



256 Gray's Inn Road

A new centre for world-leading dementia and neurology research and academic excellence

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UCL ION/DRI FLOOD RISK ASSESSMENT

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Dental Hospital Site on Grays Inn Road Redevelopment Site**

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1. INTRODUCTION

1.0.1 Planning permission 2019/2879/P was granted in March 2020 for the redevelopment of 256 Grays Inn Road to provide a dementia and neurology research centre along with academic space for University College London (UCL). This Flood Risk Assessment has been prepared by Ramboll in connection with the planning application to amend the above permission to extend the basement of the new academic building, known as Plot 3.

The first phase of the approved development comprises the partial redevelopment of the former Royal Free Hospital (Plot 1) to deliver a world-leading medical research facility to tackle dementia and neurological diseases. Work on site is currently underway on Plot 1.

Subsequent phases of the approved development comprise the refurbishment of the grade II listed Eastman Dental Clinic (referred to as Plot 2) and the erection of a new building on the site of the Levy Wing (referred to as Plot 3) to deliver additional academic space for UCL. This academic space will complement the University's vision for creating a world class environment for education and academic research. The proposed development would also deliver a comprehensive landscaping scheme to open up new publicly accessible spaces within the site, and new public connections across it.

This planning application relates to the proposal to extend the basement of the Plot 3 building underneath the public realm area in the centre of the site to provide two lecture theatres for the academic use. UCL has identified a requirement for larger lecture theatres than would be delivered in the approved scheme. It also reflects UCL's intention to bring the delivery of the Plot 3 basement works forward at the same time as the Plot 1 basement works to deliver the development in a more efficient and less disruptive way.

This planning application also proposes small extensions to the basement of the Plot 1 building to allow for the provision of a sprinkler tank and additional plant. These extensions are not expected to have any impact on the assessment of the flood risk.

This report supersedes the previous Flood Risk Assessment. There is no revision to the outcome of the assessment. The revision is only to the description of the works to bring this in line with the wider planning amendment associated with the extended basement.

1.0.2 Ramboll was appointed by UCL to undertake a FRA and develop an outline surface water and foul drainage design for the proposed refurbishment and redevelopment of 256 Grays Inn Road. This report is solely the FRA but the Surface water Strategy plan is appended within this document for continuity purposes.

1.0.3 The application site at 256 Grays Inn Road is 1.207ha in area, made up of a group of buildings comprising:

- the former Royal Free Hospital (Plot 1)
- the grade II listed Eastman Dental Clinic (Plot 2); and
- the Levy Wing (Plot 3).

1.0.4 The key sources of information used to prepare this report include:

- i. Environment Agency (EA) database of indicative floodplain, hydrogeological maps, and Light Detection and Ranging (LiDAR) data provided under the Open Government licence v3.0 for public sector information;
- ii. Environment Agency – Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities (last update published in March 2016);
- iii. Environment Agency – Flood Map for Planning viewer, <https://flood-map-for-planning.service.gov.uk> (accessed September 2018);

- iv. Sewers for Adoption – A Design and Construction Guide for Developers – Seventh Edition (August 2012);
- v. The British Geological Survey (BGS) Geology of Britain Viewer <http://www.bgs.ac.uk/data/mapViewers/home.html> (accessed September 2018);
- vi. National Planning Policy Framework (NPPF);
- vii. National Planning Practice Guidance (NPPG): Flood Risk and Coastal Change (April 2015);
- viii. Planning application documents/drawings
- ix. Topographical Survey, Gleeds Geomatics (2018); and
- x. Camden geological, hydrogeological and hydrological study, ARUP (November 2010).

1.0.5 The references for the key sources of information used to prepare this document are included in the reference section at the rear of this report. Ramboll cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

1.1 Scope and Objectives

- 1.1.1 This document considers the risks of various sources of flooding to the site and the consequent risk of flooding to downstream receptors (such as people, property, habitats, infrastructure and statutory sites) from the proposed development as a result of surface water runoff. A comparison is made between the current situation and the proposed future development.
- 1.1.2 This FRA has been carried out in accordance with the National Planning Policy Framework (NPPF)¹. It is to be used to assist the Local Planning Authority (LPA) and Environment Agency (EA), when considering the flooding issues of the proposed development, as part of a planning application. An FRA is required as the developable area is larger than 1 hectare (ha).
- 1.1.3 This report provides the following information:
- i. An assessment of the flood risk to the site based upon flood data and the flood maps provided by the EA and Strategic Flood Risk Assessment (SFRA) and;
 - ii. An assessment of the impact of the new development in terms of surface water runoff and foul water;
 - iii. Proposals for measures to mitigate the generation of surface water runoff water as well as foul generated by the proposed development; and
 - iv. Proposals to mitigate any residual flood risks to the development (if any).

