



44 & 46 Hampstead Lane London N6 4LL

Desk Study
& Basement Impact
Assessment Report

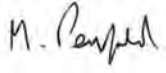
Harrison Varma

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EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a pre-planning geotechnical assessment conducted by Geotechnical and Environmental Associates (GEA) on the instructions of Harrison Varma. The purpose of the work has been to determine the history of the site, to assess the potential for contamination, and to review any possible impact of the proposed redevelopment on the local soil and groundwater regime. The proposed redevelopment of the site comprises demolition of the existing buildings and subsequent construction of a new apartment building of up to four storeys plus a lower ground and basement level. The basement will extend to a depth of around 7.0 m.

The report also includes information required to comply with the London Borough of Camden Planning Guidance, CPG Basements, with regard to the provision of a Basement Impact Assessment (BIA). Although the site lies outside the London Borough of Camden, the Camden procedure for assessing the effects of basements has been adopted as it is widely known and is considered to provide a robust approach to the issues of concern.

DESK STUDY FINDINGS

The site was developed with the existing houses at some time between 1915 and 1936, prior to which it comprised an area of scattered woodland, and has since undergone few significant changes to its layout.

On the basis of the desk study findings, the contamination risk has been assessed as very low.

GROUND CONDITIONS

Below a variable thickness of made ground, the Bagshot Formation was encountered overlying the Claygate Member, which was proved to the maximum depth of the investigation, of 8.0 m (106.3 m OD to 105.5 m OD).

The made ground extended to depths of between 0.50 m (110.5 m OD) and 2.0 m (111.5 m OD) and generally comprised dark brown, grey or greenish grey silty sandy clay with variable amounts of gravel, brick, concrete, ash and charcoal fragments. The Bagshot Formation generally comprised firm pale orange-brown mottled grey and orange-brown sandy to very sandy clay which extended to depths of between 1.5 m (109.4 m OD) and 4.9 m (109.4 m OD). The underlying Claygate Member initially comprised a mixture of medium dense pale orange-brown to greenish grey clayey sand and firm becoming stiff pale orange-brown mottled grey and orange-brown sandy to very sandy clay, which was proved to depths of 6.0 m (107.5 m OD) and 6.9 m (107.4 m OD). Below this, the Claygate Member comprised medium dense becoming dense pale orange-brown, brown or greenish grey clayey sand, which was encountered to the full depth of the investigation, of 8.0 m (106.3 m OD to 105.5 m OD).

GEA has previously completed a ground investigation on the adjoining site to the east, which found these upper layers of the Claygate Member to extend to depths of 11.20 m (103.05 m OD) and 10.90 m (103.48 m OD). Stiff grey silty clay with layers of clayey silt and clayey sand was then encountered to depths of between 20.70 m (93.55 m OD) and 19.55 m (94.83 m OD). Medium dense grey slightly clayey silt of the London Clay was then proved to the full depth of the investigation of 25.00 m (89.25 m OD).

Groundwater was encountered during drilling at depths of between 3.6 m (107.4 m OD) and 7.0 m (107.3 m OD) and has previously been measured at depths of between 4.32 m (107.83 m OD) and 6.60 m (107.65 m OD) in standpipes installed on the adjoining site of No 42 Hampstead Lane, immediately to the east.

BASEMENT IMPACT ASSESSMENT

A number of potential impacts have been identified as a result of the screening exercise, but all of these impacts can be mitigated by appropriate design and standard construction practice. The proposed development is unlikely to result in any specific groundwater or land stability issues and a requirement for a flood risk assessment has not been identified.

1.0 INTRODUCTION

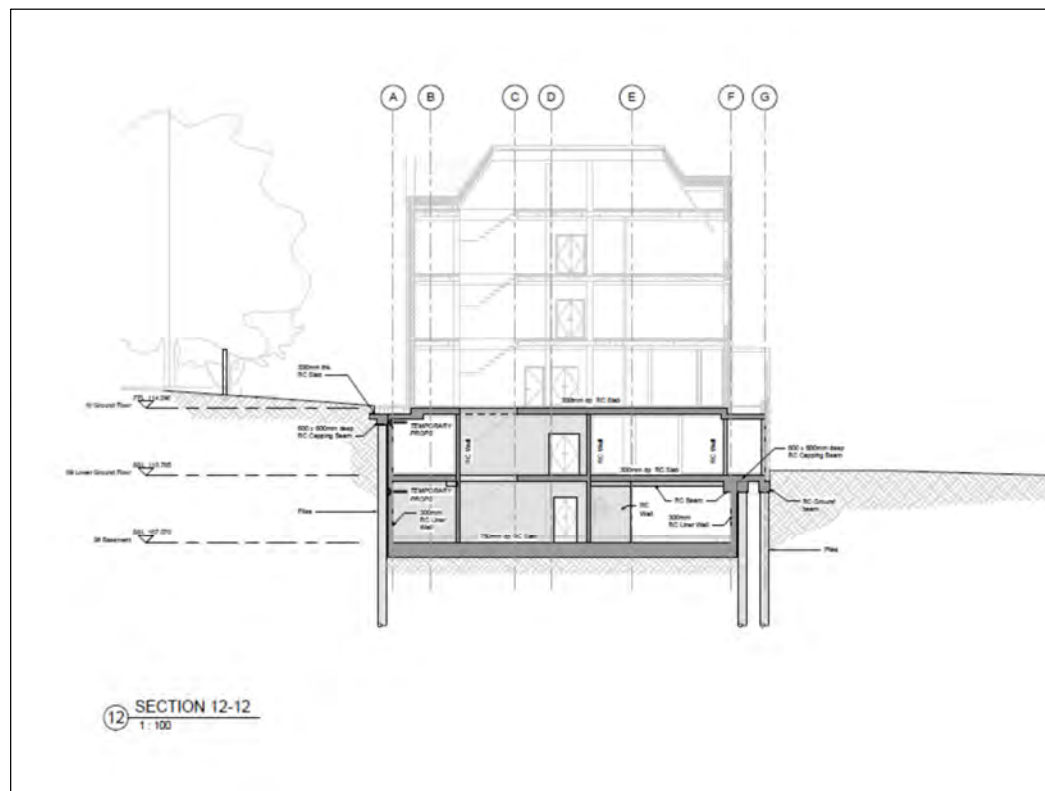
Geotechnical and Environmental Associates (GEA) has been commissioned by Harrison Varma to carry out a Desk Study and Basement Impact Assessment (BIA), for Nos 44 and 46 Hampstead Lane, London N6 4LL.

The site lies in the London Borough of Haringey while the boundary with Camden borough lies on the south side of Hampstead Lane. Although the site lies outside the London Borough of Camden, the Camden procedure for assessing the effects of basements has been adopted as it is now widely known and is considered to provide a robust approach to the issues of concern.

A pre-planning report (ref J21167, dated June 2021) has previously been prepared by GEA for the site and has been used to form the basis of this report. GEA has also previously undertaken an investigation for the adjoining property of No 42 Hampstead Lane, immediately to the east of the site (report ref J14154-Rep Issue 6, dated September 2019), and information from this investigation has been used to assist with the assessment of this site.

1.1 Proposed Development

Following demolition of the existing buildings it is proposed to construct a new apartment building of up to four storeys plus a lower ground and basement level. It is expected that the new lower ground floor and basement construction will be supported by a bored pile wall and will extend to a depth between 3.6 m and 7.2 m below existing ground level, as shown on the section below.



This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- ❑ to check the history of the site and surrounding area, particularly with respect to any previous or present potentially contaminative uses;
- ❑ to check records of data on groundwater, surface water and other publicly available environmental data;
- ❑ to provide an assessment of the risk of encountering unexploded ordnance (UXO) beneath the site;
- ❑ to provide an assessment of the impact of the proposed development on groundwater, surface water and land stability in support of a planning application;
- ❑ to provide an indication of the degree of soil contamination present; and
- ❑ to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- ❑ a review of readily available geological and hydrogeological maps;
- ❑ a review of publicly available environmental data sourced from the Envirocheck database;
- ❑ a review of historical Ordnance Survey (OS) maps supplied by Envirocheck;
- ❑ commissioning of a Preliminary UXO Risk Assessment by 1st Line Defence, a specialist in the field;
- ❑ a walkover survey of the site; and
- ❑ a review of records from previous nearby investigations conducted by GEA.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- ❑ two boreholes advanced to a depth of 8.00 m by means of an open-drive percussive sampler;
- ❑ two additional boreholes, advanced to refusal at depths of 3.4 m and 4.1 m within the existing rear gardens, using hand-held window sampling equipment;
- ❑ standard penetration tests (SPTs) carried out at regular intervals within the opendrive boreholes to provide quantitative data on the strength of the soils;

- ❑ installation of a groundwater monitoring standpipes to depths of between 6.5 m and 7.0 m in the opendrive boreholes and to a depth of 3.2 m within one of the window sampler boreholes;
- ❑ testing of selected soil samples for contamination purposes;
- ❑ a ground movement and building damage assessment; and
- ❑ provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

This report includes a contaminated land assessment which has been undertaken by a suitably qualified and competent professional in accordance with the methodology presented by the Environment Agency in their Land contamination risk assessment (LCRM) published 8 October 2020. This involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. Risk management is divided into three stages; Risk Assessment, Options Appraisal and Remediation, and each stage comprises three tiers. The Risk Assessment stage includes preliminary risk assessment (PRA), generic quantitative risk assessment (GQRA) and detailed quantitative risk assessment (DQRA); this report includes the PRA, with a GQRA to be added upon completion of the proposed laboratory analysis.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent, where applicable, and relevant published information.

