

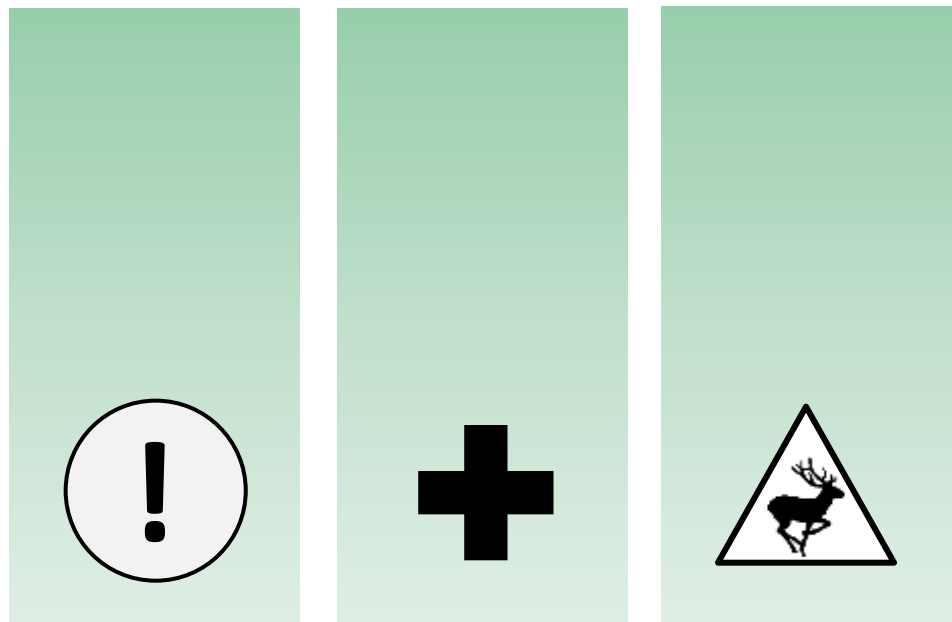
PHASE I AND II GEO-ENVIRONMENTAL ASSESSMENT

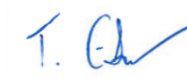
**BRUNEL UNIVERSITY, KINGSTON LANE,
LONDON, UXBRIDGE, UB8 3PH**

ENSAFE PROJECT REFERENCE: 1CO108935

PREPARED FOR: GILBERT ASH

DATE: MAY 2020



Issue/Revision	Issue	Revision 1	Revision 2	Revision 3	Revision 4	Revision 5
Remarks	Draft	Draft	Gas monitoring data added	Updated following client comments	Updated to provide guidance regarding unexpected contamination	Updated to address error in sections 9.1.1 and 10.1
Date	March 2020	March 2020	April 2020	April 2020	April 2020	May 2020
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Project Number	1CO108935					

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EXECUTIVE SUMMARY

Site Address	Brunel University, Kingston Lane, London, Uxbridge, UB8 3PH	
Grid Reference	506056 182718	
Site Area	0.52 ha	
Current Site Use	Previously demolished John Crank Building, a building previously part of the University. The area has site hoarding around its perimeter with entrance to the site available from the south only. Rubble deposits from the demolition covered the site floor.	
Proposed Use	Ensafe understands that the proposed development is to comprise a teaching and learning centre as an additional education facility for the university.	
Site Investigation Findings	Made Ground	Encountered between Ground Level and 2.00mbgl
	Superficial Deposits	Encountered between 0.30 and 2.80mbgl
	London Clay Formation	Encountered between 2.70 and >4.00mbgl
	Groundwater	Encountered between 1.50 and 2.10mbgl
Geo-Environmental Assessment		
Revised Conceptual Site Model (CSM)	Human Health – Quantification of ACM identified within TP202 indicated 0.814% (Stage 2 and 3). Given the proposed structure is to vacate the entire blue line area the risk posed to human health is not anticipate to be unacceptable. Groundwater – No unacceptable risk identified Ground Gas – A CS1 should be employed for the site.	
Recommendations		
Ensafe recommends that should any further asbestos contaminating materials be identified that the Principal Contractor suitably assesses the risk, and ensure materials are separated, handled and disposed of in an appropriate manner.		

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Background	1
1.2	Proposed Development	1
1.3	Objectives	1
1.4	Source of Information	2
1.5	Previous Reports	2
1.6	Risk Classification	2
1.7	Limitation of the Study	3
1.8	Confidentiality	3
2.0	SITE SETTING	4
2.1	Site Details	4
2.2	Current Site Use	4
2.3	Surrounding Area	5
3.0	SITE HISTORY	6
3.1	Historical Mapping	6
3.2	Historical Development	7
3.3	Planning History	7
4.0	ENVIRONMENTAL SETTING	8
4.1	Ground Conditions	8
4.2	Geotechnical Data	8
4.3	Mining & Ground Workings	9
4.4	Railways & Tunnels	9
4.5	Hydrology	9
4.6	Radon Risk Potential	10
4.7	Industrial Land Uses	10
5.0	CONSULTATIONS	11
5.1	Contaminated Land Officer	11
5.2	Landfill and Waste Disposal Sites	11
5.3	Regulatory Database	12
6.0	CONCEPTUAL SITE MODEL (CSM)	13
6.1	Initial CSM	13
6.2	Contaminant Sources	13
6.2.1	On Site Potential Sources	13
6.2.2	Off-site Potential Sources	13
6.3	Potential Pathways	13
6.4	Potential Receptors	14
6.4.1	Human Receptors	14
6.4.2	Controlled Waters	14
6.5	Risk Assessment	14
6.5.1	Severity	14
6.5.2	Likelihood	15

6.5.3	Risk Rating	15
6.6	Conceptual Site Model	16
7.0	SITE INVESTIGATION	19
7.1	Desk Study Information	19
7.2	Site Investigation Rationale	19
7.3	Laboratory Analysis	20
7.3.1	Soil Chemical Analysis	20
7.3.2	Groundwater Chemical Analysis	20
7.4	Gas and Groundwater Monitoring	21
8.0	GROUND AND GROUNDWATER CONDITIONS	22
8.1	Ground Conditions	22
8.1.1	Summary of Ground Conditions	22
8.1.2	Made Ground	22
8.1.3	Superficial Deposits	22
8.1.4	London Clay Formation	23
8.2	Groundwater Conditions	23
8.3	Land Gas and Groundwater Monitoring	23
9.0	TIER II GENERIC QUANTITATIVE CONTAMINATED LAND RISK ASSESSMENT	25
9.1	Human Health Risk Assessment	25
9.1.1	Asbestos	27
9.2	Controlled Waters	27
9.3	Ground Gas	29
9.4	Revised Conceptual Site Model	30
10.0	CONCLUSIONS	31
10.1	Contamination	31
11.0	RECOMMENDATIONS	32
12.0	UNEXPECTED CONTAMINATION	33
13.0	ACRONYMS	34

APPENDICIES

Appendix I	Figures
	1CO108935-001 – Site Location Plan
	1CO108935-002 – Proposed Development Plan
	1CO108935-003 – Exploratory Hole Location Plan
Appendix II	Photographs
Appendix III	Historical Maps
Appendix IV	Limitations
Appendix V	Exploratory Hole Logs
Appendix VI	Chemical Laboratory Results

1.0 INTRODUCTION

1.1 Background

Ensafe Consultants Ltd (hereafter referred to as Ensafe) has been commissioned by Gilbert-Ash ('the Client') to undertake a Phase I and II Geo-Environmental Site Assessment at Brunel University, Kingston Lane, London, Uxbridge, UB8 3PH ('the site').

