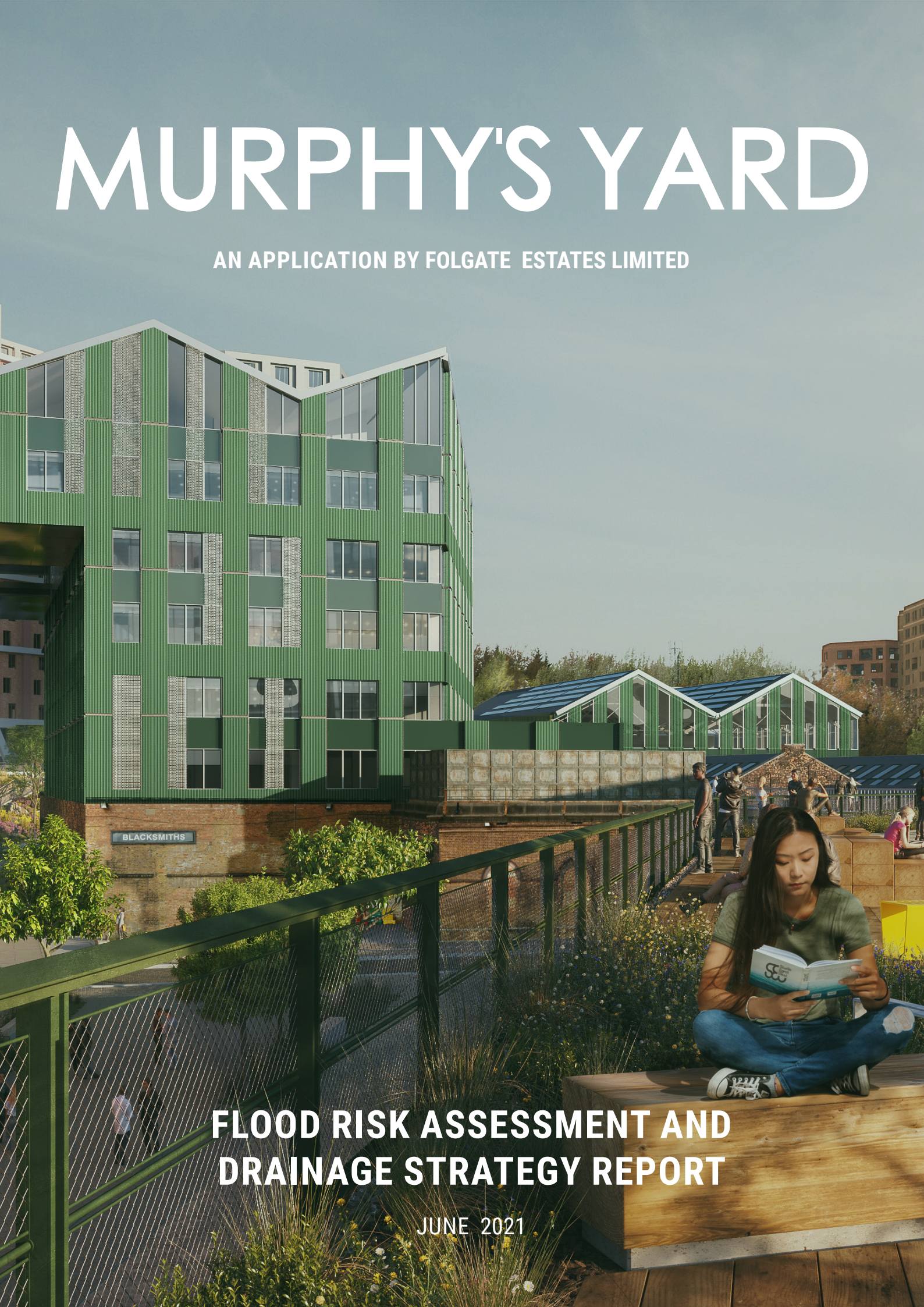
MURPHY'S YARD

AN APPLICATION BY FOLGATE ESTATES LIMITED



FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY REPORT

JUNE 2021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Folgate Estates Ltd

Murphy's Yard

Flood Risk Assessment and Drainage Strategy Report

MUR-ARP-ZZ-XX-RP-CX-0001

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Contents

Tables

Figures

Appendices

LBC SUDS proforma

Glossary

Acronym	Definition
AEP	Annual Exceedance Probability
BGS	British Geological Society
EA	Environment Agency
CC	Climate Change
CDA	Critical Drainage Area
CPG	Camden Planning Guidance
FRA	Flood Risk Assessment
FRMS	Flood Risk Management Strategy
FZ	Flood Zone
LBC	London Borough of Camden
LFRZ	Local Flood Risk Zone
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
SFRA	Strategic Flood Risk Assessment
SPZ	(Groundwater) Source Protection Zone
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TWUL	Thames Water Utilities Limited

Executive Summary

Ove Arup & Partners Limited ("Arup") has been commissioned to prepare a Flood Risk Assessment and Drainage Strategy Report in support of the Outline Planning Application associated with land to the south of Gordon House Road bounded by railway lines to the east, west and south, known as Murphy's Yard.

After a comprehensive review of flood risk data and publicly available information, this report concludes that the risk of flooding from all sources is low in line with the requirements of:

- National Planning Policy Framework,
- London Borough of Camden Local Plan (and supporting planning guidance)
- The London Plan 2021

A summary of flood risk is provided below:

Flood Source	**Pathway**	**Comment**	***Risk**
Fluvial and Tidal	River Thames is located 5km south of Site	EA flood maps confirm the Site is entirely located within FZ1. Less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)	Low
Groundwater	Through underlying strata when groundwater levels rise above surface levels.	Site is not located in an area of increased susceptibility of groundwater. No superficial deposits at the site and underlain with London Clay. No historic record of groundwater flooding at Site or immediate Site environs. Proposed basements are highly unlikely to cause wider significant changes to the local groundwater regime. Groundwater found in made ground. Risk of perched/localised groundwater. Residual Risk during construction of groundwater ingress.	Low (Operation) Medium (During Construction)
Artificial Sources	Risk of reservoir flooding from Highgate Ponds 2 and 3.	EA flood maps show that part of the Site is potentially at risk of reservoir flooding, but probability is low-negligible. No other artificial sources of flooding near to the Site. No specific mitigation against reservoir flooding required.	Low
Pluvial	Overloading of sewers or overland flow	Western portion of the Site predominantly has a "very low" surface water flood risk, with annual probability greater than 1 in 1000. The eastern portion of the Site has a "low risk" of surface water flooding, with an annual probability between 1 in 100 year and 1 in 1000 year. Hazard mapping confirms residual risk in extreme rainfall event (100-1000 year storm event). Not located within a LFRZ. Existing public sewers within the site at significant depth.	Low

Infrastructure Failure	Burst water main inundating local sewer network	No significant water mains or trunk mains in close proximity to the site.	Low

As the existing Site is predeveloped and constrained, it is the intention to limit surface water flows to three times the Greenfield runoff rate applied at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change. This has been discussed and agreed with the LLFA in preparation of this report.

The proposed drainage strategy uses a range of sustainable drainage systems following an appraisal of appropriate drainage techniques considered viable in line with the development proposals. These systems, characterised by the extensive use of green/blue roofs across the development, will provide the necessary attenuation required to meet the proposed surface water runoff restrictions.

Based on our understanding of the site setting and the proposals, it is considered that the development can be constructed and operated safely and will not increase flood risk elsewhere.

1 Introduction

Ove Arup & Partners Limited ("Arup") has been commissioned by Folgate Estates Limited to prepare a Flood Risk Assessment (FRA) and Drainage Strategy Report in support of the Outline Planning Application associated with land to the south of Gordon House Road bounded by railway lines to the east, west and south, known as Murphy's Yard. (hereafter referred to as "the Site").

This FRA has been prepared in accordance with the requirements of the National Planning Policy Framework (NPPF) (specifically Chapter 14) and Technical Guidance of the NPPF and will be submitted to London Borough of Camden (LBC) as the Local Planning Authority (LPA) and Lead Local Flood Authority (LLFA)

1.1 Development Proposals and Planning Context

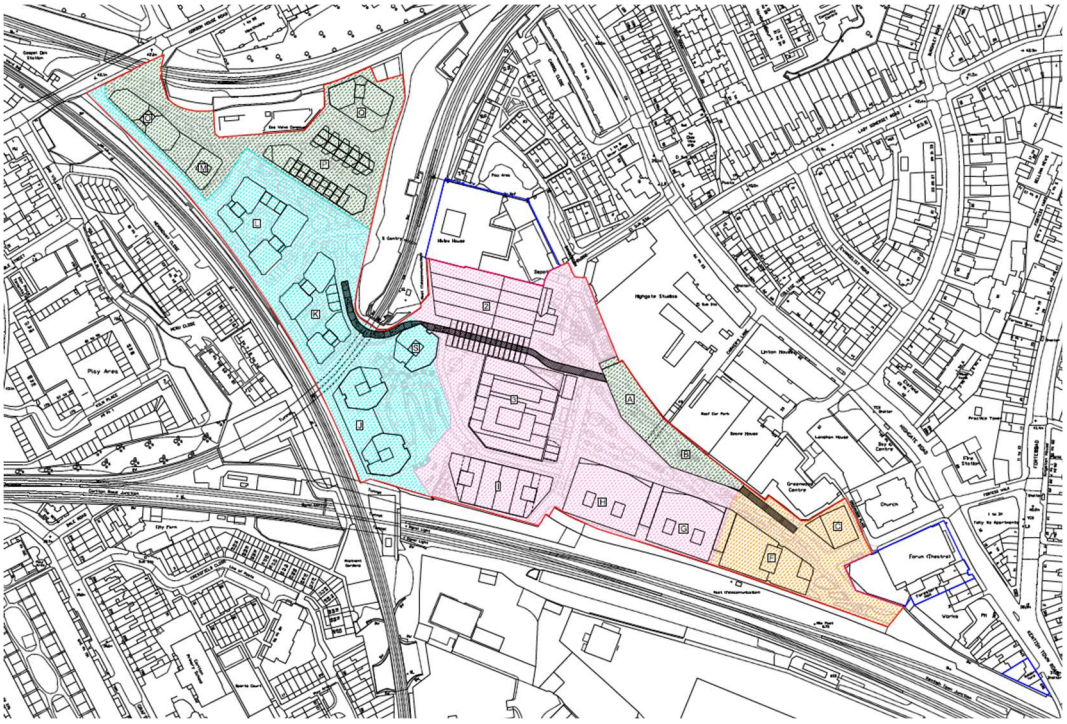


Figure 1: Development Plan

This FRA is written in relation to and supports outline planning permission with all matters reserved for the demolition of existing buildings and structures and redevelopment to be carried out in phases (with each phase being an independent act of development) comprising the following mix of uses: residential (Use Class C3), residential institution (Use Class C2), industrial (Use Class B2 and/or B8), commercial floorspace (Class E), flexible commercial and Sui Generis floorspace (Use Class E and/or Sui Generis Use), Community (F1 and/or F2), Sui Generis, and cycle and vehicle parking, refuse and recycling storage, plant, highway and access improvements, amenity space, landscape and public realm improvements, and all associated works.

1.2 Scope of Report

This report is written with reference to the NPPF and draws upon both regional and local policy pertinent to surface water and flood risk management and uses publicly available data.

Although the Site is located wholly within Flood Zone 1, under the requirements of the NPPF a detailed Flood Risk Assessment is still required as it is greater than 1ha.

The purpose of this report is to provide an assessment of flood risk to demonstrate that the Site is at low risk from all sources and will:

- Identify and assess potential sources of flooding to the Site;
- Assess historical flood events associated with the Site;
- Assess the potential impacts of the development proposals upon the local hydrological regime;
- Outline strategies to manage the flood risk to the Site and local area allowing for future climate change;
- Propose a surface water management strategy; and
- Propose measures for the management of residual risks.

1.3 Sources of Information

The key sources of information reviewed as part of this study are listed in Table 1 below:

Table 1: Key Sources of Information

Title	Author	Date
London Borough of Camden Local Plan	London Borough of Camden	July 2017
Camden Planning Guidance – Water and Flooding CPG	London Borough of Camden	January 2021
London Borough of Camden Strategic Flood Risk Assessment	URS Infrastructure & Environment UK Ltd on behalf of London Borough of Camden	July 2014
London Borough of Camden Surface Water Management Plan	Halcrow on behalf of London Borough of Camden	July 2011
The London Borough of Camden Flood Risk Management Strategy	London Borough of Camden (LLFA)	June 2013
The London Plan 2021	Greater London Authority	March 2021
Environment Agency Flood Mapping Data	Environment Agency (Online source)	February 2021
Thames Water Utilities Limited Asset Plans	TWUL Plans	-

1.4 Consultation

1.4.1 Lead Local Flood Authority

Consultation with the LLFA to agree the proposed approach to surface water management was undertaken in advance of the planning application. A record of the consultation has been provided in Appendix D. A number of potential criteria for the calculation of the proposed discharge restriction from the development were tabled to the LLFA.

The following surface water discharge restriction scenarios were assessed for the purposes of the discussion:

- Greenfield runoff rates at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change.
- Existing brownfield runoff rate at the 1 in 1-year and 1 in 10-year return periods and existing 1 in 10 year brownfield runoff rate for all return periods up to and including 1 in 100-year + 40% climate change.

The LLFA acknowledged that the site is severely constrained and consequently recognised that restricting the site to greenfield runoff rates is not practicable. The LLFA requested that if greenfield runoff rates cannot be achieved then the following options should be adopted as part of the strategy (in order of preference):

- 3 x Greenfield runoff rates applied at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change.
- 50% reduction of existing brownfield runoff rates at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change.

In light of the above, the proposed drainage strategy has applied 3 x Greenfield runoff rates as detailed in Section 5 of this report.

A completed LBC SUDS proforma has been provided in Appendix F.

1.4.2 Thames Water

A pre-development enquiry was been submitted to TWUL in April 2021 to confirm acceptance of the proposed foul and surface water discharge rates into the local public sewer network, as detailed in this report. A response from TWUL dated 10th May 2021 confirms that there is currently sufficient sewerage capacity in the local combined sewer network to accommodate the proposals.

With respect to surface water TWUL has stated the following:

"Our Asset Planning team have raised concerns as the site is approximately 6.3ha and the proposed discharge rates are far too high at a total of 258.8l/s. Therefore, we would expect to see surface water discharge rates reduced much further towards greenfield runoff rates. I understand you were in discussion with LLFA, therefore please seek approval from Lead Local Flood Authority (LLFA)

and forward email/letter with their decisions/confirmation on your surface water strategy."

A copy of meeting minutes following consultation with the LLFA as detailed in Section 1.4.1 above have been provided to TWUL to justify the proposed discharge rates as detailed within Section 5.2 of this report.

The TWUL full response is provided within Appendix D.

1.5 Report Structure

Policy relevant to flood risk and drainage matters associated with the development is addressed in Section 2. The environmental setting, focusing on the hydrological conditions and Site surroundings is outlined in Section 3. Section 4 describes the development proposals, and Section 5 the proposed drainage strategy. The assessment of flood risk at the Site is presented in Section 6 with mitigation of residual risks discussed in Section 7. Conclusions are presented in Section 8

2 Policy and Guidance

The following section details specific local policy and guidance pertinent to flood risk and surface water drainage that are applicable to the proposals. This section does not outline National Legislation, Regulations or Guidance which is provided in Appendix A

2.1 London Borough of Camden Local Plan

The LBC Local Plan was adopted in July 2017 and was prepared in accordance with Regulation 19 of the Town and Country Planning (Local Planning) (England) Regulations 2012. It sets out the council's vision for the borough until 2031. The following policies directly relate to climate change and flood risk considerations:

Policy CC2 (a, b & c): *Adapting to Climate Change;*

Policy CC3: *Water and Flooding.*

In relation to drainage Policy CC2 states:

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 Policy CC3 States:

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 to achieve a greenfield run-off rate where feasible; and

f) not locate vulnerable development in flood-prone areas.

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

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

2.2 London Borough of Camden Strategic Flood Risk Assessment (SFRA) (July 2014)

The LBC SFRA July 2014 is a planning tool that enables the council to select and develop sustainable Site allocations away from vulnerable flood risk areas and inform strategic land use planning.

The document collates and presents the most up to date flood risk information for use by LBC to inform the preparation of robust planning documents as part of the Local Plan.

The SFRA provides mapping data for various sources of flooding which are replicated within this report where noted. Chapter 7 specifically advocates the use of Sustainable Drainage Systems (SuDS) and promotes implementation of the SuDS hierarchy.

2.3 Camden Planning Guidance Water and Flooding CPG (March 2019)

CPG provides advice and information on how LBC apply planning policies. The adopted CPG documents can be 'material considerations' in planning decisions, however they have less weight than the Local Plan or other development plan documents. A number of CPG documents were adopted in January 2021 including "Water and Flooding CPG".

The Water and Flooding CPG encourages Sites to meet London Plan runoff reduction targets (discussed further below) and drainage designs to accommodate all storm events up to and including the 1 in 100-year 6 hour storm event (including allowances for climate change).

It also continues to promote the use of the SuDS hierarchy when considering management of surface water and rainwater harvesting tanks and green roofs are preferred over other SuDS ranked lower down, such as attenuation tanks.

Specifically, the Water and Flooding CPG states that LBC expect the following to support planning:

"A drainage report is required for all major applications, basement development, and vulnerable development in areas identified as at risk of flooding (details of what this should include can be found in paragraph 8.67 of the Local Plan). The Council will expect plans and application documents to describe how water will be managed within the development, including an explanation of the proposed SuDS,

the reasons why certain SuDS have been ruled out and detailed information on materials and landscaping The Council will expect developments to achieve a greenfield surface water run-off rate where feasible once SuDS have been installed."6

2.4 The London Plan (March 2021)

The London Plan 2021 is a broad plan to shape the way London develops over the next 20-25 years.

Policy SI12 – Flood Risk Management and Policy SI13 – Sustainable Drainage are pertinent in the content this report. In general, the above policies largely echo the requirements of the previous London Plan (2016) including the requirement to follow a hierarchal approach to surface water management, with a preference for green over grey features.

The London Plan 2021 advocates that drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improve water quality, and enhance biodiversity, urban greening, amenity and recreation.

The Plan suggests that development proposals should aim to get as close to greenfield run-off rates as possible depending on Site conditions.

2.5 Thames Water Utilities Limited

In accordance with the Building Act 2000 Clause H3.3, positive connections to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable.

The disposal hierarchy being: 1st Soakaways; 2nd Watercourses; 3rd Sewers.

Only when it can be proven that soakage into the ground or a connection into an adjacent watercourse is not possible would TWUL consider a restricted discharge into the public surface water sewer network.

TWUL request that every attempt should be made to use flow attenuation and SUDS/storage to reduce the surface water discharge from the Site as much as possible.

If they are consulted as part of any planning application, TWUL Planning team would ask to see why it is not practicable to attenuate the flows to Greenfield run-off rates i.e. **5l/s/hectare** of the total Site area (or if the Site is less than 1 hectare in size then the flows should be reduced by 95% of existing flows).

3 Environmental Setting

3.1 Site Location

The Site is located in LBC between Gospel Oak and Kentish Town train stations. The Site has a postcode of NW5 1TN and Ordnance Survey National Grid Reference TQ 28597 85563.