1.3.1 Basement Impact Assessment (BIA)

The work carried out also includes information required for a Hydrological and Hydrogeological Assessment and Land Stability Assessment (also referred to as Slope Stability Assessment), which form part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance: Basements¹ and their Guidance for Subterranean Development² prepared by Arup. Although the site lies outside the London Borough of Camden, the Camden procedure for assessing the effects of basements has been adopted as it is now widely known and is considered to provide a robust approach to the issues of concern. The aim of this work is to provide information on the groundwater conditions specific to this site and land stability, in particular to assess whether the development will affect the stability of neighbouring properties and whether any identified impacts can be appropriately mitigated.

1.4 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the research carried out. The results of the research should be viewed in the context of the work that has been carried out and no liability can be accepted for matters outside the stated scope of the research. Any comments made on the basis of information obtained from third parties are given in good faith on the assumption that the information is accurate. No independent validation of third-party information has been made by GEA.

¹ London Borough of Camden Planning Guidance (2018) *Basements*

² Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

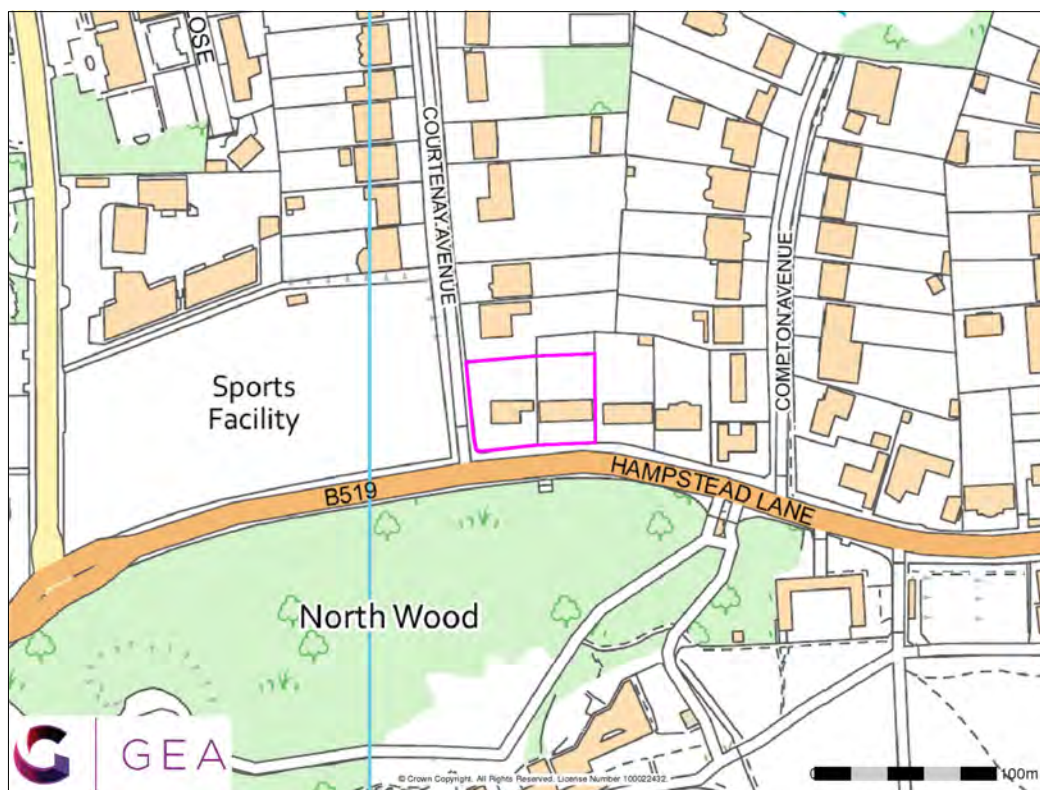
2.0 THE SITE

2.1 Site Description

The site is located in a residential area in the London Borough of Haringey, roughly 1.2 km southwest of Highgate London Underground Station. It is roughly rectangular in shape, measuring approximately 47 m north-south and 65 m east-west and fronts onto Hampstead Lane to the south. It is bordered by No 1 Courtenay Avenue to the north, Courtenay Avenue to the west and No 42 Hampstead Lane to the east. The site may be additionally located by the National Grid Reference 527095, 187640 and is shown on the map extract overleaf.

The site is currently occupied by No 46 Hampstead Lane in the west and No 44 in the east. Both properties include tarmac driveways to the front, with limited soft landscaping, with laburnum, magnolia and bay trees in the south of No 46, and two silver birch and a cypress tree hedge in the south of No 44. Within the rear gardens, tree species include sycamore, cypress, oak and plum, of which, four trees are to be removed from the central part of the site as part of the proposal. Mature London plane trees are present in the footpath on Hampstead Lane, adjacent to the site. Landscaped gardens with lawns and mature trees are present on the northern side of each house. A swimming pool is also located in the rear garden of No 44, along with a tarmac covered tennis court in the far northeast, although the tennis court does not fall within the proposed development footprint.

The topography of the site generally falls towards the north, from a level of 115 m OD at the southern boundary with Hampstead Lane, to 110 m OD at the northern boundary, over a horizontal distance of almost 50 m. The front driveways slope gently down to the houses which have a ground floor level of around 114 m OD and the change in slope at the rear is accommodated by a series of terraces at the rear of each house.



2.1.1 Nearby Basements

Planning permission has recently been granted (HGY/2019/2944) for the demolition of the adjoining property of No 42 Hampstead Lane, to the east of the site, and construction of a new three-storey house with a lower ground floor level and a single level basement beneath the entire footprint of the building, which is to include a swimming pool.

At the time of the investigation, this property was noted to be vacant with evidence that the interior and exterior had been partially stripped out, but that construction of the proposed basement was yet to start.

2.2 Site History

The site history has been researched by reference to historical Ordnance Survey (OS) maps sourced from the Envirocheck database.

The earliest map studied, dated 1864, shows the site to be undeveloped with scattered trees, located to the south of Bishop's Wood. Hampstead Lane bounded the site to the south and North Hill and North Wood were noted to the south of the site. Kenwood House is shown 150 m to the south of the site on the map dated 1870 and there were a number of glasshouses, associated with Kenwood, 180 m to the southeast.

The site was developed with the existing houses at some time between 1915 and 1936, along with Courtenay Avenue immediately to the west and Compton Avenue 100 m to the east. Other detached houses had also been developed in the area to the north of Hampstead Lane during this time and a sports ground had been developed on the western side of Courtenay Avenue. The map indicates that some cutting and filling had occurred on the sports ground site to create a level playing field. The 1952 map shows No 46 to be labelled as "The Garth" and No 44, as "Lydbrook".

At some time between 1953 and 1975 an electrical substation was constructed on the southern side of Hampstead Lane, opposite the site, in open fields. The land immediately to the north, at No 1 Courtenay Avenue was first developed with "Longwood" between 1991 and 1995. The site layout and surrounding area underwent very few changes throughout the 20th Century.

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and a summary of the results of this search is included in the Appendix. More detailed information relating to the search can be provided on request.

The desk study research has indicated that there are no registered landfills, historic landfills, registered waste transfer sites or waste management facilities within 1 km of the site. There are also no areas of potentially infilled land within 500 m.

No pollution incidents to controlled waters are recorded within 250 m of the site, and no local authority pollution prevention and controls are recorded within 1 km of the site. There are no contemporary trades listed within 250 m of the site.

The site is located in an area where less than 1% of homes are affected by radon emissions; therefore, no radon protective measures will be necessary.

The site is not located within a nitrate vulnerable zone. Hampstead Heath Woods, located roughly 15 m to the south are recorded as a Site of Special Scientific Interest, and Ken Wood, located 450 m to the south, is recorded as Ancient and Semi Natural Woodland.

2.4 Preliminary UXO Risk Assessment

A Preliminary UXO Risk Assessment has been completed by 1st Line Defence (report ref EP13625-00, dated June 2021), and the report is included in the appendix. The risk assessment has been carried out in accordance with the guidelines provided by CIRIA³, which state that the likelihood of encountering and detonating UXO below a site should be assessed along with establishing the consequences that may arise. The first phase comprises a preliminary risk assessment, which should be undertaken at an early stage of the development planning. If such an assessment identifies a high level of risk, then a detailed risk assessment should be carried out by a UXO specialist, which will identify an appropriate course of action with regard to risk mitigation.

The report indicates that, during World War II (WWII), the site was located within the Municipal Borough of Hornsey, which sustained an overall high density of bombing. However, the site does not appear to have been directly affected by bombing and is not labelled as suffering any damage on available damage mapping. As such, no significant risk of encountering unexploded ordnance has therefore been identified for the site and, in accordance with the recommendations of the report, no further action is recommended.

2.5 Geology

The British Geological Survey (BGS) map of the area indicates that the site is underlain by the dense fine sands of the Bagshot Formation, which overlie the sandy silty clays of the Claygate Member which is underlain by the London Clay Formation. The basal boundary of the Bagshot Formation correlates to an elevation on the 25k OS map at approximately 108 m OD in this area.

The previous investigation carried out by GEA on the adjoining site of No 42 Hampstead Lane, immediately to the east, encountered a moderate thickness of made ground over the Bagshot Formation, underlain by the Claygate Member which was in turn overlying the London Clay which extended to the maximum depth of the investigation, of 25.00 m. The made ground extended to depths of between 0.50 m and 0.90 m. The Bagshot Formation generally comprised firm becoming stiff orange-brown mottled brown and grey silty sandy silty clay and extended to depths of between 2.20 m (109.95 m OD) and 4.50 m (109.75 m OD). The Claygate Member initially comprised medium dense brown mottled orange-brown slightly clayey silty fine sand with occasional layers of sandy clay extending to depths of 11.20 m (103.05 m OD) and 10.90 m (103.48 m OD). Stiff grey silty clay with layers of clayey silt and clayey sand was then encountered and extended to depths of 20.70 m (93.55 m OD) and 19.55 m (94.83 m OD). The London Clay Formation generally comprised medium dense grey slightly clayey silt and extended to the full depth of the investigation, of 25.00 m (89.25 m OD).

