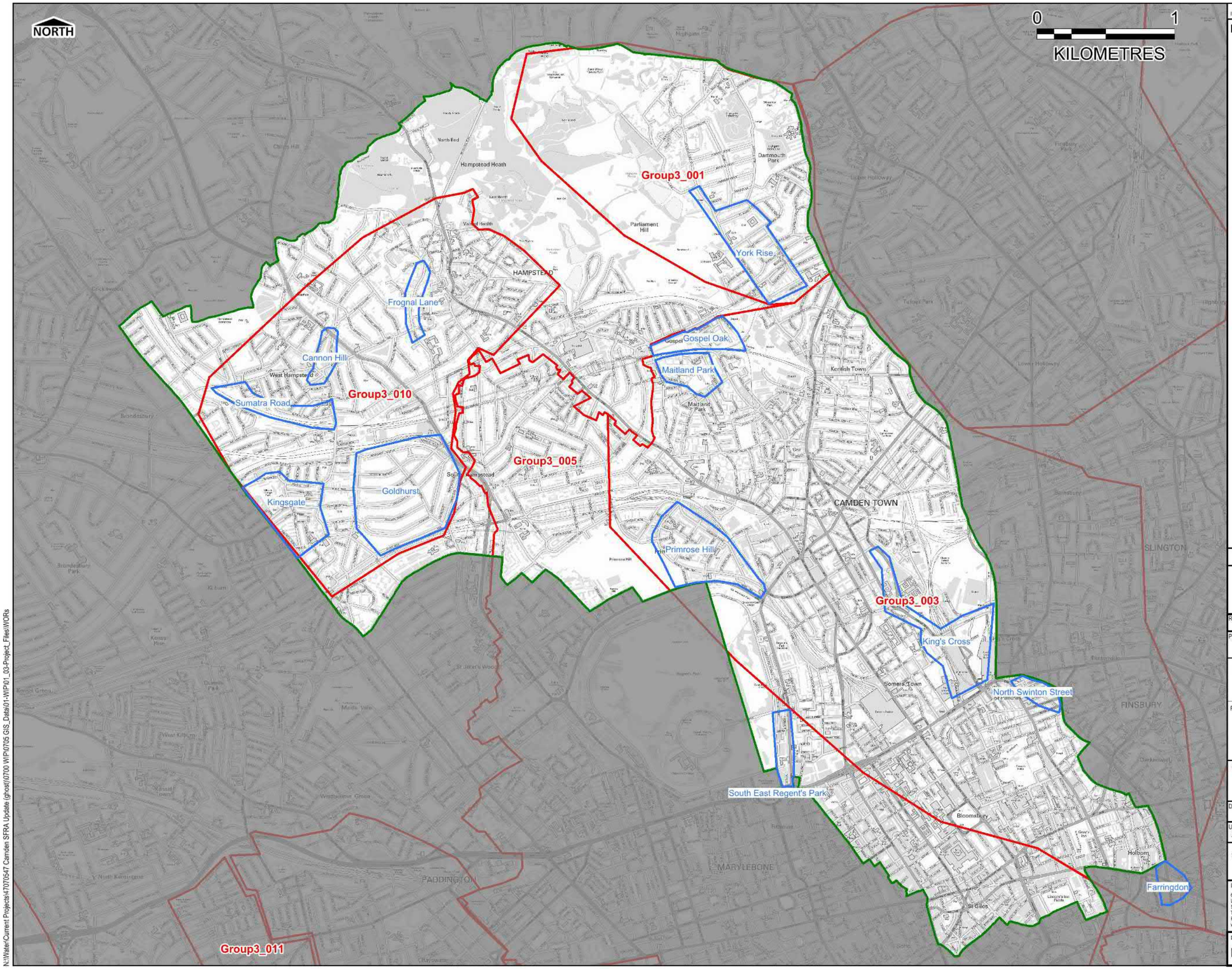
Remarks and Water Observations

1) Service inspection pit hand excavated to 1.20m.
2) Groundwater encountered at 5.00m bgl, rising to 4.85m bgl after 20 minutes. Groundwater seepage at 22.50m bgl.
3) Chiselling hard strata from 6.50m to 8.00m bgl, 1 hour 20 minutes.
4) Cable percussive boring complete at 35.00m.
5) Standpipe installed, as detailed above.
6) Shear strengths given in ( ) show results of hand vane tests undertaken in U100's.