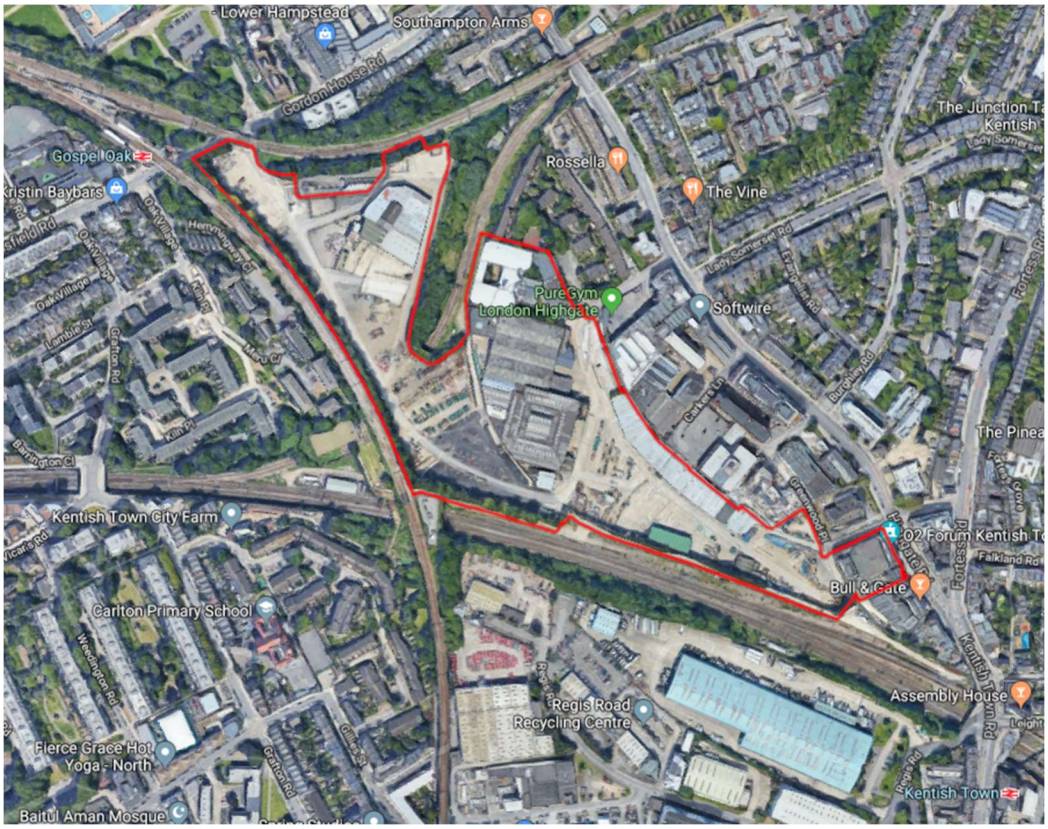


Figure 2: Site Location/Red Line Boundary (Reference: Google Maps)

The ownership boundary for the Site is 6.8ha but the proposed redevelopment encompasses an area of 6.2ha. It is bounded by Network Rail tracks to the east, north-west and south and by Highgate Road to east. An additional Network Rail line bisects the Site from north to south before running underground. A small proportion of protected natural reserve and wildlife occupies the Site as well as two listed buildings.

3.2 Existing Site Use

The Site is currently brownfield with general industrial uses within classes E(g)(iii), B2 and B8 with ancillary office.

The Site is occupied by a large operational depot owned by Murphy's, Murphy's headquarters and courtyard to the east, car parking, car wash and jet washing facility in the centre and TWUL owned land to the west. Most of the Site is hardstanding and it is assumed that only 5-10% of the Site is vegetated. An existing buildings area schedule is provided in Table 2below:

Table 2: Existing Buildings Area Schedule

Existing Building	GIA	GEA
Shed 2	4,733	5,002
Shed 3	6,176	6,696
Workshops and Offices	3,838	3,959
Building Q	2,649	2,748
Thames Water	727	735
Training Centre	105	140
Security Gate	74	92
Total	**18,303**	**19,373**

According to a Ground Investigation Report by Ian Farmer Associates (2019), the Site was historically used for industrial activities such as railway cuttings, gas works and oil processing plants and comprised of associated infrastructure such as railway sheds and coal sheds. A waste transfer facility was recorded around 1982 which was accepting commercial, construction and demolition wastes. There is also a record of potentially infilled land on the Site and contaminated land under Part IIA EPA 1990 within 200m to the east with no records of soil remediation.

3.3 Existing Topography

The existing levels vary across the Site with high points of around 46.0-46.5mAOD within the western portion of the Site to low points of around 33.0m AOD in the east.

The eastern (33.500-34.500mAOD) and western (42.500-44.500mAOD) portions of the Site are largely flat with the change in levels facilitated by a steep slope (1:12.5) in the centre of the Site with a change of circa 10m.

3.4 Geology

The British Geological Society (BGS) geological mapping indicates that the Site is underlain with the London Clay formation (Bedrock). No superficial deposits are present across the Site.

The Site does not lie within a Groundwater Source Protection Zone (SPZ).

According to the LBC SFRA the Site is not located in an area of increased susceptibility to elevated groundwater flooding and there is no recorded history of flooding from groundwater flood incidents with the Site boundary.

According to the Ground Investigation Report by Ian Farmer Associates (2019), the sequence of strata and indicative thicknesses encountered in the eastern part of the Site are as below:

Table 3: Geology in eastern part of Site

Strata Encountered	Depth Encountered (m bgl)		Strata Thickness (m)
	From	To	
Made Ground	0.00	0.80 - 1.30	0.80 - 1.30
London Clay Formation	0.80 - 1.30	>20.45	>19.65

In the central and northern part of the Site, the following sequence of strata and indicative thicknesses have been encountered.

Table 4: Geology in central and northern part of Site

Strata Encountered	Depth Encountered (m bgl)		Strata Thickness (m)
	From	To	
Made Ground	0.00	3.50 - 9.00	3.50 - 9.00
Superficial Deposits	4.50 & 7.40	4.60 & 8.00	0.10 & 0.60
London Clay Formation	3.50 - 9.00	>20.45	>13.45

A soil assessment carried out by Ian Farmer Associates (2019) identified widespread contamination of the Made Ground in the north western part of the Site, proposed for residential development, with regard to TPH and PAH compounds, together with the presence of a number of VOCs and SVOCs at detectable concentrations across the entire Site. Elevated lead was also identified in two locations in the central part of the Site, also proposed for residential development.

No contamination was within the underlying natural London Clay. Notable concentrations of organic contaminants were recorded in the groundwater encountered within the Made Ground, together with elevated levels of methane gas.

Due to potential volatilisation of the hydrocarbons and VOCs identified within the Made Ground and associated shallow groundwater, and their degradation products, where inhalation exposure is a valid pathway, any sustainable drainage systems (SuDS) will be lined with an appropriate membrane to close the exposure pathway and infiltration through the ground will not be encouraged.

Further investigation may be required once the proposed development plans have been confirmed, and prior to the detailed remediation strategy being produced.

3.5 Hydrogeology

The bedrock geology at the Site is classified by the Environment Agency (EA) as “Unproductive Strata”, defined as “rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow”.

During onsite investigations, it was found that there was a significant depth of Made Ground upto 9m in some areas and groundwater associated with the Made Ground was observed in the south eastern part of the Site at depths of between 0.50m and 0.70m bgl. In the north western part of the Site, groundwater also associated with the Made Ground was observed at depths of between 0.60m and

3.00m bgl. The groundwater in borehole WS6 was described as oily, indicating contaminated soils.

Given the underlying London Clay this groundwater may indicate localised perched water.

3.6 Existing Rivers/Water bodies

There are no main rivers within the London Borough of Camden

The Highgate Ponds (1, 2 & 3) are located approximately 1km north west of the Site within Hampstead Heath and connect to the Fleet Trunk Sewer Highgate branch which passes beneath the Site (discussed in 3.7 below). Highgate Pond 2 and 3 are classified as 'large raised reservoirs" under the Reservoirs Act 1975.

3.7 Existing Drainage Infrastructure

The River Fleet historically ran through Gospel Oak and Kentish Town before converging north of Camden Town. The river was culverted in the 19th Century and now forms part of the TWUL public sewer network as the Fleet Trunk Sewer. In the 1870s the Fleet Storm Relief Sewer was constructed, beginning approximately at Kentish Town Station and out falling into the Thames.

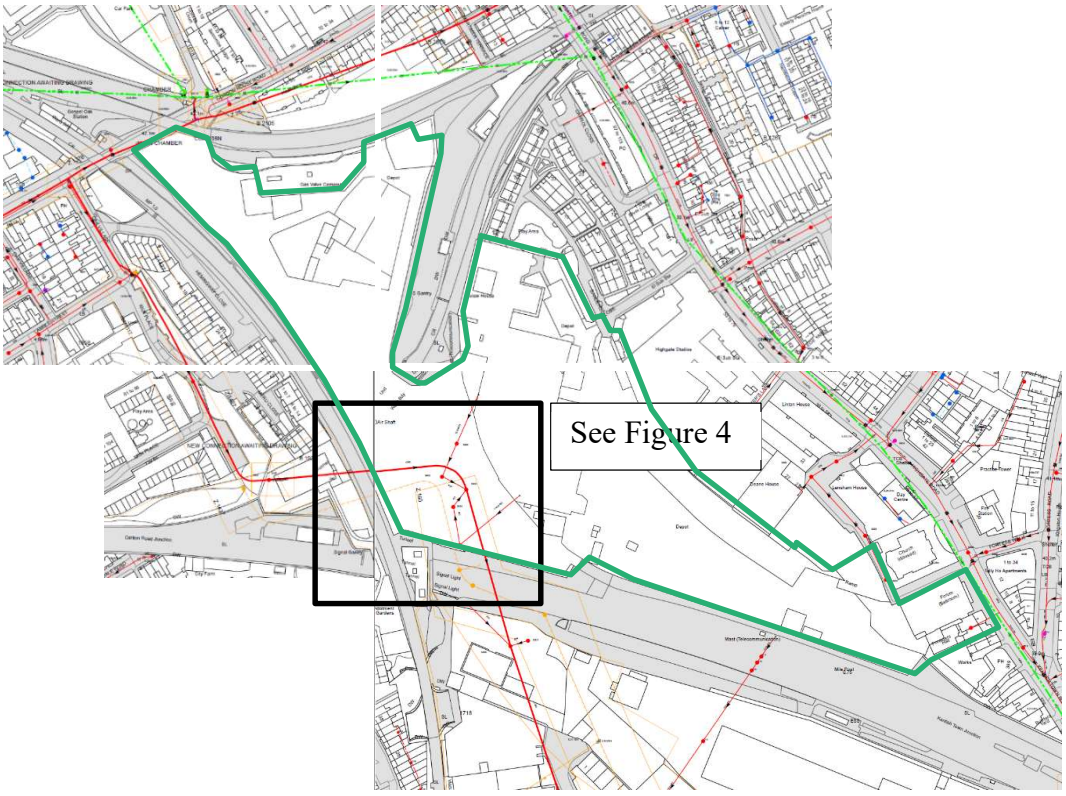


Figure 3: TWUL Asset Plans (Extracts)

TWUL asset plans are presented in Figure 3 above for the full extents of the site and in Figure 4 below for the centre of the site where the Fleet Sewer encroaches the site

Site records (see Appendix B) show existing drainage pipes and manholes in the central and eastern part of the Site. The existing drainage accepts flows from the vehicle car wash, existing buildings (both offices and warehouses), and hard standing areas. The existing drainage discharges to the Fleet Sewer at three points. It is understood that this is a combined sewer and it is assumed that the existing drainage on Site is also combined.

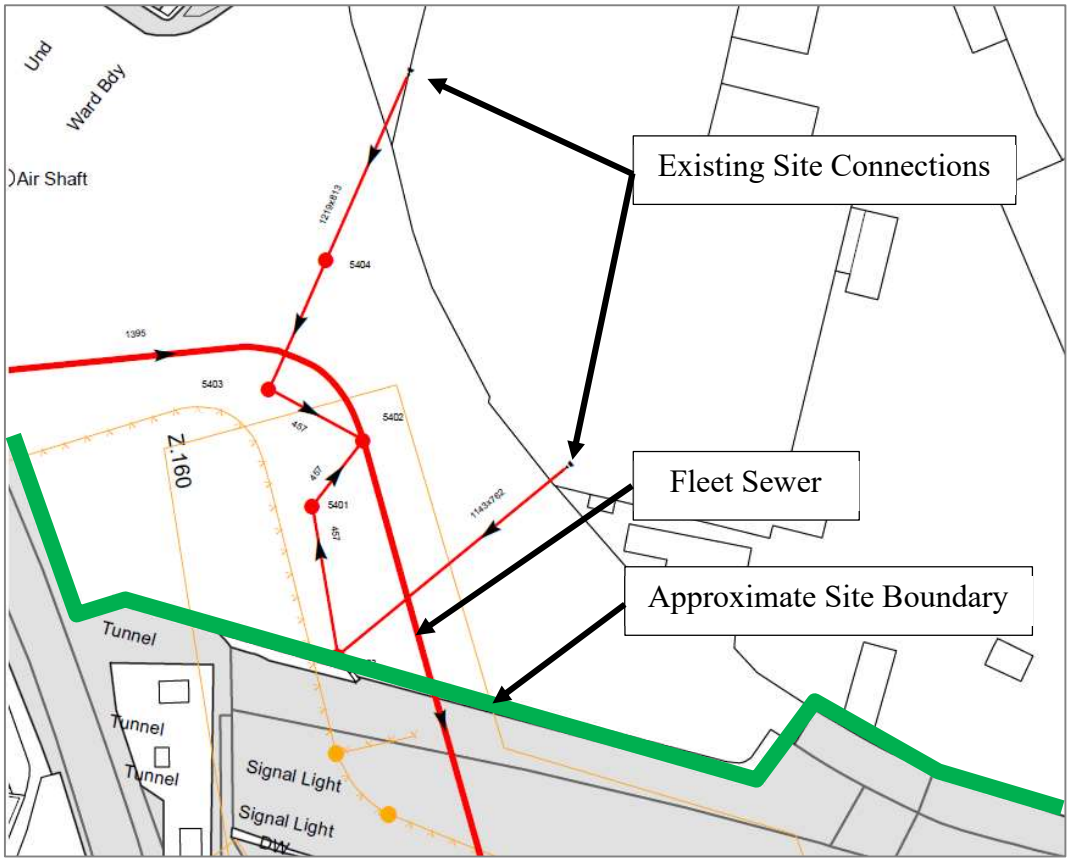


Figure 4: Fleet Storm Relief Sewer Encroaching Site Boundary

4 Development Proposals

4.1 Proposed development

The redevelopment proposals (which are to be completed in four phases) comprise of an outline planning permission with all matters reserved for the demolition of existing buildings and structures and redevelopment to be carried out in phases (with each phase being an independent act of development) comprising the following mix of uses: residential (Use Class C3), residential institution (Use Class C2), industrial (Use Class B2 and/or B8), commercial floorspace (Class E), flexible commercial and Sui Generis floorspace (Use Class E and/or Sui Generis Use), Community (F1 and/or F2), Sui Generis, and cycle and vehicle parking, refuse and recycling storage, plant, highway and access improvements, amenity space, landscape and public realm improvements, and all associated works. Figure 5 and Figure 6 below outline the planning application boundary and the plot phasing and construction sequence.

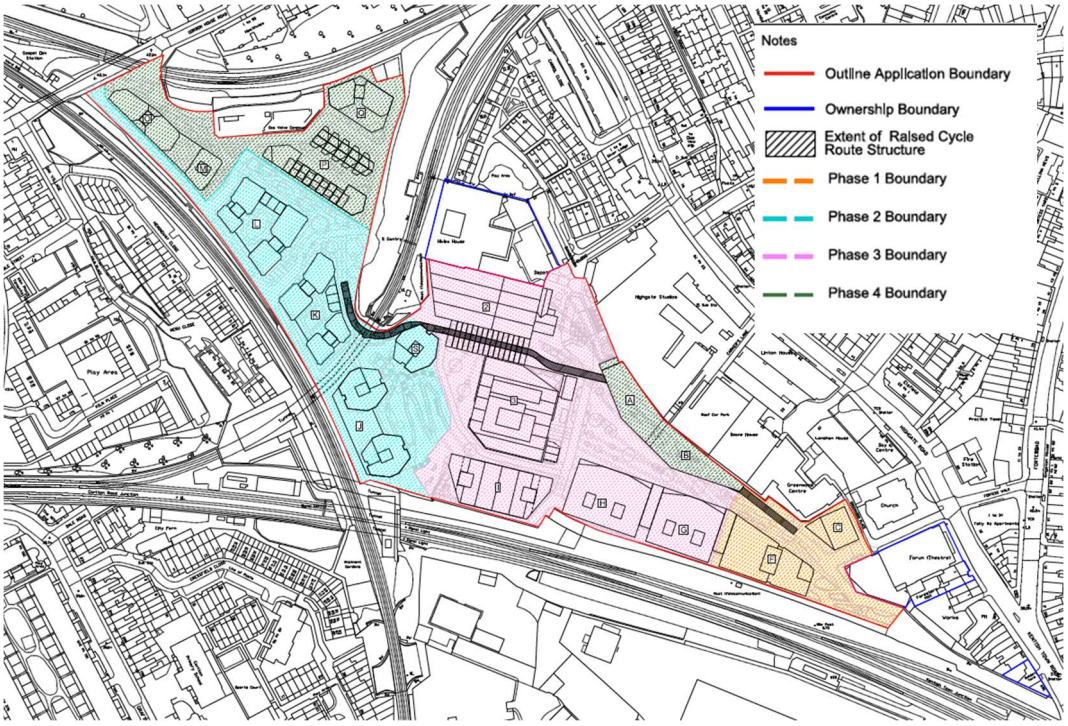


Figure 5: Planning Boundary and Phasing Diagram

Phase 1	C, F						
Phase 2		J	S	K	L		
Phase 3		I	G	H	Shed 2	Shed 3	
Phase 4					Q	A,B	P, M

Figure 6. Phasing plots and sequence

5 Drainage Proposals

The following section of the report details the intended surface water and foul drainage strategy. This Section should be read in conjunction with the Site wide drainage strategy drawing provided in Appendix C, suitable for outline planning.

5.1 Surface Water Discharge Restriction

5.1.1 Brownfield Runoff Rates

Rainfall data has been obtained from Flood Estimation Handbook (FEH) CD version 3.0 (2013) to determine approximate existing discharge rates at the Site. The 30-minite and 60-minute storm durations were used within these calculations as typical duration storm events and the Rational Method applied:

Q = 2.78 CIA, where;

Q = flow (l/s);
C = runoff coefficient (1);
I = rainfall (mm/hr); and
A = catchment area (ha).

Table 5 below provides existing discharge rates for the 1 in 2, 1 in 10, 1 in 30 and 1 in 100-year storm events for a 30-minute duration storm event:

Table 5 Existing Discharge Rates for 30-minute Storm Duration

Rainfall Event	Rainfall Depth 30-min (mm)	Intensity (mm/hr)	Existing Discharge Rate (30-min storm duration)
1 in 2 Year	9.77	19.54	337.47
1 in 10 Year	22.42	44.84	774.41
1 in 30 Year	31.07	62.14	1073.20
1 in 100 Year	41.61	83.22	1437.26

Table 6 below provides existing discharge rates for the 1 in 2, 1 in 10, 1 in 30 and 1 in 100-year storm events for a 60-minute duration storm event:

Table 6 Existing Discharge Rates for 60-minute Storm Duration

Rainfall Event	Rainfall Depth 60-min (mm)	Intensity (mm/hr)	Existing Discharge Rate (30-min storm duration)
1 in 2 Year	11.87	11.87	205.00
1 in 10 Year	27.19	27.19	469.59
1 in 30 Year	37.83	37.83	653.35
1 in 100 Year	50.75	50.75	876.48

5.1.2 Greenfield Runoff Rates

Greenfield runoff rates have been obtained for the Site in accordance with Institute of Hydrology (IoH)124 methodology using the www.uksuds.com

greenfield runoff estimation tool. Rates are provided for the 1 in 1 year, 1 in 30 year and 1 in 100 year in Table 7 below based on a Site area of 6.2ha:

Table 7 Greenfield Runoff Rates (IH124)

Rainfall Event	Greenfield Runoff Rate (l/s)
1 in 1 Year	22.99
1 in 30 Year	62.21
1 in 100 Year	86.28

5.2 Proposed Discharge Rate

To assess the proposed discharge rate, the Site has been divided into catchments based on the development phasing, Site topography and construction sequence.

The surface water drainage catchment plan in Figure 7 below shows the breakdown of each catchment. In total there are seven catchments associated with the four phases of the development. The catchment areas have been outlined in Table 8 below.