A borehole drilled by the BGS on Hampstead Lane, generally referred to as the Hampstead Heath borehole, to a depth of 66.74 m (61.97 m OD), about 800 m to the southwest of the site at National Grid Reference 526455, 186890, found the Bagshot Formation to extend to a level of 109.71 m OD and penetrated the full thickness of the Claygate Member. This borehole found the Claygate Member to extend to a level of 93.71 m OD and in the lower 5 m to 10 m of the Claygate Member, it encountered yellowish brown silt interbedded with occasional sand and

3 CIRIA C681 (2009) *Unexploded ordnance (UXO) A guide for the construction industry*

clay with varying quantities of silt, sand and clay. A band of limestone was encountered between 97.06 m OD and 96.76 m OD. The London Clay comprised an initial layer of clayey slightly sandy silt with occasional layers of silty clay extending to a depth of 42.92 m (85.82 m OD) which is underlain by layers of fissured grey clay, silty clay and clayey silt and extended to the base of the borehole, at a depth of 66.74 m (61.97 m OD).

A deeper BGS borehole, located approximately 250 m to the west, indicates that the London Clay in the area is likely to extend to a depth of approximately 110 m to 115 m, below which the Lambeth Group, Thanet Sand and White Chalk are expected to be present.

2.6 Surface Water and Groundwater Conditions

The Bagshot Formation and the Claygate Member are classified as Secondary A Aquifers, which refers to 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, as defined by the Environment Agency (EA). The London Clay is classified as an Unproductive Stratum, which refers to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Groundwater is likely to be present within the Bagshot Beds and the Claygate Member, and other investigations carried out around the area of Hampstead Heath indicate that spring lines are present at the interface of the Bagshot Beds and the Claygate Member, and to a much lesser extent at a lower level at the boundary between the Claygate Member and the underlying essentially impermeable London Clay. These springs have been the source of a number of London's "lost" rivers, notably the Fleet, Westbourne and Tyburn, which all rose on Hampstead Heath, to the south of the current site, at the base of the Bagshot Beds.

The nearest surface water feature to the site is located 196 m to the northeast which appears to be a small headwater stream located within Highgate Golf Course which flows south-north for a short distance before flowing underground and re-emerging roughly 220 m north where it then flows to the northwest disappearing below ground level until it is assumed it joins with a pond and series of streams just north of Courtenay Avenue. The site is not within an area at risk from flooding as defined by the EA.

Historically⁴, a tributary to the Fleet, one of London's "lost" rivers, originated approximately 300 m to the south of the site, flowing through the Highgate Pond chain, and flowed in a south to south-easterly direction through Camden Town before issuing into the River Thames approximately 7.80 km to the south-southeast of the site, near Blackfriars Bridge. Additionally, the sources for a number of the other "Lost Rivers of London" were located within 500 m of the site, including the Tyburn and the Westbourne to the south and the Brent to the northwest, generally at the interface between the Bagshot Formation and the underlying Claygate Member. The Tyburn and the Westbourne then flowed in a generally southerly direction before issuing into the River Thames. Hampstead Lane roughly runs along the top of the ridge formed of Bagshot Beds which forms a watershed between these lost rivers, which flow generally southwards, and streams on the northern side of the ridge, where the site is located, which flowed in a generally northerly direction.

Groundwater within the permeable horizons of both the Bagshot Formation and the Claygate Member is likely to flow in a generally northerly direction, following topographic contours. Any groundwater flow within the underlying London Clay will be at a very slow rate, due to its negligible permeability. The permeability will be predominantly secondary, through fissures in

⁴ Nicholas Barton and Stephen Myers (2016) *London's Lost Rivers. Revised Edition*. Historical Publications Ltd

the clay. Published data indicates the horizontal permeability of the London Clay to generally range between 1×10^{-11} m/s and 1×10^{-9} m/s. Vertical permeability within the Claygate is also likely to be slow in view of the presence of layers of clay, but horizontal permeability is likely to be one or two orders of magnitude higher. The Bagshot Formation is likely to have a permeability of about 1×10^{-5} m/s to 1×10^{-6} m/s.

During the GEA site investigation at No 42, groundwater was initially encountered within the sand layers of the Claygate Member at depths of between 4.00 m (108.17 m OD) and 8.80 m (105.58 m OD), below which inflows of groundwater were regularly encountered to the full depth of the investigation, of 25.00 m (89.25 m OD). Groundwater was subsequently measured at depths of between 4.32 m (107.83 m OD) and 6.60 m (107.65 m OD) within the standpipes installed in a selection of the boreholes.

The site is largely covered by the existing building and hardstanding in the south and therefore infiltration of rainwater into the ground beneath the site is limited to the area of soft landscaping forming the rear and front gardens, and runoff would generally be downslope, towards the rear garden in the north.

2.7 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. As part of the new regime local authorities are required to carry out inspections of their area to identify sites that may be contaminated. The determination of contaminated sites is based on a “suitable for use” approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of establishing one or more “pollution linkages”; a pollution linkage requires a source of contamination, a sensitive target or receptor that is at risk from the contamination and a pathway by which the contamination can travel from the source to the target.

A risk assessment should be carried out for consideration by the Local Planning Authority (LPA) before the planning application is determined. Where unacceptable risks are identified proposals will need to be made to address these risks as part of the development process. The guidance recognises the benefits of a phased approach, and the desk study is the first phase in the process of investigating and identifying contamination to assist in the determination of a planning application.

2.7.1 Source

The desk study research has indicated that the site has only been occupied by the existing detached house throughout its developed history. On this basis the site is not deemed to have had a contaminative history. In addition, no contaminative historical uses have been identified in the surrounding area.

There are no historical or existing landfill sites within 1 km of the site and on this basis no potential sources of soil gas have been identified.

2.7.2 Receptor

Following the redevelopment, residential end users will represent high sensitivity receptors. Buried services are likely to come into contact with any contaminants present within the soils through which they pass, and site workers are likely to come into direct contact with any contaminants present in the soil and through inhalation of vapours during basement excavation

and construction. Being underlain by a secondary aquifer, groundwater is also a potential receptor.

The adjacent SSSI, Hampstead Heath, to the south and neighbouring houses would be sensitive nearby receptors.

2.7.3 Pathway

The Bagshot Beds could allow the migration of contaminated groundwater through the shallow soils to surrounding sites. Within the site, end users will be largely isolated from direct contact with any contaminants present within the made ground by the presence of the buildings and the extent of the hardstanding. However, in proposed areas of soft landscaping potential contaminant exposure pathways exist with respect to end users. Buried services may be exposed to any contaminants present within the soil through direct contact and site workers will come into contact with the soils during construction works. There is thus considered to be a low potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.7.4 Preliminary Risk Appraisal

In accordance with the guidelines provided by CIRIA⁵, the following table summarises possible pollution linkages for the site.

SOURCE	RECEPTOR	PATHWAY	PROBABILITY	CONSEQUENCE
Contamination within near surface soils resulting from past use of the site or adjacent sites	End users	Ingestion of contaminated soil or dust, through skin contact or inhalation	Unlikely	Medium
	Vegetation	Uptake via soil through roots	Unlikely	Mild
	Groundwater	Percolation and leaching of surface run-off	Unlikely	Medium
	Site workers	Ingestion of contaminated soil or dust, through skin contact or inhalation	Low likelihood	Mild
	Buried services	Direct contact	Low likelihood	Mild
	Adjacent sites	Surface water flow or drain runs dust	Unlikely	Medium

This method of risk evaluation involves classification of the magnitude of the potential consequence (severity) and probability (likelihood) of the risk. The method by which these factors are classified is detailed in the Appendix. On the basis of the consequence and probability the site can be attributed a level of risk, ranging from very low to very high and the procedure for making this assessment is shown in the Appendix, together with a description of each level of assessed risk and the actions that may be required to mitigate the risk.

On this basis of the above it is considered that there is a LOW RISK of there being a significant contaminant linkage at this site which would result in any requirement for any remediation work. It would be prudent to carry out chemical analyses on samples of the near surface soil to assess the presence of soil contamination before the excavation of the basement, for purpose of waste disposal classification.

⁵ Rudland, DJ, Lancefield, RM and Mayell, PN (2001) *Contaminated land risk assessment. A guide to good practice. CIRIA C552*

Furthermore, there is not considered to be a significant potential for hazardous soil gas to be present on or migrating towards the site: there should thus be no need to consider landfill gas exclusion systems.

3.0 BASEMENT SCREENING ASSESSMENT

The Camden guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full Basement Impact Assessment (BIA) is required. A number of screening tools are included in the Arup document and for the purposes of this report reference has been made to Appendices E1, E2 and E3 which include a series of questions within screening flowcharts for surface flow and flooding, subterranean (groundwater) flow and land stability.

The flowchart questions and responses to these questions are tabulated below.

3.1 Subterranean (Groundwater) Flow Screening Assessment

Reference has been made to Appendix E of the Arup document, which includes six questions within a subterranean (groundwater) flow screening flowchart. Responses to the questions are tabulated below.

