ARUP

Colt Data Centre Services

Bullsbrook Road Substation

Flood Risk Assessment

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Ove Arup & Partners Limited
Central Square
Forth Street
Newcastle upon Tyne
NE1 3PL
United Kingdom
arup.com

ARUP

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1. Introduction

1.1 Context and Scope

Ove Arup & Partners Ltd (Arup) has been commissioned by Colt Data Centre Services (Colt DCS) (hereafter referred to as 'the Client'), to undertake a Level 2 Scoping Flood Risk Assessment (FRA) for the proposed construction of the 'Hayes Campus Masterplan Project 5 Substation 2' also known as 'Bullsbrook Road Substation'(hereafter referred to as 'the Proposed Development'). The Proposed Development is located at Beaconsfield Road, Hayes, UB4 0SL (grid reference TQ 11523 80341) (hereafter referred to as 'the Site').

The scope of this report is to provide an assessment of flood risk posed to the Proposed Development from all sources, including fluvial, tidal, pluvial (surface water), groundwater and artificial sources. Further, it will consider the nature of the Proposed Development, and identify mitigation measures where necessary.

Assessment is made in accordance with the National Planning Policy Framework (NPPF)[1] and with reference to the NPPF Flood Risk and Coastal Change Guidance (NPPF)[2]; most recently updated in 2022. The FRA follows the methodology prescribed in CIRIA C624: Development and Flood Risk – Guidance for the Construction Industry[3].

Note that the report has been prepared solely for the benefit of the client in connection with the Proposed Development. It shall not be relied upon or transferred to any other party without the prior written authorisation of Arup. The report does not address any other potential environmental impacts that may result from the development. Arup does not accept any liability for the accuracy or otherwise of any information derived from secondary sources. However, endeavours have been made to verify the suitability and appropriateness of information obtained in this way.

1.2 Data Sources

The key documents and sources of information and data that have been used in the production of this FRA include (not exhaustive):

- West London Strategic Flood Risk Assessment (SFRA) (2016)[4]
- The London Plan (2021)[5]
- 2022 Topographical survey of site (Appendix A.1)
- Environment Agency (EA) Flood map for planning[6]
- EA Risk of flooding from surface water map[7]

[1] Ministry of Housing, Communities, and Local Government (2023) National Planning Policy Framework, Dec 2023 update. Available at: https://assets.publishing.service.gov.uk/media/65a11af7e8f5ec000f1f8c46/NPPF_December_2023.pdf [Accessed 04-07-24].

[2] Ministry of Housing, Communities, and Local Government (2022) NPPF Flood Risk and Coastal Change, Aug 2022 update. Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change [Accessed 04-07-24].

[3] CIRIA (2004) Development and Flood Risk: Guidance to the Construction Industry.

[4] Metis Consultants (2016) West London Strategic Flood Risk Assessment. Available at: https://westlondonsfra.london/ [Accessed 04-07-24].

[5] Greater London Authority (2021) The London Plan. Available at: https://maps.london.gov.uk/planning/ [Accessed 04-07-24].

[6] Environment Agency (2024) Flood Map for Planning. Available at: https://flood-map-for-planning.service.gov.uk/ [Accessed 04-07-24].

[7] Environment Agency (2024) Risk of Flooding From Surface Water Map. Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk [Accessed 04-07-24].

- EA Spatial Flood Defences dataset[8]
- EA Flood risk assessments: climate change allowances[9];
- The National Planning Policy Framework (NPPF)[1] and
- National Planning Policy Guidance (NPPG): Flood Risk and Coastal Change[2]

1.3 Key Stakeholders

There are several key stakeholders associated with the Proposed Development in relation to planning, flood risk and the water environment. These include:

- **EA:** The EA have wide ranging powers for main rivers and groundwater bodies under the Water Resources Act (1991) and the Environment Act (1995). Under the Flood and Water Management Act (FWMA) (2010), the EA have a responsibility to produce a national strategy towards managing flood risk and are a statutory planning consultee for development and flood risk issues;
- **Thames Water (TW):** the public sewerage undertaker under The Water Industry Act (1991). They operate and maintain sewerage infrastructure in proximity to the Site. TW are also the primary supplier of public potable water with powers under The Water Industry Act (1991) covering the Site. They operate and maintain significant infrastructure in proximity to the Site.
- **London Borough of Hillingdon (LBH):** LBH are the Lead Local Flood Authority (LLFA). Under the FWMA the LLFA have responsibility for local flood risk. This includes ordinary watercourses, groundwater, and surface water (including the implementation of Sustainable Urban Drainage Systems (SuDS)),

[8] Environment Agency (2024) Spatial Flood Defences. Available at: https://data.gov.uk/dataset/cc76738e-fc17-49f9-a216-977c61858dda/aims-spatial-flood-defences-inc-standardised-attributes [Accessed 04-07-24].

[9] Environment Agency (2022) Flood risk assessments: climate change allowances. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances [Accessed 30-06-24].

2. Legislation and Planning Context

2.1 National Planning Policy Framework

The NPPF[1] , introduced in 2012 and revised in 2023, is the overarching planning framework guiding the development process at a national level across England. The NPPF aims to ensure that flood risk is considered at all stages in the planning process, and to direct inappropriate development away from areas at high risk of flooding (Table 1). Where development is necessary in areas at risk of flooding, the NPPF aims to make it safe without increasing flood risk elsewhere. To ensure development is appropriate, the NPPF posits a risk-based approach towards flooding, to be adopted at all levels of planning. The NPPF is supported by web based technical guidance[2].

The NPPF requires application of the Sequential Test during the planning process. The Sequential Test aims to ensure that low flood-risk areas take precedence when assigning areas for future development. The test requires that development only be considered within Flood Zone 2 if there are no appropriate development sites in Flood Zone 1. Similarly, development in Flood Zone 3 should only be considered where no suitable Flood Zone 2 areas are available. The local planning authority (LPA)/LLFA should undertake this process.

The starting point for the Sequential Test is the system of 'flood zoning' for flooding from rivers and sea; it does not cover other sources of flooding (e.g. surface water or groundwater). The flood zoning system adopted in England is summarised in Table 1, as described in NPPF. The flood zoning definitions describe the flood risk of an area by rivers and in coastal areas, estuaries, and the sea. This information is generated by the EA and LPA and used to support land use planning decisions. The flood zoning system is shown on the EA's Flood Map for planning[6] and is also found in LPA's SFRA[4].

Table 1: River and Sea flood zoning system used across England as defined in the NPPF River and Sea flood zoning system used across England as defined in the NPPF.

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 (0.1%) Annual Exceedance Probability (AEP) of river or sea flooding. (Shown as 'clear' on the EA Flood Map for Planning[6], all land outside Zones 2 and 3).
Zone 2 Medium Probability	Land having between a 1 in 100 (1%) and 1 in 1,000 (0.1%) AEP of river flooding; or land having between a 1 in 200 (0.5%) and 1 in 1,000 (1%) AEP of sea flooding in any given year. (Land shown in light blue on the Flood Map).
Zone 3a High Probability	Land having a 1 in 100 (1%) or greater AEP of river flooding; or Land having a 1 in 200 (0.5%) or greater AEP of sea flooding in any given year (land shown in dark blue on the EA Flood Map for Planning.
Zone 3b Functional Floodplain	This zone comprises land where water needs to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the EA. Flood Zone 3b is not separately distinguished from Zone 3a on the Flood Map.

The Sequential Test requires that development only be considered within Flood Zone 2, if there are no appropriate development sites in Flood Zone 1. Development in Flood Zone 3 should only be permitted if development is not possible in Flood Zone 2; assuming development in Flood Zone 1 has also been ruled out. This process should be undertaken by the LPA on behalf of the Secretary of State, to identify areas appropriate for development. The Sequential Test should be adopted by developers on a site-specific basis.

The NPPF also encourages those involved in development to consider the flood vulnerability of a proposed site to the impact of flooding. The vulnerability of different types of development is listed in the online guidance[1] for the NPPF. Vulnerability classification is relevant for considering what type of development is appropriate for a given site (based on its Flood Zone). Furthermore, vulnerability classification can inform

how a development site should be laid out if it covers multiple Flood Zones. The compatibility of development in terms of its vulnerability and flood zoning is described in Table 2.