A Site Location Plan is presented in Appendix I as Drawing No. 1CO108935-001.

1.2 Proposed Development

Ensafe understands that the proposed development comprises the construction of a new teaching and learning centre on the site of the previously demolished John Crank Building.

A Proposed Site Development Plan (Drawing No. 1CO108935-002) is presented within Appendix I.

1.3 Objectives

The scope of the Geo-Environmental investigation is outlined within Ensafe's fee proposal letter (Ref. 1CO108935/200304/P1R2, dated 6th March 2020).

The purpose of this investigation is to provide a Phase I and Phase II Geo-Environmental Site Assessment, providing information to assist in the discharge of Condition 15 of planning application ref: 532/APP/2018/3375.

A scope plan was provided by the clients Engineer 'BDP' an excerpt of which is included below in Figure 1.1. This plan outlines in red the boundary to be included within the Phase I Assessment and within 'Blue' the area requiring inclusion within the Phase II intrusive assessment.

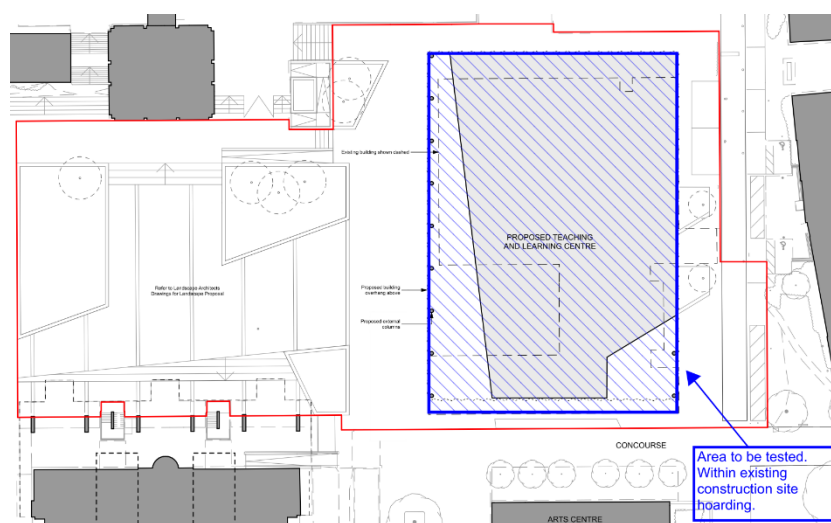


Figure 1.1 – Excerpt of BDP Boundary Plan

1.4 Source of Information

Background information was sought from the following sources:

- Groundsure Database Search (GS-6704861);
- REC Phase I & II Geo-environmental Assessment (Report ref: 1CO102981P1R1);
- Geotechnical Engineering Ltd Quad Report (Report ref: 34460);
- Historical mapping dated 1866 to 2020. A selection of historical maps are reproduced in Section 3.1 and Appendix III;
- Radon: Guidance on protective measures for new buildings (BRE Document BR 211, 2015);
- Online planning records held by London Borough of Hillingdon; and
- British Geological Survey Online GIS Mapping.

1.5 Previous Reports

REC undertook a site investigation in 2017 (report ref: 1CO102981P1R1) which comprised the wider site area. The investigations were undertaken prior to demolition of the John Crank Building.

The investigation encountered several exceedances of PAHs in a single location (WS2) north of the John Crank Building. In order to delineate the extent of the contamination, hand pits were undertaken in the vicinity of exploratory hole WS2. Following completion of the works, a clean cover system was recommended within the vicinity of this location. Following gas monitoring the site was also classified as Characteristic Situation 2. As such, gas protection measures were recommended for the proposed development.

Geotechnical Engineering Ltd undertook a site investigation (Report ref: 34460) within the quad area (adjacent to the west of the John Crank Building) in 2018. No determinands that were submitted for chemical laboratory analysis exceeded the generic assessment criteria for the proposed end use and so the report concluded that the risk posed to human health for the proposed end use was low.

1.6 Risk Classification

Ensafe has utilised the available data to classify the site on the basis of its likely contaminated land liability and potential for geotechnical constraints in relation to the property development. The risk classification definitions are summarised below:

Table 1.1 Risk Classification

Risk	Definition
Low	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property.
Low-Moderate	There are unlikely to be significant contaminated land liabilities/geotechnical constraints associated with the property with regard to the proposed use. However, minor issues may require further consideration in the event of a future redevelopment of the site etc.
Moderate	Some potential contaminated land liabilities/geotechnical constraints are likely to affect the property as a result of historical and/or current activities. The risks identified are unlikely to pose an immediate significant issue but the purchaser/developer may wish to make further enquiries of the vendor or undertake further environmental improvements. Redevelopment of the site will likely require further site investigation.
Moderate-High	Some potentially significant contaminated land liabilities/geotechnical constraints have been identified at the property that requires further assessment including intrusive ground investigations.
High	Significant potential contaminated land liabilities/geotechnical constraints have been identified at the property. Further assessment including intrusive ground investigation will be required to determine to level of risk and associated liability.

1.7 Limitation of the Study

The full limitations of this report are presented in Appendix IV.

1.8 Confidentiality

Ensafe has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Ensafe. A charge may be levied against such approval.

2.0 SITE SETTING

2.1 Site Details

Table 2.1 Site Details

Site Address	Brunel University, Kingston Lane, London, Uxbridge, UB8 3PH
National Grid Reference	506056 182718
Site Area	0.52 ha

All acronyms used within this report are defined within Section 12 of this report.

2.2 Current Site Use

A site walkover was undertaken on the 20th March 2020 and the following site description comprises the site's current layout and features based on the Ensafe Engineer's observations at the time.

The subject site redline boundary comprises two separate section. The first of which comprises the demolish John Crack Structure to the East, and to West is 'The Quad' an area of public open space surrounded by further university structures and steps down for access. The surface material within the demolished John Crank area comprised a 6F rubble material (see Plate 15 in Appendix II).

Selected photographs from the site walkover are presented in Appendix II.

Hazardous Materials Storage and PCBs

No Above Ground Storage Tanks (ASTs) or evidence of Underground Storage Tanks (USTs) were observed on site. No electricity substations were noted on site with the potential to contain PCB's.

Asbestos Containing Material (ACM)

No ACMs were noted during the site walkover.

Waste Storage

No waste streams were identified that may migrate to potential receptors via a pathway.

2.3 Surrounding Area

The surrounding land uses are summarised below:

Table 2.2 Summary of Surrounding Land Uses

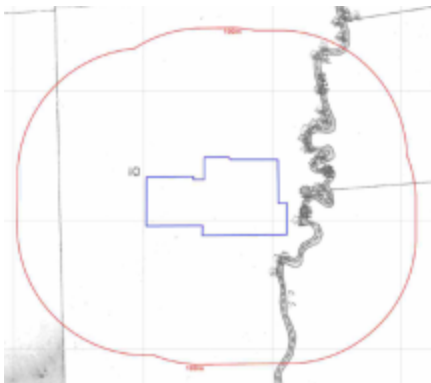
Direction	Land Use
North	University Facilities
East	University Accommodation Facilities
South	University Facilities
West	University Facilities

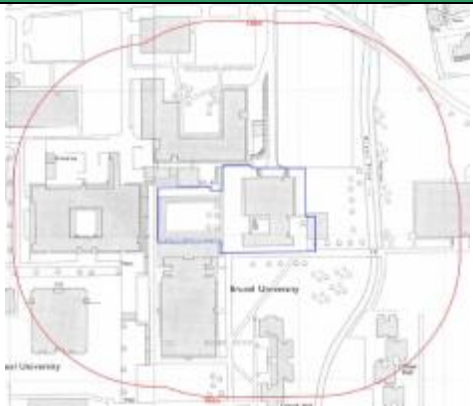
3.0 SITE HISTORY

3.1 Historical Mapping

A review of historical maps pertinent to the site are summarised below in Table 3.1.