GL (m AOD)
-
Easting:
-
Northing:
-

Fig. No.
BH3

Appendix C CDA and LFRZ Map



THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

LEGEND

- London Borough Camden Boundary
- Critical Drainage Area
- Local Flood Risk Zone

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Critical Drainage Areas / Local Flood Risk Zones

Drawn	Checked	Approved	Date
CB/EB	EY	MT	04/06/2014

URS Internal Project No.: 47070547

Scale at A3: 1:25,000

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Drawing Number: FIGURE 6

Rev: Rev 2

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Appendix D Proposed Development Plan

Do not scale from this drawing. Use figured dimensions only. Figured dimensions are in millimetres. All levels are in metres. All dimensions and levels shall be verified on site before proceeding with works. Detailed site survey to be carried out to verify positions and level relationships with site features and ordnance survey. The Architect must be notified of any discrepancy. Where building components are described in the specification as Descriptive Specification - (Contractor Design) elements shown on this drawing pertaining to those components are to be read as "Issued for Design Intent only".

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REV	DATE	DESCRIPTION	CKD
P1	20.06.2017	DRAFT ISSUE	MCull

REV	DATE	DESCRIPTION	CKD

REV	DATE	DESCRIPTION	CKD

0 10 20 50

Social rented	1B2P	2B4P	3B5P	4B6P	
Intermediate rented	1B2P	2B3P	2B4P		
Market	Studio	1B2P	2B3P	2B4P	3B5P

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London SE1 0HX
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email info@alliesandmorrison.com

A&M JOB NO: 1095

CAMDEN GOODS YARD

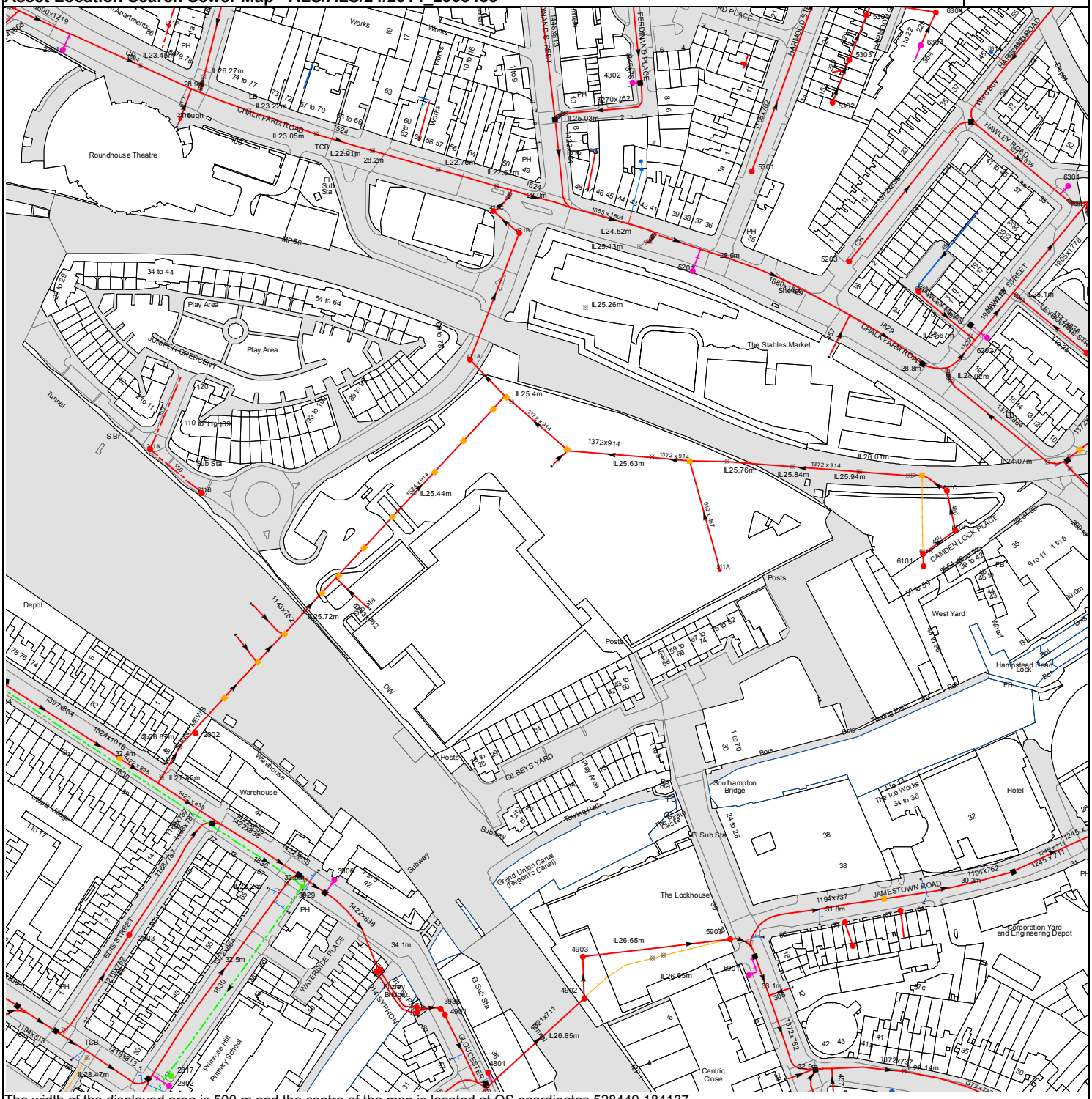
MASTERPLAN DRAWINGS
GROUND FLOOR PLAN
1095_00_07_100