Table 2: Flood risk vulnerability and compatibility (based on Table 2 of the NPPG) Flood risk vulnerability and compatibility (based on Table 2 of the NPPG).

Flood zone	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception test required	✓	✓
Flood Zone 3a	Exception test required	✓	×	Exception test required	✓
Flood Zone 3b "Functional Floodplain"	Exception test required	✓	×	×	×

✓ Development is appropriate

× Development should not be permitted.

The NPPF vulnerability classification system illustrates how higher vulnerability land uses should be directed to lower flood risk sites and vice versa.

Should the sequential approach show it is not possible for a development to be located in zones of lower flood risk, the Exception Test may apply. The Exception Test is designed to demonstrate that development is compatible with flood risk if flood risk management and mitigation measures are adopted. Importantly, flood risk management measures must not increase flood risk elsewhere. The Exception Test requires the demonstration of the following:

- The development provides wide sustainability benefits that outweigh the flood risk; and
- A FRA must be provided.

A FRA is required for any development irrespective of Flood Zone, for all development in excess of 1 hectare (ha). This is due to the potential flood risk caused by increases in surface water discharges.

A NPPF compliant FRA should ensure the following:

- The risk posed by all potential sources of flooding while also considering the impact of climate change (in most cases the risk should be less than 1% in any given year);
- The development would not increase flood risk elsewhere from any potential source, with allowance for climate change;
- The development is designed with appropriate flood protection and emergency access and egress arrangements;
- The development process should seek to reduce overall flood risk, wherever practicable;
- Management and funding arrangements to ensure the Site can be developed and occupied safely over its proposed lifetime; and
- Sustainable drainage systems are incorporated into the development, unless there is clear justification that this would be inappropriate.

The implementation of sustainable drainage and the requirement for flood risk reduction were specifically reinforced in the July 2018 update of the NPPF.

2.2 Flood and Water Management Act 2010

The FWMA has been developed in response to the Pitt Report[10]. It provides for more comprehensive management of flood risk for people, homes, and businesses, helps safeguard community groups from unaffordable rises in surface water drainage charges and protects water supplies to the consumer. The FWMA sets out a legislative framework that complements the NPPF[1]. The principles of the FWMA have been applied to this FRA.

2.3 Other Relevant Policy and Guidance

The following planning policy and guidance has also been used to inform this assessment:

- **West London Strategic Flood Risk Asssessment (SFRA)[4]:** This document sets out the specific policies and requirements for FRAs within the area.
- **River Thames Catchment Flood Management Plan (CFMP)[11]:** The proposed site sits within sub area 9 (London catchments) which adopts Policy Option 4: Areas of low, medium or high flood risk where flood risk is currently being managed effectively but where further action to keep pace with climate change may need to be taken.
- **Local Flood Risk Management Strategy (LFRMS)**: All development in this area should also have regard to the Crane Valley Partnership's catchment plan, Objective 4 – Reduced Risk of Flooding in Built-Up Areas. This specifies that there is a need to increase *"innovative solutions to improve the catchment's capacity to store and slowly release stormwater".* Further requirements ensure that redevelopment in London aims to reduce surface water run-off to greenfield run-off rates. Sustainable Design and Construction Supplementary Planning Guidance[13] sets out a minimum target of a 50% reduction. The London Sustainable Drainage Action Plan also identifies further actions.
- **Hillingdon Local Plan Part 1: Strategic Policies[12]**Error! Reference source not found.**:** This document sets out the overall level and broad locations of growth in the Borough of Hillingdon up to 2026. This sets out Policy EM3: The Blue Ribbon Network, and Policy EM6: Flood Risk Management.
- **Hillingdon Local Plan Part 2: Site Allocations and Designations[13]:** This document "sets out sites for development to meet the Borough's needs to 2026, based on the level of growth and general locations set out in the Local Plan Part 1".
- **Hillingdon Local Plan Part 2: Development Management Policies[12]:** This document provides detailed policies that help guide the Borough's decisions on individual planning applications. The management of flood risk and water are referred to in Policies DMEI 9 (Management of Flood Risk) and 10 (Water Management, Efficiency and Quality) specifically. Policy DMEI 8 (Waterside Development) addresses flood risk and water management as part of the overall policy.

[10] Pitt, M. (2007) Learning Lessons From the 2007 Floods. Available at: https://www.jesip.org.uk/downloads/pitt-review-uk-floods/ [Accessed 04-07-24].

[11] Environment Agency (2009) River Thames Catchment Flood Management Plan: Summary Report. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293903/Thames_Catchment_Flood_Management_Plan.pdf [Accessed 04-07-2024].

[12] London Borough of Hillingdon (2020) Development Management Policies. Available at: https://www.hillingdon.gov.uk/local-plan [Accessed 04-07-24].

[13] Greater London Authority (2021) Sustainable Design and Construction. Available at: https://www.london.gov.uk/priorities/planning/consultations/draft-sustainable-design-and-construction [Accessed 26-07-24].

3. Methodology

The methodology adopted for this FRA is outlined below, in accordance with the NPPF[1] and national guidance[2] on the preparation of FRAs. Accordingly, the purpose of this FRA is to:

- Define the baseline conditions for the Site, provide description of the Site and the Proposed Development. Describe the existing surface and groundwater features, locate existing water related infrastructure (e.g. surface and foul drainage). Identify the key baseline flood risk considerations for the Site;
- Proposals are then normally evaluated against the Sequential Test. This determines the suitability of the Site for development, considering existing flood risk and land-use vulnerability. However, consultation with the EA Planning team have confirmed that '*taking into account the existing commercial uses located on the site, it is noted that the proposal would not result in a change in terms of the vulnerability classification. It is not therefore considered that sequential test is necessary in flood risk terms.'* They also clarified that *'the proposal should take a sequential approach within the site itself, setting the most vulnerable elements of development away from the areas of the site which are most at risk of flooding.'* This FRA will therefore address the placement of site elements in relation to their relative flood risk as indicated on the EA flood mapping platforms to ensure that a sequential approach has been applied.
- Identify all potential flood risk considerations affecting the Site and outline suitable mitigation measures. Note that this FRA focuses on the potential operational flood risk impacts, based on the current level of information available for the Site. Construction related flood risk impacts should be primarily addressed by the measures described in the Code of Construction Practice (CoCP) and/or Construction Environmental Management Plan (CEMP). These documents are anticipated to be authored and submitted by the developer, as part of the wider contract documentation for the project at a later stage (detailed design).

3.1 Assumptions and Limitations

- This FRA does not address any cumulative assessment and is strictly limited to the Site, as defined in **section 3.1 Site Location and Description.** Assessment of cumulative effects would be provided in any Environmental Statement (ES) that will accompany the application for full Planning Permission; and
- At the time of writing, a CoCP and/or CEMP is anticipated to be submitted at a later design stage. The CoCP and/or CEMP will address any flood risk and mitigation associated with the construction phase of the Development. Similarly, application for any permits or licences (e.g. EA Environmental Permit) will be confirmed at a later design stage.

3.2 Engagement and Consultation

Throughout the pre-application process, input has been sought from the following key stakeholders:

3.2.1 London Borough of Hillingdon

A pre-application meeting was held with LBD on 14th July 2021, as part of the FRA application for the adjacent southern data centre site. It was noted that further modelling work was currently being undertaken for the Yeading Brook by the EA. However, timescale for when this work would be complete was unknown and so it was agreed that the latest available EA information is acceptable for use. At the time of writing (July 2024), the latest EA modelling data is still not available. See Appendix A.3 for correspondence and latest modelling data requests.