¹ Department of Communities and Local Government – National Planning Policy Framework (February 2019)

2. SITE CONTEXT

2.1 Application Site Description

2.1.1 The application site at 256 Grays Inn Road is 1.207ha in area, and is bounded to the west by Grays Inn Road, to the north by the Calthorpe Project and the New Calthorpe Estate, to the east by Langton Close, and to the south by Trinity Court and St Andrew's Gardens. The main part of the site is currently occupied by the Eastman Dental Hospital, which is due to vacate the site and relocate to a new development at Huntley Street in 2019. The Eastman Dental Hospital is made up of a group of buildings comprising:

- the former Royal Free Hospital (Plot 1)
- the grade II listed Eastman Dental Clinic (Plot 2); and
- the Levy Wing (Plot 3).

2.1.2 The rear part of the application site includes the existing student accommodation at Frances Gardner House. The site location plan is provided in Figure 1 at the rear of this report.

2.2 Site Topography

2.2.1 The topographical site survey was provided by Gleeds Building Surveying Ltd (surveyed 14 February 2018). The survey shows the site ground level varies between +16.0 mAOD to +21 mAOD. The elevations for each plot are generally level, the variation in elevation is between the three plots. There is an evident reduction in elevation at the boundary between Plot 1 and Plot 2. The digital terrain model is provided in Figure 2, at the rear of this report.

2.3 Geological Setting

2.3.1 The British Geological Survey (BGS) map of the area (1:50,000 scale map series), accessed via online digital mapping², indicates the site is underlain by London Clay Formation bedrock geology, comprising clay, silt and sand. The southern boundary of the site is situated on the boundary where the London Clay Formation is overlain by Hackney Gravel Member superficial deposits. The coarse resolution of the mapping means that the Hackney Gravel Member superficial deposits may encroach within the site boundary. There is also likely to be Made Ground present on site due to existing development.

2.3.2 A ground investigation has been undertaken to assess the geology of the site. This included seven boreholes and eight trial pits. The analysis of the borehole results found Made Ground to depths of between 2 mbgl and 4.7 mbgl. Three of the boreholes also reference the presents of Alluvium between 2.5 mbgl and 3 mbgl, and Hackney Gravel Member superficial deposits between 3 mbgl and 4.5 mbgl. This is underlain by Weathered London Clay to depths of between 5.2 mbgl and 8 mbgl and London Clay below this to depths of approximately 20 mbgl. This is then underlain by the Lambeth Group to depths of approximately 40 mbgl, incorporating the Reading Formation, Woolwich Formation, Mottled Upnor Formation and Upnor Formation. The layers of clay are underlain with Thanet Sand Formation to depths of approximately 45 mbgl, before finally reaching Chalk.

2.3.3 The key source of flooding from groundwater will be from the ground above the Clay bedrock. This ground was found to include Made Ground, Alluvium and River Terrace Deposits - Hackney Gravel Member. Groundwater monitoring standpipes were implemented at four of the boreholes to measure groundwater levels close to the surface, between 4 mbgl and 1.5 mbgl. A water level reading was taken once a week for three weeks. The results from this recorded a single reading of 2.48 mbgl, with the remaining 11 entries recorded as dry.

² The British Geological Survey (BGS) Geology of Britain Viewer. <http://www.bgs.ac.uk/data/mapViewers/home.html> (accessed September 2018)

2.3.4 The BGS mapping database also include historic borehole records. There are several records available immediately to the north, west and south of the site boundary. Fifteen borehole and trial pit record scans were reviewed (Ref TQ38SW500, TQ38SW2066E, TQ38SW1075, TQ38SW1073, TQ38SW1354, TQ38SW1355, TQ38SW1356, TQ38SW1357, TQ38SW1358, TQ38SW1359, TQ38SW1360, TQ38SW1361, TQ38SW2488A, TQ38SW2488B, TQ38SW2490).