Table 8 Breakdown of catchment areas

Catchment reference	Area (ha)
Phase 1 (Plots F&C)	0.63
Phase 2 North	1.43
Phase 2 South	0.37
Phase 3 (Shed 2 & 3)	1.39
Phase 3 (minus Sheds 2&3)	1.16
Phase 4 North	0.99
Phase 4 South	0.26
Total	**6.23**

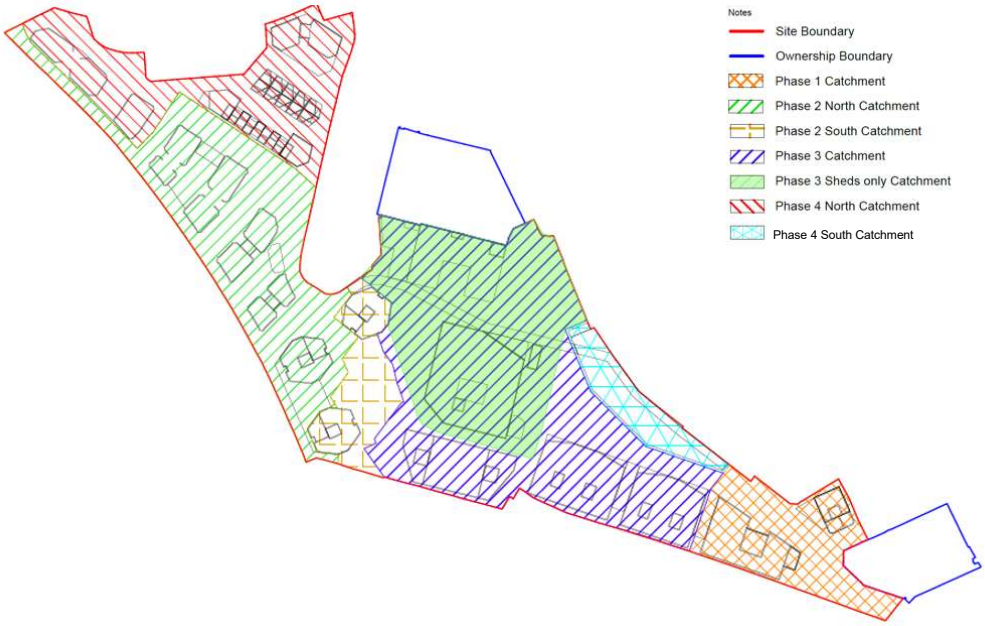


Figure 7. Approximate Surface Water drainage catchments.

Current best practice and policy stipulates that new developments should, as far as practicable, strive to achieve greenfield runoff rates. However, for this development the proposed discharge rate is impacted by a number of existing on-site constraints which restrict the available area for attenuation, these are namely;

- Thames Water Fleet Trunk Sewer;
- Existing buildings to be retained and heritage Sheds 2 & 3;
- Network rail infrastructure, railway tunnel;
- Network Rail surface water infrastructure exclusion zone within 20m of their boundary; and
- Site topography and Site contamination.

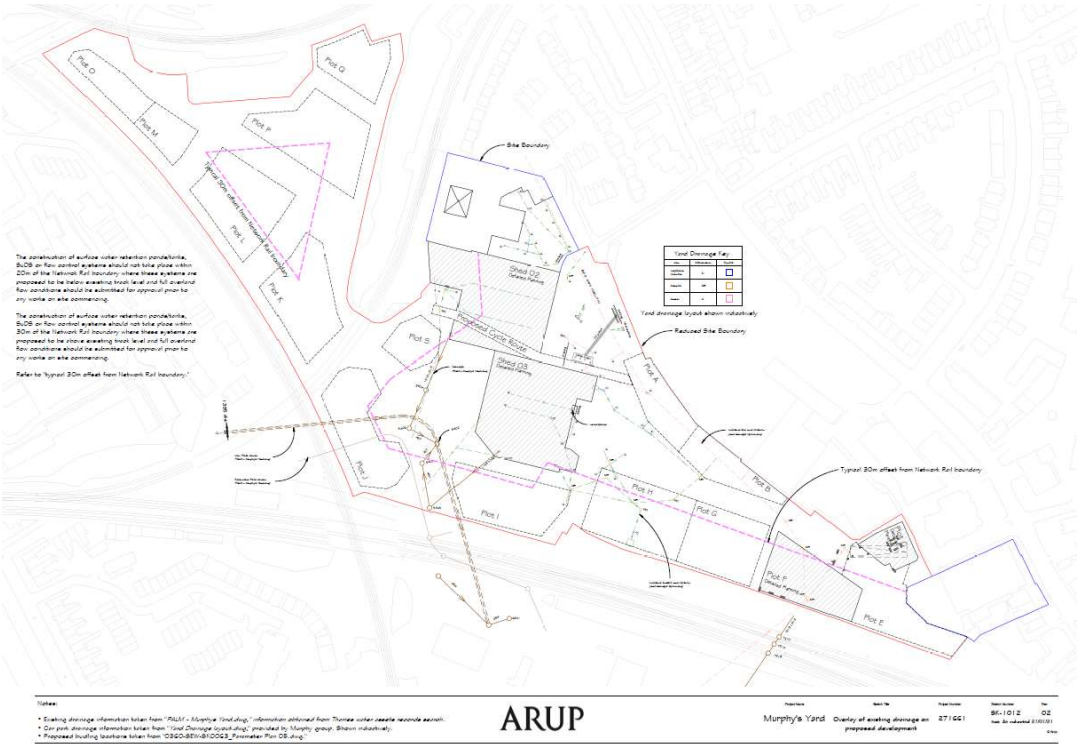


Figure 8. Network Rail (NR) 30m exclusion zone offset from NR boundary

As shown in Figure 8 above the Network Rail exclusion zone (shown by the pink dashed line) greatly impacts the available locations for underground storage across the development. The exclusion zone is based on the following guidance provided by Network Rail:

"The construction of Surface water retention ponds/tans, SuDS or flow control systems should not take place within 30m of the Network Rail boundary where these systems are proposed be above existing track level and full overland flow conditions should be submitted for approval prior to any works on site commencing."

For the proposed development, it is the intention to restrict surface water runoff rates to a discharge rate that offers betterment to the existing Site discharge. As per the LBC SFRA (Section 4.4), whilst public sewers are now typically designed

to accommodate rainfall events up to the 1 in 30 year storm event, the sewer network within some parts of Camden is particularly old with some sewers potentially only designed to accommodate the 1 in 10 year storm event.

As the existing Site is predeveloped and constrained, it is the intention to limit surface water flows to three times the Greenfield runoff rate applied at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change. This approach has been discussed with LBC as the LLFA in a pre-application meeting, minutes of which are provided in Appendix D.

It is proposed to retain the existing sewer connections on Site for the majority of the redevelopment. The total three times greenfield runoff rate for the site at the 1 in 100 year rainfall event is 258.84 l/s. The proposed flow rates by phase and for the full development are outlined in Table 9 below. This is an overall reduction of 70.5% in comparison to the existing 1 in 100-year brownfield runoff rate.

Table 9. Proposed discharge rates for 1 in 1 year and 1 in 100 year+CC storm events

	Proposed restricted rate criteria	**Proposed Discharge rate for 1 in 1-year storm event (l/s)**	**Proposed Discharge rate for 1 in 100 year storm event (l/s)**	**Proposed Discharge rate for 1 in 100 year +40% Climate change storm event (l/s)**
Phase 1	3x Greenfield Runoff Rate	7.0	26.2	26.2
Phase 2 North	3x Greenfield Runoff Rate	15.9	59.5	59.5
Phase 2 South	3x Greenfield Runoff Rate	4.1	15.5	15.5
Phase 3 (Shed 2 & 3)	3x Greenfield Runoff Rate	15.4	57.9	57.9
Phase 3 (minus Sheds 2&3)	3x Greenfield Runoff Rate	12.9	48.3	48.3
Phase 4 North	3x Greenfield Runoff Rate	11.0	41.3	41.3
Phase 4 South	3x Greenfield Runoff Rate	2.9	10.8	10.8
Total		**69.2**	**259.5**	**258.8**

5.3 Surface Water Drainage Strategy

5.3.1 Climate Change

Current NPPF Guidance stipulates that to allow for the predicted impacts of climate change on surface water runoff, increases to peak rainfall intensity should be used

Table 10 is an extract from the updated government guidance in relation to climate change allowances. It is recommended that the 'upper end' climate change allowance should be used.

Table 10: Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline) (Source: Environment Agency Climate Change Guidance)

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%

Under the NPPF an allowance of 40% for the effects of climate change to the year 2115 should be used to achieve the policy requirements for the proposed redevelopment.

Applying a 40% additional allowance will enable surface water from storm events up to and including the 1 in 100-year event plus climate change to be safely stored on-Site without detriment to existing flood risk. As a result, the proposed surface water drainage strategy will serve to improve the resilience of the existing Site to the anticipated changes in rainfall patterns.

5.4 Opportunities for SuDS

Chapter 14 of the NPPF recommends that SuDS should be utilised, where possible, within all new drainage schemes. SuDS generally mimic the natural drainage patterns of the undeveloped Site allowing infiltration into the ground (where feasible) and controlling outflow rates from the development. This reduces the impact and risk of flooding on downstream developments and can provide additional benefits such as pollution control, increased biodiversity and provision of water-based amenity space.

Table 11 below provides a detailed Site-specific assessment of the suitability of a variety of SuDS considered within the proposed surface water drainage strategy.

Table 11 Site Specific SuDS Assessment

SUDS Function & Type	Description	Advantages	Disadvantages	Site Suitability/Designer Comments	
Blue Roof	A roof specifically intended and designed to store water. This can be via open water surfaces, storage within or beneath porous medium or modular surfaces, within shallow geo-cellular crates or below a raised decking/impermeable surface.	No additional land take making them effective within dense urban Sites and can contribute significantly to overall Site attenuation requirements.	Additional weight and cost to structure (compared to normal roof design). Damage to waterproof membrane can be critical. Does not always provide treatment dependent on system.	**Whilst blue roofs are considered feasible to be implemented throughout the development, siting and sizing will need to be assessed on an individual building basis and co-ordinated with structural design. It is likely that any blue roof system will have a restricted discharge rate to maximise attenuation.**	✓
Green/Brown Roof	Multi-layered system that covers the roof of a building with vegetation/landscaping over a drainage layer. Designed to intercept and retain rainfall; reducing the volume of runoff and attenuating peak flows. Typically either defined as intensive or extensive systems depending on the nature of the selected flora.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation. Damage to waterproof membrane can be critical	**Living roofs are considered feasible at the Site but planting type, species, and layout will need to be assessed on an individual building basis and co-ordinated with structural design and roof top mechanical plant requirements.**	✓
Rainwater Harvesting	The collection of rainwater (usually within underground storage tanks) for later re-use in either buildings (treated), wash down facilities (commercial) or irrigation.	Can provide source control of storm water runoff, reduces demand on mains water.	Use is dependent on demand requirements, contributing surface area, and seasonal rainfall characteristics	**Rainwater harvesting to supply the buildings will need to be assessed on an individual building basis Opportunities for rainwater re-use intended for landscaping/irrigation purposes however should be explored at detailed design stage.**	~
Infiltration Systems/Soakaways	Any system which stores and discharges water directly to the underlying soils. These are typically soakaways, infiltration trenches, infiltration basins or infiltration blankets.	Provides groundwater recharge, ease of construction and can have minimal land take subject to design. Manages surface water at source.	Increased risk of groundwater ingress and pollution. Not suitable for poor draining soils or where infiltrating water may pit structural foundations at risk. Uncertainty over long term performance. Requires comprehensive geotechnical knowledge of underlying soils.	**As the Site is underlain with London Clay, with potential perched and contaminated groundwater, infiltration to ground as a means of surface water management is not considered viable.**	✘
Swales	Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be	Can be incorporated into landscaping proposals, offers good removal of	Not suitable for steep areas, and requires significant land take (not suitable for high density urban	**The urban nature of the Site with a high proportion of shared vehicular and pedestrian spaces does not lend**	✘

	designed to allow infiltration, where appropriate.	pollutants and reduces runoff rates and volumes. Relatively low cost.	Sites). Not suitable in areas with roadside parking.	**itself to the use of swales. Given the larger spatial requirements of swales and the irregular shape of the public realm, larger linear features are not appropriate in the context of the Site.**	
Filter Drains	Filter drains are shallow trenches filled with stone/gravel that accept runoff through sheet flow and provide temporary subsurface storage (typically provided adjacent to highways or as interception features). They can drain via infiltration or be lined and positively drained via a perforated collection pipe.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into Site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	**Filter drains can be considered feasible at the Site as a means of boundary interception drainage if needed. It is unlikely however that they will be required following implementation of other SUDS.**	~
Bio-retention Systems/Rain Gardens	Shallow planted features, which receive runoff directly from adjacent hardstanding. Typically under drained, surface water will infiltrate to the underlying piped drainage system and in doing so promote storage, plant up-take and filtration.	Easily incorporated into soft landscaping, flexible shape and planting mix and provide good degree of storage (reducing the below ground requirement). High degree of pollutant removal and high biodiversity potential. Reduces need for surface drainage (gullies, channels etc) and low cost.	Requires considered use of water tolerant plant species and landscaping & management. Susceptible to clogging if poorly managed and not suitable for steeply sloping Sites.	**The urban landscaping within the public realm lends itself well to the utilisation of bio-retention as a means of surface water management. Careful consideration will need to ensure suitable plant species are selected which are both in keeping with the overall aesthetics of the Site and suitable for semi-aquatic siting.**	✓
Tree Pits	Tree pit systems generally accept sheet runoff from adjacent hardstanding areas in the same manner as bio-retention systems. They can be used in urban settings and provide a range of aesthetic benefits.	Easily incorporated into soft landscaping with high degree of pollutant removal and high biodiversity potential. Reduces need for surface drainage (gullies, channels etc) and low cost.	Limited tree species/size depending on system and requires careful co-ordination with services due to root spread	**The landscaping strategy includes several trees and linear tree lined elements. Providing tree selection is such that it is in keeping with the aesthetics of the Site, this potentially presents a good opportunity to utilise tree pits within the drainage strategy.**	✓
Permeable Pavements	Pavements that allow rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltrating the ground (unlined) or discharging to the sewerage system (lined).	Provides low-level treatment of highway-derived pollutants (as recognised by the EA) and reduces need for surface drainage (gullies, channels etc). Available in a range of surface types (not just block paving).	Often requires increased construction depth and not suitable for use with Type 1 sub-base. May not be applicable for heavy traffic loadings and irregular maintenance required in certain situations. Not suitable for utility routes.	**Whilst the development potentially lends itself to the implementation of permeable block paving within the central public realm space, this will need to be co-ordinated with proposed utility corridors. As the Site is potentially contaminated any system would also need to be lined with an impermeable geomembrane and positively drained to the main surface water drainage system – making future maintenance potentially problematic.**	~

Detention Basins	Detention basins are surface storage basins that provide flow control through attenuation of storm water runoff. They facilitate settling of particulate pollutants. Typically dry, they can also offer multi-functional recreational use.	Can cater for a wide range of rainfall events, easy to maintain, potential for dual land use, can be incorporated in to landscaping proposals and low cost.	Not suitable for steep areas, significant land take and little reduction in runoff volume	**Given the land take required for such a feature, detention basins are not considered appropriate at the Site.**	✘
Ponds	Ponds can provide both storm water attenuation and treatment. They are designed to support emergent and submerged aquatic vegetation along their shoreline.	Good removal capability of urban pollutants, high potential ecological, aesthetic and amenity benefits, can cater for all storm events and good community acceptability.	No reduction in runoff volume; Anaerobic conditions can occur without regular inflow; Significantly land take; No suitable for steep Sites;	**Given the land take required for such a feature, ponds are not considered appropriate at the Site.**	✘
Sub-Surface/Geo-cellular Storage	Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios, can be installed beneath trafficked and soft landscaped areas.	No water quality treatment.	**The proposed layout lends itself well to the use of geo-cellular storage as a key attenuation feature within the development. These can be installed at depth and be linked with other SuDS within the system.**	✓
Rills/Canals	Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in runoff volume via plant uptake and infiltration.	Potential trip/wheel hazard, disabled access issues.	**The use of rills within the development will be largely dependent on the final hard landscaping intentions and could be used in lieu of larger linear features if desired. Inclusion will be subject to detailed design and an assessment of whether they present a hazard to pedestrian/vehicular use.**	~

Legend

✓ - Suitable for consideration on Site

✘ - Not suitable for consideration on Site

~ - Further consideration to be carried out during detailed design

5.5 SuDS Selection

Further to the assessment presented in Table 11, the following SuDS are considered viable within the context of the development:

- Blue and Green Roofs (subject to individual building assessment);
- Bio-retention Systems and Tree Pits (co-ordinated with the landscaping design)
- Sub-surface Geo-Cellular/ Tank Attenuation.

Opportunities to use the following additional systems should be explored at detailed design stage:

- Rainwater Harvesting for Irrigation only (subject to detailed design);
- Filter Drains (if required for residual runoff);
- Rills or smaller above ground hard landscaping features (if appropriate within the hard landscaping proposals)
- Permeable Paving (lined and positively drained to the wider network);

SUDS which are not appropriate for the development due to spatial constraints and existing ground conditions include:

- Infiltration Systems/Soakaways;
- Swales;
- Detention Basins/Ponds

5.6 Required Storage volume

5.6.1 Storage capacity

Based on a limiting discharge rate of 258.8l/s it has been estimated through a hydraulic Quick Storage Estimate (QSE) (using Innovyze MicroDrainage) that an attenuation volume in the range of 2170m^3 to 3250m^3 will be required. A breakdown for phase by phase requirement and overall Site attenuation is provided in Table 12. It should be noted that this volume does not include any contribution from main pipework or the effects of delayed time of entry to the system via SuDS such as green roofs.

It is currently proposed to utilise blue/green roofs and underground attenuation tanks to store the attenuated volume required. The use of blue/green roofs will reduce the requirement for below ground attenuation as advocated within the LBC CPG.

The application and integration of rainwater harvesting for irrigation will be assessed at detailed design stage.

Table 12. Approximate Proposed attenuation volume for 1 in 100year + CC storm event using Quick Storage Estimates

	Proposed restricted rate criteria	**Proposed Discharge Rate for 1 in 1-year storm event (l/s)**	**Proposed Discharge rate for 1 in 100 year +40% Climate change storm event (l/s)**	**Total attenuation required for 1 in 100 year +40%CC storm event (m3)**
Phase 1	3x Greenfield Runoff Rate	7.0	26.2	353
Phase 2 North	3x Greenfield Runoff Rate	15.9	59.5	733
Phase 2 South	3x Greenfield Runoff Rate	4.1	15.5	189
Phase 3 - Shed 2 & 3	3x Greenfield Runoff Rate	15.4	57.9	712
Phase 3 (minus Sheds 2&3)	3x Greenfield Runoff Rate	12.9	48.3	594
Phase 4 North	3x Greenfield Runoff Rate	11.0	41.3	496
Phase 4 South	3x Greenfield Runoff Rate	2.9	10.8	173
			TOTAL	**3250**

A summary of the proposed attenuation distribution by phase has been provided in Table 13 below, in line with QSEs as stated in Table 12 above.

It is possible that the actual storage volume required for the outline planning catchments may be lower than the quoted attenuation values once more detailed network modelling has been undertaken.

Table 13. Attenuation distribution by phase

	Proposed restricted rate criteria	Proposed Discharge Rate for 1 in 1-year storm event (l/s)	Proposed Discharge rate for 1 in 100 year +40% Climate change storm event (l/s)	Total attenuation required for 1 in 100 year +40%CC storm event (m3)	Blue/green roof (m3)	Underground tank storage/podium storage/lined permeable pavement etc. (m3)
Phase 1	3x Greenfield Runoff Rate	7.0	26.2	353	49.5	303.5
Phase 2 North	3x Greenfield Runoff Rate	15.9	59.5	733	423	310
Phase 2 South	3x Greenfield Runoff Rate	4.1	15.5	189	32	157
Phase 3 - Shed 2 & 3	3x Greenfield Runoff Rate	15.4	57.9	712	0	712
Phase 3 (minus Sheds 2&3)	3x Greenfield Runoff Rate	12.9	48.3	594	153	441
Phase 4 North	3x Greenfield Runoff Rate	11.0	41.3	496	253	243
Phase 4 South	3x Greenfield Runoff Rate	2.9	10.8	173	173	0
Total		**69.2**	**259.5**	**3250**	**1083.5**	**2166.5**

5.6.2 Compliance with London Plan

In preparation of the proposed SuDS strategy and following the assessment in Table 4 the 'drainage hierarchy' presented within the London Plan 2021 Policy SI13 has also been considered (see Table 14 below). This process aims to ensure that surface water runoff is managed as close to its source as possible and in a sustainable manner which delivers the other policy objectives.