Table 3.1 Summary of Potentially Contaminative Historical Land Uses

Map Edition	Historical Land Use	Historical Map
1866-1896	In the 1866 map, the site is situated in open fields. A river is located adjacent to the east of the site. A railway is located approximately 240m west of the site running N-S. The surrounding area is predominantly open fields with sporadic settlements to the north of the site.	 Map Scale 1:2,500, dated 1866
1896-1964	In the 1896 map, the site is noted to be situated within a 'nursery' with parallel arranged structures (greenhouses) running N-S. Approximately 250m north east of the site is a 'Hospital' which is noted to treat infectious diseases. Urbanisation has occurred in the surrounding area, again most notably to the north, where some terraced houses have been constructed. No heavy industry is noted within the proximity of the site area.	 Map Scale 1:2,500, dated 1896
1964-1975	In the 1964 map, a road is noted to be running N-S through the east of the site. The 'nursery' previously noted was shown as 'disused' in the 1963 map. The 'hospital' to the north east of the site has expanded. The area to the north has undergone further urbanisation although the area immediately to the south is still noted to be fallow land.	 Map Scale 1:2,500, dated 1964

Map Edition	Historical Land Use	Historical Map
1975-Present	In the 1975 map, a structure resembling the layout of the recently demolished John Crank Building occupies the site. The site area is situated within the grounds of the 'Brunel University' which was founded in 1966. The railway to the west is noted to have been 'dismantled'. The surrounding area is now dominated by buildings associated with the university.	 Map Scale 1:1,250, dated 1975

3.2 Historical Development

A review of potentially contaminative land uses identified on historical Ordnance Survey maps within 250m of the site are summarised below in Table 3.2.

Table 3.2 Summary of Potentially Contaminative Historical Land Uses

Feature	Distance (m)	Date	Direction
On Site			
Nursery	-	1896 - 1960	-
Unspecified Commercial/Industrial	-	1913 - 1938	-
Off Site			
Nursery	36 - 214	1895 - 1960	Various
Tramway Sidings	48	1935	South
Electricity Substation*	74m	1973 - 1994	West
Unspecified Tanks	108 - 137	1897 - 1987	East and North East
Unspecified Commercial/Industrial	134	1938	North
Unspecified Pit	182	1970 - 1989	West
Cemetery	240 - 248	1895 - 1975	North East

Note: * - Nearest feature listed only.

3.3 Planning History

Ensafe has undertaken a review of online planning records held by the London Borough of Hillingdon and a total of 6no. historic planning applications for the subject site are recorded. However, no pertinent geo-environmental information was identified.

4.0 ENVIRONMENTAL SETTING

4.1 Ground Conditions

A review of the online British Geological Survey (BGS) mapping for the area indicates that the site is underlain by the geological sequence given as 4.1.

Table 4.1 Published Geology Underlying Site

Classification	Geological Unit	Description	Aquifer Classification	Permeability
Artificial and Made Ground	Worked Ground (Undivided)	Void	N/A	N/A
Superficial	Langley Silt Member	Clay and Silt	Unproductive	Very Low to Low
Bedrock	London Clay Formation	Clay, Silt and Sand	Unproductive	Very Low to Moderate

The nearest publicly available historical borehole record is located approximately 113m west of the site (BGS Ref. TQ08SE31) and records the following geological sequence:

Langley Silt Member	-	Ground Level	5.80mbgl
London Clay Formation	-	5.80mbgl	19.20mbgl
Lambeth Group	-	19.20mbgl	39.60mbgl

Groundwater was encountered at 7.20mbgl.

There are no groundwater potable water or surface water abstraction licenses within a 1km radius of the site.

The site is not located within a Groundwater Source Protection Zone. However, a Source Protection Zone 2 is located 392m east of the site.

On site the soil leaching potential is categorised as Unproductive Aquifer/Low Leaching Potential – Soil information for urban areas assumed to be highly permeable in the absence of site-specific information.

4.2 Geotechnical Data

Geotechnical data obtained within the data report identifies the following ground conditions relating to natural subsidence, summarised in Table 4.2 overleaf.

Table 4.2 Summary of Data Search Information

Hazard	Area of Site	Designation	Comments
Shrink-Swell Clay	West	Very Low	Ground conditions predominantly low plasticity.
	East	Low	Ground conditions predominantly medium plasticity.
Running Sands	Whole Site	Negligible	Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.
Compressible Deposits		Negligible	Compressible strata are not thought to occur.
Collapseable Deposits		Low	Deposits with potential to collapse when loaded and saturated are possibly present in places.
Landslides		Very Low	Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
Ground Dissolution		Negligible	Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.

It should be noted that this data is qualitative and based on anticipated ground conditions only and not on any other topographical or geotechnical data.

4.3 Mining & Ground Workings

The site is in an area which is not affected by coal mining and as such, no coal authority reports were required for this assessment. The nearest ground working is located 170m west of the site associated with small scale surface ground excavation which occurred during railway construction.

4.4 Railways & Tunnels

The Groundsure report indicates that there are 5no. records of historical railway and tunnel features present within 250m from site. Tramway siding are noted 48m south of the site in 1935. A railway is noted 173 – 181m west of the site between 1868 and 1935.

4.5 Hydrology

A review of available data has identified an inland river not influenced by normal tidal action, named River Pinn, is situated 38m east of the site at its nearest point.

There are no surface water abstraction licences are located within 2km of the site.

The site is not located within an Environment Agency Flood Zone 2, has a **Medium** Risk of Flooding from Rivers and the Sea (RoFRaS) and has a **Moderate** potential for groundwater flooding at surface.

Additionally, the site is not prone to surface water flooding with a highest risk of 1 in 30 years. The maximum flood depth for this return period is between 0.30 and 1.0m.

4.6 Radon Risk Potential

The Indicative Atlas of Radon in Great Britain indicates the site is situated in an area where less than 1% of homes are above the Action Level and that the BGS reports that no radon protective measures are necessary in the construction of new dwellings or extensions.

4.7 Industrial Land Uses

The university and the site boundary is situated within a predominately residential area. Available records identify 4no. current industrial land uses within 250m, all of which were electricity substations which are presented in the Table 4.3 below.

Table 4.3 Summary of Potentially Contaminative Industrial Land Uses

Feature	Category	Distance (m)	Direction
Electricity Substation *	Infrastructure and Facilities	96	West

Note: * - Nearest feature listed only.

No further potentially contaminative industrial land uses were identified.

5.0 CONSULTATIONS

5.1 Contaminated Land Officer

Ensaf accessed the contaminated land register on the London Borough of Hillingdon website on 23rd March 2020 and no potentially contaminative sites were noted to be within a 250m radius of the site boundary.