- The records to the north of the site show Made Ground to depths of between 1.0m to 5.8m below ground level (bgl), London Clay and Reading Beds to 31.6 mbgl, gravel, sand and mottled clays (Thanet Sand and in part Reading Beds) to 41.91 mbgl and Chalk below this, down to the deepest borehole depth of 96.3 mbgl.
- The records to the west of the site show Made Ground to depths of between 2.6 m to 4.9 mbgl and London Clay below this, down to the deepest borehole depth of 18.3 mbgl.
- The records to the south of the site show Made Ground to depths of between 5.7 m to 6.5 mbgl, medium dense orange brown silty sand and sub-rounded fine to coarse gravel to between 8.3m to 9.9 mbgl and below this, London Clay down to the deepest borehole depth of 25 mbgl.

2.4 Hydrological Settings

2.4.1 The River Thames is situated approximately 1.8 km south of the site. The Regent's Canal system is located to the north of the site, at its closest 935 m away.

2.4.2 The River Fleet, a subterranean culverted watercourse, passes underground adjacent to the site. The River Fleet is artificially channelled to route through manmade culverts and into the local storm drainage network, eventually discharging into the Thames. The presence of the river channel is likely to have affected the underlying geology, highlighted in the borehole analysis with the presence of River Terrace Deposits - Hackney Gravel Member superficial deposits and Alluvium. Thames Water combined sewer and storm relief sewer main is known to run beneath Grays Inn Road, 10 m west of the site, providing flood relief for the River Fleet.

2.5 Hydrogeological Settings

2.5.1 The EA has developed Groundwater Source Protection Zones (SPZs) to assist in the assessment of risk to groundwater supplies taken from an abstraction point. The site does not lie within a Groundwater Source Protection Zone.

2.5.2 The EA website shows aquifers and provides designations which are in line with the Water Framework Directive and are based on maps produced by the BGS. Definitions for the aquifer types are provided below based on the EA website:

Principal Aquifer: "layers of rock or drift deposits that have high intergranular and/ or fracture permeability – meaning they usually provide a high level of water storage. They may support water and/ or river base flow on a strategic scale."

Secondary A Aquifer: "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers."

Secondary B Aquifer: "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering."

Secondary Undifferentiated Aquifer: "assigned where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously

been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."

- 2.5.3 According to EA mapping, the underlying superficial deposit of Hackney Gravel Member is designated as a "Secondary A Aquifer". Hackney Gravel Member superficial deposits are sedimentary deposits of fluvial origin. They form the beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary. The underlying bedrock is London Clay which is designated as Unproductive Strata.

2.6 Existing Flood Risk

Fluvial and Tidal Flood Risk

- 2.6.1 The EA floodplain maps identify areas in England and Wales at risk of flooding by allocating them into flood risk zones. The flood risk zones shown on the flood maps are defined in Table 1 (Flood Zones) of the Technical Guidance to the NPPF:

Zone 1: Low Probability

According to the Technical Guidance to the NPPF, land in this zone is considered to have less than 1-in-1000 annual probability of river or sea flooding in any year. This is <0.1%.

Zone 2: Medium Probability

According to the Technical Guidance to the NPPF, land in this zone is considered to have between a 1-in-100 and 1-in-1000 annual probability of river flooding in any year (between 1% and 0.1%) or between a 1-in-200 and 1-in-1000 annual probability of sea flooding in any year (0.5% to 0.1%).

Zone 3a: High Probability

According to the Technical Guidance to the NPPF, land in this zone is considered to have a 1-in-100 or greater annual probability of river flooding in any year (>1%) or a 1-in-200 or greater annual probability of flooding from the sea in any year (>0.5%).

Zone 3b: The Functional Floodplain

According to the Technical Guidance to the NPPF, land in this zone is used for water flow or storage in times of flood. This flood zone should be identified by a Strategic Flood Risk Assessment (SFRA). It is considered to have a 1-in-20 or greater chance of river flooding in any year which is >5%. Another probability, however, can also be agreed between the Local Planning Authority (LPA) and the EA.

- 2.6.2 The EA's online flood maps for planning currently shows the site to be location with Flood Zone 1, suggesting the land in this zone is considered to have a less than 0.1% annual probability of river or sea flooding in any year.
- 2.6.3 The subterranean River Fleet flows adjacent to the site. The river is artificially channelled to route through manmade culverts and into the local storm drainage network to eventually discharge into the River Thames. To manage the potential flood risk from the River Fleet, the channel is connected to the Thames Water combined sewer and storm relief sewer main. The topographical survey data provided by Gleeds Building Surveying Ltd (surveyed 14 February 2018) does not show any access points to the subterranean culvert system within the site boundary however, six manholes were marked around the site boundary. There is no historical evidence of flooding to the site from the subterranean River Fleet. The River Fleet is considered to be a low flood risk.