SCALE 1:500 @A1 1:1000@A3

P1
Revision

Appendix E TWUL Asset Plan

Asset Location Search Sewer Map - ALS/ALS/24/2014_2903436



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 528449,184137

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
211A	n/a	n/a
421A	n/a	n/a
231B	n/a	n/a
2301	n/a	n/a
231A	n/a	n/a
611C	n/a	n/a
6204	27.89	23.85
6202	n/a	n/a
621A	n/a	n/a
5201	n/a	n/a
5203	28.17	24.3
421B	n/a	n/a
421C	n/a	n/a
6301	n/a	n/a
5301	27.93	24.41
431B	n/a	n/a
431A	n/a	n/a
5302	n/a	n/a
4302	n/a	n/a
531A	n/a	n/a
531B	n/a	n/a
5303	n/a	n/a
631A	n/a	n/a
6303	n/a	n/a
5304	n/a	n/a
6304	n/a	n/a
2817	32.6	21
2903	n/a	n/a
3929	32.68	21.5
3906	n/a	n/a
2002	32.37	25.9
211B	n/a	n/a
2802	n/a	n/a
3902	31.25	26.98
3904	32.24	26.96
3908	0	n/a
3907	0	n/a
3936	33.6	27.27
4901	33.56	27.57
4801	n/a	n/a
4903	n/a	n/a
4902	n/a	n/a
511A	n/a	n/a
5903	n/a	n/a
5901	n/a	n/a
59BI	n/a	n/a
59AF	n/a	n/a
69CI	n/a	n/a
611A	n/a	n/a
6101	30.18	27.3
611B	n/a	n/a

Appendix F Sewer Flooding Map

NORTH

0 1
KILOMETRES

NW3 1
NW3 5
NW6 2
NW6 3
NW6 4

Hampstead Heath
North End
Parliament Hill
Dartmouth Park
HAMPSTEAD
West Hampstead
Gospel Oak
Kentish Town
Maitland Park
CAMDEN TOWN
Primrose Hill
ISLINGTON
FINSBURY
Somers Town
St Pancras
Bloomsbury
Holborn
MARYLEBONE
PADDINGTON
St Giles

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LEGEND

London Borough Camden Boundary

Exterior Sewer Flooding
No. of Properties affected

- 1
- 2
- 4
- 18

Revision Details	By / Check	Check Date	Suffix

Purpose of issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: DG5 External Sewer Flooding

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No.	Scale at A3
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Drawing Number: FIGURE 5b