5.2 Landfill and Waste Disposal Sites

The Environment Agency and Local Authority records do not show any historic landfill or licenced waste sites within 500m of the site.

A review of available information identified 5no. waste exemption records within 500m of the site. These activities involve the storage, treatment, use or disposal of waste that are exempt from needing a permit.

Table 5.1 Summary of Waste Exemptions

Site	Category	Sub-Category	Description	Distance (m)	Direction
Outside Hamilton Building, Kingston Lane, UXBRIDGE, Middlesex, UB8 3PH	Treating waste exemption	Non-agricultural waste only	Aerobic composting and associated prior treatment	35	West
	Using waste exemption		Spreading waste on non-agricultural land to confer benefit		
KINGSTON LANE, UXBRIDGE, UB8 3PH	Treating waste exemption	Not on a farm	Aerobic composting and associated prior treatment	41	South West
	Using waste exemption		Spreading waste on non-agricultural land to confer benefit		
Brunel Pharmacy Medical Centre, Brunel University, Uxbridge, Greater London, UB8 3PH	Treating waste exemption	Non-agricultural waste only	Sorting and de-naturing of controlled drugs for disposal	157	South

5.3 Regulatory Database

The following information has been obtained from a commercially available environmental database. The summary table only includes records not otherwise detailed in the report.

Table 5.2 Summary of Data Search

Activity	Distance from Site (m)		Details
	0-249m	250-500m	
Records of Category 3 or 4 radioactive substances authorisations	5	0	Nearest is Brunel University, Kingston Lane, Uxbridge, UB8 3PH – 45m S - Keeping And Use Of Radioactive Materials. Effective from 23/06/1998.
Pollution Incidents (EA/NRW)	0	1	Incident dated 16/10/2001. Incident classified as Category 2 (Significant) impact to water, Category 3 (Minor) impact to land and Category 4 (No Impact) Air.
Pollutant release to public sewer Records	1	0	ITRI LTD, Kingston Lane, Uxbridge, Middlesex, UB8 3PH – Last received date 01/01/2018
List 1 Dangerous Substances	0	3	Nearest active is Itri Ltd, Kingston Lane, Middx (432m SE) – Mercury and Cadmium Receiving into the Thames Estuary.

6.0 CONCEPTUAL SITE MODEL (CSM)

6.1 Initial CSM

In accordance with CLR11 - Model Procedures for the Management of Land Contamination (Environment Agency, 2004) and BS 10175:2011+A1:2013 (Investigation of Potentially Contaminated Land. Code of Practice), Ensafe has developed a preliminary Conceptual Site Model (CSM) to identify potential contamination sources, migration pathways, and significant receptors within the study area.

6.2 Contaminant Sources

Based on the information presented in the above sections, the following on and off-site sources of potential contamination have been identified.

6.2.1 On Site Potential Sources

Potential sources of contamination identified on site include:

- Made Ground associated with the historical development and subsequent demolition of Nurseries; and
- Unspecified Industrial.

6.2.2 Off-site Potential Sources

Potential sources of contamination identified off site include:

- Licensed radioactive substance use and disposal (45m south);
- Historical Tramway Sidings (located 48m south);
- Historical and active Electricity Substations (nearest located 74m west);
- Historical Unspecified Tanks (nearest located 108m east);
- Historical Unspecified Commercial/Industrial (134m north);
- Historical Unspecified Pit (182m west); and,
- Historical Cemetery (240 – 248m north east).

6.3 Potential Pathways

Receptors may be potentially at risk from the identified potential sources of contamination via the following pathways:

- Migration of mobile contaminants on or off site via services, sewers and manmade conduits;
- Direct contact, ingestion (grown produce and contaminated dusts) and inhalation of contaminants on site; and
- Migration of mobile contaminants into groundwater and transport into surface waters.

6.4 Potential Receptors

6.4.1 Human Receptors

Ensafé has identified the following potential receptors:

- Future users of the site and buildings.

Construction workers are not considered to be a plausible receptor as exposure will be managed through the use of appropriate PPE and hygienic working practices, as required under HSE/ CDM regulations. Furthermore, potential exposure to possible contaminants is not expected to be over prolonged work duration thereby limiting any impact to ground workers.

6.4.2 Controlled Waters

The following potential controlled waters receptors have been identified:

- The River Pinn (38m east at its nearest point).

6.5 Risk Assessment

CIRIA 552: Contaminated Land Risk Assessment 'A Guide to Good Practice' provides guidance on risk assessment taking into account factors such as severity of the potential harm that may arise from a successful pollutant linkage, potential magnitude of the hazard, and the sensitivity of the target receptor. Risk assessment is initially assessed by determining the severity of the potential hazard, which takes into account receptor sensitivity and the magnitude of the potential impact as detailed in Tables 6.1 & 6.2 below.

6.5.1 Severity

Table 6.1 Receptor Sensitivity

Category	Human Sensitivity	Environmental Sensitivity
Very Low	Ground Workers	Non-Sensitive Water Course
Low	Commercial / Industrial	Secondary Aquifer
Moderate	Residential without Plant Uptake	Principle Aquifer / Sensitive Watercourse
High	Residential with Plant Uptake	Groundwater Source Protection Zone

Table 6.2 Magnitude of Impact

Category	Example
No Impact	No identified or potential pollutants present / Greenfield Site
Slight Impact	Minor leaks and spills from fuel infrastructure, inert landfills / Residential, retail or offices
Moderate Impact	Major leaks and spills from fuel infrastructure / Railways, collieries, scrapyards
Gross Impact	Heavily contaminated industrial sites, hazardous landfills / Gas and chemical works

Severity is subsequently assessed considering the potential receptor and magnitude of impact as outlined within Table 6.3 below.

Table 6.3 Determination of Level of Severity for Potential Hazards

	Receptor Sensitivity			
	Very Low	Low	Moderate	High
No Impact	Minor	Minor	Minor	Minor
Slight Impact	Minor	Minor	Minor	Mild
Moderate Impact	Minor	Minor	Mild	Medium
Gross Impact	Minor	Mild	Medium	Severe

6.5.2 Likelihood

The likelihood of an event is assessed while considering the potential for presence of a contaminant, presence of receptor, and the substantiality of the pollutant pathway. Likelihood is broken down into four separate categories within the CSM as shown in Table 6.4 below.

Table 6.4 Definitions of Likelihood Categories

Category	Definition
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable
Low Likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
High Likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor

6.5.3 Risk Rating

Table 6.5 demonstrates the methodology used to provide an overall risk rating within the preliminary CSM with respect to any potential sources of contamination that may affect the site. An overall risk rating is assigned to each potential contaminant considering the assessed likelihood and severity as determined using the methodologies within Tables 6.1 to 6.4.

Table 6.5 Level of Risk Rating For Hazard Definition

Likelihood	Severity			
	Minor	Mild	Medium	Severe
Unlikely	Very Low	Very Low	Low	Low / Moderate
Low Likelihood	Very Low	Low	Low / Moderate	Moderate
Likely	Low	Low / Moderate	Moderate	High
High Likelihood	Low / Moderate	Moderate	High	Very High

6.6 Conceptual Site Model

A site specific CSM has therefore been created using the above information and is provided on the following page as Table 6.6.