Surface Water and Sewer Drainage Flood Risk

2.6.4 The Flood and Water Management Act 2010 defines surface water flooding as flooding that takes place when surface runoff generated by rainwater falls on the surface of the ground and has not yet entered a watercourse, drainage system or public sewer. It is important to note that flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. In addition, local features can greatly affect the chance and severity of flooding. The EA's indicative surface water maps identify areas in England and Wales at potential risk of surface water flooding, defining the flood risk as follows:

- High risk: *"The chance of flooding at this area is greater than 3.3% in any year."*
- Medium risk: *"The chance of flooding at this area is between than 1% and 3.3% in any year."*
- Low risk: *"The chance of flooding at this area is between than 0.1 and 1% in any year."*
- Very Low risk: *"The chance of flooding at this area is less than 0.1% in any year."*

2.6.5 Review of the EA indicative surface water flood risk maps show most of the site is at very low risk of surface water flooding however, the lower areas of the site are categorised to have a low risk of surface water flooding. The Camden geological, hydrogeological and hydrological study (ARUP-2010) shows the site to be at very low risk, however it identified that the area north east of the site has a potential surface water flood risk. There are no records of previous surface water or sewer flooding at the site. Therefore, surface water and sewer flood risk to the site is considered to be low.

Groundwater Flood Risk

2.6.6 Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a rise in groundwater level sufficient for the water table to intersect the ground surface and inundate low lying land. Groundwater floods may emerge from either point or diffuse locations. They tend to be long in duration developing over weeks or months and prevailing for days or weeks.

2.6.7 As discussed in Section 2.3, following analysis of the site geology, the key source of flooding from groundwater will be from the ground above the Clay bedrock, where ground investigation found this to be Made Ground, Alluvium and Hackney Gravel Member superficial deposits. Groundwater monitoring standpipe readings over a three week period at four boreholes on site, measuring groundwater levels between 4 mbgl and 1.5 mbgl, recorded a single water level of 2.48 mbgl with the remaining readings recorded as "Dry". The presence of Alluvium and Hackney Gravel Member superficial deposits would indicate towards a potential for a groundwater flood risk however, there are no records of previous groundwater flooding at the site and the site is not situated in an area at risk of elevated groundwater levels. Therefore, flood risk to the site from ground water is considered to be low.

Risk from Reservoirs, Canal and Other Artificial Sources

2.6.8 Reservoirs in the UK have an extremely good safety record. The EA is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected and essential safety work is carried out. The EA's indicative reservoir flood risk maps show that the site is not at risk of reservoir flooding in the event of reservoir failure. Reservoirs therefore present a minimal risk. There are no known artificial water bodies within the site and therefore, flood risk to the site from artificial sources is considered to be low.

Flood Risk Summary

2.6.9 A summary of the risk of flooding from all sources is provided in Table 2.1.

Table 2.1: Flooding Sources at the Proposed Development Site

Sources of Flooding	High	Medium	Low	Comments
Tidal/ fluvial			√	Data reviewed suggests site is in Flood Zone 1 and therefore, has a less than 0.1% annual probability of river or sea flooding in any year. Therefore, the site should be considered to have a very low risk of tidal/fluvial flooding. Subterranean River Fleet flowing adjacent to the site is connected to the Thames Water combined sewer and storm relief sewer main. There are no access points to the subterranean culvert system within the site boundary and no historical evidence of flooding to the site from the River Fleet.
Surface water and drainage flood risk			√	EA maps show most of site to be at very low risk of surface water flooding, with a small area showing a low risk. No previous records of surface water flooding.
Groundwater			√	Low groundwater levels, no previous records of flooding.
Reservoirs, canals and other artificial sources			√	No artificial sources on site, site not at risk of reservoir flooding.

3. ASSESSMENT OF NEW DEVELOPMENT

3.1 Development Proposal

- 3.1.1 The first phase of the proposed development comprises the partial redevelopment of the former Royal Free Hospital (Plot 1) to deliver a world-leading medical research facility to tackle dementia and neurological diseases. The new research centre is collectively referred to as the IoN/DRI.
- 3.1.2 Subsequent phases of the proposed development comprise the refurbishment of the grade II listed Eastman Dental Clinic (referred to as Plot 2) and the erection of a new building on the site of the Levy Wing (referred to as Plot 3) to deliver additional academic space for UCL.
- 3.1.3 The proposed development would also deliver a comprehensive landscaping scheme to open up new publicly accessible spaces within the site, and new public connections across it.
- 3.1.4 Only minor works are proposed to the existing student accommodation at Frances Gardner House, comprising the installation of photovoltaic panels on the roof, and alterations to the landscaping within the courtyard.