3.2.2 Environment Agency

EA consultation has been ongoing, commencing during the planning application of the southern adjunct **Lon4/5** components of the extended development. This process, taking place in 2021, is summarised as:

- The EA hold no records of historic flood events from rivers and/or the sea at the Proposed Development site. However, there was a nearby flood event on 6th August 1977 between Camden Avenue and Delamere Road 1 km north of the Site;
- The Site sits within Flood Zone 2;
- The EA advised that a ner model for the Yeading Brook is not yet available [confirmed again in June 2024] and that using the latest model provided, River Crane Mapping Study (Halcrow 2008), is acceptable;
- The current hydraulic model does not contain uplift values at 17% but does contain 20% uplift. The EA confirmed that it is acceptable to use a 20% uplift value in place of 17% for the purpose of climate change uplift.

3.2.3 Thames Water

Thames Water (TW) is the local sewerage undertaker and potable water supply undertaker for the Site.

A preliminary enquiry with Thames Water was undertaken to obtain historical sewer flooding information for the Proposed Development site in July 2021. Thames Water responded to this request, stating that the data requested was confidential. Data from the West London SFRA[4] and the Thames Water Sewer Flood Records (2017) have been used instead. Further information is detailed in the Arup Drainage Strategy report (LONDPSS2-ARUP-SS-SS-XX-RP-C-52001).

A summary of the record of these engagements is provided in Appendix A.3.

4. Location and Description

4.1 Site Location and Description

The Site of the Proposed Development forms part of the Springfield Road Industrial Area, a wider commercial development bound to the north by Uxbridge Road, the west by Springfield Road, to the east by the Yeading Brook, and to the south by Beaconsfield Road (UB4 0JZ, grid reference TQ 11524 80355). The area comprises of mixed commercial and retail developments and a hotel, located predominantly in the northern section closer to Uxbridge Road, with industrial storage and manufacturing facilities being located across much of the central and southern areas. The Site location is demarcated in Figure 1.

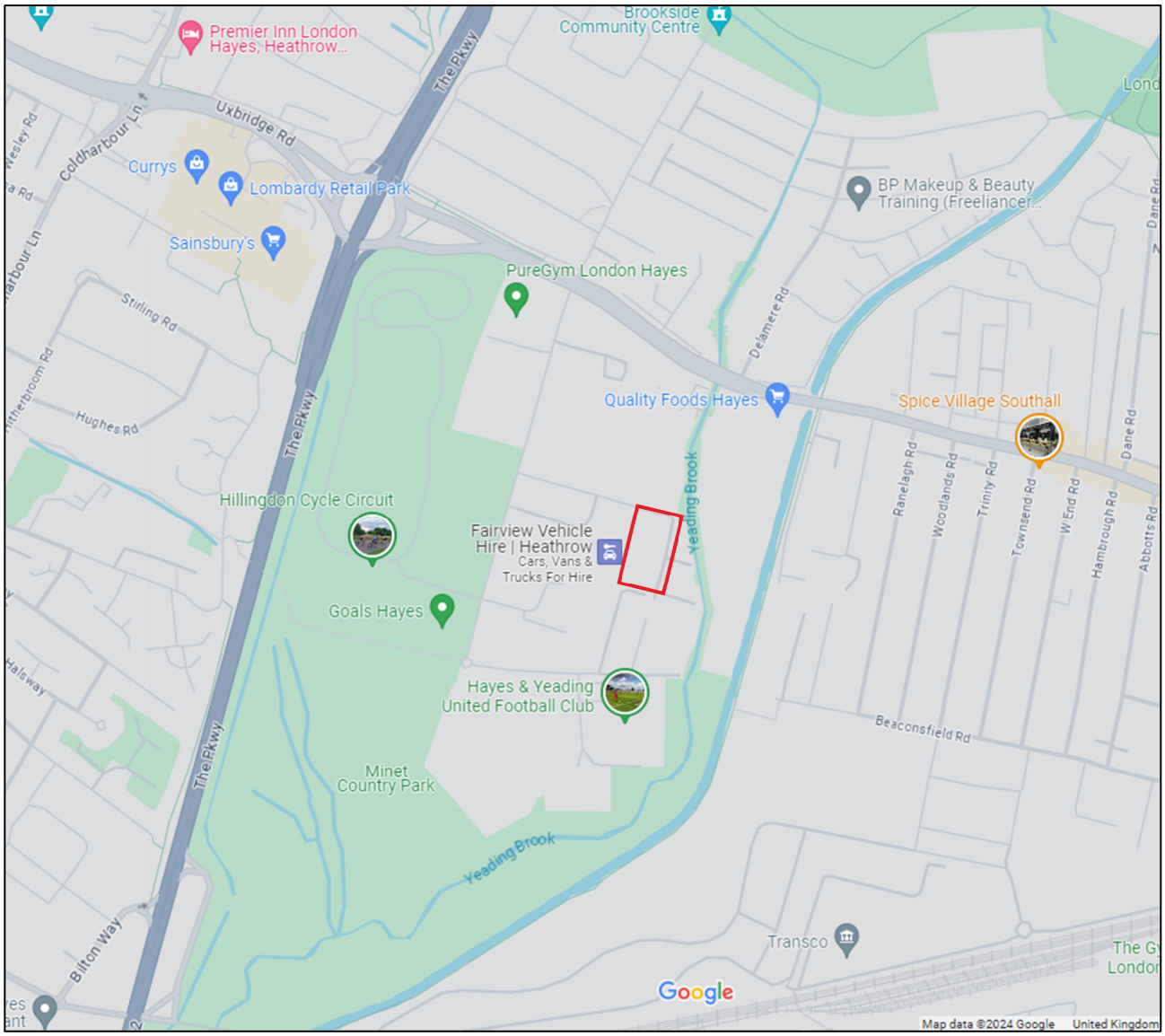

Figure 1: Location map for the Site (existing) of the Proposed Development

Currently, the Site is bordered by a multiple use industrial unit to the south and west, the Bullsbrook Road to the north, and the Yeading Brook to the east.

4.2 Topography

A topographical survey (Appendix A.1) along with GPR survey of the Site was undertaken by Catsurveys in December 2021-January 2022, with additional GPR survey anticipated in August 2024.

Additionally, 2019 LiDAR data with a 1m resolution are available from the EA as both a Digital Terrain Model (DTM) and a Digital Surface Model (DSM). A DSM is produced from the last return LIDAR signal and includes the elevations of objects, such as vehicles, buildings, and vegetation, as well as the terrain surface. A DTM is the terrain model of just the lower / topographic surface, using bespoke algorithms and manual data editing to remove any surface objects from the DSM.[14]

Topograhical survey identifies that the existing levels on the carpark vary between approximately 28.52m and 28.66m AOD. The project architects (StudioNWA) confirm that these levels are to be adopted (i.e. remain largely unchanged) for the Proposed Development. Further, they confirm that the post-construction ground floor finished floor level (FFL) will be approximately 28.85mAOD for both control room and transformer elements of the Proposed Development.

4.3 Existing Surface Water Features

The closest surface water feature to the Site is the Yeading Brook, running parallel to the Grand Union Canal. Both water bodies have a north to south flow direction and lie a minimum of 5m and 110m away, respectively. Approximately 1.5km south of the Site, the Yeading Brook crosses another section of the Grand Union Canal (flowing west to east) and joins the river Crane (flowing north to south).

According to the EA Spatial Flood Defences dataset, areas of high ground are located along the right and left bank of the Yeading River. The high ground runs for ~2 km and has an actual condition rating of 3 (fair). The crest level along the bank, recorded in the EA Asset Information Management Systems (AIMS), ranges from 25.77 m Above Ordnance Datum (AOD) to 28.28 m AOD. The relatively high ground is not considered to be a formal defence. There is a flood storage area at Charville Lane (~83,000 m^2), which is 5.2km upstream of the Site.

4.4 Existing Hydraulic Infrastructure and Drainage

Neither the 2022 GPR survey nor TW sewer asset records identified any hydraulic assets in the vicinity – this includes, not is not limited to: flow control devices, pumping stations, dual manholes, weirs and/or bifurcated lines. Existing roads and buildings are known to drain into a separated surface and foul sewer network.

Refer to Arup Drainage Strategy report (LONDPSS2-ARUP-SS-SS-XX-RP-C-52001) for further details on existing drainage.