Table 6.6 Conceptual Site Model

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Severity	Overall Risk Rating	Active / Inactive	
On-Site								
Made Ground associated with the historical development of the site and former use as a nursery and unspecified Commercial / Industrial	Heavy Metals	Dermal contact Migration into buildings Vertical migration	Future site users	Likely	Minor	Low	Potentially Active – further investigation is recommended.	
			River Pinn	Likely	Minor	Low		
	Total Petroleum Hydrocarbons (TPH)	Inhalation of vapours Ingestion of soils Dermal contact with soils	Future Site Users	Likely	Minor	Low		
			Lateral and vertical migration	Future site users	Likely	Minor		Low
		Polycyclic Aromatic Hydrocarbons (PAHs)		Ingestion of and dermal contact with soils	Future site users	Likely		Minor
			Lateral and vertical migration		River Pinn	Likely		Minor
	Asbestos fibres	Inhalation of fibres		Future site users	High Likelihood	Minor		Low/Mode rate
	Ground gases	Vertical migration into buildings	Future site users	Likely	Minor	Low		
	Off Site							
Licensed radioactive substance use and disposal (45m south)	Radioactive materials	Vertical and lateral migration	Future site users	Unlikely	Minor	Very low	Inactive – given the stringency of licensing in place, it is deemed that the risk posed to the site is very low.	
Historical Tramway Sidings (48m south)	Heavy metals, PAHs and TPHs	Lateral and vertical migration	Future site users	Likely	Minor	Low	Potentially Active – further investigation is recommended.	
	Ground Gases	Lateral migration into buildings	Future site users	Likely	Minor	Low		
Historical and active Electricity Substations	PCBs	Lateral migration	Future site users	Unlikely	Minor	Very low	Inactive – Due to the relative immobility of PCBs, this is not	

(nearest located 74m west)							considered a risk to human health.
Unspecified Tanks (located 108m east)	PAHs and TPH's	Lateral and vertical migration	Future site users	Likely	Minor	Low	Potentially Active – further investigation is recommended.
Unspecified Commercial / Industrial (134m North)	Heavy metals, PAHs and TPHs	Lateral and vertical migration	Future site users	Likely	Minor	Low	Potentially Active – further investigation is recommended.
	Ground Gases	Lateral migration into buildings	Future site users	Low likelihood	Minor	Low	
Historical Unspecified pit (182m west)	Ground Gases	Lateral migration into buildings	Future site users	Unlikely	Minor	Very Low	Inactive – Given the distance from site and the age of the record, it is unlikely that contaminants would migrate on to site
Historical Cemetery (240 – 248m north east)	Ground Gases	Lateral migration into buildings	Future site users	Unlikely	Minor	Very Low	Inactive – Given the distance from site and the age of the record, it is unlikely that contaminants would migrate on to site

7.0 SITE INVESTIGATION

7.1 Desk Study Information

Potential contamination sources identified from the desk study are listed in Table 7.1 below.

Table 7.1 Summary of Potential Contamination Sources

Potential Source	Potential Contaminants	Potential Impact
On Site		
Made Ground associated with the historical development of the site and former use as a nursery and unspecified Commercial / Industrial	Heavy Metals, Asbestos Fibres, TPH, PAH, Ground Gases	Future Site Users River Pinn (38m east)
Off-Site		
Historical Tramway Sidings (48m south)	Heavy metals, PAHs and TPHs	Future site users
Unspecified Tanks (located 108m east)	PAHs and TPH's	Future site users
Unspecified Commercial / Industrial (134m North)	Heavy metals, PAHs and TPHs & Ground Gasses	Future site users

Note: PAH – Polycyclic Aromatic Hydrocarbon, TPH – Total Petroleum Hydrocarbon

7.2 Site Investigation Rationale

Exploratory holes have been advanced to provide information on baseline ground conditions within the identified blue line boundary provided by BDP. The investigation was focused on determining the chemical characteristics of the underlying shallow soils.

Standards employed during the investigation include BS5930:2015 (BS5930: 'Code of Practice for Site Investigation', 2015), Geotechnical Design (Ref. BS-EN 1997-2:2007) and Geotechnical Investigation and Testing – Sampling Methods and Groundwater Measurements, Part 1 (Ref. BS EN ISO 22474-1:2006).

Ground investigation works were undertaken by Ensaf between 12th and 13th March 2020 as summarised in Table 7.2 overleaf.

Table 7.2 Summary of Fieldwork

Hole Location	Potential Source/Rationale	Type	Maximum Depth (mbgl)	Monitoring Wells Response Zone (mbgl)
TP201	To obtain information on baseline chemical and conditions across the site	Trial Pit	1.80	N/A
TP202			2.40	
TP203			2.50	
TP204			2.00	
TP205			2.00	
WS201	To obtain information on baseline chemical and geotechnical conditions across the site	Windowless Sample	4.00	1.00 – 1.80
WS202			3.00	1.00 – 2.80
WS203			3.00	1.00 – 3.00

Note: mbgl – metres below ground level, N/A – Not applicable

Exploratory Hole Logs are presented within Appendix V.

All samples were collected using appropriate PPE and sampling equipment that was cleaned at each sampling location. A detailed copy of Ensafe's sampling methodology, QA procedures and laboratory chain of custody forms can be provided upon request.

Laboratory analysis results are presented within Appendix VI, with an Exploratory Hole Location Plan (Ref. 1CO108935-003) contained within Appendix I.

7.3 Laboratory Analysis

7.3.1 Soil Chemical Analysis

A total of 5no. samples were submitted to UKAS accredited i2 Analytical of Watford and analysed for a range of chemical determinants including:

- Asbestos identification (Quantification where required);
- Soil Organic Matter (SOM);
- Heavy metals (As, Ba, Be, B, Cd, Cr, Cr VI, Cu, Pb, Hg, Ni, Se, V, Zn);
- Cyanide (Total);
- Phenols (Total);
- Total and speciated Polycyclic Aromatic Hydrocarbons (PAH); and
- Banded Total Petroleum Hydrocarbons (TPH).

7.3.2 Groundwater Chemical Analysis

A total of 3no. groundwater samples were submitted to i2 Analytical of Watford and analysed for the following determinants:

- Heavy Metals (As, Cd, Cr, Cr VI, Cu, Pb, Hg, Ni, Se, Zn);
- Cyanide (total);
- Phenols (mono);
- Total and Speciated Polyaromatic Hydrocarbons (PAHs) : USEPA 16 SE;
- Total Petroleum Hydrocarbons (CWG);
- pH; and,
- Sulphate expressed as SO₄

7.4 Gas and Groundwater Monitoring

A total of three monitoring wells were installed on site, 3no. were installed for purposes of monitoring ground gas. Following the intrusive phase of site works, a total of two return ground gas and groundwater monitoring visits were undertaken on 16th and 20th March 2020. A third monitoring visit will be completed and included as an addendum to this report when access to site has been re-confirmed.

Concentrations of methane (CH₄), carbon dioxide (CO₂) and Oxygen (O₂) were measured using an infra-red gas analyser (GA2000), calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an attached flow pod. Gas measurements were recorded for a minimum of 120 seconds at each location, at which point the maximum concentration of CH₄ and CO₂ together with the lowest concentration of O₂ were recorded.

Groundwater level monitoring was undertaken using an electronic dip meter to record the depth to groundwater.

The results of monitoring visits are presented within Table 8.3 and discussed in Sections 8.3.