Question	Response for 44 & 46 Hampstead Lane
1a. Is the site located directly above an aquifer?	<i>Yes the site is located above a Secondary 'A' Aquifer as designated by the EA.</i>
1b. Will the proposed basement extend beneath the water table surface?	<i>Possibly. The FFL of the basement is proposed to be at a level of 107.07 m OD, with formation level at 106.3 m OD and stairwells and lift shafts slightly deeper. Groundwater has been measured at a level of 107.8 m OD and 107.6 m OD on an adjacent site and is therefore expected to be close to the deepest part of the excavation.</i>
2. Is the site within 100 m of a watercourse, well (used/disused) or potential spring line?	No. The site is not located within 100 m of a known spring line.
3. Is the site within the catchment of the pond chains on Hampstead Heath?	No.
4. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	<i>Yes. The amount of hard surfaced areas is likely to increase as a result of the development.</i> However, there will be no surface expression of the basement development, which will be entirely beneath the proposed new building.
5. As part of the site drainage, will more surface water (e.g., rainfall and run-off) than at present be discharged to the ground (e.g., via soakaways and/or SUDS)?	<i>Possibly.</i> The Claygate Member is not usually considered suitable for the use of soakaways due to its variable nature, although particularly sandy soils were encountered on the adjacent site. The incorporation of soakaways would improve recharge of the ground, but testing should be carried out to see if this is viable. Or provision will need to be made for surface water drainage through the existing infrastructure.
6. Is the lowest point of the proposed excavation (allowing for any drainage and foundation space under the basement floor) close to or lower than, the mean water level in any local pond or spring line?	No. There are no local ponds or spring lines.

The above assessment has identified the following potential issues that need to be assessed:

- Q1a The site is located directly above an aquifer.
- Q1b The proposed basement may extend below the groundwater table.
- Q4 The proportion of hard-surfaced / paved areas is likely to increase.

3.2 Stability Screening Assessment

Reference has been made to Appendix E of the Arup document, which includes 14 questions within a slope stability screening flowchart. Responses to the questions are tabulated below.

Question	Response for 44 & 46 Hampstead Lane
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No. The overall existing slope angle has been estimated to be 6 degrees.
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No. Significant slope re-profiling is not understood to form part of the proposed works.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	Yes. Reference to Figure 16 in the Arup study indicates that the immediate area surrounding the site includes slope angles in excess of 10°. With lower slope angles extending to the north
5. Is the London Clay the shallowest stratum at the site?	No.
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	Yes. Although the majority of the existing trees on site are to be retained, it is understood that some small trees in the rear garden are to be felled.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	No.
8. Is the site within 100 m of a watercourse or potential spring line?	No.
9. Is the site within an area of previously worked ground?	No.
10. Is the site within an aquifer?	Yes. the site is located above a Secondary 'A' Aquifer as designated by the EA
11. Is the site within 50 m of Hampstead Heath ponds?	No.
12. Is the site within 5 m of a highway or pedestrian right of way?	Yes. The site fronts onto Hampstead Lane to the south and Courtenay Avenue to the west, although the proposed building line will be >5 m from the carriageway.
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	Yes. The development will increase the foundation depths relative to the neighbouring properties to a relatively significant extent.
14. Is the site over (or within the exclusion zone of) any tunnels, e.g., railway lines?	No. A search of publicly available maps has not indicated tunnels under the site.

The above assessment has identified the following potential issues that need to be assessed:

- Q4 The development is located within a wider hillside setting where the general slope angle is greater than 7°.
- Q6 The proposed works will locally extend into tree protection zones, and some small trees are to be felled.
- Q10 The site is underlain by a Secondary 'A' Aquifer.
- Q12 The site is within 5 m of a public highway.
- Q13 The proposed basement will significantly increase the differential depth of foundations to neighbouring properties.

3.3 Surface Flow and Flooding Screening Assessment

Reference has been made to Appendix E of the Arup document, which includes six questions within a surface flow and flooding screening flowchart. Responses to the questions are tabulated below.

Question	Response for 44 & 46 Hampstead Lane
1. Is the site within the catchment of the pond chains on Hampstead Heath?	No. Figure 14 of Arup report confirms that the site is not located within this catchment area.
2. As part of the proposed site drainage, will surface water flows (e.g., volume of rainfall and peak run-off) be materially changed from the existing route?	No. Any additional surface water from the increase hardstanding/roof area will be attenuated and discharged into the Thames Water sewers to ensure the surface water flow regime will be unchanged. The basement will be beneath the footprint of the new building, and the 1m distance between the roof of the basement and ground surface as recommended by section 3.2 of the CPG Basements 2018 does not apply across these areas.
3. Will the proposed basement development result in a change in the proportion of hard surfaced / paved areas?	Yes. <i>The proposals will have a larger footprint than existing; thus, the development will result in an increase in the extent of hard surfacing/roof areas.</i> However, there will be no surface expression of the basement development, which will be entirely beneath the proposed new building.
4. Will the proposed basement development result in changes to the profile of the inflows (instantaneous and long term) of surface water being received by adjacent properties or downstream watercourses?	No. Any additional surface water from the increase hardstanding/roof area will be attenuated and discharged into the Thames Water sewers to ensure the surface water flow regime will be unchanged. The basement will be beneath the footprint of the new building, and the 1m distance between the roof of the basement and ground surface as recommended by section 3.2 of the CPG Basements 2018 does not apply across these areas.
5. Will the proposed basement result in changes to the quality of surface water being received by adjacent properties or downstream watercourses?	No. The proposed basement is very unlikely to result in any changes to the quality of surface water being received by adjacent properties or downstream watercourses as the surface water drainage regime will be unchanged and the land uses will remain the same.
6. Is the site in an area identified to have surface water flood risk according to either the Local Flood Risk Management Strategy or the Strategic Flood Risk Assessment or is it at risk of flooding, for example because the proposed basement is below the static water level of nearby surface water feature?	No The findings of this BIA together with the Haringey SFRA and Environment Agency online flood maps show that the site has a very low flooding risk from surface water. There is a very low risk from sewers, and reservoirs (and other artificial sources), and fluvial/tidal watercourses. It is possible that the basement will be constructed within perched groundwater and the recommendations outlined in the BIA with regards to waterproofing and tanking of the basement will reduce the risk to acceptable levels. In accordance with paragraph 6.16 of the CPG a positive pumped device and non-return valve will be installed in the basement in order to further protect the site from sewer flooding.

The above assessment has identified the following potential issues that need to be assessed:

Q3 Proportion of hardstanding and paved areas will increase.

4.0 BASEMENT SCOPING and SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

4.1 Potential Impacts

The following potential impacts have been identified.

Screening Issue	Potential Impact
The site is located above an aquifer	The site is entirely underlain by the Bagshot Formation, over the Claygate Member, both of which are classified as Secondary 'A' Aquifers. They have the potential of being able to support local water supplies as well as forming an important source of base flow for local rivers. There is the potential for the hydrogeological setting to be affected by a basement development.
The proposed basement may extend below the water table.	It is possible the basement excavation could extend below the water table. Should this happen, the basement structure is capable of diverting groundwater flow such that groundwater level is affected on both the up slope and down slope side of the basement structure. This in turn has the potential to affect the local hydrogeology and any adjacent structures.
Increase in proportion of hard-standing and paved areas	The sealing of the ground surface to rainfall, by increasing the building area, would result in decreased recharge to the underlying ground
The development is located within a wider hillside setting where the general slope angle is greater than 7°.	Local instability within the site and adjoining sites may occur
Some trees will be removed as a result of the proposal	If foundations of nearby buildings are within the zone of influence of the removed trees some damage could result.
The proposed works may extend into tree protection zones	Excavation within a tree root protection zone may damage the tree resulting in loss of valued tree asset and changes to groundwater uptake and availability and ultimately damage to nearby buildings. However, the expected ground conditions should not be susceptible to shrink/swell
The proposed basement will significantly increase the differential depth of the foundations to neighbouring properties	The depth of the proposed excavation is significant and could pose a risk to adjacent structures from ground movements associated with the basement excavation.
The site is within 5 m of a public highway; it fronts onto Hampstead Lane to the south and Courtenay Avenue to the west	Excavation for a basement may result in damage to the road, pathway or any underground services buried in trenches beneath the road or pathway.

4.2 Exploratory Work

In order to meet the objectives described in Section 1.2, two boreholes were drilled using an opendrive sampling rig, to a depth of 8.0 m (106.3 m OD to 105.5 m OD). The boreholes were supplemented by two hand-held window sampler boreholes, extended to refusal at depths of 3.4 m (107.5 m OD) and 4.1 m (106.9 m OD) within the existing rear gardens.

During boring disturbed and undisturbed samples were obtained from the boreholes for subsequent laboratory examination and testing. Standard Penetration Tests (SPTs) were carried out at regular intervals to provide additional quantitative data on the strength of soils encountered.

Groundwater monitoring standpipes were installed within the opendrive boreholes to depths of 6.5 m (107.0 m OD) and 7.0 m (107.3 m OD), with an additional standpipe installed to a depth of 3.2 m (107.8 m OD) within one of the window sampler boreholes on the rear part of the site. Monitoring will be undertaken in due course, with the results included in an updated version of this report.

A selection of the samples recovered from the boreholes was submitted to an analytical laboratory for a programme of contamination testing. Geotechnical testing did not form part of the brief for this investigation.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole records are appended, together with a site plan indicating the exploratory positions. The Ordnance Datum levels shown on the borehole records have been interpolated from a 'Land Survey' drawing (ref: 27085A-1, dated November 2020).

4.2.1 Sampling Strategy

The boreholes were positioned on site by GEA, in accessible areas whilst avoiding areas of buried services.

Four samples of the made ground have been sent for chemical analyses; this work is currently in hand and an updated version of this report will be issued upon completion of this testing.

The analytical suite of testing was selected to identify hydrocarbon contamination resulting from the former use of the site and a range of typical industrial contaminants for the purposes of general coverage. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTs accreditation and test methods are included with the attached results and further details are available upon request.

The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. Details of the MCERTs accreditation and test methods are included in the Appendix together with the analytical results.

5.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, below a variable thickness of made ground, the Bagshot Formation was encountered over the Claygate Member, which extended to the maximum depth of the investigation, of 8.0 m (106.3 m OD to 105.5 m OD).