Table 14 London Plan 2021 Drainage Hierarchy

Surface Water Management	Considered Within Design?	Design Comments
1 – Store Rainwater for later use	Yes	Rainwater re-use for irrigation purposes only (landscaping) is viable at the Site – rainwater re-use in buildings to be assessed on a building by building basis.
2 – Use infiltration techniques, such as porous surfaces in non-clay areas	No	Site is predominantly underlain with London Clay Infiltration systems not considered viable.
3 – Attenuate rainwater in ponds or open water features for gradual release	Partially	Due to spatial constraints, larger above ground pond features or large open bodies of water are not viable. Smaller hard landscaped ponds/rills may be viable. Shallow open features such as rain gardens and bio-retention areas are considered viable at the Site and could be integrated with the internal landscaping layout. *[Underground geo-cellular storage crates and blue roofs are viable to attenuate storm water on Site, with downstream outflows restricted to an approved/acceptable discharge rate before entering public surface water sewer.]*
5 – Discharge rainwater direct to a watercourse	No	N/A.
6 – Discharge rainwater to a surface water sewer/drain	No	No surface water public sewers are located near the Site – likely to all be combined.
7 – Discharge rainwater to a combined sewer	Yes	The Site currently discharges to a combined public sewer and will continue to do so. The on Site foul and surface water drainage networks will remain completely separate and individual outfalls from the Site will discharge to the combined sewer.

5.7 Surface Water Drainage Proposals

5.7.1 Runoff from Roofs

Roof runoff will be collected/stored within either blue or green/brown roofs (subject to detailed design) and limited via an orifice plate or similar flow control to maximise attenuation usage. From here, runoff will discharge directly to the main below ground piped network within the public realm space of the development. The below ground piped network will run to below ground

attenuation tanks throughout the site and discharge via gravity to the public sewer network.

5.7.2 Runoff from Shared Surfaces/External Areas

Surface water runoff from shared surfaces/external areas will be collected via standard sump gullies, linear drains and/or lined permeable pavement. Surface water runoff will be stored in a below ground attenuation tank. From here, the below ground piped network will flow via gravity to the public sewer network.

5.7.3 Surface Water Treatment

Due to the limitations of the Site to provide significant above ground green infrastructure for surface water treatment (such as swales or ponds), it is envisaged that petrol interceptors will be used at outfalls to the public sewer network for more heavily trafficked areas of the development. This approach will ensure that the quality of surface water runoff from the proposals will not adversely affect the off-site public sewer network.

5.8 Drainage Connections to Existing Public Sewer

TWUL record drawings suggest that most of the south and east of the Site drains to an existing TWUL combined sewer, Fleet Trunk sewer, via TWUL manhole (MH) ref: 5402 within the Site boundary. The southernmost area of the Site discharges also to the TWUL Fleet Trunk sewer via a connection to TWUL MH ref: 721C outside the southwest extent of the Site boundary.

Within the development boundary the surface and foul water drainage networks will be kept separate, before combining at a demarcation chamber prior to discharging to the existing combined sewers. It is proposed to provide three separate points of connections to the TWUL public sewer network for the development.

The proposed connections will retain the existing connections to MH5402 and MH721C with a new connection to the north of the Site for the northern areas of phase 2 and phase 4 as per Table 15

Table 15. Proposed Point of Connection and flow rate by phase

	Proposed restricted rate criteria	**Proposed Discharge Rate for 1 in 1 year storm event (l/s)**	**Proposed Discharge rate for 1 in 100 yr +40% Climate change storm event (l/s)**	**Proposed Point of Connection (PoC)**
Phase 1	3x Greenfield Runoff Rate	7.0	26.2	TW ref 721C
Phase 2 North	3x Greenfield Runoff Rate	15.9	59.5	TW MH ref 3602
Phase 2 South	3x Greenfield Runoff Rate	4.1	15.5	TW MH ref 5402
Phase 3 - Shed 2 & 3	3x Greenfield Runoff Rate	15.4	57.9	TW MH ref 5402

Phase 3 (excluding Sheds 2&3)	3x Greenfield Runoff Rate	12.9	48.3	TW MH ref 721C
Phase 4 North	3x Greenfield Runoff Rate	11.0	41.3	TW MH ref 3602
Phase 4 South	3x Greenfield Runoff Rate	2.9	10.8	TW MH ref 721C
	Total	69.2	259.5	

The proposed points of connections, discharge rates and attenuation volume distribution for the development have been captured in Figure 9 below and in Appendix C. Also shown is the existing TWUL Fleet Trunk Sewer and other local public sewers.

It is proposed that Phase 1 will retain the existing connection to TW MH721C and this will allow for the phase to be developed independently of the other phases' drainage requirements.

It is proposed that plots A and B of phase 4 south and the remainder of phase 3 excluding the Sheds will discharge to TW MH712C. Plots A and B in phase 4 south are proposed to attenuate all their storage needs at roof level.

Phases 2 and 4 have been subdivided into north and south catchments due to the site topography and proximity to Network Rail assets. It is proposed that the north catchments will discharge to TW MH 3602. The south catchment of phase 2 and the sheds will discharge to TW MH 5402.

There are three underground attenuation tanks required in phase 3 and phase 4 of the development.

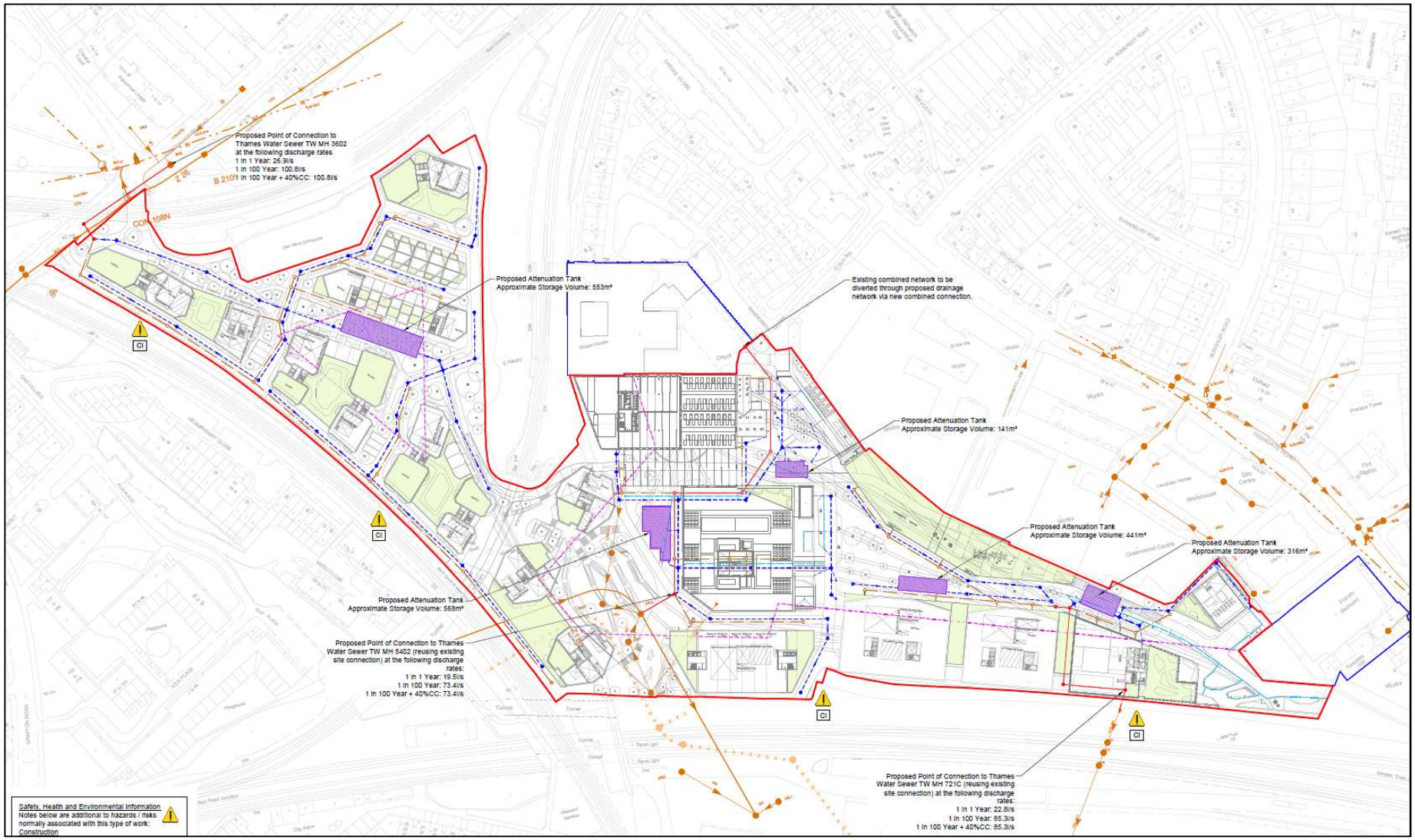


Figure 9. Proposed Surface Water Drainage plan (extract)

5.9 SuDS Maintenance Schedules

It is the intention that the surface water drainage and SuDS features will be managed and maintained by a private management company.

The following tables Table 16, Table 17 and Table 18 outline the minimum maintenance requirements for the different elements of the proposed strategy and are intended to form the basis of a final detailed operation and maintenance strategy document produced by the appointed private management company.

Maintenance requirements have been informed by the guidance outlined within CIRIA C753 and current best practice. The following information would also be supplemented by manufacturer's specifications and be dependent on the specific type of system/products used.

Table 16 Operation and Maintenance Requirements for Drainage Pipes

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove sediment and debris from inspection chambers and flow control chambers	Annually
	Cleaning of gutters and any filters on downpipes	Annually
	Remove any root ingress	As Required
Occasional Maintenance	CCTV survey of drains to check alignment, cracking and joint displacement	10 Year Intervals

Table 17: Operation and Maintenance Requirements for Geo-Cellular Attenuation Tanks

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as required
Remedial Actions	Repair/rehabilitate inlets, outlet, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tank for sediment build up and remove if necessary.	Every 5 years or as required.

Table 18: Operation and Maintenance Requirements for Green Roofs

Maintenance Schedule	Required Action	Frequency
Regular Inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability.	Annually and after severe storms

	Inspect soil substrate for evidence of erosion channels and identify any sediment sources.	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system.	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular Maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth.	Six monthly and annually or as required
	During Establishment (i.e. 1 year) replace dead plants as required.	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where >5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage.	Six Monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled.	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

5.10 Foul Drainage proposal

Although not a mandatory requirement of the NPPF this FRA has considered the management of foul water disposal from the development.

5.10.1 Existing Foul Water Drainage

Site records (Appendix B) show existing drainage pipes and manholes in the central and eastern part of the Site. The existing drainage accepts flows from the vehicle car wash, existing buildings (both offices and warehouses), and hard standing areas. The existing drainage discharges to the Fleet Trunk Sewer Fleet at three points. It is understood that the Fleet Trunk Sewer is a combined sewer and it is assumed that the existing drainage on Site is also combined.

The existing foul water discharge rate from the site is unknown.

5.10.2 Proposed Discharge Rate

A proposed peak discharge rate of 146.55l/s has been calculated based on typical occupancy and water demands for the proposed development. A breakdown of the proposed foul water discharge by plot has been provided in Table 19 below.

Table 19. Proposed Foul Water discharge rates per plot

Foul water discharge rate	
Plot	Peak discharge (l/s)
Shed 2	5.7
Shed 3	8.8
A	2.7
B	2.7
C	7.3
F	7.8
G	1.8
H	2.2
I	4.45
J	22.5
K	15.9
L	14.3
M	8.4
O	9.1
Q	10.9
P	7.8
S	14.2
Total	146.55

5.10.3 Point of Connection to Existing Public Sewer

The existing foul water connection from the Site is to the Fleet Trunk Sewer which is a 1395mm egg shaped combined sewer. It is the intention to retain this connection for the proposed Site. It is anticipated that a new connection will be the northern area of the Site, as summarised in Table 20 below and section 5.7.3.

Table 20. Proposed point of connection to Thames Water sewer

Thames Water point of connection (POC)	**Proposed phase to POC**
TW MH ref 721C	Phase 1& Phase 4 South
TW MH ref 5402	Phase 2 South, Phase 3
TW MH ref 3602	Phase 2 North & Phase 4 North

This provides a total discharge rate of 405.39 l/s into the existing Thames Water combined public sewer.

A pre-development enquiry has been issued to Thames Water on this basis, and their response is currently awaited.

6 Flood Risk Assessment

The Technical Guidance of the NPPF requires flood risk from the following sources to be assessed:

- Fluvial and Tidal sources (flooding from rivers and the sea);
- Groundwater sources;
- Artificial sources, canals, reservoirs etc; and,
- Pluvial sources (flooding resulting from surface water/overland flows);
- It also requires the risk from increases in surface water discharge to be assessed (surface water management).

6.1 Fluvial and Tidal Flood Risk

Current EA Flood Maps for Planning show that the Site in its entirety is located within Flood Zone 1 (FZ1), defined as land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%) – very low.

As a result of the above the risk of flooding from fluvial/tidal sources is **low**.

6.2 Groundwater Flood Risk

Groundwater flooding typically occurs in areas underlain with aquifers or permeable rock/superficial deposits that permits groundwater to rise to the surface during high/long rainfall events. Low lying areas are particularly susceptible given that the water table is usually at a much shallower depth.

Figure 10: Recorded Groundwater Flooding Incidents (LBC SFRA Extract Figure 4e)

The Site is not located in an area of increased susceptibility to elevated groundwater flooding and there is no recorded history of flooding from

groundwater flood incidents within the Site boundary. The closest recorded incident of groundwater flooding is some 500m east of the site as shown in Figure 10 above.

The presence of groundwater at shallow depths noted within the Site investigation report may indicate perched water which could lead to a potentially increased risk of groundwater flooding during the construction phase. Residual risks from groundwater flooding will need to be appropriately managed during demolition and construction and this is addressed in Section 7

For the above reasons, the risk of groundwater flooding to the Site is deemed **low** during operation and **medium** during construction (but reduced to **low** risk with suitable mitigation).

6.3 Flooding from Artificial Sources

In general, reservoir flooding is extremely unlikely to occur and there has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensures that reservoirs are inspected regularly, and essential safety work is carried out.

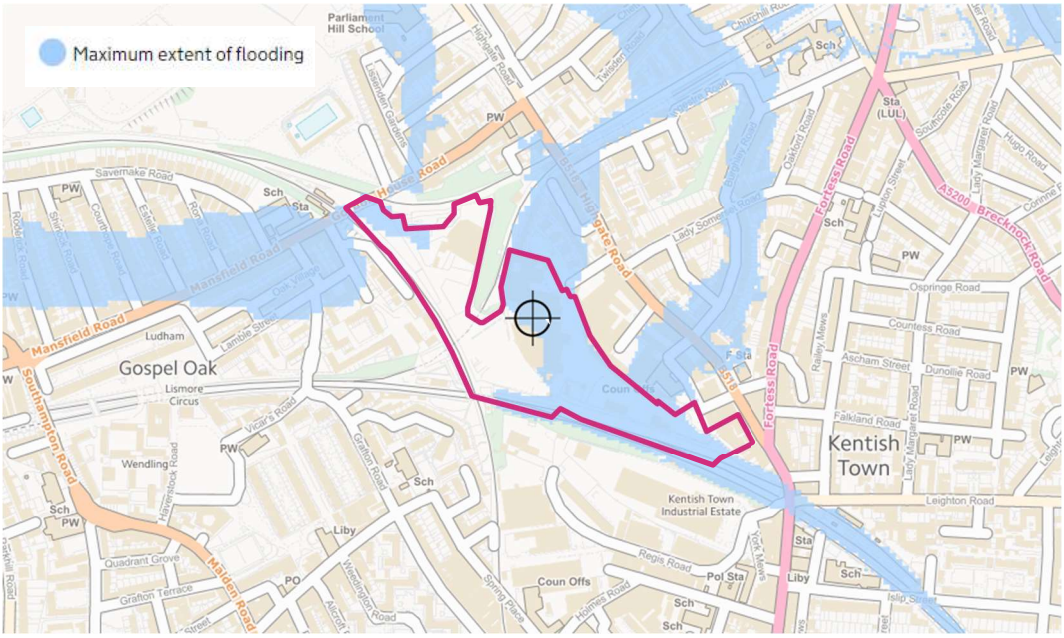


Figure 11: EA Reservoir Flood Mapping (Extract)

Highgate Pond 2 and 3 are classified as 'large raised reservoirs" under the Reservoirs Act 1975. Whilst the eastern lower portion of the Site is shown to be at risk of reservoir flooding in the event of failure of the Highgate Ponds 2 and 3, the Environment Agency do not require specific mitigation measures to be provided as part of an NPPF compliant FRA due to the extremely low likelihood of occurrence.

As a result of the above, the risk of flooding from artificial sources is **low**.

6.4 Pluvial Flood Risk

Flooding attributable to surface water/overland flows typically arises when surface water is unable to discharge directly to a sewer or watercourse. The EA's Flood Maps for Surface Water provide a general indication of potential flow routes or areas that may be at risk of surface water ponding in extreme events. They take a broad account of existing drainage, topography and typical storms which are likely to cause flooding. The creation of surface water flooding mapping often relies on coarse LiDAR data and does not always take into consideration any localised changes in level. EA surface water flood mapping for the Site is provided in Figure 12 below.

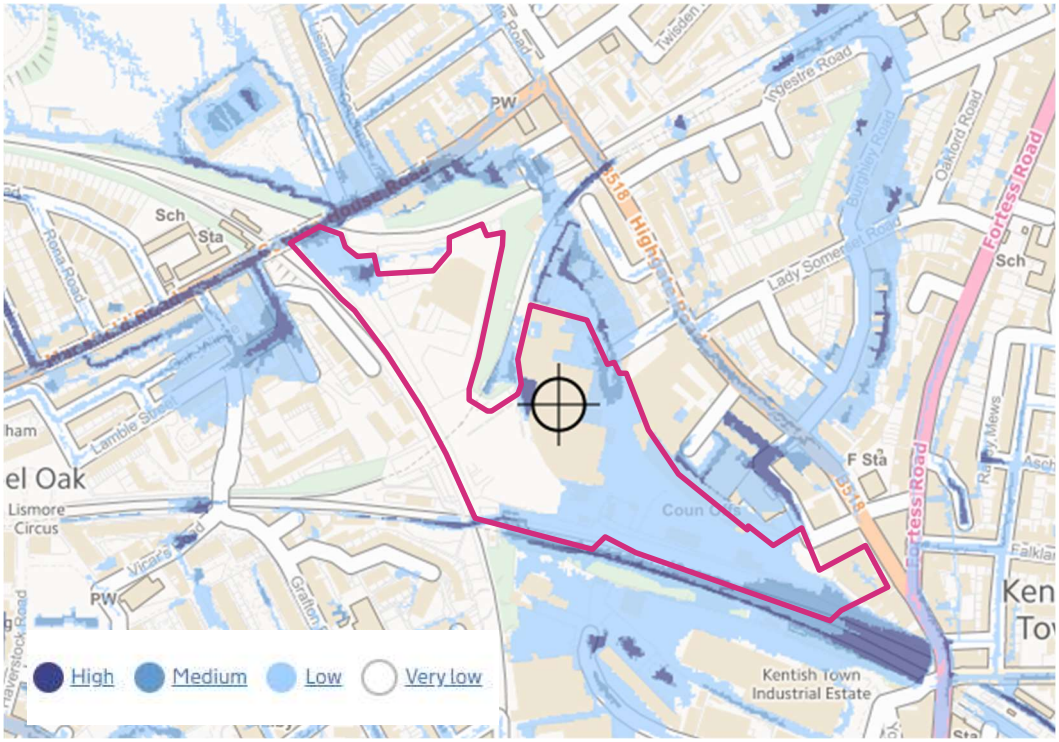


Figure 12: EA Surface Water Flood Maps (Extract)

Figure 12 above shows the extent of surface water flooding at the Site for the 1 in 30-year annual probability (high risk), between 1 in 30-year and 1 in 100-year annual probability (medium risk), between 1 in 100-year and 1 in 1000-year probability (low risk) and then in excess of the 1 in 1000-year probability (very low). Figure 14, Figure 15 and Figure 16 show the individual surface water flood maps for low, medium and high risk respectively with approximate flood depths.