8.0 GROUND AND GROUNDWATER CONDITIONS

8.1 Ground Conditions

8.1.1 Summary of Ground Conditions

The strata identified in the ground investigation is identified set out in Table 8.1 below.

Table 8.1 Summary of Ground Conditions Encountered

Stratum	Minimum Depth to Top of Strata (m)	Maximum Depth to Top of Strata (m)	Max Thickness (m)
Made Ground	0.00	0.00	2.00 (WS202)
Superficial Deposits	0.30	2.00	2.40 (WS201)
London Clay Formation	2.70	2.70	>1.30 (WS201) NP

Note: NP – Strata Thickness Not Proven

8.1.2 Made Ground

Made Ground was identified at all locations and varied in thickness from 0.30 to 2.00m. The material was heterogeneous and variable in both colour and composition comprising Clay, Sand, Gravel and Cobbles in varying proportions.

Typically, sands were fine to coarse. Gravels were highly variable comprising brick, flint, concrete, metal objects, plastic, slate, cement, ceramic, and glass. Cobbles were found to comprise flint, ceramic, brick and concrete. Boulders were encountered within TP202 and comprised paving slabs and concrete.

No olfactory evidence of contamination was identified in this strata.

8.1.3 Superficial Deposits

The Deposits were found to directly underlie the Made Ground across the site and was predominantly recorded as interbedded fine and coarse grained materials, likely fluvial in origin and have therefore been identified as superficial and not bedrock deposits. Fine grained deposits were typically sandy gravelly CLAY with varying proportions of sand and gravel. Granular deposits were found to comprise clayey sandy gravel with varying proportions of each. Sands were fine to coarse. Gravels were angular to rounded fine to coarse flint. Cobbles were also found within some locations and were found to comprise subangular to sub rounded flint.

Where coarse grained strata was identified it was noted that these materials were largely unstable following excavation with side wall collapse.

8.1.4 London Clay Formation

London Clay Formation was identified within WS201 & WS202 and was found to generally comprise Grey clay and grey silty clay respectively.

8.2 Groundwater Conditions

Groundwater was encountered within eight exploratory holes as detailed in Table 8.2 below.

Table 8.2 Summary Groundwater Strikes

Location	Stratum	Aquifer Classification of Stratum	Depth to Strike (mbgl)
TP201	SD	Secondary (A)	1.60
TP202	MG		1.50
TP203	SD		1.50
TP204	SD		1.50
TP205	SD		1.55
WS201	MG		1.70
WS202	SD		2.10
WS203	SD		1.55

Note: MG – Made Ground, SD – Superficial Deposits

8.3 Land Gas and Groundwater Monitoring

Ground gas and groundwater monitoring wells were installed within WS201, WS202 and WS203 to varying target depths. The results of initial return monitoring visits are presented in Table 8.3 overleaf.

Table 8.3 Summary of Ground Gas Monitoring Results

Well	Date	Flow (l/hr)		Low O ₂ %v/v	Concentration CH ₄		CH ₄ Qhg l/hr	Concentration CO ₂		CO ₂ Qhg l/hr	PID (ppm)	Atmospheric Pressure (mb)/ Dynamic	Response Zone (mbgl)	Depth to Base (mbgl)	Depth to Water (mbgl)	Response Zone Flooded?
		Peak	Steady		Peak %v/v	Steady %v/v		Peak %v/v	Steady %v/v							
BH2*	21/04/17	<0.1	<0.1	18.3	<0.1	<0.1	<0.0001	0.5	0.5	0.0005	-	1027 (Falling)	1.00 – 2.00	2.13	Dry	No
	02/05/17	<0.1	<0.1	19.2	<0.1	<0.1	<0.0001	0.6	0.6	0.0006	-	1014 (Steady)		2.13	Dry	No
	05/05/17	<0.1	<0.1	18.9	<0.1	<0.1	0.0001	0.6	0.6	0.0006	-	1020 (Falling)		2.11	2.08	No
BH3*	21/04/17	<0.1	<0.1	13.2	<0.1	<0.1	<0.0001	0.3	<0.1	0.0003	-	1014 (Steady)	1.00 – 2.00	2.08	Dry	No
	02/05/17	<0.1	<0.1	14.7	<0.1	<0.1	<0.0001	0.2	<0.1	0.0002	-	1014 (Steady)		2.08	Dry	No
	05/05/17	<0.1	<0.1	17.7	<0.1	<0.1	0.0001	<0.1	<0.1	0.0001	-	1017 (Falling)		2.08	Dry	No
WS5*	21/04/17	<0.1	<0.1	18.9	<0.1	<0.1	0.0001	0.5	0.3	0.0005	-	1030 (Falling)	1 – 3.50	3.43	2.18	No
	02/05/17	<0.1	<0.1	19.0	<0.1	<0.1	0.0001	0.6	0.2	0.0006	-	1015 (Steady)		3.43	2.16	No
	05/05/17	<0.1	<0.1	20.4	<0.1	<0.1	0.0001	0.2	0.2	0.0002	-	1019 (Falling)		3.43	2.18	No
WS201	16/03/20	<0.1	<0.1	19.7	<0.1	<0.1	0.0001	<0.1	<0.1	0.0001	3.2	1021 (Rising)	1.00 – 1.80	1.80	1.8	No
	20/03/20	<0.1	<0.1	20.0	<0.1	<0.1	0.0001	0.1	<0.1	0.0001	2.3	1023 (Steady)		1.80	1.59	No
WS202	16/03/20	<0.1	<0.1	20.2	<0.1	<0.1	0.0001	<0.1	<0.1	0.0001	0.9	1021 (Steady)	1.00 – 2.80	2.45	1.52	No
	20/03/20	<0.1	<0.1	19.8	<0.1	<0.1	0.0001	<0.1	<0.1	0.0001	0.5	1023 (Steady)		2.49	1.64	No
WS203	16/03/20	<0.1	<0.1	20.2	<0.1	<0.1	0.0001	<0.1	<0.1	0.0001	0.2	1020 (Falling)	1.00 – 3.00	2.63	1.44	No
	20/03/20	<0.1	<0.1	19.7	<0.1	<0.1	0.0001	<0.1	<0.1	0.0001	0.7	1026 (Rising)		1.65	1.57	No

*Results from REC site investigation in 2017

9.0 TIER II GENERIC QUANTITATIVE CONTAMINATED LAND RISK ASSESSMENT

Ensafe has undertaken a Tier II qualitative risk assessment to determine if any potential contaminants within the underlying soils and groundwater pose an unacceptable level of risk to the identified receptors.

9.1 Human Health Risk Assessment

At a Tier II stage, the long term (chronic) toxicity risk to human health is assessed by utilising appropriate and conservative generic assessment criteria (GAC) to determine whether there are actual or potentially unacceptable risks at the site and if any viable pollutant linkages are present.

To undertake the Tier II assessment within the context of the proposed development, Ensaf has used worst case GAC values for the proposed development, as such those based upon a commercial/industrial end use with a Soil Organic Matter (SOM) of 1%.

The following assessment, summarised below and overleaf in Table 9.1, has primarily adopted the S4UL (Suitable for Use Levels reference values published by LQM/CIEH in 2015, the S4ULs). Currently, no published GAC value is available for cyanide and therefore Ensaf has utilised the Environmental Agency Contaminated Land Exposure Assessment Tool (CLEA v1.06) to derive the relevant GAC for this proposed land use. Due to the absence of a published lead GAC for direct use within the planning regime, the 2014 Defra C4SL (Category 4 Screening Level) has been used as this value is considered to incorporate the latest toxicological, bio-accessibility and exposure modelling research to date.