3.2 Flood Risk Vulnerability

- 3.2.1 The EA's online flood maps for planning currently show the site to be located within Flood Zone 1, suggesting the site has a less than 0.1% annual probability of river or sea flooding in any year. The site is a commercial property. According to Table 2 (Flood Risk Vulnerability Classification) in the Planning Practice Guidance to NPPF, buildings used for services and industrial use are classified as "Less Vulnerable". Table 3 (Flood Risk Vulnerability and Flood Zone Compatibility) in the Planning Practice Guidance to NPPF, states that "Less Vulnerable" developments are appropriate to locate in Flood Zone 1.

3.3 Sequential Test

- 3.3.1 The Sequential Test aims to steer development to areas with the lowest probability of flooding. In accordance with the NPPF "Less Vulnerable" developments, indeed all developments, are suitable for location in Flood Zone 1; therefore, the sequential test is deemed to have been passed and the Exception Test is not required for the proposed development.

3.4 Surface Water Runoff

- 3.4.1 The development has the potential to increase the rate and volume of surface water runoff, and therefore the potential flood risk elsewhere. A Drainage Philosophy has been submitted with the planning application, which sets out the anticipated rainfall runoff rates, including allowances for the expected increases due to climate change. Options for attenuation of runoff rates are presented and quantified in the document. Favoured options include blue roofs and below-ground cellular storage. The Drainage Philosophy will be developed into a detailed drainage strategy in discussion with the London Borough of Camden.
- 3.4.2 A surface water drainage strategy developed in line with Drainage Philosophy would reduce the surface water runoff rate from the current situation, reducing the flood risk to downstream receptors.

4. SUMMARY

- i. The application site at 256 Grays Inn Road is 1.207ha in area, made up of a group of buildings comprising the former Royal Free Hospital (Plot 1), the grade II listed Eastman Dental Clinic (Plot 2) and the Levy Wing (Plot 3).
- ii. The first phase of the proposed development comprises the partial redevelopment of the former Royal Free Hospital (Plot 1) to deliver a new research centre IoN/DRI. Subsequent phases of the proposed development comprise the refurbishment of the grade II listed Eastman Dental Clinic (Plot 2) and the erection of a new building on the site of the Levy Wing (Plot 3) to deliver additional academic space for UCL. The proposed development would also deliver a comprehensive landscaping scheme to open up new publicly accessible spaces within the site, and new public connections across it. Only minor works are proposed to the existing student accommodation at Frances Gardner House, comprising the installation of photovoltaic panels on the roof, and alterations to the landscaping within the courtyard.
- iii. The EA's flood map data show the site to be located within Flood Zone 1, indicating the site has a less than 0.1% annual probability of river or sea flooding in any year. The Planning Practice Guidance to the NPPF states that commercial properties, such as this site, are classified as "Less Vulnerable" and that "Less Vulnerable" developments are appropriate to locate in Flood Zone 1;
- iv. The flood risk from surface water and drainage, groundwater, reservoirs, canals and other artificial sources is considered to be low;
- v. The development has the potential to increase the rate and volume of surface water runoff, and therefore the potential flood risk elsewhere. A Drainage Philosophy has been submitted with the planning application, which sets out the anticipated rainfall runoff rates, including allowances for the expected increases due to climate change. Options for attenuation of runoff rates are presented and quantified in the document. Favoured options include blue roofs and below-ground cellular storage.
- vi. The Drainage Philosophy will be developed into a detailed drainage strategy in discussion with the London Borough of Camden. A surface water drainage strategy developed in line with Drainage Philosophy would reduce the surface water runoff rate from the current situation, reducing the flood risk to downstream receptors.

FIGURES

- FIGURE 1 SITE LOCATION PLAN
- FIGURE 2 DIGITAL TERRAIN MODEL
- FIGURE 3 ENVIRONMENT AGENCY RISK OF FLOODING FROM RIVERS AND SEA
- FIGURE 4 ENVIRONMENT AGENCY RISK OF FLOODING FROM SURFACE WATER
- FIGURE 5 EXISTING SITE PLAN
- FIGURE 6 RIVER FLEET SUBTERRANEAN CHANNEL (SOURCE, BARTON, LOST RIVERS OF LONDON)

FIGURE 6 RIVER FLEET SUBTERRANEAN CHANNEL
(Source, Barton, Lost Rivers of London)