Rev: Rev 1

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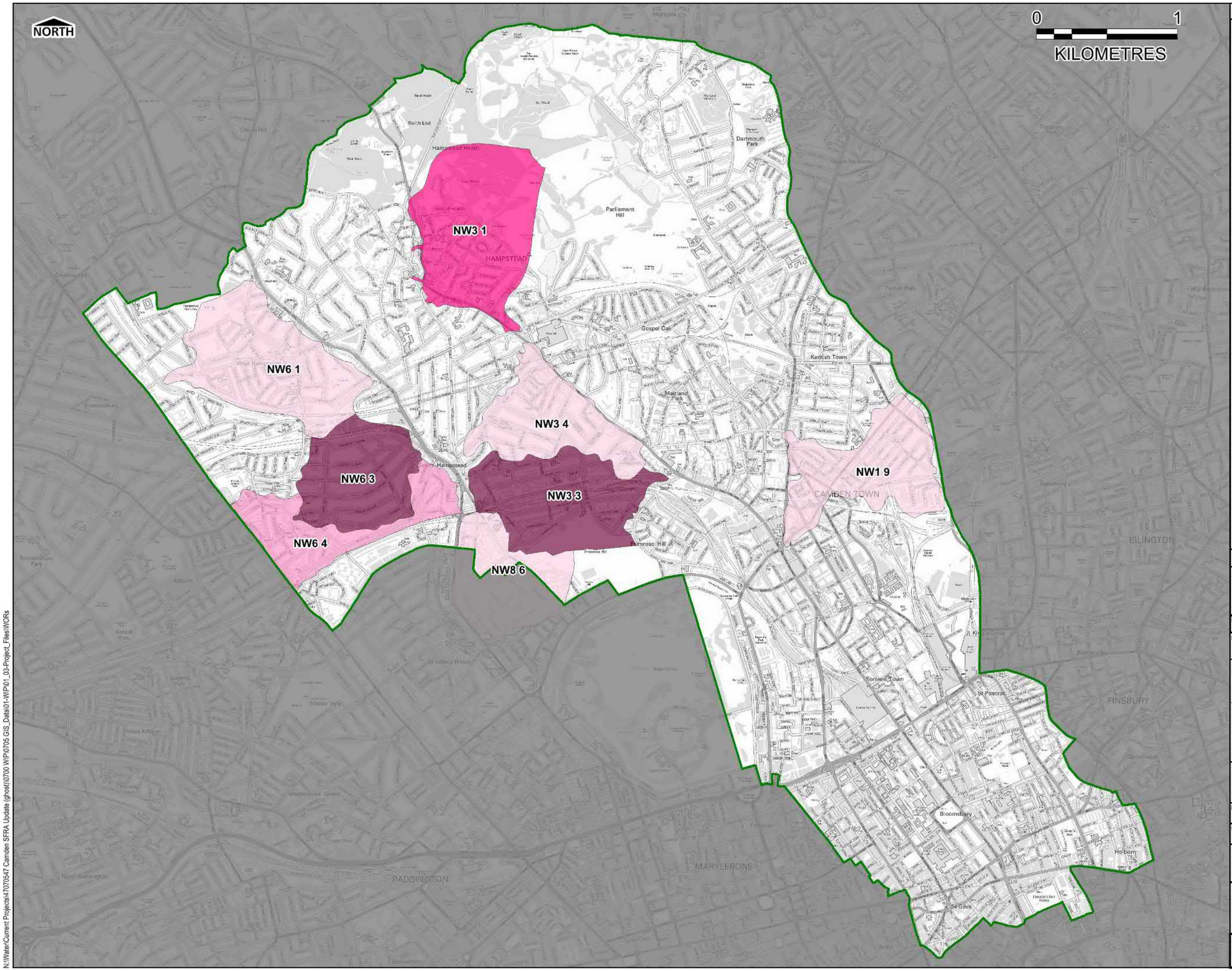

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LEGEND

London Borough Camden Boundary

Internal Sewer Flooding
No. of Properties affected

- 1
- 2
- 4
- 8

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: DG5 Internal Sewer Flooding

Drawn	Checked	Approved	Date
CB	JS	MT	03/07/2014

URS Internal Project No.: 47070547

Scale at A3: 1:40,000

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Drawing Number: **FIGURE 5a**

Rev: **Rev 1**

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