Table 9.1 Summary of Generic Human Health Toxicity Assessment for a Commercial/Industrial End Use (SOM of 1%)

Determinant	Units	GAC	GAC Source	n	[mc]	Location / Strata	Primary Pathways	Assessment
Inorganics								
Arsenic	mg/kg	640	(i)	5	21	N/A	1	No Further Action
Barium	mg/kg	22,000	(i)	5	110		1	
Beryllium	mg/kg	12	(i)	5	1.2		1,3	
Boron	mg/kg	240,000	(i)	5	2		1,2	
Cadmium	mg/kg	190	(i)	5	<0.2		1	
Chromium	mg/kg	8,600	(i)	5	36		1	
Chromium (VI)	mg/kg	33	(i)	5	<1.2		1	
Copper	mg/kg	68,000	(i)	5	35		1	
Lead	mg/kg	2,330	(iv)	5	120		1	
Mercury [Inorganic]	mg/kg	1,100	(i)	5	<0.3		1	
Nickel	mg/kg	980	(i)	5	41		1	
Selenium	mg/kg	12,000	(i)	5	3.5		1	
Zinc	mg/kg	730,000	(i)	5	280		1	
Cyanide [Total]	mg/kg	1,200	(v)	5	<1		1	
Asbestos	-	D.	-	5	D.	TP202 ES1	3	See Discussion
Organics – PAHs and Phenol								
Phenols	mg/kg	760	(ii)	5	<1	N/A	5	No Further Action
Naphthalene	mg/kg	190	(ii)	5	<0.05		4	
Acenaphthylene	mg/kg	83,000	(ii)	5	<0.05		1	
Acenaphthene	mg/kg	84,000	(ii)	5	<0.05		1	
Fluorene	mg/kg	63,000	(ii)	5	0.33	N/A	1	No Further Action

Determinant	Units	GAC	GAC Source	n	[mc]	Location / Strata	Primary Pathways	Assessment
Phenanthrene	mg/kg	22,000	(ii)	5	3.2		1	
Anthracene	mg/kg	520,000	(ii)	5	1.1		1	
Fluoranthene	mg/kg	23,000	(ii)	5	4.3		1	
Pyrene	mg/kg	54,000	(ii)	5	3.5		1	
Benzo(a)Anthracene	mg/kg	170	(ii)	5	2.1		1	
Chrysene	mg/kg	350	(ii)	5	2.2		1	
Benzo(b)Fluoranthene	mg/kg	44	(ii)	5	2.5		1	
Benzo(k)Fluoranthene	mg/kg	1,200	(ii)	5	0.97		1	
Benzo(a)Pyrene	mg/kg	35	(ii)	5	1.8		1	
Indeno(123-cd)Pyrene	mg/kg	500	(ii)	5	0.79		1	
Dibenzo(a,h)Anthracene	mg/kg	3.5	(ii)	5	<0.05		1	
Benzo(ghi)Perylene	mg/kg	3,900	(ii)	5	0.91		1	
Organics – TPH								
TPH C ₅ -C ₆	mg/kg	3,200	(iii)	5	<0.001	N/A	4	No Further Action
TPH C ₆ -C ₈	mg/kg	7,800	(iii)	5	<0.001		4	
TPH C ₈ -C ₁₀	mg/kg	2,000	(iii)	5	<0.001		4	
TPH C ₁₀ -C ₁₂	mg/kg	9,700	(iii)	5	<1.0		4	
TPH C ₁₂ -C ₁₆	mg/kg	36,000	(iii)	5	16		1, 4	
TPH C ₁₆ -C ₂₁	mg/kg	28,000	(iii)	5	110		1	
TPH C ₂₁ -C ₃₅	mg/kg	28,000	(iii)	5	260		1	
Monoaromatics & Oxygenates								
Benzene	mg/kg	27	(ii)	5	<0.001	N/A	1	No Further Action
Toluene	mg/kg	56,000	(ii)	5	<0.001		1	
Ethylbenzene	mg/kg	5,700	(ii)	5	<0.001		1	
p & m Xylene	mg/kg	6,200	(ii)	5	<0.001		1	
o-xylene	mg/kg	6,600	(ii)	5	<0.001		1	
Key [mc]Maximum Concentration Recorded D.Detected N.D.None Detected (Limit of Detection = <0.0001%) Primary Pathways 1Ingestion of soil and indoor dust and / or oral background exposure; 2Consumption of home-grown produce and attached soil; 3Inhalation of dust (background and indoor); 4Inhalation of vapour (background and indoor); 5Direct dermal / skin contact. Generic Assessment Criteria (GAC) Source (i)LQM/CIEH Suitable For Use Level (S4UL) (2015); (ii)S4UL – Conservative Assessment Approach of 1% SOM; (iii)S4UL – 1% SOM and assumed worst case aliphatic / aromatic compound; (iv)Defra Category 4 Screening Level (2014); (v)CLEA 1.06 Derived Value.								

Referring to Table 9.1 above, the results of this direct comparison indicate that the Generic Assessment Criteria (GAC) has been exceeded for the following determinant analysed:

- **Asbestos** – TP202 ES1 @ 0.30-0.40mbgl.

9.1.1 Asbestos

Asbestos was identified within a single location on site and was identified as comprising Amosite (sheeting/board debris). Quantification of the sample is presented below in Table 9.2.

Table 9.2 Asbestos Quantification

Sample Location	Sample Depth (mbgl)	Asbestos Type	Asbestos (%) Stage 2 & 3
TP202	0.30 – 0.40	Amosite Sheeting/Board Debris	0.814

Given that the structure is to cover the entire blue line boundary the risk posed to human health is not anticipated to be unacceptable.

9.2 Controlled Waters

The groundwater vulnerability map indicates the site is underlain by the Langley Silt Member (Unproductive Aquifer) which in turn is underlain by bedrock of the London Clay Formation (Unproductive Aquifer). The Conceptual Site Model (CSM) indicates that the site does not lie within a Source Protection Zone. Ensafé has assumed a worst case scenario of a Secondary (A) Aquifer based upon on site observations of strata recovered as it comprised both coarse and fine grained strata, believed to be of fluvial origin and water bearing

During the monitoring phase of works, having allowed time for groundwater to stabilise following the ground investigation, groundwater samples were recovered from monitoring standpipes installed within the Superficial Deposits.

A Tier II risk assessment has been undertaken with concentrations of determinants compared with the relevant criteria. The maximum concentrations for each well is summarised as Table 9.3 overleaf.