4.4.1 Surface Water

GPR and drainage records indicate that the Site drains to an existing 600mm surface water sewer situated parallel to the northern site boundary, on the Bullsbrook Road. This terminates via outfall to watercourse on the north-eastern boundary of the Site.

From Arup's previous involvement in the wider project, it is known that the entirety of the Heathrow Interchange site drains to the adjacent Yeading Brook via pipework that is routed to the north of Unit 1. The network here is pending full CCTV survey as initiated by the Arup drainage strategy lead (anticipated Q3 2024). However, it is believed that the Heathrow Interchange discharges unrestricted. See Appendix A.4 (TW sewer asset records) for existing drainage and sewerage network details.

[14] Environment Agency DSM (2024) https://data.gov.uk/dataset/80c522cc-e0bf-4466-8409-57a04c456197/lidar-composite-dsm-2017-1m

4.4.2 Foul Water

GPR and drainage records indicate that foul water from the Site drains to an existing 225mm foul water sewer situated parallel to the northern site boundary, and adjacent to the SW sewer, on Bullsbrook Road. This drains by gravity to the west, where it joins an existing south-north trunk main foul sewer which services the wider Hayes Business and Retail Park. Note that the exact sewer outfall location and dimensions are TBC, pending latest survey returns – surveys took place in June 2024 and their receipt is anticipated in August 2024.

5. Proposed Development

5.1 Details of Proposed Works

A draft Proposed Development site layout is presented in Appendix A.2.

This FRA is in support of planning application 1 which covers the Proposed Development comprised of an electrical substation – with two transformers and a control centre. This substation and associated infrastructure will service the wider data centre campus, including the data centre buildings previously approved under application reference (38421/APP/2021/4045) on a temporary basis, and a number of future data centres (which will be subject to future planning applications (planning application 2) on the adjacent site to the south, west, and north.. These 2 planning applications are explained below as their connectivity is important context for this FRA.

5.1.1 Substation (planning application 1)

The Proposed Development comprises of Substation 2 (B3/B4/B5) which includes 2x transformers, a control centre, a vehicular access road and carpark, security fencing, and associated soft landscaping. See Appendix A.2 for masterplan layout.

5.1.2 Data Centre (planning application 2 – Not covered by this FRA)

The adjunct, separate application for the proposed data centre development comprises four main elements, where elements 2, 3, and 4 are addressed within a separate planning application:

1. **Two separate but interlinked data centre buildings:** The campus will primarily consist of two data centre buildings which will deliver 39,359 m^2 (gross internal area excluding gantries) of new data centre floorspace. The data centre buildings (Building 1 – East; Building 2 – West) will be five storeys in height (with additional plant level above the data halls) and will be interlinked at an upper floor level. Building 1 will also support ancillary office area. Building 1 has a ground floor area of 4,182 m^2 and Building 2 has a ground floor area of 3,400 m^2.

2. **Security measures:** Security measures include the construction of a 2.4 m high security fence enclosing the entire perimeter site in addition to a security gatehouse and reception centre at the entrance into the campus from Beaconsfield Road. This will provide 24-hour security, managing access and egress to the Site.

3. **Associated energy and electricity infrastructure:** Comprises an energy centre (primarily a substation and fuel storage) to the north, as well as back-up generators within the footprint of the main data centre buildings which are likely to include fuel storage, switch rooms, uninterrupted power supply equipment, and plant.

4. **Car parking, cycle parking and access:** Access to the Site will be via Beaconsfield Road. The proposals currently include the provision of 65 car parking spaces located within the perimeter fence along the Site's southern boundaries and to the west of Building 1.

5.2 Development Type and Vulnerability Classification

The Proposed Development is required to support the wider data centre development of the Heathrow Interchange Park and is considered to be an emerging activity that falls within this class of use' (use class B8). Under flood risk assessment (Planning Practice Guidance on Flood Risk) guidance, the Proposed Development is therefore classified as being *less vulnerable* (Table 3).

Table 3: Flood vulnerability classifications (as shown in Table 2, Paragraph: 066 Reference ID:7-066-20140306 of Planning Practice Guidance on Flood Risk) (best matching description for the Proposed Development highlighted).

Essential infrastructure • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly vulnerable • Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure").
More vulnerable • Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill* and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less vulnerable • Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; **offices; general industry, storage and distribution**; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill* and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water-compatible development • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

The vulnerability classifications in Table 3 hold specific meaning under the Flood Risk Assessment Guidance[2], to inform sequential and exception tests and to determine the selection of appropriate climate change allowances for design flood levels.

5.2.1 Operational Criticality of the Proposed Development

It should be noted that whilst the Proposed Development is classified as *less vulnerable* under Planning Policy Guidance for Flood Risk, it may still incur damages or disruption in the event of a flood, and clients should have their own additional expectations and mitigation in place for flood resilience to satisfy the economic viability of intended operations and/or for insurance purposes.

When considered within the context of the wider development (and separate planning application) of the adjacent data centre, and to avoid confusion with the vulnerability classifications described above, the Proposed Development (the Bullsbrook Substation) should be considered a *critical* asset by the client due to the potential local implications of outages due to flood and water damage.

Power disruption on the National Grid (i.e. blackout) would cause loss of power and function of the data centre servers. The backup energy infrastructure on site (the Proposed Development) is therefore considered *critical* for the continuity of the data centre. In the event of a flood, it is possible that wider disruption to the National Grid could result in loss of power to the servers. In this case, ensuring the backup generators can continue to provide uninterrupted supply during a flood event is therefore also considered *critical*, and the equipment may be highly susceptible to water damage.

It is recommended that separate discussions are held on specific flood resilience measures for the proposed development as part of the ongoing design process, so that infrastructure is resilient to a point that meets client requirements,

5.3 Sequential & Exception Test

5.3.1 Sequential Test

An EA Planning Applications Team response dated May 2024 (Appendix A.3) confirms that sequential testing for site selection is not required:

'Taking into account the existing commercial uses located on the site, it is noted that the proposal would not result in a change in terms of the vulnerability classification. It is not therefore considered that sequential test is necessary in flood risk terms. However, the proposal should take a sequential approach within the site itself, setting the most vulnerable elements of the development away from the areas of the site which are most at risk of flooding.'

Ggiven that the Proposed Development contains only one primary site element (the substation structure) any exercise in sequential location assessment of site elements is not possible. However, as referenced in section 7.1, the Site, including the Proposed Development (Bullsbrook Substation) FFL, is positioned above 1in100+CC AEP flood levels, retaining in excess of 600mm freeboard, as predicted by hydraulic modelling study outputs.

5.3.2 Exception Test

The Proposed Development is categorised as *less vulnerable* development under the NPPG[2] and is therefore considered to be a compatible development within Flood Zone 2, so there will be no need to satisfy the exception test.

6. Climate Change

There are two accepted approaches when designing for climate change:

- **Precautionary approach:** this involves incorporating measures to mitigate potential climate change impacts from the outset.
- **Manged adaptive approach:** this focuses on making provisions for future adjustments to be undertaken later. This allows for greater certainty regarding the specific climate change impacts as they become clearer over time.

The EAs most recent updates on *peak river flow climate change allowances (*July 2021) are included in Table 4:

Table 4: Potential CC allowances for the Proposed Development site.

Central			Higher Central			Upper End		
2020s	**2050s**	**2080s**	**2020s**	**2050s**	**2080s**	**2020s**	**2050s**	**2080s**
10%	7%	17%	14%	14%	27%	26%	30%	54%

6.1.1 Project Specifics

The Site of the Proposed Development is situated in the **London management catchment** within the **Thames River basin district.**

As the Site is FZ2 (less vulnerable), the central allowance from the EA applies. These allowances translate to projected increases in peak river flow of:

- 10% for 2020s
- 7% for 2050s
- 17% for 2080s

Note that the Yeading Brook hydraulic model from the EA lacks the specific 17% uplift data. However, as part of the 2021 FRA for the adjacent **Lon4/5** development (Appendix A.2), consultation with the EA confirmed that a substitute 1% AEP + 20%CC was acceptable. This 20% uplift was applied to peak river flows in the model to determine peak water levels.