As indicated in Figure 12, the western portion of the Site predominantly has a "very low" surface water flood risk, with annual probability greater than 1 in 1000. This is except for a small localised area at the north west corner that has a "low risk" with an annual probability between 1 in 100 year and 1 in 1000 year.

The eastern portion of the Site has a "low risk" of surface water flooding, with an annual probability between 1 in 100 year and 1 in 1000 year. This is considered an extreme and low occurrence event and the risk is inherent of the fact that the

east of the site is generally flat and set at a lower level compared to land north of the site which would make it more susceptible to ponding in extreme events.

Flood hazard mapping for surface water has been generated by LBC within the SFRA, presented in Figure 13 below for the 1 in 1000-year storm event. The hazard rating is based on a function of speed and depth and accommodates a debris factor. The rating system is as follows:

Table 21: Surface Water Hazard Rating

Flood Hazard Rating	Degree of Flood Hazard	Description
<0.75	Low	Caution – "Flood zone with shallow flowing water of deep standing water"
0.75-1.25	Moderate	Dangerous for some (i.e. children) – "Danger: Flood zone with deep or fast flowing water"
1.25-2.0	Significant	Dangerous for most people – "Danger: flood zone with deep fast flowing water"
>2.0	Extreme	Dangerous for All – "Extreme danger: flood zone with deep fast flowing water"

The hazard rating mapping removes areas that have a very low hazard rating below 0.575 using debris factors where flood water depth and velocity are low to highlight the areas at highest risk for assessment.

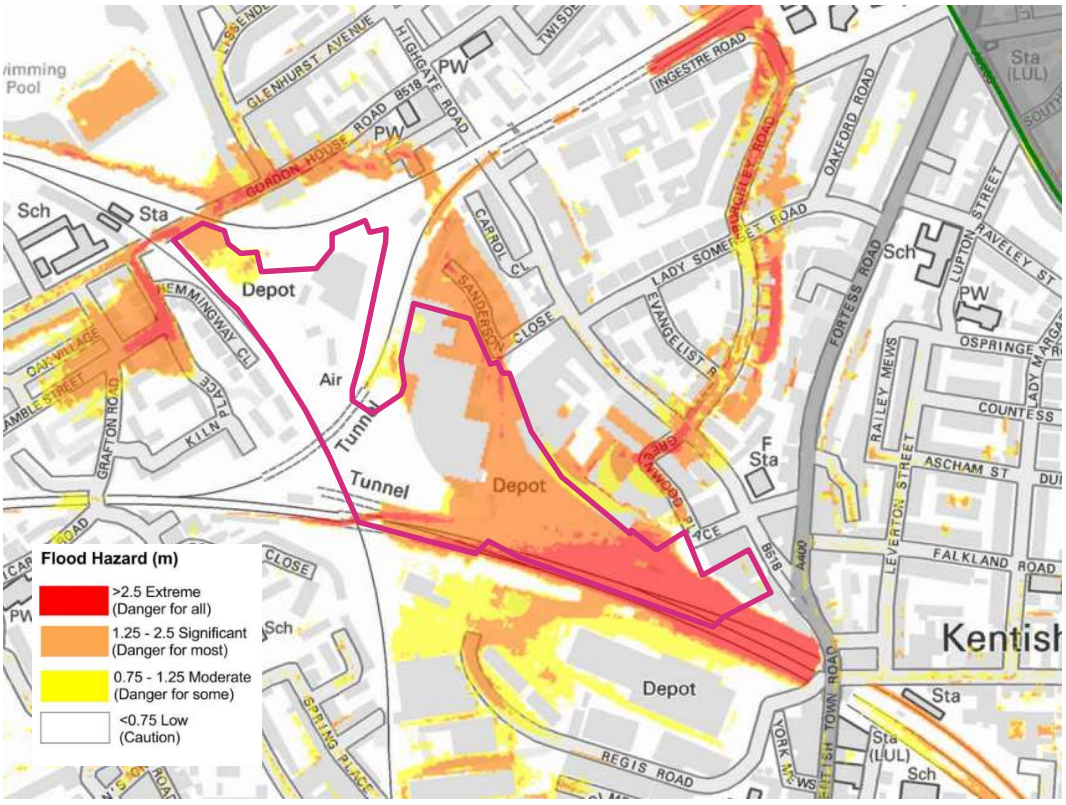


Figure 13: Hazard Mapping Surface Water 1 in 1000 Year Flood Event (SFRA Figure viii Extract)

Whilst this does show an "extreme" hazard rating for the south east of the site (concurrent with the surface water flood mapping for the same event) as a result of the lower lying areas immediately adjacent to the railway line to the south, this

is localised and will largely be mitigated through implementation of the proposed surface water management strategy and SuDS.

For higher probability events up to the 1 in 100-year storm events Figure 15 and Figure 16 for “medium” and “high” risk respectively show very little ponding across the site.

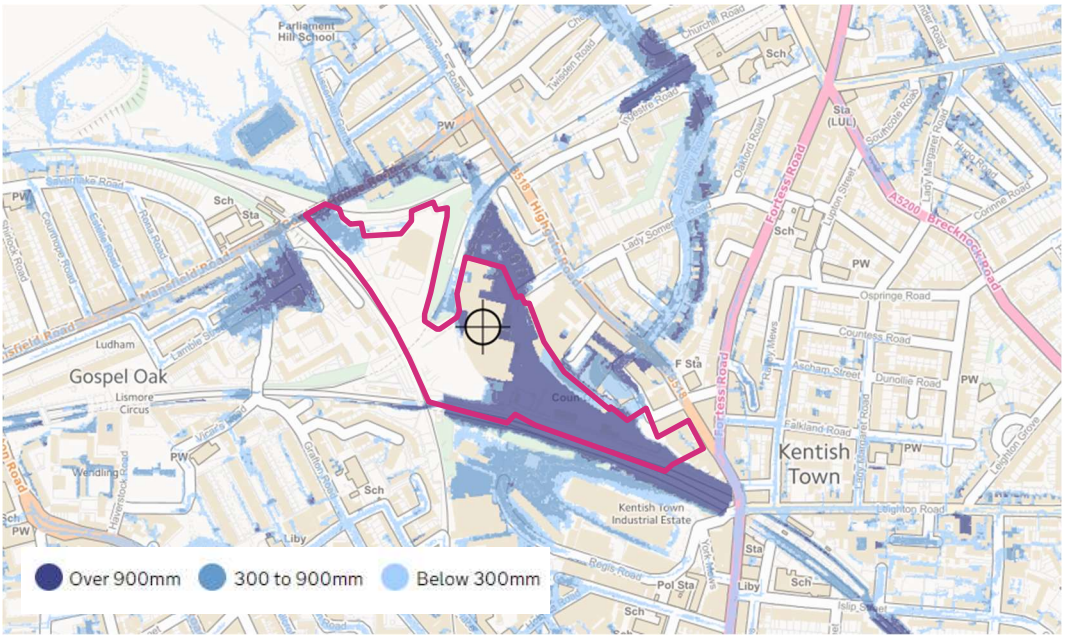


Figure 14: EA "Low Risk" Surface Water Flood Maps (Extract)

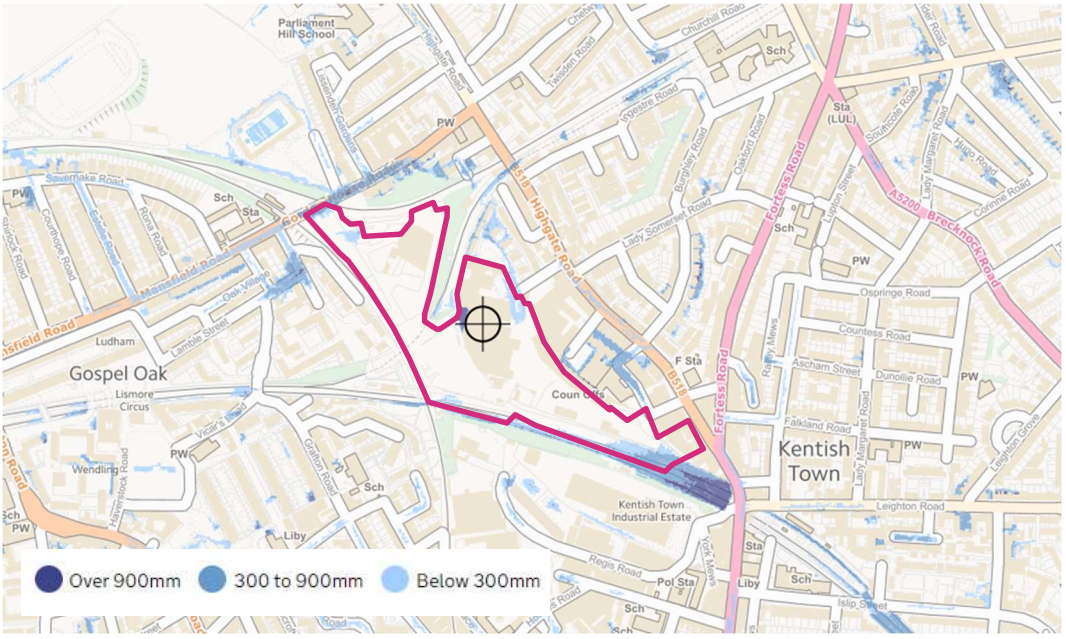


Figure 15: EA "Medium Risk" Surface Water Flood Maps (Extract)

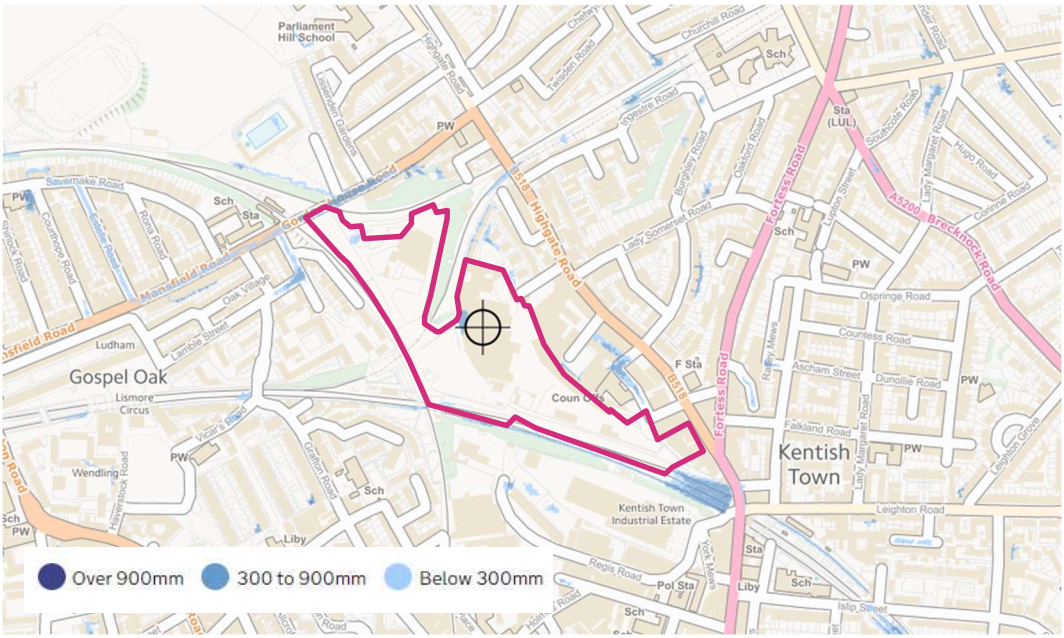


Figure 16: EA "High Risk" Surface Water Flood Maps (Extract)

The LBC SFRA defines a Critical Drainage Area (CDA) as:

"*A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure."*

and a Local Flood Risk Zone (LFRZ) as:

"Discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location."

The LBC SFRA identifies that the Site lies within CDA reference Group3_003, however outside of any LFRZ. Whilst the "Gospel Oak" LFRZ is located immediately west of the Site it is separated by the existing railway lines along the western boundary (see Figure 17 below).

The LBC Flood Risk Management Plan (FRMP) confirms that the Gospel Oak area (west of the site) was subject to surface water flooding in 1975 and original modelling suggested that the Gospel Oak area was the highest risk area in North Camden. The FRMP confirms:

"The council produced preliminary work for flood mitigation schemes for Gospel Oak which showed that, due to the flood relief sewer constructed in 1987, the flood risk was significantly reduced. While there is still some residual flood risk in the area, it is not as significant as originally believed. This is confirmed by the lack of significant flooding in 2002, even when nearby South End Road was heavily flooded."

To this end, the "Gospel Oak" LFRZ is not considered to pose a risk to the site.

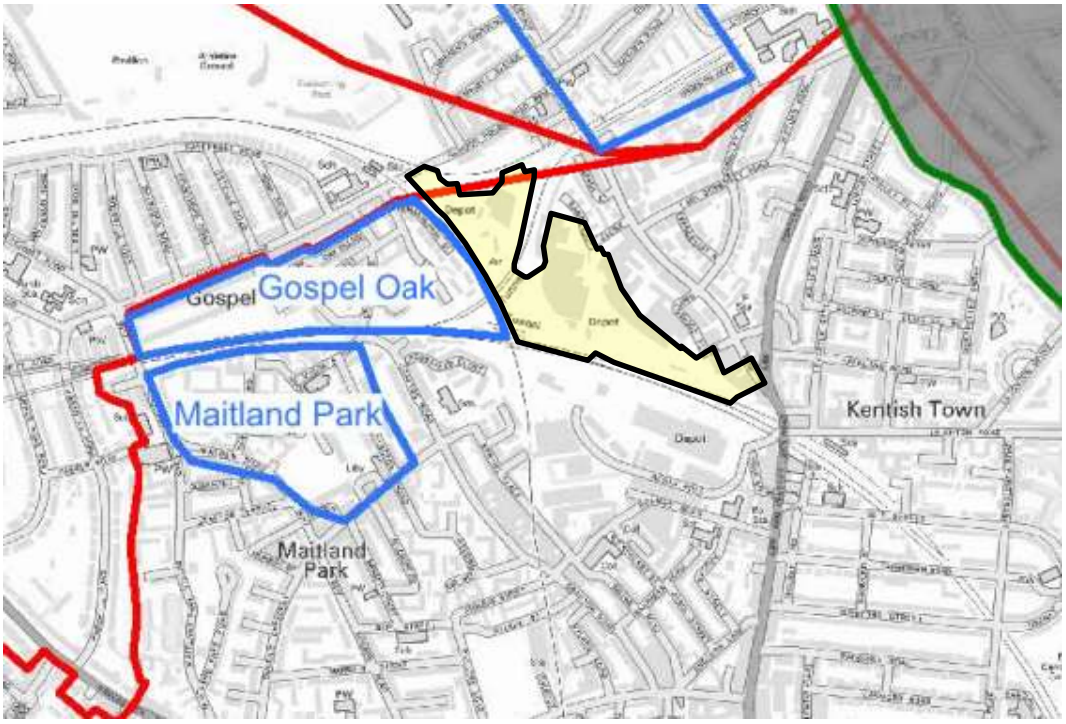


Figure 17: Local Flood Risk Zones (LBC SFRA Figure 6 Extract)

Based upon the above evidence and acknowledging that the proposals will introduce a new surface water management strategy across the Site which utilises SuDS, the risks from pluvial flooding and overland flow is **low**.

6.5 Sewer Flooding

Figure 18 shows the extent of existing TWUL public sewers within the site boundary (this does not show existing private sewers also located within the site which will be removed as part of the redevelopment).

These assets include:

- 1219mm x 813mm combined sewer (to a 450mm diameter);
- 1443mm x 762mm combined sewer (to a 450mm diameter); and
- 1395mm Fleet Trunk Sewer.

TWUL records suggests that the Fleet Trunk Sewer is some 5.5m below ground level as it passes within the site.

TWUL asset mapping identifies the following additional existing significant combined sewers within proximity to the site:

- 1168mm x 737mm in Highgate Road to the North of the Site;
- 1194mm x 762mm in Gordon House Road to the North West of the Site; and
- 1372mm Trunk Sewer in Gordon House Road to the North West of the Site; and

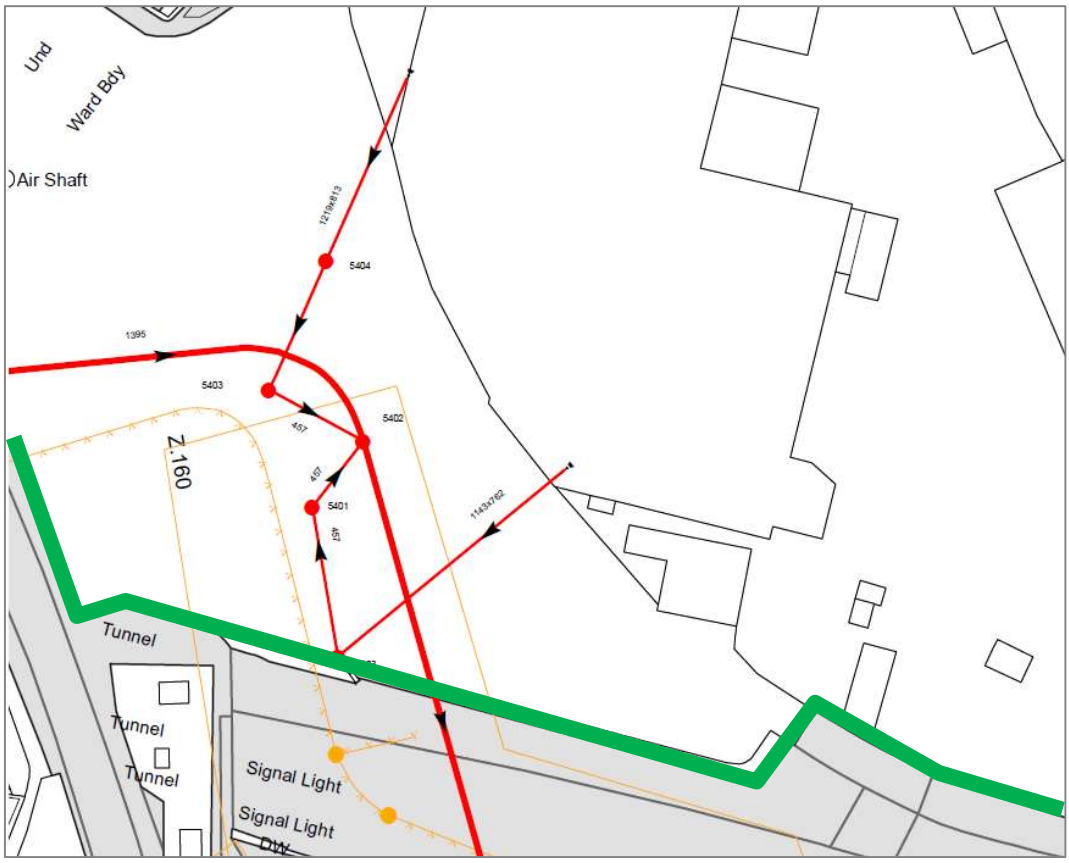


Figure 18: TWUL sewers within the Site

The sizes shown on the Thames Water Asset mapping suggest that these are likely the egg shaped Victorian sewers that are renowned in this part of London.

Potential flooding from the existing sewers would be from a combined system which presents additional health risks in comparison with storm-only flooding.