The precise location of the boundary between the lower part of the Bagshot Formation and the underlying Claygate Member is often difficult to define due to its gradational contact, and the close similarities in composition and geotechnical properties of each stratum. The boundaries have therefore been placed on the attached borehole records as described below, but part of what is described as Claygate Member may in fact comprise the Bagshot Formation, and vice versa.

5.1 Made Ground

The made ground extended to depths of between 0.50 m (110.5 m OD) and 2.0 m (111.5 m OD) and generally comprised dark brown, grey or greenish grey silty sandy clay with variable amounts of gravel, brick, concrete, ash and charcoal fragments.

Apart from the presence of fragments of extraneous material noted above, no visual or olfactory evidence of contamination was observed during the fieldwork. However, four samples of the made ground have been analysed for a range of contaminants as a precautionary measure; this work is currently in hand and an updated version of this report will be issued upon completion of this testing.

5.2 Bagshot Formation

The Bagshot Formation generally comprised firm pale orange-brown mottled grey and orange-brown sandy to very sandy clay which extended to depths of between 1.5 m (109.4 m OD) and 4.9 m (109.4 m OD).

5.3 Claygate Member

The Claygate Member initially comprised a mixture of medium dense pale orange-brown to greenish grey clayey sand and firm becoming stiff pale orange-brown mottled grey and orange-brown sandy to very sandy clay, which was proved to the base of the window sampler boreholes, at depths of 3.4 m (107.5 m OD) and 4.1 m (106.9 m OD), but was proved to depths of 6.0 m (107.5 m OD) and 6.9 m (107.4 m OD) in the opendrive sampler boreholes.

Below the initial layers, the Claygate Member comprised medium dense becoming dense pale orange-brown, brown or greenish grey clayey sand, which was proved to the full depth of the investigation, of 8.00 m (106.30 m OD to 105.50 m OD). This material was found on the adjacent site to extend to 11.20 m (103.05 m OD) and 10.90 m (103.48 m OD) and below which stiff grey silty clay with layers of clayey silt and clayey sand was encountered to a depth of between 20.70 m (93.55 m OD) and 19.55 m (94.83 m OD).

Medium dense grey slightly clayey silt of the London Clay was then proved to the full depth of the investigation of 25.00 m (89.25 m OD).

5.4 Groundwater

Groundwater was encountered during drilling at depths of between 3.6 m (107.4 m OD) and 7.0 m (107.3 m OD) and has previously been measured at depths of between 4.32 m (107.83 m OD) and 6.60 m (107.65 m OD) in standpipes installed on the adjoining site of No 42 Hampstead Lane, immediately to the east.

Three groundwater monitoring standpipes were installed to depths of between 3.2 m (107.8 m OD) and 7.0 m (107.3 m OD) and will be monitored in due course.

6.0 GROUND MOVEMENT ASSESSMENT

6.1 Construction Sequence

In order to assess the ground movements arising from the proposed development, the construction needs to be broken down into the key stages at which ground movements may be most onerous rather than merely considering the completed building in the long term.

It is currently understood that a contiguous bored pile wall will be installed to support the proposed lower ground floor and basement construction. The following sequence of operations has been derived to enable analysis of the ground movements around the basement, both during and after construction, and is based on information provided by the structural engineer.

Essentially the sequence may be considered as two groups of activities, the first comprising the short-term temporary works, whilst the second represents the construction of the permanent works.

The detail of the support provided to adjacent walls is beyond the scope of this report and the structural engineer will be best placed to agree the methodology with the chosen contractor(s) once appointed.

6.1.1 Temporary Support to Piled Wall

Following the installation of the bored pile wall and associated capping beams, temporary props will be installed, and the basement excavation will proceed.

The detail of section sizes and spacings will be finalised by the contractor but it is anticipated that the general philosophy adopted will be for diagonal braces to be used across the corners or returns of the basement walls whilst props will be positioned at regular intervals along the long walls of the basement.

Where horizontal restraint cannot be provided by other parts of the piled wall the prop forces can be provided by so-called 'flying shores' where the reaction to horizontal forces is provided by pile caps, gravity blocks or basement thickenings in the centre of the excavation.

It is anticipated that steel temporary props will be used with strut forces spread along the wall by steel waling beams fixed to the piles. Although the detail of the propping is to be finalised there is the option to use hydraulic 'active' props where the propping force is applied prior to excavation in order to minimise movement at critical locations.

6.1.2 Permanent Works

When the final excavation depths have been reached the permanent works will be formed which, from the information provided, are understood to comprise reinforced concrete walls with a drained cavity lining discharging to a sump pit.

Reinforced concrete will be used for the proposed basement floor slab.

It is anticipated that the floor slabs, which will act as permanent props, will be constructed lowest level first and when each floor has achieved adequate strength, the temporary props will be removed, and the subsequent walls and floors cast until the structure is complete.

6.2 Basis of Assessment

An assessment of ground movements within and surrounding the excavation has been undertaken using the X-Disp and P-Disp computer programs licensed from the OASYS suite of geotechnical modelling software from Arup. These programs are commonly used within the ground engineering industry and are considered to be appropriate tools for this analysis.

The X-Disp program has been used to predict ground movements likely to arise from the construction of the proposed basement. This includes the settlement of the ground (vertical movement) and the lateral movement of soil behind the proposed retaining walls (horizontal movement).

The analysis of potential ground movements within the excavation, as a result of unloading of the underlying soils, has been carried out using the Oasys P-Disp software package and is based on the assumption that the soils behave elastically, which provides a reasonable approximation of soil behaviour at small strains.

For the purpose of these analyses, the corners have been defined by x and y coordinates, with the x-direction parallel with the orientation of the boundaries with the orientation of Hampstead Lane (approx. east-west), whilst the y-direction is parallel with the orientation of Courtenay Avenue (approx. north-south). Vertical movement is in the z-direction.

For this movement analysis, the basement has been modelled as a polygon, approximately 54.0 m by 20.0 m in maximum extent, which will extend to a depth of about 7.0 m below the upper, or southern, part of the site.

In order to calculate ground movements as a result of pile installation, a minimum embedment of approximately two-thirds of the retained height has been adopted for the purpose of stability, giving a pile length of approximately 12.0 m for proposed bored piled wall.

It is understood that propping will be provided during the construction of the basement and in the permanent condition, such that the walls can be considered to be stiff for the purpose of the ground movement modelling.

Samples of the output movement contour plots are included within the appendix and the full outputs of all the analyses can be provided on request.

6.3 Ground Movements Surrounding the Basement

6.3.1 Model Used

For the X-Disp analysis, the soil movement relationships used for the embedded retaining walls are the default values within CIRIA report C760⁶, which were derived from a number of historic case studies.

6 Gaba, A, Hardy, S, Powrie, W, Doughty, L and Selemetas, D (2017) *Embedded retaining walls – guidance for economic design*
CIRIA Report C760

Installation of piled retaining walls:

Table 6.1 of CIRIA C760 gives the normalised horizontal movement for a contiguous wall of 0.04% of the installed pile length. However, there is some doubt as to the applicability of these movement curves to a relatively small project where smaller diameter piles are proposed. In this respect, recent papers by Ball & Langdon *et al*^{7,8}, consider a number of contiguous bored pile walls in central London, which represent, in scale and currency of data, a closer representation to this site, and where measured wall installation movements normalised to between 0.006 % and 0.012 % of pile length. The papers then suggest that, subject to careful control of installation, a normalised relationship of 0.02 %, i.e., half of the C760 movements, could be appropriate for a contiguous wall within a range of ground conditions, whilst remaining relatively conservative.

Based on the fact that piles installed into clay soils typically exhibit smaller movements than those on which the above paper is based, and that the proposed wall is constructed in a hit and miss sequence and similar controls on pile installation are maintained, it follows that there is no reason why a similar relationship cannot be adopted for this site.

An amended ground movement curve for the ‘installation of a contiguous pile wall in stiff clay’, with a normalised relationship of 0.02% has therefore been adopted to represent the effects of the installation of the piled walls that will form the proposed basement structure.

Excavation Phase:

The ground movement curves for ‘excavations in front of a stiff wall in stiff clay’ have been adopted for the subsequent excavation phase.

6.3.2 Results

The movements predicted by X-Disp are summarised in the table below; the results are presented below and in subsequent tables to the degree of accuracy required to allow predicted variations in ground movements around the structure to be illustrated, but may not reflect the anticipated accuracy of the predictions.

Phase of Works	Maximum Movements due to Wall Deflection (mm)	
	Vertical Settlement	Horizontal Movement
Contiguous bored pile wall installation	< 3	< 3
Combined movements from installation and subsequent excavation behind contiguous bored pile wall	6 to 7	12 to 13

The analysis has indicated that the maximum vertical and horizontal settlements that will result from the piled retaining wall installation are less than 3 mm, while the movements arising from the combined wall installation and excavation phases are likely to range between 6 mm to 7 mm of vertical settlement and 12 mm to 13 mm of horizontal movement.

The estimated movements are considered to represent a worst-case scenario, particularly as the movements resulting from basement excavation will be minimised due to control of the propping in the temporary works and a regime of monitoring.

- 7 Ball, R, Langdon, N, and Creighton, M (2014) *Prediction of party wall movements using CIRIA report C580*. Ground Engineering Sep 2014, pp 25-29
- 8 Langdon, N, Ball, R, and Giles, D (2021) *Ground movement prediction for a piled basement: A case study from Garlickhythe, City of London, UK*. Ground Engineering July 2021 pp 26-33

6.4 Movements within the Excavation (Heave / Settlement)

6.4.1 Model Used

The analysis of potential ground movements, as a result of unloading of the underlying soils and the loads applied through the underpinning, has been carried out using the Oasys P-Disp software package and is based on the assumption that the soils behave elastically, which provides a reasonable approximation to soil behaviour at small strains.