The associated drainage strategy (LONDPSS2-ARUP-SS-SS-XX-RP-C-52001) incorporates consideration of potential changes in rainfall patterns due to climate change. This aims to ensure the drainage system can handle future scenarios over the building's anticipated lifespan, including mitigating the increased risk of flooding caused by overwhelmed drainage systems during larger fluvial events.

7. Source, Mechanism, and Likelihood of Flooding

7.1 River (Fluvial) and Coastal

The EA Flood Map for Planning[6] indicates that the Site falls entirely within FZ2 of the Yeading Brook (Figure 2), which flows north to south, situated immediately adjacent (approx. 5-10m) to the Site's eastern boundary. Flood zones refer to the probability of flooding from river and sea sources, ignoring the presence of defences. The NPPF[2] defines 'medium probability' FZ2 flood risk as:

'*Land having between a 1 in 100 (1%) and 1 in 1,000 (0.1%) AEP of river flooding; or land having between a 1 in 200 (0.5%) and 1 in 1,000 (1%) AEP of sea flooding in any given year. (Land shown in light blue on the Flood Map).*'

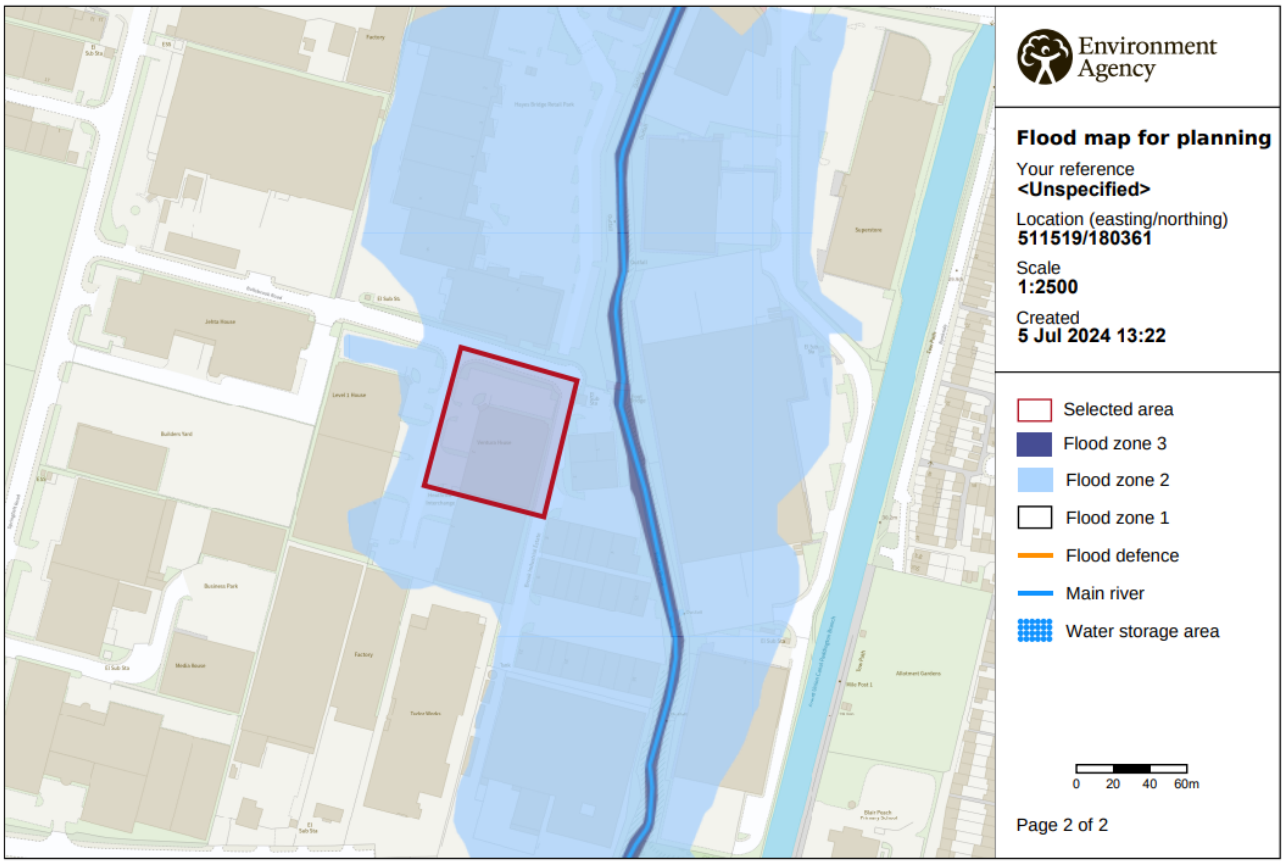

Figure 2: EA flood map for planning. (the Site boundary shown in red polygon)

The EA have also provided model output data for the 1D River Crane Mapping Study (Halcrow 2008) model. This includes peak water levels and peak flows at model nodes within the area of interest (Table 5) and flood extents derived from the 1D model results for a range of return periods and climate allowances (Figure 3). All events consider defences except for the 1 in 100 (1%) AEP and the 1 in 1000 (0.1%) AEP which contain flood extent outlines for both defended and undefended scenarios. Node Y726, which lies just upstream of the southern extent of the Site, is used to inform design flood levels.

Table 5: River Crane Mapping Study - node flood levels

Modelled Flood Level (m AOD) (defended)					
Node Label	Easting	Northing	Return Period		
			100yr	100yr +20%	1000yr
Y727d	511586	180384	27.61	27.70	29.11
Y726	**511612**	**180266**	**27.48**	**27.59**	**29.09**
Y725	511584	180082	27.34	27.47	29.08

Figure 3: River Crane Mapping Study - flood extents and 1d node locations (1in1000 defended extent in blue; 1in1000 undefended extent in yellow)

In both the defended and undefended scenarios, water levels in the 1 in 100 (1%) AEP event, even with climate change uplift applied at 20%, are below the current ground levels ((~28.52-28.66 m AOD) across the whole of the Site and therefore it would not be inundated.

In the 1 in 1000 (0.1%) AEP event, the maximum water level is 29.09m AOD. The extent of the 1 in 1000 (0.1%) AEP event flood mapping shows that the entirety of the Site would be inundated in both defended and undefended scenarios.

Based on typical ground levels from the topographical survey information (~28.52-28.66 m AOD), the depth across the Site during the 1 in 1000 (0.1%) AEP event would be approximately 0.43-0.57 m. Topographic survey information and suggested indicative ground floor FFL of the Proposed Development is 28.85 m AOD and therefore the flood depths in this location of the Site are likely to be 0.24 m.

7.1.1 Historic Flooding

The EA historic flood events map indicates that recorded flooding has not affected the Site historically and the EA have confirmed no records of flooding from the Yeading Brook at the location of the Proposed

Development (during times when records have been collected). It has been confirmed that flooding did occur within 1km (upstream) of the Proposed Development site on 6th August 1977 between Camden Avenue and Delamere Road. Since this event, local flood defences have been constructed to manage fluvial flood risk within the borough. These defences do not impact the Proposed Development site. In the wider LBH area, the LFRMS reports flooding in August 1977 and May 1988 and more recently, events were recorded in 2000, 2001, 2003, 2007, 2009, 2013, 2014 and 2016, at greater than 1km from the Site.

7.1.2 EA Flood Warning Areas

The Site lies within the River Crane at Southall flood warning area (062FWF36Southall). Within a 1km radius, there is also the Yeading Brook at Hillingdon flood warning area (062FWF36Hilling) to the north of the proposed site.

7.1.3 Coastal and Near Coastal

According to the West London SFRA, the Proposed Development site is not affected by tidal flooding from the Thames, nor is it an area benefitting from tidal flood defences.

7.2 Surface Water (Pluvial)

The EA surface water flood risk map (Figure 4) indicates that the Site is mostly (approximately ~90%) at very low risk (<0.1% chance) of surface water flooding, with a small (approximately ~10%) area of 'low risk' (0.1% - 1% chance) of flooding in the north western corner. Overall, the mapping indicates a very low risk of surface water flooding, which should be managed via appropriate surface drainage design.