Whilst public sewers are now typically designed to accommodate rainfall events up to the 1 in 30 year storm event, the LBC SFRA identifies that the sewer network within some parts of Camden is particularly old with some sewers potentially only designed to accommodate the 1 in 10 year storm event. Notwithstanding the above the LBC SFRA confirms that exterior sewer flooding records are all concentrated at the North West of the borough.

In the wider context Thames Water is constructing a new 25km strategic storm relief tunnel network to mitigate sewer flooding across London known as the Thames Tideway Project. The necessary expansion of London's sewer network is due for completion in 2025.

The Thames Tideway project will seek to reduce the incidence of flooding from the sewer network across London and improve the quality of water in the event of a flood incident and water quality entering the Thames.

The combination of the depth of the sewers in this location and the fact that there have not been any historical occurrences of flooding in the area are considered appropriate evidence that this location is generally at 'low' risk of flooding from the public drainage network. Any offsite flooding of the adjacent road network

associated with overloading of sewers will likely be contained within the public highway extents and flow away from the site.

The risk of sewer flooding is considered **low.**

6.1 Infrastructure Failure

TWUL asset mapping shows the following notable existing water mains near the site:

- 315mm water main in Gordon House Road to the north west of the site; and
- 10" Cast Iron slip lined with 180mm PE water main in Highgate Road to the north of the site.

The site is also served by a 180mm HPPE water main via Sanderson Close.

There are no large infrastructure features have been identified in the local area.

It is considered that the risk of the site being flooded is due to a burst water main is **low** due to the relatively small size of the water mains listed above. Any flooding is likely to be retained within the local highways network surrounding the Site.

6.2 Historic Flooding

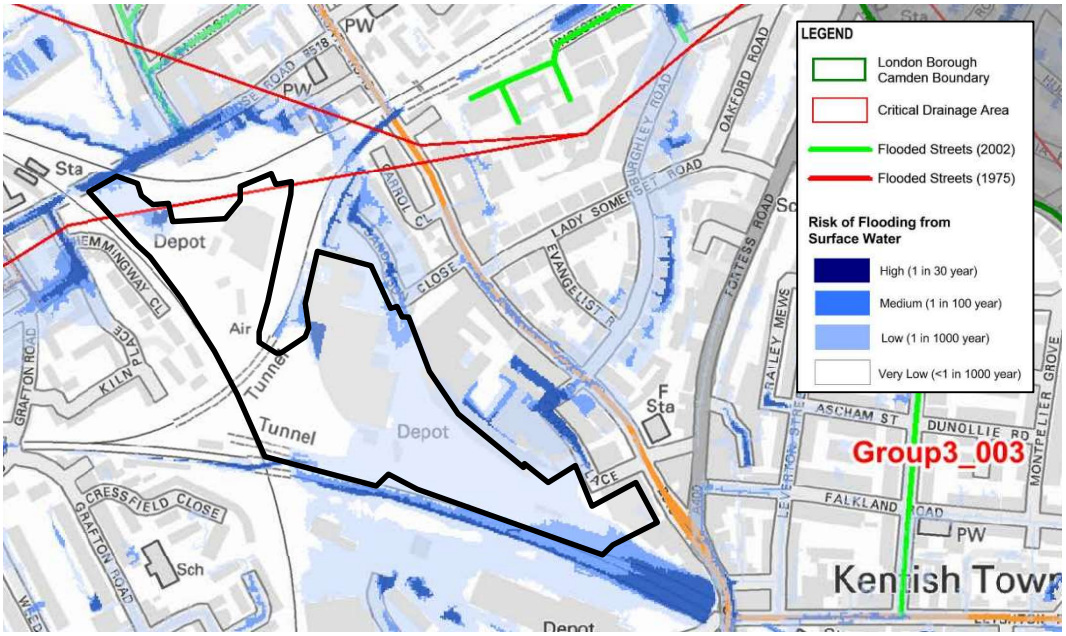


Figure 19: Historic Flooding (LBC SFRA Figure 3iii Extract)

Figure 19 shows the extent of flooded streets for historic flood events in 1975 and 2002 in and around the Site. In 1975 flooding was recorded in Highgate Road

east of the Site and in 2002 there was some recorded flooding in Lissenden Gardens and Glenhurst Avenue to the north.

According to the LBC SFRA there is no recorded history of internal or exterior sewer flooding within the Site boundary or in the immediate environs.

6.3 Flood Risk Summary

A summary of flood risk is provided below following the above assessment from all sources. The level of risk is defined as low, medium or high and as described by the following:

Low: Probability of flooding is low-negligible and risk to people or property should not form a material consideration for development. There is little or no residual risk.

Medium: Whilst probability of flooding is low, residual risk to people or property may be severe and require the development proposals to consider mitigation or further investigation. Mitigation may include flood resilience measures or protection of key infrastructure.

High: Flooding is likely to occur and should be specifically addressed as part of the development proposals. There is a significant risk to people or property and a flood management plan, evacuation plan/safe refuge plan or permanent flood prevention measures should be provided. May require further modelling, investigation, survey or consultation with LLFA/EA/Drainage Authority.

Table 22: Flood Risk Summary

Flood Source	Pathway	Comment	*Risk
Fluvial and Tidal	River Thames is located 5km south of Site	EA flood maps confirm the Site is entirely located within FZ1. Less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)	Low
Groundwater	Through underlying strata when groundwater levels rise above surface levels.	Site is not located in an area of increased susceptibility of groundwater. No superficial deposits at the site and underlain with London Clay. No historic record of groundwater flooding at Site or immediate Site environs. Proposed basements are highly unlikely to cause wider significant changes to the local groundwater regime. Groundwater found in made ground. Risk of perched/localised groundwater. Residual Risk during construction of groundwater ingress.	Low (During Operation) Medium (During Construction)
Artificial Sources	Risk of reservoir flooding from Highgate Ponds 2 and 3.	EA flood maps show that part of the Site is potentially at risk of reservoir flooding, but probability is low-negligible. No other artificial sources of flooding near to the Site. No specific mitigation against reservoir flooding required.	Low

Pluvial	Overloading of sewers or overland flow	Western portion of the Site predominantly has a "very low" surface water flood risk, with annual probability greater than 1 in 1000. The eastern portion of the Site has a "low risk" of surface water flooding, with an annual probability between 1 in 100 year and 1 in 1000 year. Hazard mapping confirms residual risk in extreme rainfall event (100-1000 year storm event). Not located within a LFRZ. Existing public sewers within the site at significant depth.	Low
Infrastructure Failure	Burst water main inundating local sewer network	No significant water mains or trunk mains in close proximity to the site.	Low

6.4 Impacts on Local Flood Regime

It is proposed to attenuate flows to limit the stormwater peak flows to no more than the 1 in 10-year brownfield runoff rate for all storm events up to and including the 1 in 100 year storm event + climate change. The new drainage network will be designed to the following standards:

- No surcharging on Site for the 1 in 2-year storm event;
- No flooding on Site from a 1 in 30-year storm event; and
- No flooding which may pose a significant risk to people and property from a 1:100-Year storm (including an allowance for climate change)

All connections to the existing sewer network will be agreed with Thames Water, to ensure that flood risk isn't increased. The proposed SuDS and attenuation features will minimise discharge from the Site to alleviate off Site flood risk/surcharging and ensure that surface water within the development is managed to appropriate levels (including climate change). The above approach ensures that the development proposals offer betterment to the wider local flood regime for storm events in excess of the 1 in 10 year and offer future resilience to the potential effects of climate change.

7 Residual Mitigation Measures

The preceding sections of this report demonstrate that there is low risk of flooding to the site from fluvial and tidal sources, artificial sources, pluvial sources, sewer flooding and infrastructure failure.

There is a residual risk related to the potential for groundwater flooding of excavations during construction due to the presence of potentially high perched groundwater within the made ground across the site.

Groundwater flood risk will need to be managed by ensuring the following during demolition and construction:

- Stability of excavations is appropriately considered within the Demolition and Construction Method Statements;
- De-watering equipment is available on-site to prevent/remedy the flooding of excavations; and
- Groundwater removed from excavations is not to be discharged into the surface water drainage system. This is due to the potential for the groundwater to be polluted with sediment, contaminants leached from made ground, and oils/fuels from on-site materials/machinery. Groundwater is to be discharged to the public foul water drainage system.

The Construction Environment Management Plan (CEMP) for the proposed development should outline suitable methods to prevent any adverse effects on surface waters from construction operations. This should ensure that the risk of fuel and oil contamination is minimised by reducing the risk of accidental spillage as well as the severity of a spillage should it occur. This includes the use of appropriate containers, the construction of bunded areas within which fuels and oils are to be stored and vehicles refuelled, and the implementation of an incident response plan.

A temporary surface water management strategy should be implemented by the contractor during the construction works phase. This should, where possible, utilise a staged approach whereby the final drainage strategy is brought online incrementally.

8 Conclusion

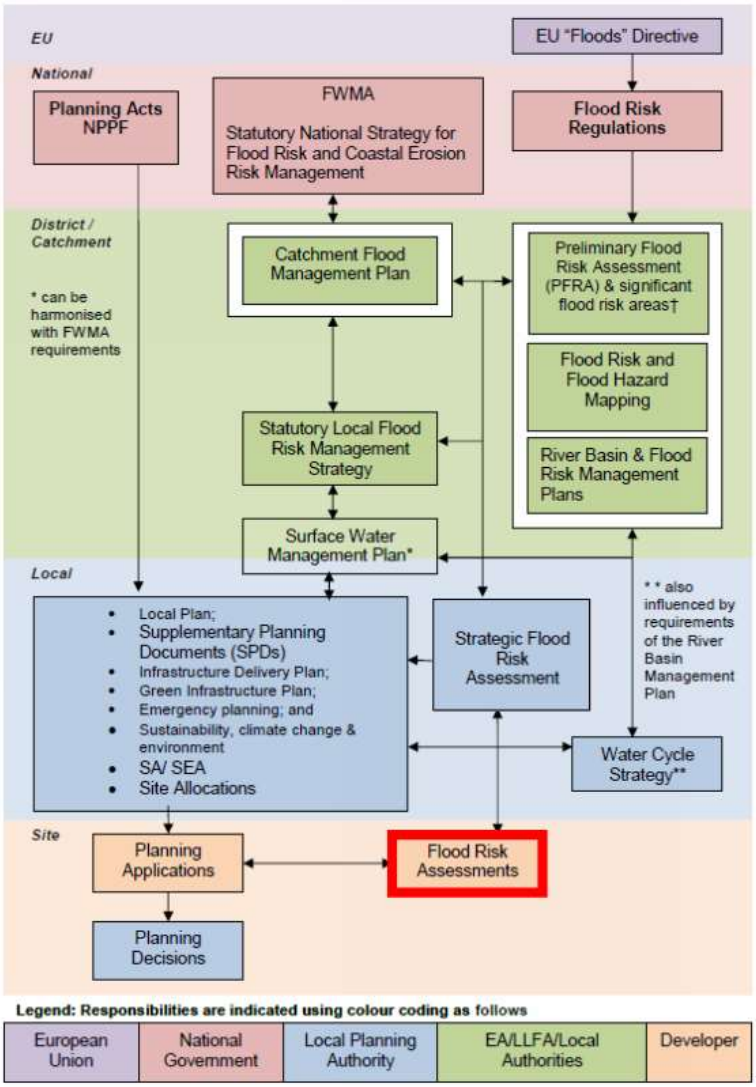
This FRA is based on observations, a review of published data and hydraulic modelling. The following points are considered pertinent to the proposed development's suitability for this Site:

- The site is located within Flood Zone 1.
- Flood risk from tidal/fluvial sources, pluvial sources, groundwater, artificial sources and infrastructure failure are all considered to be low.
- In accordance with the requirements of Chapter 14 of the NPPF consideration has been given both to risk to the site, and to potential offsite risk as a result of the proposed development.
- Based on our understanding of the site setting and the proposals, it is considered that the development can be constructed and operated safely and will not increase flood risk elsewhere.
- The drainage design intent is for the site limit surface water flows to three times the Greenfield runoff rate applied at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change. This has been discussed and agreed with the LLFA in preparation of this report.
- The above approach requires approximately 2170m^3 to 3250m^3 of attenuation to be provided across the Site.
- Following a SuDS appraisal, blue and green roofs are both considered viable to provide the above storage requirement and are included within the surface water drainage proposals. In addition, geo-cellular storage within the public realm space, subsidised with bioretention areas/green infrastructure integrated as part of the landscaping proposals will ensure the site can fully accommodate the 1 in 100-year storm event + 40% without causing flood risk on or off site.
- The proposal for surface water management is consistent with the aims of the NPPF and Intend to Publication London Plan and demonstrates a sustainable approach consistent with current best practice. This ensures that the site is not at increased risk of flooding and provides future resilience to the effects of climate change.

Appendix A

National Legislation, Regulations and Flood Risk Guidance

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is considered at every stage of the planning process. The following diagram outlines the key planning policy for flood risk management and associated documents.



A1 International Planning Policy

A1.1 Water Framework Directive (2000/60/EC)

The Water Framework Directive (WFD) sets out objectives prioritising future water protection across the European Union, with the aim of achieving improvements in the quality of polluted water bodies and maintaining the quality of clean water bodies.

Member states were required to transpose the Water Framework Directive (WFD) into domestic law by December 2003. This took place in England and Wales through the WFD England and

Wales Regulations 2003 (WFD Regulations). In the UK, the Environmental Agency (EA) is the 'competent authority' under the WFD Regulations.

Member water bodies are categorised as: 'rivers'; 'lakes'; 'transitional waters'; 'coastal waters'; or 'groundwaters'. Each is identified within each category as being 'at risk'; 'probably at risk'; 'probably not at risk'; or 'not at risk' of failing WFD objectives with regard to 'water abstraction and flow regulation'; 'physical or morphological alteration'; or 'alien species'.

Under the WFD Regulations, each river basin district must have a river basin management plan in place which sets out environmental objectives for the district and a programme of measures to be applied in order to achieve those objectives. Water in rivers, estuaries, coasts and aquifers will improve as a result of the measures set out in the river basin management plans.

A1.2 EU Floods Directive (2007/60/EC)

The aim of the Directive is to provide a consistent approach across the European Union to reducing and managing the risks posed by flooding to human health, the environment, cultural heritage and economic activity. The Floods Directive is to be delivered in conjunction with the objectives of the Water Framework Directive (2000/60/EC) to deliver a better water environment through river basin management.

In the UK, the Floods Directive is transposed into law via the Flood Risk Regulations by setting out the duties of local government in assessing flood risk to their area.

A2 National Policy and Guidance

A2.1 Environmental Permitting Regulations (2016)

The Environmental Permitting Regulations 2016 consolidate and replace the 2010 Regulations and subsequent amendments. The permitting regime covers a range of activities that release emissions to land, air and water, or that involve waste.

Schedule 21 relates to water discharge activities and Schedule 25 relates to flood risk activities. Schedule 22 relates to groundwater activities and the regulations place a duty on regulating authorities to implement the Water Framework Directive.

A2.2 The Water Resources Act (1991) and Water Acts (2003, 2014)

The Water Resources Act 1991 provides legislation for the control of the pollution of water resources. Under this Act, offences of polluting controlled waters occur if a person knowingly permits any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters. The Water Resources Act 1991 also provides an all-embracing system for the licensing of the abstraction of water for use, which is administered by the EA. The Water Acts (2003, 2014) modernise water legislation and amend the Water Resources Act 1991 to improve long-term water resource management.

A2.3 Flood Risk Regulations (2009)

The Flood Risk Regulations 2009 transpose the Floods Directive (2007/60/EC) into law in England and Wales.

The regulations required the Lead Local Flood Authority (LLFA), to produce:

- A Preliminary Flood Risk Assessment (PFRA) by December 2011;
- Flood hazard and flood risk maps by December 2013; and
- A Local Flood Risk Management Strategy by December 2015.

A2.4 The Flood and Water Management Act (2010)

The Flood and Water Management Act 2010 (FWMA), which received Royal Assent on 8 April 2010, takes forward some of the proposals in three previous documents published by the UK Government:

- Future Water;
- Making Space for Water; and
- The Government's Response to the Sir Michael Pitt's Review of the summer 2007 Floods.

The FWMA gives the EA a strategic overview of the management of flood and coastal erosion risk in England. In accordance with the Government's Response to the Pitt Review, it also gives upper tier local authorities in England responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

A2.5 Land Drainage Acts (1991, 1994)

The water quality and flood risk management of controlled waters including rivers and aquifers is protected by legislation under the Land Drainage Acts (1991, 1994).

A2.6 National Planning Policy Framework (2019)

The NPPF includes policies on flood risk and minimising the impact of flooding under Section 14, Meeting the challenge of climate change, flooding and coastal change (Paragraphs 155 – 165). The NPPF supersedes the Planning Policy Statement 25 (PPS25).

The NPPF states that:

Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and develop policies to manage flood risk from all sources, taking account of advice from the EA and other relevant flood risk management bodies, such as LLFAs and internal drainage boards.

Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change.

When determining planning applications, Local Planning Authorities (LPAs) should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of Sustainable Urban Drainage Systems (SuDS).*

A2.7 National Planning Practice Guidance (2018)

The NPPG, comprising a web-based resource, has been issued to ensure the effective implementation of the NPPF and contains a section covering Flood Risk and Coastal Change. It identifies how new developments are to take flood risk and climate change into account to ensure that developments not only remain safe from flooding but also do not increase flood risk elsewhere. NPPF promotes the implementation of SuDS to manage surface water in a manner that mimics existing (pre-development) conditions.

Adherence to the requirements of the NPPF can be achieved through following the Technical Guidance to the National Planning Policy Framework.

Planning Practice Guidance Para. 080 *Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:*

into the ground (infiltration);

to a surface water body;

to a surface water sewer, highway drain, or another drainage system;

to a combined sewer.

Particular types of sustainable drainage systems may not be practicable in all locations

Planning Practice Guidance Para. 085 *When planning a sustainable drainage system, developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any personnel, vehicle or machinery access required to undertake this work. Any sustainable drainage system should be designed so that the capacity takes account of the likely impacts of climate change and likely changes in impermeable area within the development over its lifetime and continues to provide effective drainage for properties.*

A2.8 Sewerage Section Guidance Appendix C – Design and Construction Guidance (2020)

[Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code")]

Adopted drainage networks needs to meet the criteria outlined in the Design and Construction Guidance (2020). A piped drainage system is required to not surcharge for a 1 in 1-, 1 in 2-, or 1 in 5-year event depending on site conditions or flood the ground in a 1 in 30-year event using a design storm with the critical duration relevant to the site (i.e. the worst-case for a given return period). Private drainage systems also tend to use these criteria as a basis for design. Adoption of new sewers or abandonment of old sewers should take place in accordance with the Water Industry Act 1991, Sections 104 and 116 respectively.

A2.9 DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (2015)

The DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems provides guidance on:

- Flood risk outside the development;
- Peak Flow Control;
- Volume Control;
- Flood Risk within the development;
- Structual Integrity;
- Designing for Maintenance Considerations
- Construction

Key extracts from this document are provided below:

Peak flow control

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Volume control

S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Flood risk within the development

S7 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.