At this site unloading of the underlying soils will take place as a result of the basement excavation and the reduction in vertical stress will cause heave to take place. Undrained soil parameters have been used to estimate the potential short-term movements, which include the “immediate” or elastic movements because of the basement excavation. Drained parameters have been used to provide an estimate of the total movement, from which the post-construction or long-term movements can be calculated.

The elastic analysis requires values of soil stiffness at various levels to calculate displacements. Values of stiffness for the soils at this site are readily available from published data⁹ and a well-established method has been used to provide estimated values. This relates values of E_u and E' , the undrained and drained stiffness respectively, to values of undrained cohesion, indicating stiffness values of $600 \times C_u$ for the Bagshot Beds / Claygate Member and $750 C_u$ for the underlying London Clay, with a ratio of E' to E_u of 0.75. A relationship of $2000 \times \text{SPT 'N'}$ has been used to obtain values of Young's modulus for any granular soils.

The excavation of up to 7.0 m of soil to form the proposed basement will result in a net unloading of around 130 kN/m^2 .

The soil parameters used in this analysis are tabulated below, which have been estimated from the findings of the investigation of the site, the previous investigations on the adjoining and nearby sites, and assumed parameters interpreted from archive boreholes on the BGS database. Depths are given relative to ground level (approx. 114 m OD) on the upper, southern, part of the site.

Stratum	Depth Range (m)	Undrained Cohesion (kPa)	E_u (kPa)	E' (kPa)
Made Ground	GL to 1.0 (varies)	-	10,000	10,000
Bagshot Beds	1.0 to 5.0	50 to 70	30,000 to 42,000	22,500 to 31,500
Claygate Member (upper sandy layers)	5.0 to 11.0	-	-	40,000
Claygate Member (clay)	11.0 to 20.0	75 to 125	45,000 to 75,000	33,750 to 56,250
London Clay	20.0 to 50.0	125 to 350	93,750 to 262,500	70,313 to 196,875

On the basis of nearby BGS records, a rigid boundary for the analysis has been set within the London Clay at a depth of about 50 m below existing ground level, at which depth the soils are considered as being essentially incompressible, whilst an increase in cohesion of 7.5 kN/m^2 for each metre of depth has been adopted to provide a conservative estimate of the likely strength profile within the London Clay.

⁹ Burland JB, Standing, JR, and Jardine, FM (2001) *Building response to tunnelling, case studies from construction of the Jubilee Line Extension* CIRIA Special Publication 200

6.4.2 Results

An assessment of ground movements within the basement excavation has been undertaken by GEA using the P-Disp computer program licensed from the OASYS suite of programmes from Arup.

The predicted movements are summarised in the table below.

Location	Movement (mm)*		
	Short-term Heave / Settlement (excavation Phase)	Long-term Heave / Settlement (post construction)	Total Heave / Settlement
Centre of excavations	-26 to -28	-18	-44 to -46
Edge of excavations	-12 to -14	-8	-20 to -22

*A positive number denotes settlement, whilst a negative number denotes heave.

The P-Disp analysis indicates that, by the time the basement construction is complete, up to 28 mm to 28 mm of heave is likely to have taken place at the centre of the proposed excavation, reducing to around 12 mm to 14 mm at the edge of the excavations.

In the long term, following completion of the basement construction, a further 18 mm of heave is estimated as a result of long-term swelling of the underlying clay soils.

It is important to bear in mind that the results of the P-Disp analysis, which is based on an unrestrained excavation, do not take account of the mitigating effect of the existing structures, the stiffness of the proposed floor slabs and the contiguous pile walls, which in reality will combine to restrict potential heave movements within the basement excavation. The movements predicted by the model at or just beyond the site boundaries are unlikely to be fully realised and should not therefore have a detrimental impact upon any nearby structures.

In order to mitigate the effects of heave on the new building, the basement could be designed to transmit heave forces into the wall piles or onto tension piles within the basement. If a compressible material is used beneath the slab, it will need to be designed to be able to resist the potential uplift forces generated by the ground movements. In this respect, potential heave pressures are typically taken to equate to around 50 % of the total unloading pressure, assuming a linear relationship between heave movement and the pressure applied to the underside of the slab, which in this case is taken to be inflexible. However, if there is some flexibility in the slab, this value would reduce as the slab deflects and it would be reasonable to assume that the heave pressure would reduce to around 35 % of the unloading pressure.

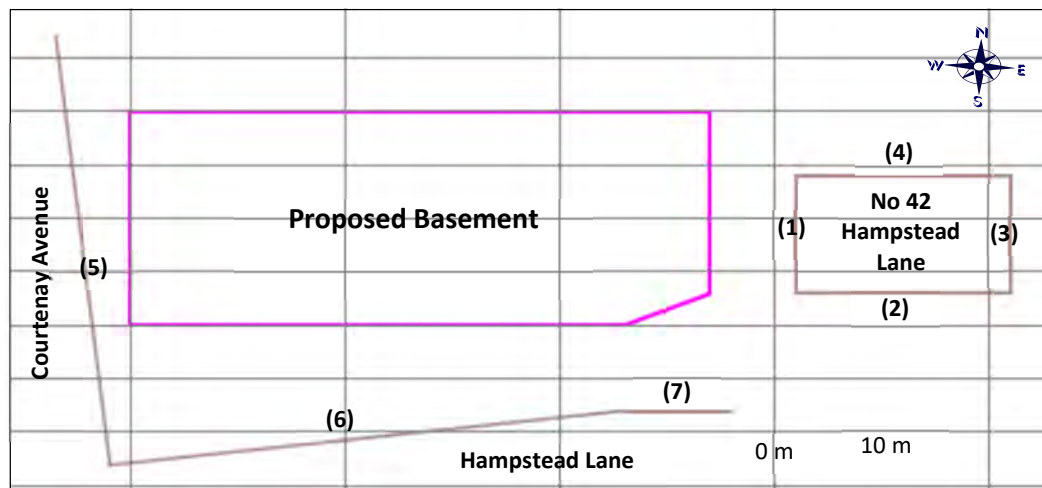
6.5 Building Damage Assessment

In addition to the assessment of the likely movements that will result from the proposed development, some of the neighbouring structures have been set as sensitive structures, requiring Building Damage Assessments, on the basis of the classification given in Table 6.4 of C760, as follows.

- No 42 Hampstead Lane, located to the east of the site, which at present is yet to be redeveloped and does not therefore have an existing basement;
- The boundary with Courtenay Avenue, located to the west of the site; and
- The boundary with Hampstead Lane, located to the south of the site.

All other nearby structures have been found to be at sufficient distance as not to be affected by the proposed development and have not therefore been included within the analysis.

The location of each of the buildings or sensitive structures is detailed on the plan below.



The sensitive structures outlined above have been modelled as lines in the analysis and are the lines along which the damage assessment has been undertaken. These lines are expected to be sensitive at their foundation level, which for the adjoining property to the east, have been conservatively assumed to be at a depth of 1.0 m below existing ground floor level on the basis of the findings of the previous investigation and the fact that this property is yet to be developed.

The heights of neighbouring buildings have been estimated from information provided by the consulting engineers and obtained from a search of planning records.

6.5.1 Damage to Neighbouring Structures

The combined movements resulting from piling and excavation of the proposed basement, calculated using the X-Disp modelling software, have been used to carry out an assessment of the likely damage to adjacent properties and the results are summarised in the table below.

Sensitive Structure	Structure References	Max Tensile Strain %	Category of Damage*
No 42 Hampstead Lane	1	<0.01	Category 0: Negligible
	2	0.04	Category 0: Negligible
	3	Less than the limit of sensitivity	
	4	0.05	Category 1: Very Slight
Boundary with Courtenay Avenue	5	0.02	Category 0: Negligible
Boundary with Hampstead Lane	6	0.02	Category 0: Negligible
	7	0.02	Category 0: Negligible

*From Table 6.4 of C760: Classification of visible damage to walls.

The building damage reports for sensitive structures highlighted in the above table predict that the damage to the adjoining and nearby structures would generally be Category 0 (Negligible), with a limited area of Category 1 (Very Slight) damage to the existing rear elevation of No 42 Hampstead Lane.

The results discussed above are based on individual building lines, or walls, that have been further divided up into a series of 1.0 m segments that can move independently of one another. In reality, this is unlikely to be the case as the walls will behave as single stiff elements that are also joined continuously with the rest of the structure. The results therefore provide a conservative estimate of the behaviour of each of the sensitive structures and overestimate the degree of damage, although they provide a useful indication of the most critical structures within the adjoining properties.

6.5.2 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis should be checked by monitoring of adjacent properties and structures. Condition surveys of the above existing structures should be carried out before and after the proposed works.

The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

6.6 Ground Movement Assessment Conclusions

The analysis has concluded that the predicted damage to the neighbouring properties from the construction of the basement retaining walls and excavation would be generally 'Negligible' to 'Very Slight'.

On this basis, the damage that has been predicted to occur as a result of the construction the proposed basement falls within the acceptable limits; although careful construction and monitoring will be required to ensure that no excessive movements occur that would lead to damage in excess of these limits.

The separate phases of work, including pile installation and excavation of the proposed basement, will in practice be separated by a number of weeks, during which time construction of permanent supports, basement slab and retaining wall curing will take place. This will provide an opportunity for the ground movements during and immediately after retaining wall construction to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted wall movements to be reassessed prior to the main excavation taking place so that propping arrangements can be adjusted if required.

7.0 BASEMENT IMPACT ASSESSMENT

The groundwater flow screening identified three potential impacts, the slope stability screening identified six potential impacts and the surface flow and flooding screening identified a single potential impact.