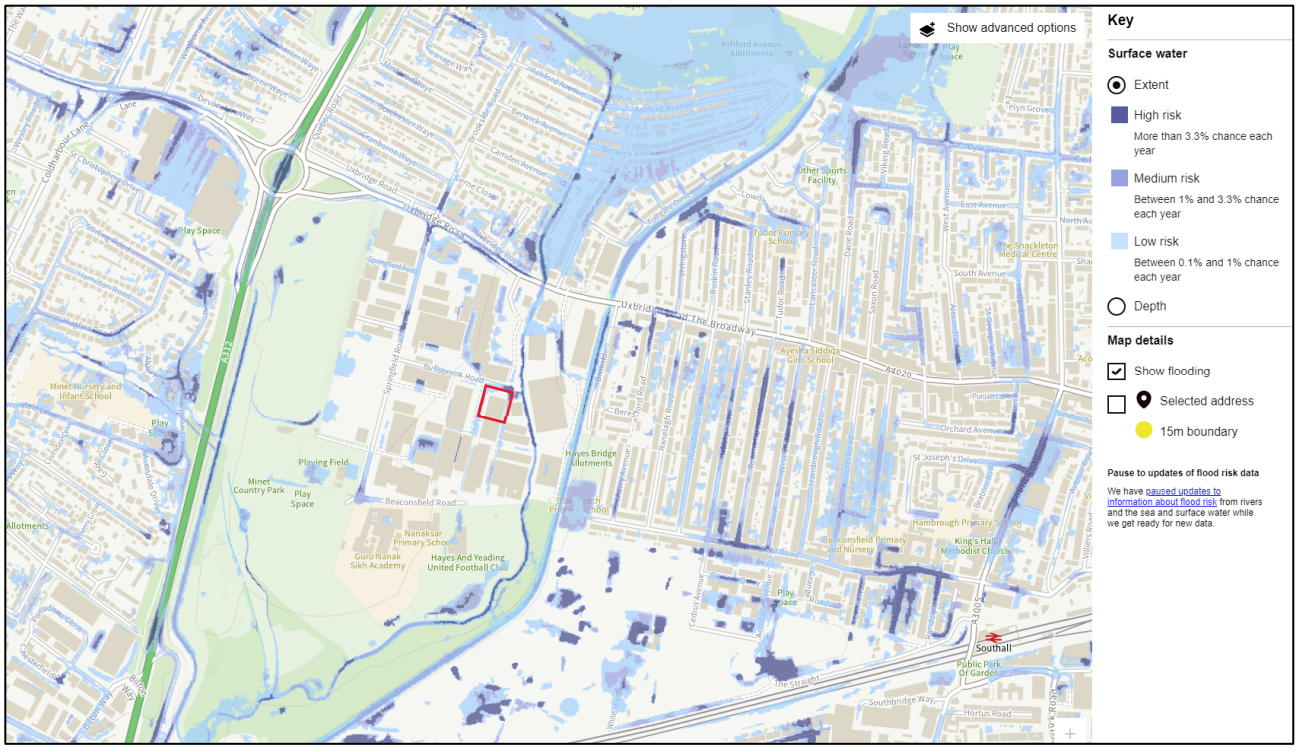

Figure 4: EA Surface water flood risk map for the Site and adjacent areas

7.3 Groundwater

According to the EA 2017 susceptibility to groundwater flooding map (Figure 5) as provided in the SFRA[4], the Site and surrounding areas are in the lowest susceptibility class.

However, The Greater London Authority (GLA) 2011 map (Figure 6) indicates that the Site is in an area of increased potential for elevated groundwater due to permeable superficial deposits underlying the Site.

Arup's Geotechnical Desk Study Report (June 2021) (DCS20190-ARUP-DC-CO-XX-RP-C-00021), written for the adjacent southern site,identified that the whole Colt Data Centre development site sits above London Clay, which is present at a depth of 12m Below Ground level (BGL). A thick layer of river terrace deposits is present above the London Clay. Groundwater in this area is subsequently high. Perched groundwater has also been encountered as shallow as 0.7m GBL within the made ground.

Given the distance to the river Thames, no tidal variation of the groundwater is expected. However, rainfall events are likely to affect groundwater levels.

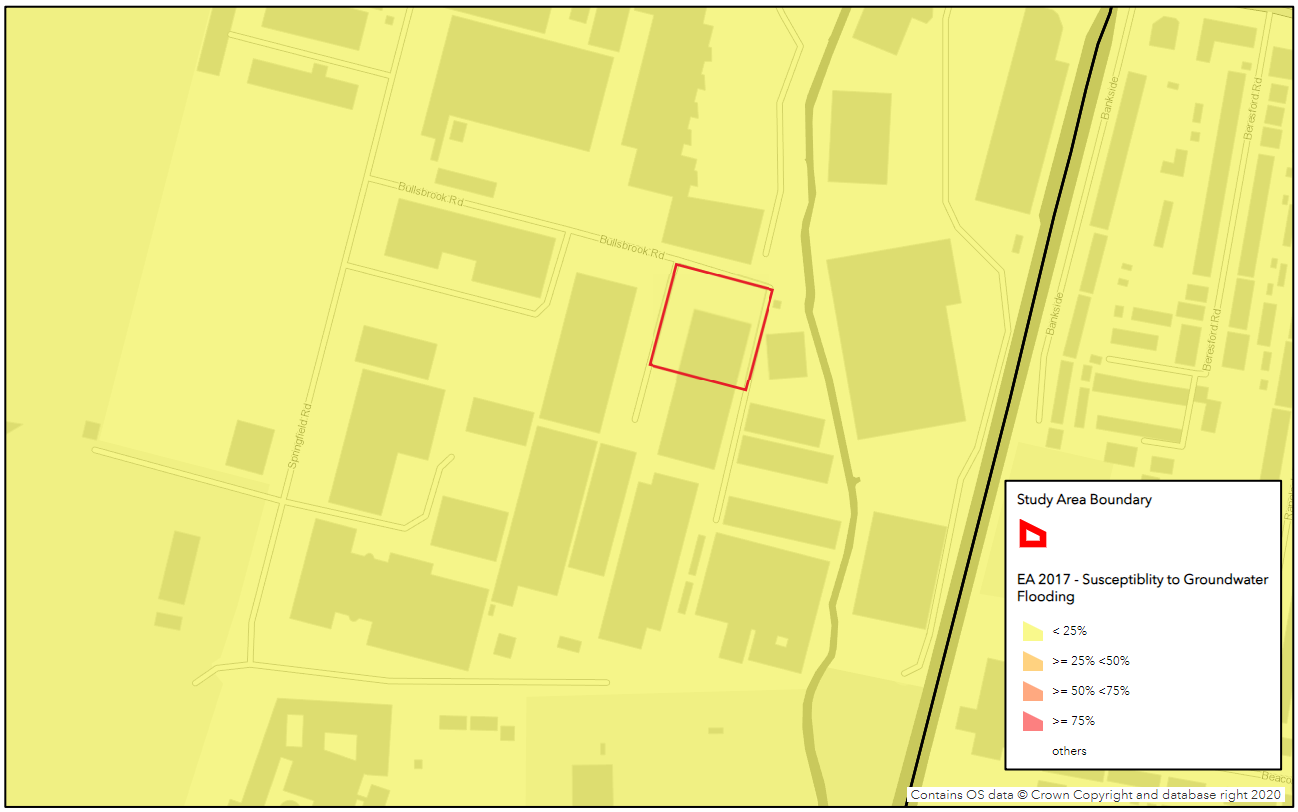

Figure 5: EA map of groundwater susceptibility for the Site and adjacent area.