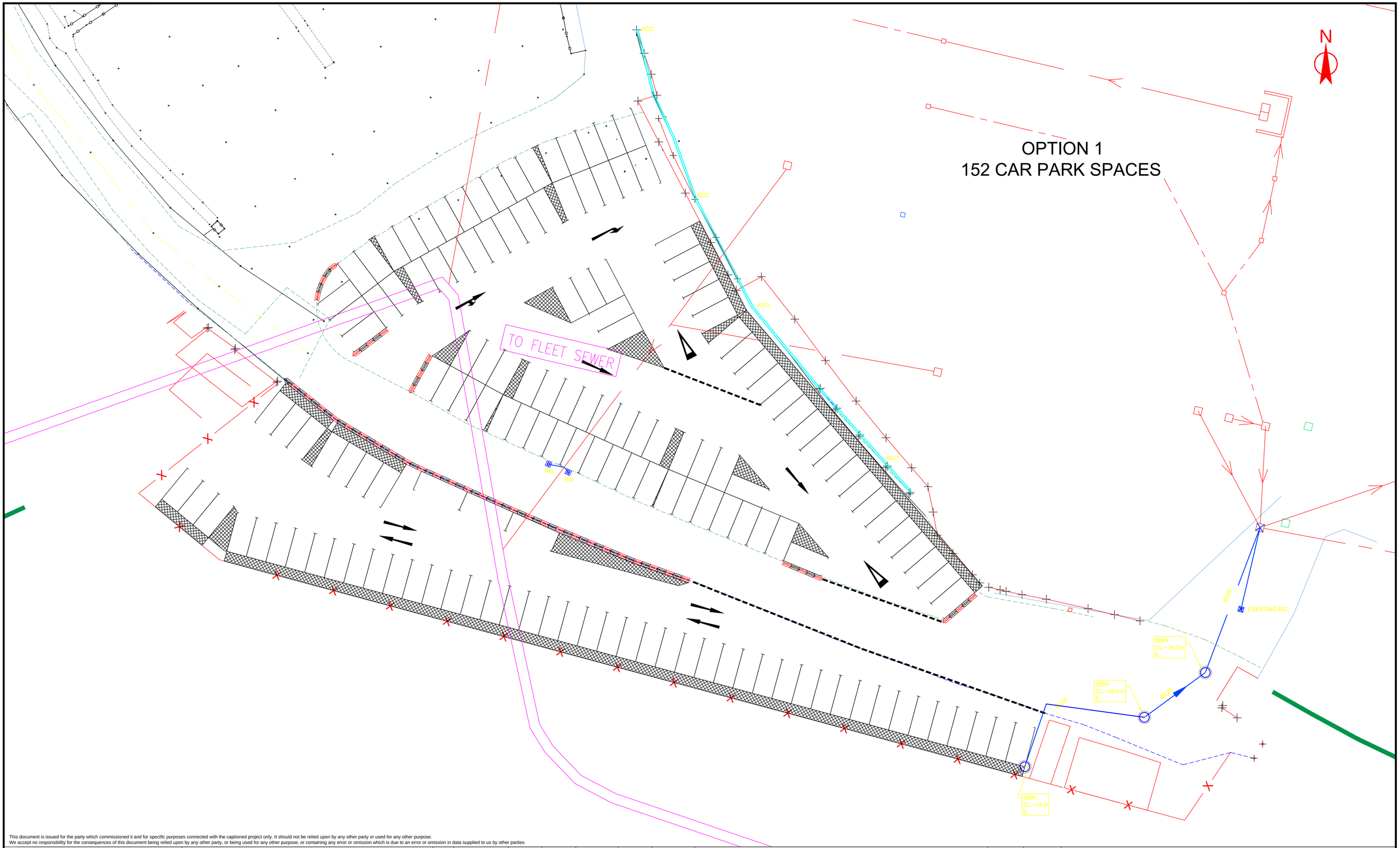
S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

S9 The design of the site must ensure that, so far as is reasonably practicable, 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 standards are supported by Practice Guidance prepared by the Local Authority SuDS Officer Organisation (LASOO).

Appendix B

Existing Drainage Survey Information



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NOTES

Rev	Status	Drawn	CAD Chk	Date	ENG Chk	Date	Revision Comments	Approved	Date
AB	DRAFT	DN		20/09/16		18/03/16	PROPOSED CAR PARK LAYOUT WITH DRAINAGE INDICATIVE SCHEME	-	-
AA	DRAFT	JS	MA	01/06/15	BS	01/06/15	FOR INFORMATION	-	-

Project: KENTISH TOWN DEPOT MAINTAINENCE

Drawing Title:
PROPOSED CAR PARK DRAINAGE
STAFF/OFFICE VEHICLES

Drawing Number: LPP0034/DWG/DN/001

Revision: AB

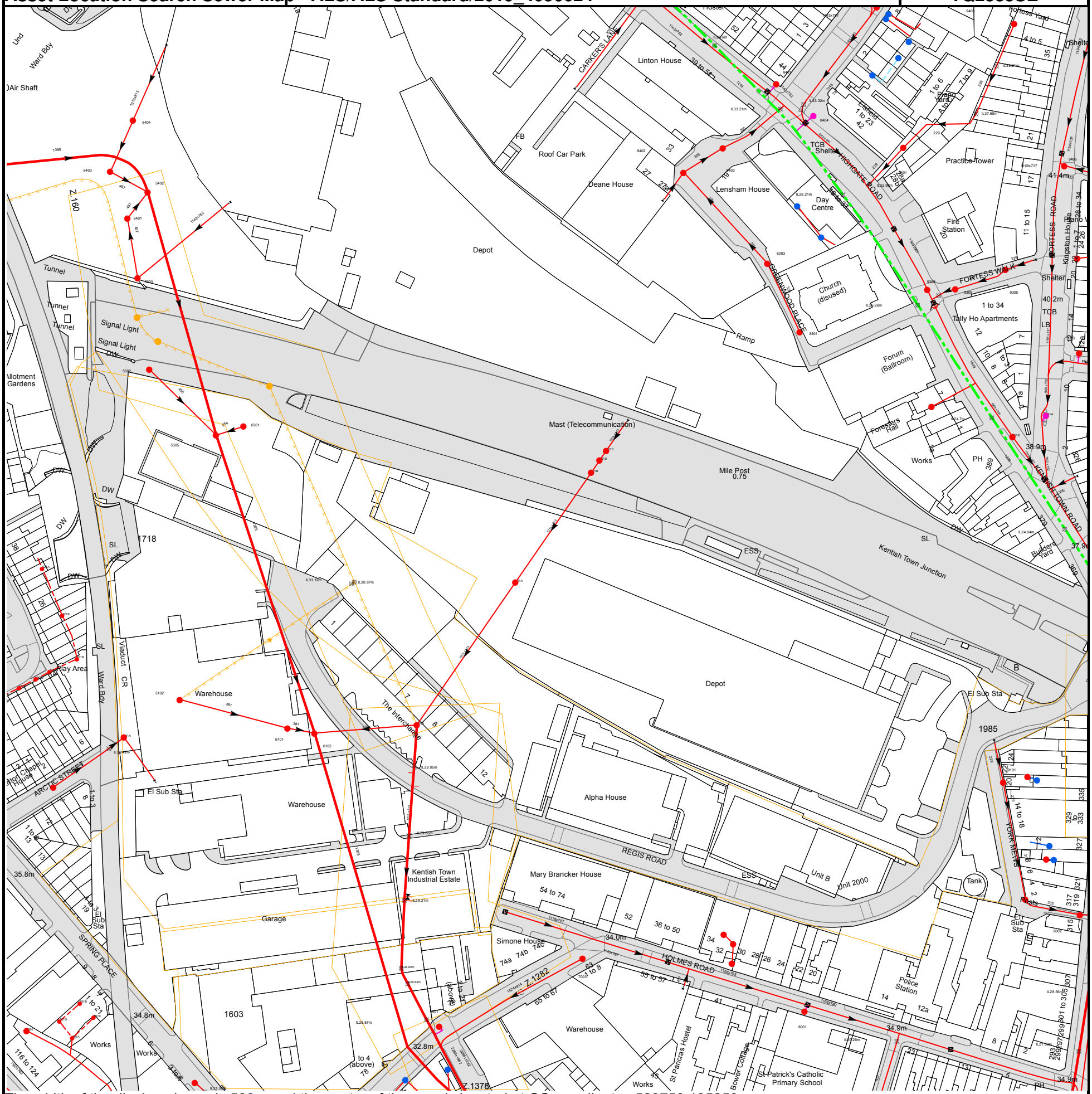
Scale: 1:200 @ A1 NTS @ A3

Sheets: 1 OF 1

Suitability: -

Asset Location Search Sewer Map - ALS/ALS Standard/2019_4056624

TQ2885SE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 528750,185250

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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
931B	n/a	n/a
931A	38.9	n/a
9303	n/a	n/a
9309	n/a	n/a
9305	39.67	37.42
93DA	n/a	n/a
9405	n/a	n/a
9403	41.06	38.74
5305	34.23	28.72
6301	n/a	n/a
6101	n/a	n/a
6102	35.11	27.66
6103	35.77	30.47
721A	n/a	n/a
721B	n/a	n/a
721D	n/a	n/a
721C	n/a	n/a
8402	36.54	34.17
8403	36.66	33.84
8303	36.54	34.92
8401	n/a	n/a
84CI	n/a	n/a
8301	36.97	35.34
8404	37.24	n/a
83AG	n/a	n/a
84BA	n/a	n/a
9411	38.41	33.74
94BE	n/a	n/a
94BH	n/a	n/a
94AE	n/a	n/a
9401	38	34.26
94BC	n/a	n/a
9308	n/a	n/a
93DD	n/a	n/a
91BI	n/a	n/a
91BJ	n/a	n/a
9101	36.58	35.5
9003	36.08	34.55
91AH	n/a	n/a
91BB	n/a	n/a
91AG	n/a	n/a
9002	35.6	32.95
60AE	n/a	n/a
6001	32.74	29.19
70AC	n/a	n/a
7003	n/a	30.55
80BG	n/a	n/a
80BF	n/a	n/a
80BE	n/a	n/a
8001	n/a	n/a
5404	n/a	n/a
5101	35.88	32.62
511A	n/a	n/a
5102	n/a	n/a
511E	n/a	n/a
511D	n/a	n/a
511C	n/a	n/a
511B	n/a	n/a
521B	n/a	n/a
521A	n/a	n/a
5302	n/a	n/a
5303	n/a	n/a
5401	n/a	n/a
5402	34.92	29.36
5403	n/a	n/a
5001	n/a	n/a
501D	n/a	n/a
501A	n/a	n/a
501B	n/a	n/a
501C	n/a	n/a
5002	n/a	n/a

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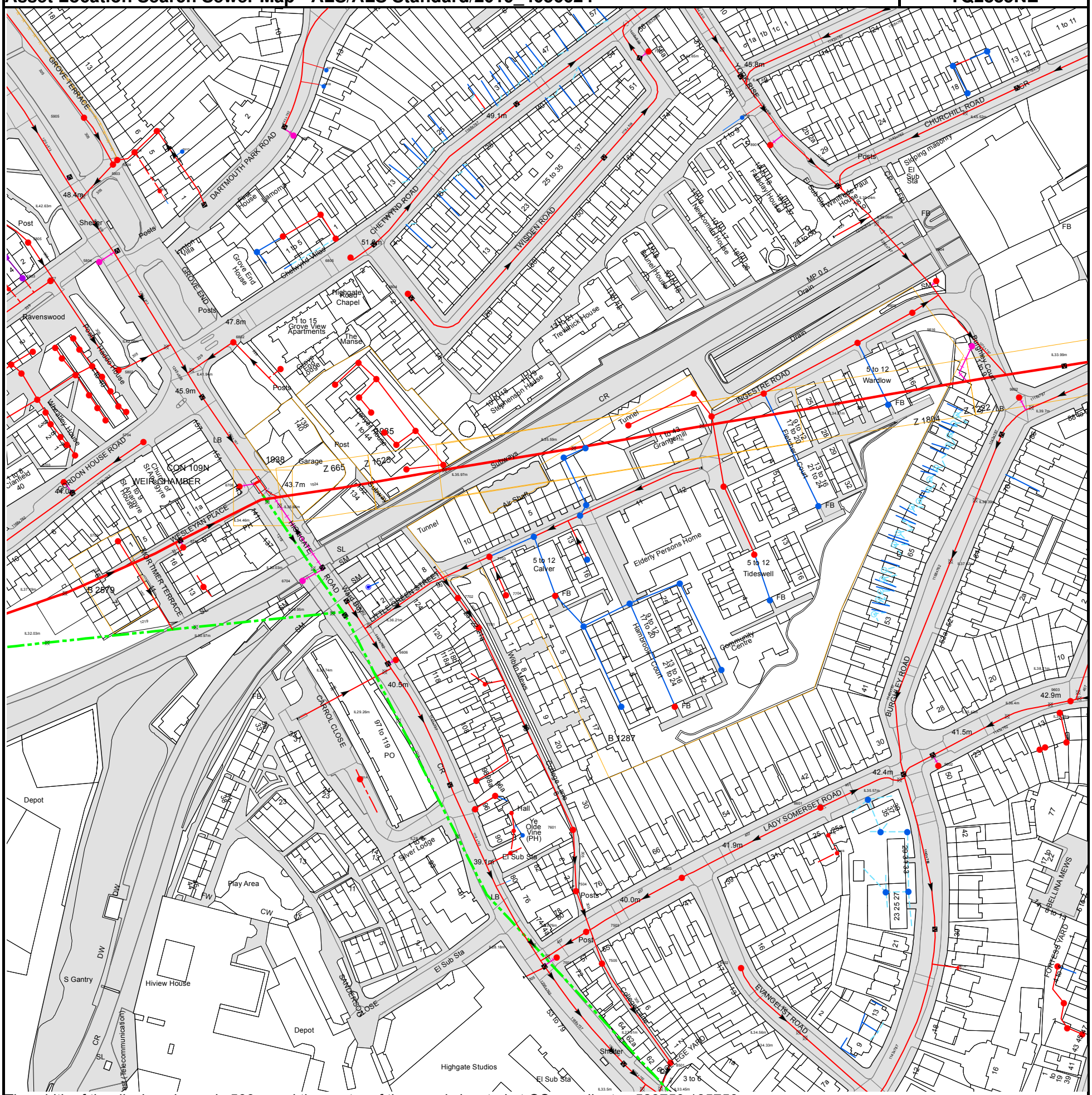
Asset Location Search Sewer Map - ALS/ALS Standard/2019_4056624

TQ2885NE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 528750,185750

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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
9816	43.32	n/a
9803	n/a	n/a
9804	43.41	38.56
99AE	n/a	n/a
99AF	n/a	n/a
99AH	n/a	n/a
6802	47.87	45.47
6708	n/a	n/a
68BA	n/a	n/a
6889	n/a	n/a
68BB	n/a	n/a
6901	n/a	n/a
6704	n/a	n/a
69BI	n/a	n/a
691B	n/a	n/a
691A	n/a	n/a
68DA	n/a	n/a
68BC	n/a	n/a
6805	51.04	48.58
68DB	n/a	n/a
68DD	n/a	n/a
68DE	n/a	n/a
68DC	n/a	n/a
68DF	n/a	n/a
67CJ	n/a	n/a
67DA	n/a	n/a
6804	51.12	48.26
68DG	n/a	n/a
77BD	n/a	n/a
87AE	n/a	n/a
7702	42.33	41.25
7706	n/a	n/a
7704	n/a	n/a
87AB	n/a	n/a
77BC	n/a	n/a
7703	n/a	n/a
87AD	n/a	n/a
77AF	n/a	n/a
77AI	n/a	n/a
87AF	n/a	n/a
77BA	n/a	n/a
87AC	n/a	n/a
77BJ	n/a	n/a
77AH	n/a	n/a
77BB	n/a	n/a
78AB	n/a	n/a
88AC	n/a	n/a
88AB	n/a	n/a
8803	n/a	n/a
88AE	n/a	n/a
8901	n/a	n/a
891A	n/a	n/a
7901	n/a	n/a
8502	39.57	37.62
7505	n/a	n/a
7501	n/a	n/a
7503	39.53	35.09
7504	39.7	36.93
8503	40.82	37.09
761B	n/a	n/a
861B	n/a	n/a
76BE	n/a	n/a
861A	n/a	n/a
76BB	n/a	n/a
7601	40.25	37.65
76BC	n/a	n/a
76CB	n/a	n/a
8601	42.71	n/a
86AG	n/a	n/a
76CA	n/a	n/a
76CI	n/a	n/a
661A	n/a	n/a
76AC	n/a	n/a
8602	n/a	n/a
761A	n/a	n/a
86AD	n/a	n/a
6606	40.56	35.35
7701	41.71	40.61
77AJ	n/a	n/a
87AI	n/a	n/a
87BA	n/a	n/a
97BH	n/a	n/a
96AJ	n/a	n/a
97CB	n/a	n/a
97CE	n/a	n/a
95BH	n/a	n/a
98AB	n/a	n/a
97DF	n/a	n/a
97EA	n/a	n/a
96BC	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
95BG	n/a	n/a
97EJ	n/a	n/a
97FD	n/a	n/a
97FI	n/a	n/a
97GC	n/a	n/a
97GH	n/a	n/a
9602	n/a	n/a
97HG	n/a	n/a
98BB	n/a	n/a
98BJ	n/a	n/a
98CC	n/a	n/a
951A	n/a	n/a
9802	n/a	n/a
96DB	n/a	n/a
96DD	n/a	n/a
95DF	n/a	n/a
96CG	n/a	n/a
95DE	n/a	n/a
96CF	n/a	n/a
9603	44.04	37.85
95DC	n/a	n/a
95DD	n/a	n/a
8501	38.84	34.64
5904	n/a	n/a
591B	n/a	n/a
591D	n/a	n/a
591C	n/a	n/a
5905	n/a	n/a
58CD	n/a	n/a
58CJ	n/a	n/a
58DJ	n/a	n/a
5802	46.81	42.9
58CC	n/a	n/a
58DI	n/a	n/a
58CI	n/a	n/a
58DH	n/a	n/a
58CB	n/a	n/a
58CH	n/a	n/a
58CA	n/a	n/a
5817	n/a	n/a
5803	47.17	n/a
5816	n/a	n/a
5804	n/a	n/a
5814	n/a	n/a
5805	47.23	43.58
591A	n/a	n/a
5903	50.14	46.33
57DE	n/a	n/a
5714	n/a	n/a
5702	42.13	41.08
5703	n/a	n/a
57CC	n/a	n/a
57CB	n/a	n/a
5704	45.17	40.87
58DG	n/a	n/a
58DF	n/a	n/a
58DC	n/a	n/a
58DE	n/a	n/a
58CG	n/a	n/a
58DB	n/a	n/a
58CF	n/a	n/a
58DD	n/a	n/a
58DA	n/a	n/a
58CE	n/a	n/a

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RAILTRACK GAS STATION

OFFICES

OFFICES

CAR PARK

GRATING

SITE ENTRANCE

FH

1.08m x 0.71m APPROX CULVERT

GRATINGS

INTERCEPTORS

ELECTRICIANS

WORKSHOP

REFER TO NOTE 1.

GRATING

TANKS UNDER

WORKSHOP/EQUIPMENT STORAGE

TO FLEET SEWER

VENT SHAFT

INTERCEPTOR WITH GRATING

REFER TO NOTE 1.

CANTEEN

MH (EMPTY)

TO FLEET SEWER

GATE

VEHICLE WASH

GATE

SITE BOUNDARY

REFER TO NOTE 1.