Knowledge of the site conditions and proposed development has been used below to review the potential impacts identified by the screening, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

7.1 Subterranean (Groundwater) Flow Risk Assessment

The three potential impacts identified are discussed below.

The site is located above a Secondary 'A' Aquifer as designated by the EA. and the proposed basement will extend beneath the water table

The site is underlain by the dense fine silty sand of the Bagshot Formation and Claygate Member strata, which are designated as Secondary Aquifer. The proposed basement formation level will be approximately 107 m OD, with groundwater encountered at a level of about 107.5 m OD, such that lowest parts of the proposed basement excavation will extend below the observed water table.

The granular soils of the upper Claygate Member are expected to extend to a depth of around 11.0 m (approx. 103 m OD) below the proposed basement structure. Additionally, a distance of approximately 4 m of open ground is present between the proposed new building and the adjacent house to the east, with no other immediate foundations to the south, west or north. Therefore, groundwater would be able to continue to flow around and below the proposed basement structure, through the granular horizons in the Claygate Member, maintaining the general groundwater flow regime across the site and to down gradient water features.

The proposed development is likely to result in an increased area of hardstanding

The proposed development is likely to result in an increase in the amount of hard-standing and paved areas, but this will have little effect as the near surface deposits typically comprise low permeability clay and are unlikely to be able to accept any significant recharge in any case.

7.2 Land Stability Risk Assessment

The potential stability impacts identified are discussed below:

The site is located within a wider hillside setting where the general slope angle is locally greater than 7°

The basement is to extend to a depth of about 7 m and is to be excavated from a level area. As the land is already sensibly level, it is considered unlikely that any engineering measures will be required other to ensure that the stability of the slope is maintained.

The proposed basement will significantly increase the differential depth of foundations relative to neighbouring properties

As development of the adjoining site to the east is yet to commence, the proposed basement will extend to a significant depth relative to the existing foundations of the present structure and will need to be designed to ensure the stability of the site and any potentially sensitive structures that

are in close proximity to the site. These solutions could include, preventing excavation within a zone that would lead to instability or constructing retaining walls using methods designed to minimise movements.

The investigation has not highlighted any issues that give rise to concerns regarding the effectiveness of these normal engineering solutions at this particular site and the results of the Ground Movement Analysis and building damage assessment have indicated that the movements arising on adjacent structures, as a result of the development, can be maintained within tolerable limits by careful control of movements.

Some trees will be felled as part of the proposals and the excavation may encroach on root protection zones

Two cypress trees, a small oak and a plum tree, all located towards the centre of the site, will be felled as part of the development and work is also likely to be carried out within the root protection zone of trees on the eastern and western boundaries. The trees on Hampstead Lane will be unaffected.

The basement will be advanced to a depth of about 7 m and as a result the removal of the tree roots and trees in the middle of the site, and any associated swelling of the clay will have very little effect on the development, or the neighbours.

The area of the building is located on a flat portion of the site and therefore the removal of tree root systems should not affect the stability of the ground on the site.

Location of public highway

The basement excavation will generally be in excess of 5.0 m from the pathways and highways to the west and south of the site, with the exception of the south-wester corner of the proposed basement, which will be within 5.0 m of the existing boundary with Courtenay Avenue. However, the proposed development will include retaining walls that will be designed to maintain the stability of the surrounding ground, thus protecting the adjacent road and associated infrastructure beyond.

In addition, there is nothing unusual or exceptional in the proposed development or the findings of the investigation that give rise to any concerns with regard to stability over and above any development of this nature.

7.3 Surface Flow and Flooding Risk Assessment

The proposed development is likely to result in an increased area of hardstanding

The proposed development has a larger footprint than the existing building, although additional changes to the external landscaping, including the removal of an outdoor pool in the northeast, will offset a proportion of the increased building area.

The existing pattern of run-off will remain the same to adjacent sites as the new structure is orientated the same as the existing. However, the control of surface water flows across the site should be considered as part of the proposed drainage strategy and it would be prudent for any external paving to be constructed using permeable paving to allow for continued infiltration of surface water into the sub-soil within these areas.

8.0 CONCLUSIONS

Consideration is being given to the proposed redevelopment of the site through the demolition of the existing houses and the subsequent construction of a new apartment building of four storeys plus a lower ground floor level and basement, extending to a depth of around 7 m. Formation level for the proposed basement is likely to be close to the Bagshot Formation / Claygate Member boundary.

8.1 Construction Considerations

It is understood that it is proposed to construct the basement using contiguous bored piles, combined with reinforced concrete lining walls, and a ground bearing floor slab. Whilst contiguous bored piles are likely to prove suitable, consideration may need to be given to the use of a secant bored pile wall, if significant groundwater inflows are encountered. If secant piles are to be included in the design, it is recommended that the BIA is reviewed to assess the impact on hydrogeology.

8.2 Contamination Risk Assessment

On this basis of the desk study research, it is considered that there is a LOW RISK of there being a significant contaminant linkage at this site that could result in any requirement for any remediation work.

8.3 Basement Impact Assessment

A Basement Impact Assessment has been carried out following the information and guidance published by the London Borough of Camden. A number of potential impacts were identified as a result of the screening exercise. It has been concluded that all potential impacts can be mitigated by appropriate design and standard construction practice.

Formation level for the proposed basement is likely to be close to the Bagshot Formation-Claygate Member boundary and the excavation may extend below the water table, although this will need to be confirmed through a continued groundwater monitoring.

Standard safe working practices and measures that will be adopted to construct the basement mean that the proposed development is unlikely to result in any specific groundwater or land or slope stability issues.

The surface water and flooding screening has not identified the requirement for a flood risk assessment to be undertaken.

9.0 OUTSTANDING RISKS AND ISSUES

This section of the report aims to highlight areas where further work is required as a result of limitations on the scope of this investigation, or where issues have been identified by this investigation that warrant further consideration. The scope of risks and issues discussed in this section is by no means exhaustive but covers the main areas where additional work may be required.

The ground is a heterogeneous natural material and variations will inevitably arise between the locations at which it is investigated. This report provides an assessment of the ground conditions based on the discrete points at which the ground was sampled, but the ground conditions should be subject to review as the work proceeds to ensure that any variations from the Ground Model are properly assessed by a suitably qualified person.

As discussed throughout the report, groundwater is likely to be encountered towards the base of the proposed basement excavations, although groundwater monitoring should be continued, and trial excavations should be considered to assess the extent of any perched groundwater inflows within the proposed basement excavations.

The investigation did not encounter any visual or olfactory signs of contamination. However, a number of samples have been submitted for contamination testing as a precautionary measure; this work is currently in hand and an updated version of this report will be issued upon completion of this testing.

These areas of doubt should be drawn to the attention of prospective contractors and further investigation will be required or sufficient contingency should be provided to cover the outstanding risk.

APPENDIX

Envirocheck Report and Extracts

Historical Maps

Preliminary UXO Report

Risk Assessment Description

Risk Assessment Classification

Proposed Development Plans

Site Plan

Borehole Records

X-DISP ANALYSIS

Movement Plots – Wall Installation

Movement Plots – Wall Installation and Excavation

P-DISP ANALYSIS

Short Term Movement Contour Plots

Total Movement Contour Plots

DAMAGE CATEGORY OUTPUTS

Tabular Output

Envirocheck[®] Report:

Datasheet

Order Details:

Order Number:

280107221_1_1

Customer Reference:

J21167

National Grid Reference:

527090, 187640

Slice:

A

Site Area (Ha):

0.34

Search Buffer (m):

1000

Site Details:

44 - 46 Hampstead Lane

LONDON

N6 4LL

Client Details:

Mr S Branch

GEA Ltd

Widbury Barn

Widbury Hill

Ware

Herts

SG12 7QE



Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	22
Hazardous Substances	-
Geological	23
Industrial Land Use	28
Sensitive Land Use	32
Data Currency	33
Data Suppliers	40
Useful Contacts	41

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client. In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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Report Version v53.0

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes		Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1				1
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls					
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 1		Yes		
Pollution Incidents to Controlled Waters	pg 1			2	7
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality					
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register	pg 3				1
Water Abstractions					
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 3	Yes	n/a	n/a	n/a
Groundwater Vulnerability - Soluble Rock Risk			n/a	n/a	n/a
Groundwater Vulnerability - Local Information			n/a	n/a	n/a
Bedrock Aquifer Designations	pg 3	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 3		3	33	127

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites					
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)					
Local Authority Landfill Coverage		1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)					
Potentially Infilled Land (Water)	pg 22				2
Registered Landfill Sites					
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 23	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry					
BGS Recorded Mineral Sites					
BGS Urban Soil Chemistry	pg 23		Yes	Yes	Yes
BGS Urban Soil Chemistry Averages	pg 26	Yes			
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas			n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 26	Yes		n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 26	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 26	Yes	Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 27		Yes	n/a	n/a
Radon Potential - Radon Affected Areas			n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 28			2	5
Fuel Station Entries					
Points of Interest - Commercial Services	pg 28			1	
Points of Interest - Education and Health	pg 28				4
Points of Interest - Manufacturing and Production	pg 29			3	5
Points of Interest - Public Infrastructure	pg 29			10	5
Points of Interest - Recreational and Environmental					
Gas Pipelines					
Underground Electrical Cables	pg 30				8