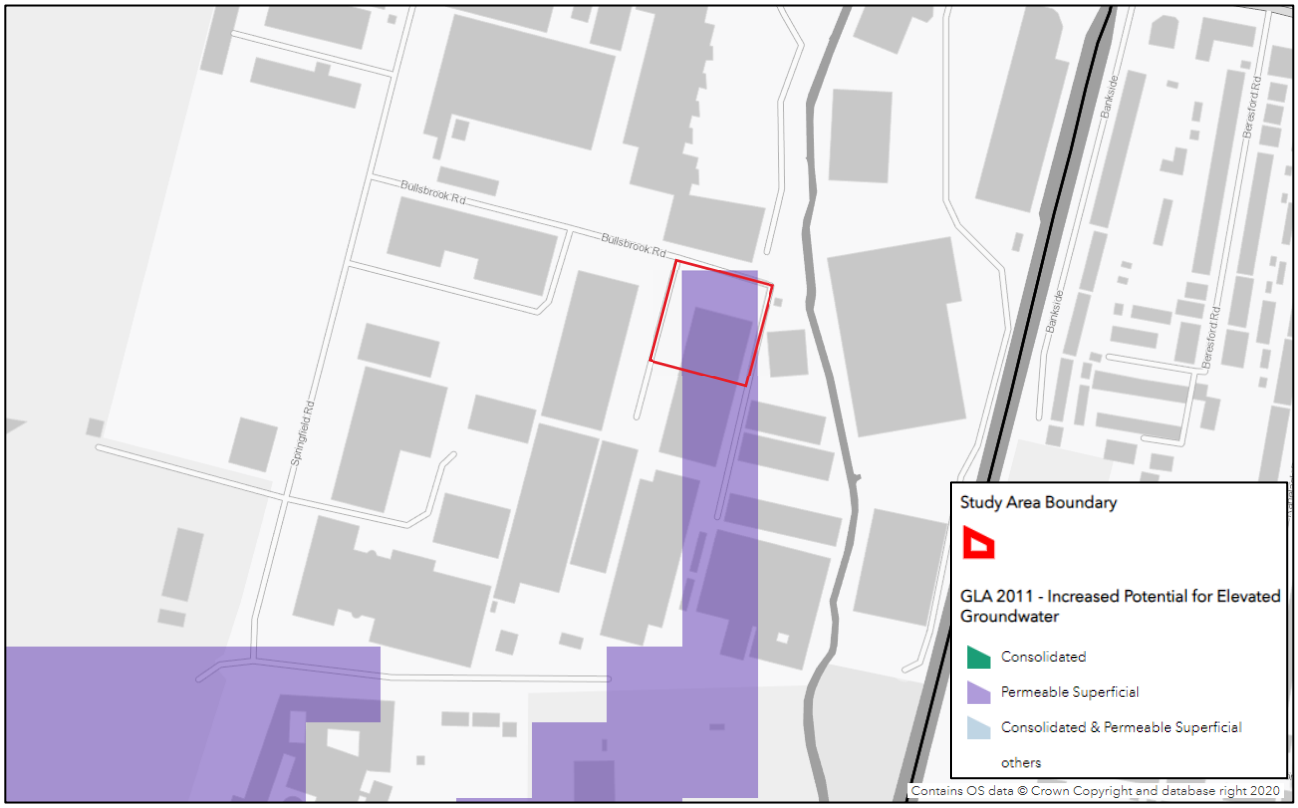

Figure 6: Greater london Authority 2011 map[15] of areas with increased potential for elevated groundwater.

7.4 Reservoirs, Canals, and Other Artificial Sources

Upstream of the Site, there is a large, raised reservoir at Charville Lane (approximately 5.2km upstream), which acts as a Flood Storage Area (FSA). The reservoir is contained by the Charville Lane FSA embankment which has a condition rating of 2 (good). In the event of its failure, the entirety of the Site is predicted to be inundated to a depth of <0.3m, according to the EA map of maximum extent of flooding from reservoir failure (Figure 7). However, due to the requirements of the Reservoir Act (1975) for such structures, and its status as a dedicated FSA, an event such as this is considered to have a **low probability** of occurring.

The Grand Union canal flows parallel to the Yeading Brook 80 m east of the Proposed Development site. The banks of the canal are higher than the ground levels in the Proposed Development site (approx. between 29.60 and 29.80 m AOD). In the event of canal overtopping or banks being breached, the topography is likely to convey any water eastward away from the development site and therefore the risk of flooding from the canal is considered **low.**

[15] Metis Consultants (2018) West London Boroughs Level 1 SFRA: Greater London Authority 2011 Groundwater flood map. Available at: https://westlondonsfra.london/ [Accessed 05-07-24]

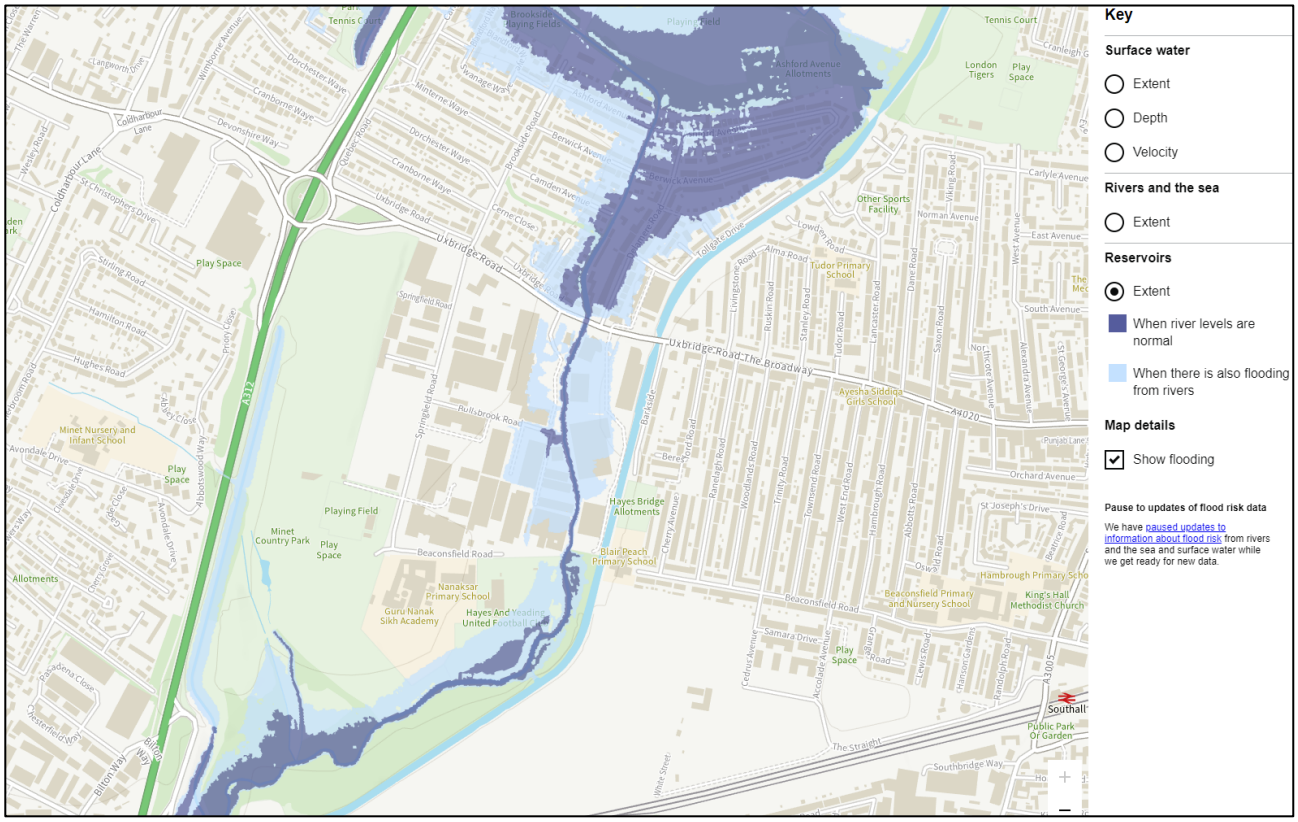

Figure 7: EA map of extent of maximum flooding from reservoir failure.

7.5 Drainage, SuDS, and Off-site Flood Risk

According to the West London SFRA[4] and Thames Water Sewer Flood Records (2017) (Appendix A.4), the Site has had no recorded incidents of flooding from a sewer source. The closest area of recorded sewer flooding lies over 1km to the north of the Site.