RAILWAY TRACKS

RAILWAY TRACKS

TO FLEET SEWER

ROUTE OF FLEET SEWER

LAYOUT OF COMPOUND DRAINAGE

SCALE 1:750

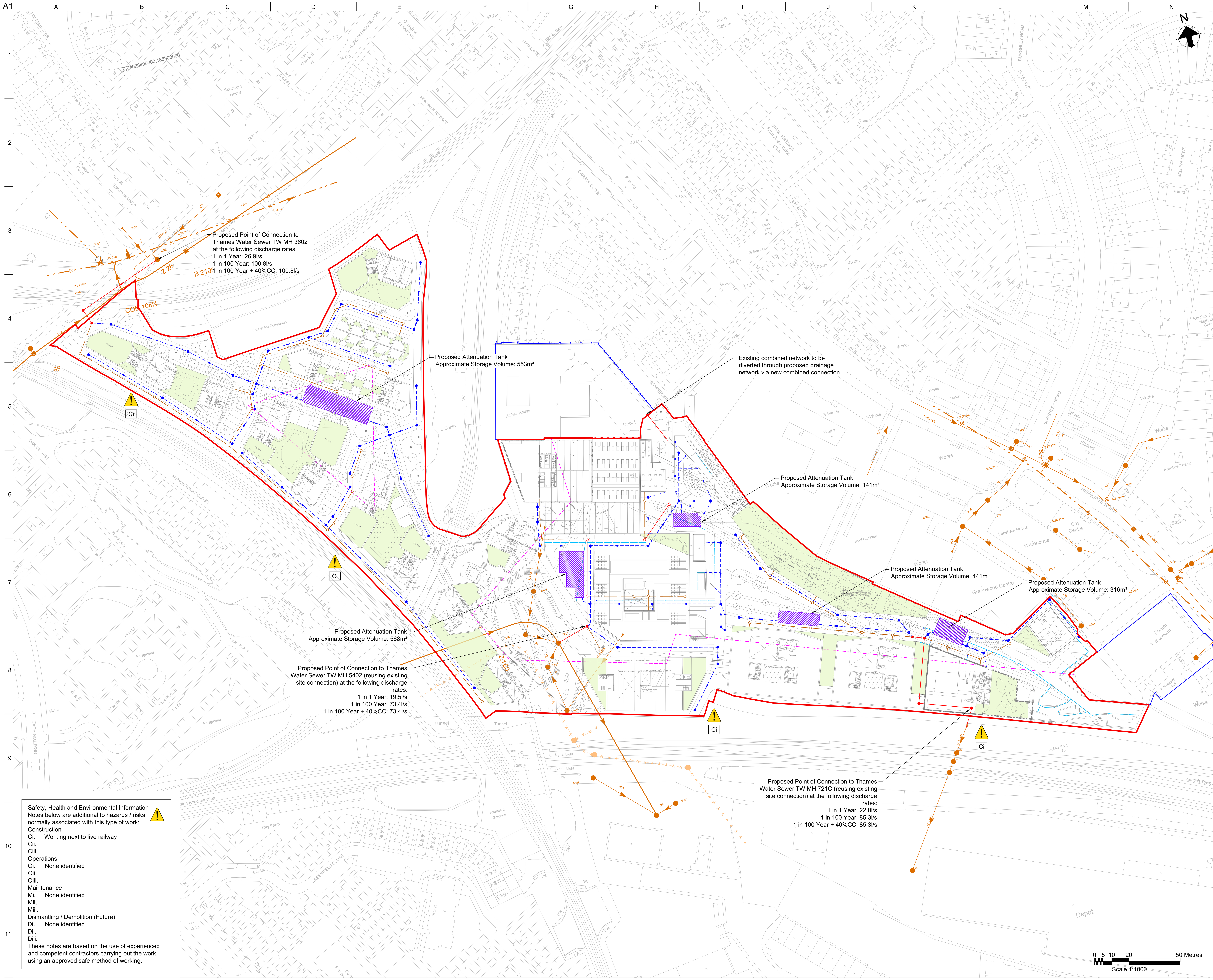
KEY TO SER

SURFACE WA
FOUL WATER

MH M
IC IN
G G
SC ST
WM W
FH FI
E E

Appendix C

Proposed Drainage plan



Notes

1. This drawing should be read in conjunction with associated Flood Risk Assessment and Drainage Strategy Report Ref: MUR-ARP-ZZ-XX-RP-CX-0001.
2. This drawing has been based upon Studio Egret West drawings 0360-SEW-ZZ-ZZ-DR-A-001007, 0360-SEW-P3-ZZ-DR-L-PL1100 and 0360-SEW-P1-ZZ-DR-L-PL1100.
3. Existing Thames Water public sewers have been transcribed from existing drainage records and co-ordinated with existing topographic survey information where possible. Invert levels shown have been derived from Thames Water asset plans and will be subject to verification on site by the Contractor. The Engineer is to be notified of any discrepancies between on site findings and the contract drawings. The location of existing Thames Water manholes and alignment of sewers should be considered indicative / for information only.
4. Threshold drainage at building access points is not shown on this drawing but may be required.

Legend

General
- Site Boundary
- Ownership Boundary
- 30m National Rail Easement

Existing Thames Water Assets
- Combined Sewer Drainage Pipe
- Abandoned Combined Sewer
- Combined Sewer Drainage Manhole
- Abandoned Combined Drainage Manhole

Proposed Drainage
- Surface Water Drainage Pipe
- Foul Sewer Drainage Pipe
- Combined Sewer Drainage Pipe
- Channel Drain
- Drainage Manhole - Type 1 / 2
- Drainage Manhole - Type 1 / 2
- Drainage Manhole - Type 1 / 2
- Attenuation Tank
- Blue Roof

Issue	Date	By	Chkd	Appd
P03	17/06/21	MA	NT	TM
	Issued for Outline Planning			
P02	21/05/21	MA	NT	TM
	Issued for Planning			
P01	30/04/21	MA	NT	TM
	Issued for Planning			

ARUP

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London W1T 4BQ
Tel +44 (0)20 7636 1531 Fax +44 (0)20 7580 3924
www.arup.com

Client
Folgate Estates Ltd.

Job Title
Murphy's Yard

Drawing Title
Proposed Surface Water and Foul Drainage Site-Wide Strategy

Scale at A1: 1:1000
Discipline: Civil
Job No: **271661-00**
Drawing Status: **Planning**
Drawing No: **MUR-ARP-ZZ-XX-SK-CD-0001**
Issue: **P03**

Safety, Health and Environmental Information
Notes below are additional to hazards / risks normally associated with this type of work:

Construction
Ci. Working next to live railway
Cii.
Ciii.

Operations
Oi. None identified
Oii.
Oiii.

Maintenance
Mi. None identified
Mii.
Miii.

Dismantling / Demolition (Future)
Di. None identified
Dii.
Diii.

These notes are based on the use of experienced and competent contractors carrying out the work using an approved safe method of working.

Do not scale

Appendix D

Consultation (LLFA)

Minutes

ARUP

Project title	Murphy's Yard	Job number 271661-00
Meeting name and number	LLFA Surface Water Drainage Proposals	File reference MUR-CIV-MIN-001
Location	MS Teams	Time and date 14:30-15:00 23 March 2021
Purpose of meeting	Discuss and agree the intended approach for surface water discharge restrictions and general design ethos for the surface water drainage proposals associated with the Murphy's Yard development.	
Present	Nigel Thompson (Arup) Craig Irvine (Arup) Patrick Scannell (Arup) Gabirel Berry-Khan (LBC LLFA) Jonathan McClue (LBC) Kate Macmillan (Folgate)	
Apologies	Alexandra Milne (DP9)	
Circulation	Those present Alexandra Milne	

Action

1. Introductions

NT outlined objectives of meeting:

1) to agree upon principles of surface water discharge restrictions
2) to agree upon principles of SuDS implementation

NT provided brief overview of site location, development proposals and main site constraints affecting surface water drainage design.

NT highlighted the following constraints:

- Existing Fleet Sewer encroaches southern boundary of site
- Existing Thames Water sewer connections/assets within the boundary of the site
- Site wide ground contaminations issues attributable to current and previous site uses

Prepared by	Nigel Thompson
Date of circulation	26th March 2021
Date of next meeting	

Action

- Existing Network Rail lines defining the southern, western and part of the northern boundary.
- Requirement of Network Rail to have 30m offset/easement for any on site drainage attenuation features above track level.
- Urban nature of site in context of surrounding area

2. Proposed approach to surface water discharge restriction

NT outlined that as the existing Site is predeveloped it is the intention to limit surface water flows to no more than the existing 1 in 1 year brownfield runoff rate up to and including the 1 in 1 year storm event and then the existing 1 in 10-year brownfield runoff rate for all storm events up to and including the 1 in 100-year + 40% climate change rainfall event. This approach is informed by the LBC SFRA which states that sewers in London Borough of Camden are unlikely to have capacity beyond the 1 in 10-year design storms.

GBK requested details of total runoff rate based on the above approach

NT confirmed total proposed discharge rate (based on 1 in 10-year brownfield runoff rate) would be 429.4l/s.

NT noted that this figure offers c.53% betterment at the 1 in 100-year storm event.

NT confirmed that the drainage proposals intend to use blue roof storage across the development and additional green/brown combined options where possible. Total storage provided in blue roofs across the site approximately 1800m^3. [*post meeting note: this figure assumes 150mm deep storage across 65% of all roof space].* Total storage volume within blue roof approximately 1800m^3.

GBK agreed with the intent to use blue/green roofs.

GBK requested details of greenfield runoff rate.

NT confirmed that the total 1 in 100-year greenfield runoff rate for the site is 86.3l/s.

GBK noted that the proposed discharge rate is nearly 5x the equivalent greenfield rate.

NT noted that restricting the site to the existing 1 in 10 year discharge rate would lead to an additional c.1000m^3 storage required as underground tanks in public realm space compared to

		Action
	c.2500m^3 using the aforementioned greenfield rate (over and above the constant value of attenuation provided in blue roofs).	
	GBK acknowledged that the site is severely constrained and consequently recognised that restricting the site to greenfield runoff rates is not practicable. The LLFA would therefore request the following (in order of preference): 1) 3 x Greenfield Runoff Rate 2) 50% reduction of existing brownfield runoff rates	
	GBK noted that option 2 should be considered as a last resort.	
	NT requested clarification whether "3 x Greenfield Runoff" should be applied for the 1 in 1 year and 1 in 100 year runoff rates at the respective events.	
	GBK confirmed that the above is correct.	
	Arup to calculate proposed rates based on the above criteria and issue a summary table of all rates (including greenfield and brownfield) to GBK for review. Table to also include estimations for attenuation requirements	NT
3.	**Proposed approach to Surface Water Management (SuDS)**	
	GBK highlighted that the site is located in an area which is potentially significant for overland flow from reservoir breaches at Hampstead Heath.	
	NT briefly described the split in levels across the northern and southern parcels of the site which is facilitated by a steep level difference which will be accommodated by terraced steps as part of the development proposals.	
	NT highlighted that other than blue/green/brown roofs and underground attenuation in public realm space, the proposed approach to surface water management will also explore the use of bio-retention areas/raingardens as part of the landscape strategy.	
	GBK agreed with approach to integrate more SuDS but wishes to see these added to any proposed drainage plan as part of the planning application.	
	GBK noted that rain gardens have been used at Camley Street elsewhere in Camden to good effect and designed as infiltration features to accommodate 1 in 30-year storm event. GBK requested that design considers something similar.	
	GBK asked whether infiltration had been undertaken at the site?	

Minutes

Project title	Job number	Date of Meeting
Murphy's Yard	271661-00	23 March 2021

	Action
CI outlined that the site has up to 9m of made ground in parts with underlying London Clay. Previous GI undertaken which has identified areas of contamination.	
GBK stated that he would expect to see exhaustive investigation of potential SuDS and infiltration testing across the development.	
CI highlighted that Network Rail requirements would limit the available area for infiltration across the site.	
GBK stated that they have had previous success with a HS2 project in close proximity to Network Rail assets, however these were on an embankment unlike the NR assets on Murphys Yard which are in cuttings.	
Arup/Client to further review potential for infiltration testing at the site	Arup/Client

Technical Note

ARUP

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d +44 20 7755 5260

Project title	Murphy's Yard	Job number	271661-00
cc	Craig Irvine (Arup) Tristan McDonnell (Arup) Patrick Scannell (Arup) Gabriel Berry-Khan (LBC LLFA) Jonathan McClue (LBC) Kate Macmillan (Folgate) Alexandra Milne (DP9)	File reference	Discharge Rate Technical Note
Prepared by	Nigel Thompson (London)	Date	31 March 2021
Subject	Proposed Discharge Rates and Attenuation Volume Option at Murphy's Yard		

This technical note has been prepared following a meeting with London Borough of Camden (LBC) Lead Local Flood Authority on 23rd March 2021. It is advised that this technical is read in conjunction with the corresponding meeting minutes File Ref: MUR-CIV-MIN-001.

1 Introduction

This technical note outlines the difference in various discharge restrictions that could be applied at the proposed redevelopment at Murphy's Yard and approximate attenuation requirements associated with each scenario. It is the intention this note is reviewed by LBC LLFA and comments provided where applicable.

2 Surface Water Discharge Restriction Scenarios

The following surface water discharge restriction scenarios have been assessed for the purposes of the technical note:

1. Greenfield runoff rates at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change.
2. Existing brownfield runoff rate at the 1 in 1-year and 1 in 10-year return periods and existing 1 in 10 year brownfield runoff rate for all return periods up to and including 1 in 100-year + 40% climate change.
3. 3 x Greenfield runoff rates applied at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change.
4. 50% reduction of existing brownfield runoff rates at the 1 in 1-year and 1 in 100-year return periods up to and including 1 in 100-year + 40% climate change.

For reference purposes and to demonstrate the relative betterment for each of the above approaches, the existing brownfield runoff rates for the 1 in 1 year and 1 in 100 year return periods are also provided.

The site area used for all calculations in 6.2ha and the existing site is considered 100% impermeable.

3 Attenuation Requirements

The surface water drainage proposals intend to use blue roof storage across the development and additional green/brown combined options where possible. Indicative total storage provided in blue roofs across the site is approximately 1815m^3 (this figure assumes 150mm deep storage across 65% of all roof space). This figure remains a constant across all drainage scenarios and as such in the table below “additional attenuation” required for each scenario refers to the “extra” attenuation that is to be provided as alternative storage within public realm space i.e. underground tanks, alternative Sustainable Drainage Systems (SuDS).

It should be noted that for consistency all attenuation figures have been generated using the upper limit of the Quick Storage Estimate tool in Innovyze Microdrainage modelling software (Source Control module). The attenuation figures presented are therefore an approximation and will be further refined as a result of detailed design and further modelling.

4 Discharge Rate Restriction Comparison

Option Ref. (see Section 2)	Restriction Criteria	Proposed Total Site Discharge Rate Restriction at specific return periods			% Reduction at 1 in 100 Year Storm Event Compared to Existing Brownfield Rate	Attenuation Required at 1 in 100 Year Storm event + 40% Climate Change (assuming 100% impermeable)		Total Attenuation Volume (m^3)
		1 in 1 Year (l/s)	1 in 100 Year (l/s)	1 in 100 Year +40% (l/s)		Blue Roof Attenuation (m^3)	Additional Attenuation Volume Required in Public Realm (m^3)	
1	[1]Greenfield Runoff Rates	22.99	86.28	86.28	90%	1815	2301	4116
2	[2]Existing Brownfield Runoff Rates (up to 1 in 10 year)	199.94	[3] 469.59	469.59	46%	1815	862	2677
3	3 x [1]Greenfield Runoff Rates	68.97	258.84	258.84	70%	1815	1359	3174
4	50% [2]Existing Brownfield Runoff Rates	99.97	438.24	438.24	50%	1815	923	2738
Baseline	[2]Existing brownfield runoff rates	199.94	876.48	-	-			

[1] Greenfield runoff rates have been obtained for the Site in accordance with Institute of Hydrology 124 methodology using the www.uksuds.com greenfield runoff estimation tool.

[2] Rainfall data has been obtained from Flood Estimation Handbook (FEH) CD version 3.0 (2013) to determine approximate existing discharge rates at the Site. The 60-minute storm duration has been used within these calculations and the Rational Method applied.

[3] Existing 1 in 10-year brownfield runoff rate.

The proposed surface water drainage design is to be developed based on the Option 3 approach of 3xGreenfield Runoff Rate. If due to site constraints it is found to be impracticable to include the required level of attenuation associated with Option 3, the design will proceed on the basis of Option 4.

DOCUMENT CHECKING

	Prepared by	Checked by	Approved by
Name	Nigel Thompson (London)	Nigel Thompson	Craig Irvine
Signature	NT	NT	CI

Appendix E

Consultation (TWUL)

Patrick Scannell

Arup
13 Fitzroy Street
London
W1T 4BQ

Wastewater pre-planning
Our ref DS6083380

10 May 2021

Pre-planning enquiry: Confirmation of sufficient capacity (Foul water only)

Site: Murphy's Yard, Hiview House, Highgate Road, London, NW5 1TN

Dear Patrick,

Thank you for providing information on your development.

Proposed site: Phase 1: Flats (30 units), Commercial premises (14,337m2)

Phase 2: Flats (458 units), Commercial premises (1966m2) – Phase 2 North (Flats:362 units, Commercial premises: 684m2), Phase 2 South (Flats:96 units, Commercial premises: 1282m2)

Phase 3: Commercial premises (67,388m2)

Phase 4: Flats (267 units), Commercial premises (3762m2), Phase 4 North (Commercial premises: 715m2), Phase 4 South (Flats:267 units, Commercial premises: 3047m2)

Catchment 1:
Proposed foul water discharge by gravity into combined water manhole TQ2885721C for Phase 1, Phase 3 (Partial Commercial premises of 44390m2) and Phase 4 South via an existing connection.
Proposed surface water discharge at 85.3 l/s l/s for all storm events up to and including 1:100yr+40%CC into combined water manhole TQ2885721C via existing connection.

Catchment 2:
Proposed foul water discharge by gravity into combined water manhole TQ28855402 for Phase 2 South, Phase 3 (Partial Commercial premises of 22,998m2) via existing connection.
Proposed surface water discharge at 73.4 l/s for all storm events up to and including 1:100yr+40%CC into combined water manhole TQ28855402 via existing connection.

Catchment 3:
Proposed foul water discharge by gravity into combined water manhole TQ28853602 for Phase 2 North and Phase 4 North via new connection.
Proposed surface water discharge at 100.1 l/s for all storm events up to and including 1:100yr+40%CC into combined water manhole TQ28853602 via new connection.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent combined water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

When developing a site, policy SI 13 of the London Plan states "Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:"

The disposal hierarchy being:

1. rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2. rainwater infiltration to ground at or close to source
3. rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
4. rainwater discharge direct to a watercourse (unless not appropriate)
5. controlled rainwater discharge to a surface water sewer or drain
6. controlled rainwater discharge to a combined sewer

Where connection to the public sewerage network is still required to manage surface water flows, we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

Please see the attached 'Planning your wastewater' leaflet for additional information.

Diversion

There are existing public sewers crossing the site. New buildings will need to be kept between 3 and 6.5m away from existing sewer depending on the size and depth of the sewer. Alternatively, it may be possible for sewers to be diverted around the new development. If you wish us to review a diversion proposal, please submit this via a Section 185 Diversion application. On some occasions it may be possible to abandon existing public sewers. Please contact us for further information on this process.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you have any further questions, please contact me on 0800 009 3921.

Kind Regards,

Hemlata Gurung
Developer Services – Technical Coordinator, Sewer Adoptions Team
Tel: 0800 009 3921
hemlata.gurung@thameswater.co.uk
Get advice on making your sewer connection correctly at connectright.org.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk

Appendix F

LBC SUDS proforma

Camden

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1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	Murphys Yard
Address & post code	Hiview House, Highgate Rd, London NW5 1TN
OS Grid ref. (Easting, Northing)	E 528599
	N 185548
LPA reference (if applicable)	
Brief description of proposed work	Outline planning permission with all matters reserved for phases 2-4 (Plots A, B, G, H, I, J, K, L, M, O, P, Q and S), for the demolition of existing buildings and structures and redevelopment comprising the following mix of uses:
Total site Area	62300 m^2
Total existing impervious area	62300 m^2
Total proposed impervious area	62300 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	Positive connection to thames water Fleet street sewer via pipes and
Designer Name	Patrick Scannell
Designer Position	Civil Engineer
Designer Company	Arup

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	None are present
Bedrock geology classification	London clay
Site infiltration rate	N/A m/s
Depth to groundwater level	N/A m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	N	N
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	N	N
7 discharge rainwater to the combined sewer.	Y	Y

2c. Proposed Discharge Details

Proposed discharge location	on to the Thames Water sewer, MH ref 7210
Has the owner/regulator of the discharge location been consulted?	ning application has been submitted to Tha

Camden

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3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for GF rate (m^3)*	*Proposed discharge rate (l/s)*
Qbar				
1 in 1	22.99	205 (1 in 2 yr)		69.2
1 in 30	62.21	653.35		n/a
1 in 100	86.3	876.48		259.5
1 in 100 + CC			3250	259.5
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Vortex control		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	7370	1083.5
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	0	0	0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	62300		2166.5
Total	**62300**	**7370**	**3250**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Section 3.4 and table 11
Drainage hierarchy (2b)	section 5.6.2
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	section 5.6.1 table 12 & Appendix C
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Section 5.2 appendix D
Proposed SuDS measures & specifications (3b)	section 5.5 and 5.7
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	
Detailed drainage design drawings, including exceedance flow routes	Appendix D & E
Detailed landscaping plans	
Maintenance strategy	Section 5.9
Demonstration of how the proposed SuDS measures improve:	section 5.9 pg 33
a) water quality of the runoff?	table 11
b) biodiversity?	table 11
c) amenity?	table 11