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland	pg 32			1	2
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest	pg 32		1		
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A13NE (N)	0	1	527090 187644
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A8NE (S)	368	1	527100 187250
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A8NE (SE)	411	1	527300 187250
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A14SW (SE)	413	1	527500 187450
1	Discharge Consents Operator: Thames Water Utilities Ltd Property Type: WTW/WATER COLLECTION/TREATMENT/SUPPLY Location: Bishops Wood Authority: Environment Agency, Thames Region Catchment Area: Not Supplied Reference: Temp.0030 Permit Version: 1 Effective Date: 15th September 1989 Issued Date: 15th September 1989 Revocation Date: 5th October 2000 Discharge Type: Trade Effluent Discharge: Freshwater Stream/River Environment: Receiving Water: River Thames Status: Authorisation revoked Positional Accuracy: Located by supplier to within 100m	A18SE (N)	655	2	527300 188300
	Nearest Surface Water Feature	A13NE (NE)	231	-	527260 187856
2	Pollution Incidents to Controlled Waters Property Type: Not Given Location: 7 White Lodge Close Authority: Environment Agency, Thames Region Pollutant: Unknown Sewage Note: Confirmed As A Pollution Incident Incident Date: 1st September 1989 Incident Reference: N1890461 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A18SW (N)	340	2	527000 188000
3	Pollution Incidents to Controlled Waters Property Type: Not Given Location: White Lodge Close Authority: Environment Agency, Thames Region Pollutant: Oils - Unknown Note: Confirmed As A Pollution Incident Incident Date: 16th January 1990 Incident Reference: N1900017 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A18SW (N)	439	2	527000 188100
4	Pollution Incidents to Controlled Waters Property Type: Not Given Location: HAMPSTEAD Authority: Environment Agency, Thames Region Pollutant: Oils - Unknown Note: Confirmed As A Pollution Incident Incident Date: 10th August 1990 Incident Reference: N1900464 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A18SE (N)	631	2	527100 188300

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
5	Pollution Incidents to Controlled Waters Property Type: Not Given Location: White Lodge Close, HIGHGATE Authority: Environment Agency, Thames Region Pollutant: Unknown Sewage Note: Not Supplied Incident Date: 16th May 1996 Incident Reference: N1960262 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A18SW (N)	638	2	527000 188300
6	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Regents Canal, Camden Authority: Environment Agency, Thames Region Pollutant: Unknown Sewage Note: Not Supplied Incident Date: 20th February 1997 Incident Reference: THN11997031084 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A8NE (S)	646	2	527300 187000
7	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Turners Wood, HAMPSTEAD Authority: Environment Agency, Thames Region Pollutant: Storm Sewage Note: Not Supplied Incident Date: 12th November 1997 Incident Reference: THN11997030884 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A12SW (W)	694	2	526400 187400
8	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Highgate View Road Authority: Environment Agency, Thames Region Pollutant: Oils - Unknown Note: Confirmed As A Pollution Incident Incident Date: 19th May 1992 Incident Reference: N1920289 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A19SE (NE)	753	2	527800 188000
9	Pollution Incidents to Controlled Waters Property Type: Not Given Location: Turners Wood, HAMPSTEAD Authority: Environment Agency, Thames Region Pollutant: Storm Sewage Note: Confirmed incident Incident Date: 17th May 1999 Incident Reference: THNE1999043091 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 10m	A12SW (W)	757	2	526300 187600
10	Pollution Incidents to Controlled Waters Property Type: Not Given Location: FINCHLEY Authority: Environment Agency, Thames Region Pollutant: Oils - Unknown Note: Confirmed As A Pollution Incident Incident Date: 28th October 1993 Incident Reference: NE930729 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 2 - Significant Incident Positional Accuracy: Located by supplier to within 100m	A9NE (SE)	758	2	527800 187280

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
11	Substantiated Pollution Incident Register Authority: Environment Agency - Thames Region, North East Area Incident Date: 17th September 2020 Incident Reference: 1849089 Water Impact: Category 2 - Significant Incident Air Impact: Category 4 - No Impact Land Impact: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 10m Pollutant: Crude Sewage	A9NW (SE)	751	2	527580 187025
	Groundwater Vulnerability Map Combined Classification: Secondary Bedrock Aquifer - High Vulnerability Combined Vulnerability: High Combined Aquifer: Productive Bedrock Aquifer, No Superficial Aquifer Pollutant Speed: Intermediate Bedrock Flow: Mixed Dilution: 300-550 mm/year Baseflow Index: >70% Superficial Patchiness: <90% Superficial Thickness: <3m Superficial Recharge: No Data	A13NE (N)	0	3	527090 187644
	Groundwater Vulnerability - Soluble Rock Risk None				
	Bedrock Aquifer Designations Aquifer Designation: Secondary Aquifer - A	A13NE (N)	0	3	527090 187644
	Superficial Aquifer Designations No Data Available				
	Extreme Flooding from Rivers or Sea without Defences None				
	Flooding from Rivers or Sea without Defences None				
	Areas Benefiting from Flood Defences None				
	Flood Water Storage Areas None				
	Flood Defences None				
12	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 10.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	231	4	527260 187856
13	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 12.3 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	232	4	527249 187864
14	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 26.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	235	4	527244 187870

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
15	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 41.8 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	254	4	527238 187896
16	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 22.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	287	4	527227 187936
17	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 2.0 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	305	4	527222 187958
18	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 52.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A13NE (NE)	307	4	527222 187960
19	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 175.3 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (N)	317	4	527179 187981
20	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 40.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	359	4	527259 187288
21	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 152.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	359	4	527270 187294
22	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 54.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A14SW (E)	368	4	527470 187497
23	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 63.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	381	4	527030 188045

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
24	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 18.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	396	4	527290 187262
25	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 33.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	414	4	527301 187247
26	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 68.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (NE)	424	4	527377 188010
27	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 15.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	429	4	527034 188094
28	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 10.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	429	4	527045 188094
29	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 42.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A14SW (E)	429	4	527536 187506
30	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 13.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A14SW (E)	438	4	527536 187474
31	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 49.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NW (S)	445	4	526955 187184
32	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 1.5 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	445	4	527032 188109

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
33	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 51.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	446	4	527032 188110
34	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 132.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (S)	451	4	527130 187170
35	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 87.8 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NW (S)	458	4	526999 187163
36	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 23.3 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (S)	469	4	527227 187163
37	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 87.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (S)	469	4	527227 187163
38	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 59.5 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NW (S)	471	4	527086 187146
39	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 10.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NW (S)	471	4	527086 187146
40	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 48.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (S)	473	4	527096 187144
41	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 23.6 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	477	4	527313 187183

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
42	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 93.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	485	4	527336 187185
43	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 2.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	486	4	527012 188149
44	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 13.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	486	4	527012 188149
45	OS Water Network Lines Watercourse Form: Marsh Watercourse Length: 23.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (S)	487	4	527216 187143
46	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 137.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NW (S)	488	4	527028 187130
47	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 15.4 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	499	4	527012 188162
48	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 27.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	513	4	527003 188175
49	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 23.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NW (SE)	513	4	527443 187220
50	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 255.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NW (S)	515	4	527078 187102

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
51	OS Water Network Lines Watercourse Form: Marsh Watercourse Length: 51.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NW (SE)	518	4	527428 187202
52	OS Water Network Lines Watercourse Form: Marsh Watercourse Length: 53.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A8NE (SE)	523	4	527414 187186
53	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 21.1 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	538	4	526991 188199
54	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 97.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12SE (W)	550	4	526510 187580
55	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 40.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	555	4	526976 188214
56	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 109.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Number 6 Pond Catchment Name: Thames Primacy: 1	A9NW (SE)	566	4	527463 187169
57	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 28.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (N)	577	4	527225 188237
58	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 64.8 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	592	4	526959 188249
59	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 5.4 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (N)	599	4	527246 188255

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
60	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 18.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (N)	604	4	527247 188260
61	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 39.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (N)	612	4	527268 188264
62	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 17.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SE (N)	636	4	527302 188279
63	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 80.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18SW (N)	649	4	526919 188300
64	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 16.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NE (NW)	651	4	526455 187921
65	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 5.2 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NE (NW)	663	4	526448 187935
66	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 191.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A14SW (SE)	664	4	527738 187371
67	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 26.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NE (NW)	668	4	526445 187939
68	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 60.4 Watercourse Level: Underground Permanent: True Watercourse Name: Highgate Ponds Catchment Name: Thames Primacy: 1	A9NW (SE)	673	4	527543 187095

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
69	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 8.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NE (N)	680	4	527210 188343
70	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 7.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NE (N)	689	4	527212 188353
71	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 156.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12SW (W)	699	4	526381 187448
72	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 35.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12SW (W)	703	4	526354 187590
73	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 57.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NW (N)	713	4	526865 188353
74	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 57.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NE (N)	718	4	527220 188381
75	OS Water Network Lines Watercourse Form: Lake Watercourse Length: 137.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Highgate Ponds Catchment Name: Thames Primacy: 1	A9NW (SE)	732	4	527571 187041
76	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 1.4 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NE (SE)	737	4	527773 187274
77	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 174.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12SW (W)	738	4	526321 187583

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
78	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 8.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NE (SE)	738	4	527774 187273
79	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 6.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NE (SE)	743	4	527775 187264
80	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 29.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NE (SE)	743	4	527775 187264
81	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 3.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NE (SE)	744	4	527773 187258
82	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 47.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NW (SE)	745	4	527751 187219
83	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 17.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NE (SE)	745	4	527773 187255
84	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 312.9 Watercourse Level: Not Supplied Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A9NW (SE)	747	4	527740 187199
85	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 46.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NW (N)	754	4	526799 188374
86	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 35.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NE (N)	755	4	527179 188422

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
87	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 13.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NW (N)	758	4	526841 188393
88	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 532.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NW (N)	759	4	526840 188392
89	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 56.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NW (W)	763	4	526342 187940
90	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 4.2 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NW (W)	763	4	526344 187943
91	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 62.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NW (W)	763	4	526344 187943
92	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 1.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A12NW (W)	767	4	526319 187887
93	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 87.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 2	A12NW (W)	768	4	526319 187888
94	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 89.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 1	A18NE (N)	773	4	527210 188437
95	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 12.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Thames Primacy: 2	A18NE (N)	774	4	527216 188437