In addition to sewer flood records, the associated Drainage Strategy report (LONDPSS2-ARUP-SS-SS-XX-RP-C-52001) created by Arup contains detailed information on drainage and SuDS. Contained within is also a review of the suitability of potential SuDS application on site.

Local planning policy requires that all future developments are to be restricted to a flow rate equivalent to greenfield run off, requiring attenuation to be provided on site. Due to limited spatial availability for tanks elsewhere, it is anticipated that the Site may be used to attenuate for the wider Heathrow Interchange development – via a buried tank and/or soft landscaping attenuation features. Further information is being actively pursued via CCTV and GPR surveys (Q3 2024) on the existing network and outfall arrangement which will further inform drainage strategy at detailed design.

It is anticipated that, considering the absence of any known historical sewer flooding, and a drainage strategy that fully adheres to local planning policy including attenuation and discharge requirements, risk of flooding from drainage and SuDS infrastructure is deemed **low**. There remains a residual risk of sewer flooding due to the withholding of historic flooding information from TW. However, it is anticipated that this residual risk can be effectively managed through the drainage strategy and design.

7.6 Flood Risk Summary

FLOOD RISK SOURCE	SIGNIFICANCE (Very low, Low, Medium, High, Very high)	COMMENTS
Fluvial	Medium	Site falls within the FZ2 of the adjacent Yeading Brook. NPPF defines this as 'between a 1 in 100 (1%) and 1 in 1,000 (0.1%) AEP of river flooding;' Outputs from the associated hydraulic model for the Yeading Brook predicts no bank overtopping up to 1in200 AEP, including undefended and with climate uplifts (20%) applied. However, it predicts that in the 1in1000 AEP scenario, with a flood level of 29.09mAOD and an average site level of 28.59mAOD, that the site would be fully inundated to approx. 0.5m depth above ground level, and 0.24m depth above FFL.
Coastal	Very low	No coastal or tidally influenced watercourses in the vicinity.
Surface water	Very low/low	Overall risk is very low (as indicated in EA mapping). Some areas around the periphery of the Site fall within the 'Low risk' category.
Groundwater	Low	While the Site is considered to be in an area in the lowest susceptibility class for groundwater flood risk, the Site might be of increased potential for elevated groundwater due to permeable superficial deposits underlying the Site. Rainfall events are likely to affect groundwater levels.
Reservoirs, canals & artificial sources	Low	There is a low probability of the Charville Lane FSA (a large, raised reservoir) failing. In the event that it does, the extent and depths would be similar to that of the fluvial Flood Zone 2. In the event of canal overtopping or banks being breached, the topography is likely to convey any water eastward away from the development site and therefor the risk of flooding from the canal is considered low.
Drainage, SuDS, and off-site	Low	The Proposed Development site has had no recorded incidents of flooding from a sewer source. The Site is currently well drained.

8. Mitigation and management measures

8.1 Overview

Source	Mitigation and management measures
General/all	**Site and Finished Floor Levels** Site ground levels and FFLs exceed the 1in100 AEP +20% climate change flood level (27.59mAOD), satisfying the requirements of the SFRA[4], meaning that no other management measures are required to satisfy national policy requirements as part of planning. **Safe route of access/egress** Access and egress to the Site, including pedestrian access as well as the vehicular route from the entrance at Bullsbrook Road, is to be set to be elevated to existing ground levels (approx. 29.50-29.70 m AOD). This would provide safe access/egress in up to 1in1000 AEP events (peak predicted flood level of approx. 29.09mAOD). **Flood warning and evacuation plan** The flood risk to staff at the Site, represented in part by the EA flood warning area, needs to be considered in the emergency planning by the operator of the Site. This should acknowledge the preparation and planning steps identified in the SFRA.[4]
Fluvial	Fluvial flood risk is considered to be *medium* overall. Although the site (including FFL) is protected to 1in100+CC AEP with in excess of 600mm freeboard, satisfying NPPF requirements – there remains a risk of inundation from a 1in1000 AEP event. It is anticipated that the 'general' mitigation measures detailed above would apply to the management of fluvial flood risk. These are: • **Suitably elevated Site and Finished Floor Levels** • **Safe route of access/egress** • **Flood warning and evacuation plan**
Coastal or near coastal	No actions required.
Surface water (pluvial)	Surface water flood risk is *very-low/low* across the Site, and should be addressed and managed via appropriate site drainage measures, utilising SuDS features where feasible. See drainage strategy LONDPSS2-ARUP-SS-SS-XX-RP-C-52001 for details.
Groundwater	There are no proposals for below-ground development within the designs for the Proposed Development. Existing surface water flood management and mitigation measures are proposed as sufficient for the low risk posed by groundwater flooding.
Reservoir, canals, and other artificial sources	Risk of flooding from reservoirs is considered *low*. In the event that this occurred, the 'general' mitigation measures detailed above would apply to the management of reservoir flood risk. These are: • **Safe route of access/egress** • **Flood warning and evacuation plan** • **Suitably elevated Finished Floor Levels**

Drainage, SuDS and off-site impacts	The Arup Drainage Strategy LONDPSS2-ARUP-SS-SS-XX-RP-C-52001 confirms that post-development surface water discharge rates will be designed to maintain surface water runoff rates at no higher than greenfield equivalent runoff up to 1in100 AEP plus climate change allowance. Further, the 'general' mitigation measures detailed above would apply to the management of drainage flood risk. These are: • **Safe route of access/egress** • **Flood warning and evacuation plan** • **Suitably elevated Finished Floor Levels**

9. Conclusion and Recommendations

The Site of the Proposed Development is situated wholly in FZ2 and is classified as *less vulnerable* in the NPPG technical guidance. The EA have confirmed that the sequential test would not be applicable here, as the Proposed Development would not result in a change of vulnerability classification. Further, given that the Proposed Development contains only one primary site element (the substation structure) any exercise in sequential assessment of site elements in relation to their relative flood risk is not possible.

The assessment concludes:

- **Flood risk:** flood risk to the Site is considered to be *very low* for coastal and surface water sources, to *low* for groundwater; reservoirs, canals and artificial sources; and drainage and off-site sources, while there remains a *medium* risk from fluvial flooding via the Yeading Brook. The model predicts that no bank overtopping would occur in up to a 1in200 AEP event. However, the 1in1000 AEP events (defended and undefended, with and without climate change allowances) are predicted to inundate the site with a flood level of 29.09mAOD. The site ground levels (approx. 28.59mAOD) and FFLs (28.85mAOD) exceed the 1in100 AEP + climate change flood level (27.59mAOD) with significant additional freeboard.

- **Climate change:** the Proposed Development is considered resilient to future climate change via application of climate allowance uplifts to design levels. It is noted that flood risk is anticipated to increase over the lifetime of any development; to account for this risk, the FRA has addressed climate change uplift values when assessing flood risk vs known and proposed design levels. The 20% value utilised is higher than those required to satisfy NPPF requirements (2080 central uplift is 17% for the Thames river basin district. The existing and proposed design levels for site and FFL are resilient to the 1in100 AEP + climate change flood levels, maintaining well in excess of 600mm freeboard across the site in these events.
- **Mitigation and management:** Appropriate measures have been delineated and considered throughout the design process for the Proposed Development. Measures include FFLs of 28.85mAOD (retaining in excess of 600mm freeboard in 1in100 AEP+CC events), identification of appropriately designed emergency access/egress routes (accessible in up to 1in1000 AEP events), and identification of need for emergency planning measures implemented by the Site occupiers.

Finally, it should be noted that this document primarily addresses NPPF minimum design requirements and their associated mitigation and management measures. The design of the Proposed Development satisfies these requirements. However, the client should be aware that as with any design proposal, there remains residual risk of flooding, and it is anticipated that this risk will be further exacerbated during the expected lifecycle of the Proposed Development due to climate change impacts. It is therefore strongly recommended that the client continues to give credence to the implementation of flood resilience and adaptation measures for the Proposed Development, embedding this into the ongoing design process in order to meet their own requirements and expectations on flood resilience.

A.1 Topographic Survey

A.2 Proposed Development Site Layout

A.3 Summary of Consultation Communications

A.4 Thames Water Sewer Records