Table 9.3 Comparison of Groundwater Analysis with Tier II Screening Values

Determinand	Units	Hardness Banding (CaCO ₃ mg/l)	Surface Water Screening Values	Groundwater Screening Values	Monitoring Well Location		
					WS201	WS202	WS203
Arsenic	µg/l	-	50	5 ⁽¹⁾	4.53	0.63	2.20
Cadmium	µg/l	>200	2,000	-	<0.02	<0.02	0.03
Chromium	µg/l	-	3.4	5	<5.0	<5.0	<5.0
Copper	µg/l	-	1	-	6.5	2.6	8.4
Lead	µg/l	-	1.2	5	0.5	<0.2	<0.2
Cyanide	mg/l	-	1	-	0.0068	0.015	0.0014
Mercury	µg/l	-	0.07	0.5	0.12	<0.05	<0.05
Nickel	µg/l	-	4.0	-	3.3	2.3	1.8
Selenium	µg/l	-	-	-	6.1	5.8	7.0
Zinc	µg/l	-	10.9	-	1.1	5.0	4.0
Sulphate (SO₄)	mg/l	-	400	-	756	948	444
Phenol	µg/l	-	7.7	-	1.7	<1.0	<1.0
Benzo(a)Pyrene	µg/l	-	0.27	0.005	<0.01	<0.01	<0.01
Benzo[b]fluoranthene	µg/l	-	0.017	0.05	<0.01	<0.01	<0.01
Benzo[k]fluoranthene	µg/l	-	0.017	0.05	<0.01	<0.01	<0.01
Benzo(ghi)perylene	µg/l	-	0.0082	0.05	<0.01	<0.01	<0.01
Indeno(123-cd)pyrene	µg/l	-	-	0.05	<0.01	<0.01	<0.01
Anthracene	µg/l	-	0.1	0.05	<0.01	<0.01	<0.01
Fluoranthene	µg/l	-	0.12 ^(MAC) (2)	-	<0.01	<0.01	<0.01
Naphthalene	µg/l	-	2 ⁽²⁾	-	<0.01	<0.01	<0.01
PAHs (Sum of Four) ³	µg/l	-	-	-	<0.01	<0.01	<0.01
PAHs (Total)	µg/l	-	-	-	<0.01	<0.01	<0.01
TPH C ₅ -C ₆	µg/l	-	-	-	<1.0	<1.0	<1.0
TPH C ₆ -C ₈	µg/l	-	-	-	<1.0	<1.0	<1.0
TPH C ₈ -C ₁₀	µg/l	-	-	-	<1.0	<1.0	<1.0
TPH C ₁₀ -C ₁₂	µg/l	-	-	-	<10	<10	<10
TPH C ₁₂ -C ₁₆	µg/l	-	-	-	<10	<10	<10
TPH C ₁₆ -C ₂₁	µg/l	-	-	-	<10	<10	<10
TPH C ₂₁ -C ₃₅	µg/l	-	-	-	<10	<10	<10
Key (1) Water Framework Directive – EQS Specific Pollutant (2) Water Framework Directive – EQS for priority Hazardous Substances. Annual Average concentration unless otherwise stated. MAC = Maximum admissible concentration unless otherwise stated. (3) Sum of Four PAHs (benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene and indeno[1,2,3-c,d]pyrene)							

Referring to Table 9.3, the results of this direct comparison indicates that the surface water screening criteria have been exceeded for copper, mercury and Sulphate (SO₄). The exceedance for mercury was, very slight. However, on-site source for these contaminants were not identified within the Conceptual Site Model.

9.3 Ground Gas

The potential impact on the proposed development from ground gases has been assessed with reference to standards and guidelines published within BS8485:2015+A1:2019. Ensafe have utilised the results of the ground gas monitoring surveys to calculate a tentative borehole hazardous gas flow rate (Qhg), previously known as a Gas Screening Value (GSV).

The maximum implied characteristic situation for the site has been calculated by combining the maximum observed flow rate and maximum observed concentrations during any monitoring event. This methodology provides a 'worst case scenario' in order to characterise the highest potential risk to human health from ground gas at the site.

Due to the Covid-19 pandemic there have been restrictions on accessing site for a third monitoring visit at the recently installed WS201, WS202 & WS203. In the absence of this data, monitoring data was utilised from locations within close proximity to the proposed building from the a previous investigation (BH2, BH3 & WS5) (Report ref: 1CO102981P1R1). The locations of these boreholes have been indicated on the exploratory hole location plan (ref. 1CO108935-003) presented in Appendix I.

Table 9.4 Summary of Hazardous Gas Flow Rate

Location	Flow rate (L/h)	Maximum CH ₄ (%)	Maximum CO ₂ (%)	CH ₄ Qhg (l/h)	CO ₂ Qhg Rate (l/h)	Implied CH ₄ CS	Implied CO ₂ CS
BH2	<0.1	<0.1	0.6	<0.0001	0.0006	1	1
BH3	<0.1	<0.1	<0.2	<0.0001	0.0002	1	1
WS5	<0.1	<0.1	0.6	<0.0001	0.0006	1	1
WS201	<0.1	<0.1	<0.1	<0.0001	<0.0001	1	1
WS202	<0.1	<0.1	<0.1	<0.0001	<0.0001	1	1
WS203	<0.1	<0.1	<0.1	<0.0001	<0.0001	1	1

On the basis of measurements in Table 9.4 above which identifies the worst case scenario within each gas monitoring well based on five return visits spanning two site investigations upon completion of the intrusive site works, the maximum CO₂ gas rate is considered to be 0.0006l/h.

It is therefore considered that a CS1 is adopted for the scheme.

9.4 Revised Conceptual Site Model

The initial conceptual site model (CSM) has been revised in light of the findings of the Phase II Geo-Environmental Site Assessment. A revised CSM is provided as Table 9.5 below.

Table 9.5 Revised Conceptual Site Model

Receptor	Potential Risk	Current Residual Risk	Migration
Human Health	Uptake of contaminants by food plants grown in contaminated soils	No	The only determinant identified above the appropriate screening criteria was asbestos amosite sheeting/board debris. This is located beneath the proposed development and thus is not anticipated does not pose an unacceptable risk to human health following completion of the development.
	Ingestion		
	Inhalation		
	Skin contact	No	Site is not within an area where radon gas is present in any significant quantities.
	Irradiation		
	Fire and explosion	No	No unacceptable risk identified.
Buildings	Fire and explosion	No	
Natural Environment	Contamination of controlled waters	No	No unacceptable risk identified.

10.0 CONCLUSIONS

Based on the findings of this report, the following conclusions can be summarised:

10.1 Contamination

- Asbestos was identified in a single sample within the proposed building footprint (Amosite sheeting/board debris (0.814% Stage 2 & 3);
- Consideration to the appropriate handling of ACMs should be given by the Principal Contractor when undertaking works;
- A ground gas regime of CS1 is recommended for the site, although further ground gas monitoring should be considered to fully assess the risk from ground gases once the site has been made accessible;
- Given the presence of asbestos containing material identified on site within the Made Ground it is recommended that careful consideration is given to this by the Principal Contractor during construction;
- Exceedances of copper, mercury and sulphate (SO₄) were identified within groundwater samples; and,
- Ground workers should adopt suitable PPE and RPE given the findings of this report.

11.0 RECOMMENDATIONS

- Ensaf recommends that should any further asbestos contaminating materials be identified that the Principal Contractor suitably assesses the risk, and ensure materials are separated, handled and disposed of in an appropriate manner.

12.0 UNEXPECTED CONTAMINATION

Should the Principal Contractor encounter materials that are believed to be potentially impacted by unrecorded contamination, an assessment should be undertaken in order to assess the risks associated and ensure appropriate mitigation is devised.

In particular it has been noted that a fragment of Asbestos board containing Amosite fibres has been identified within the underlying rubble mat / working platform, and as such the extent of which should be determined and suitable actions taken by the Principal Contractor prior to and during the construction process.

13.0 ACRONYMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH=	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation



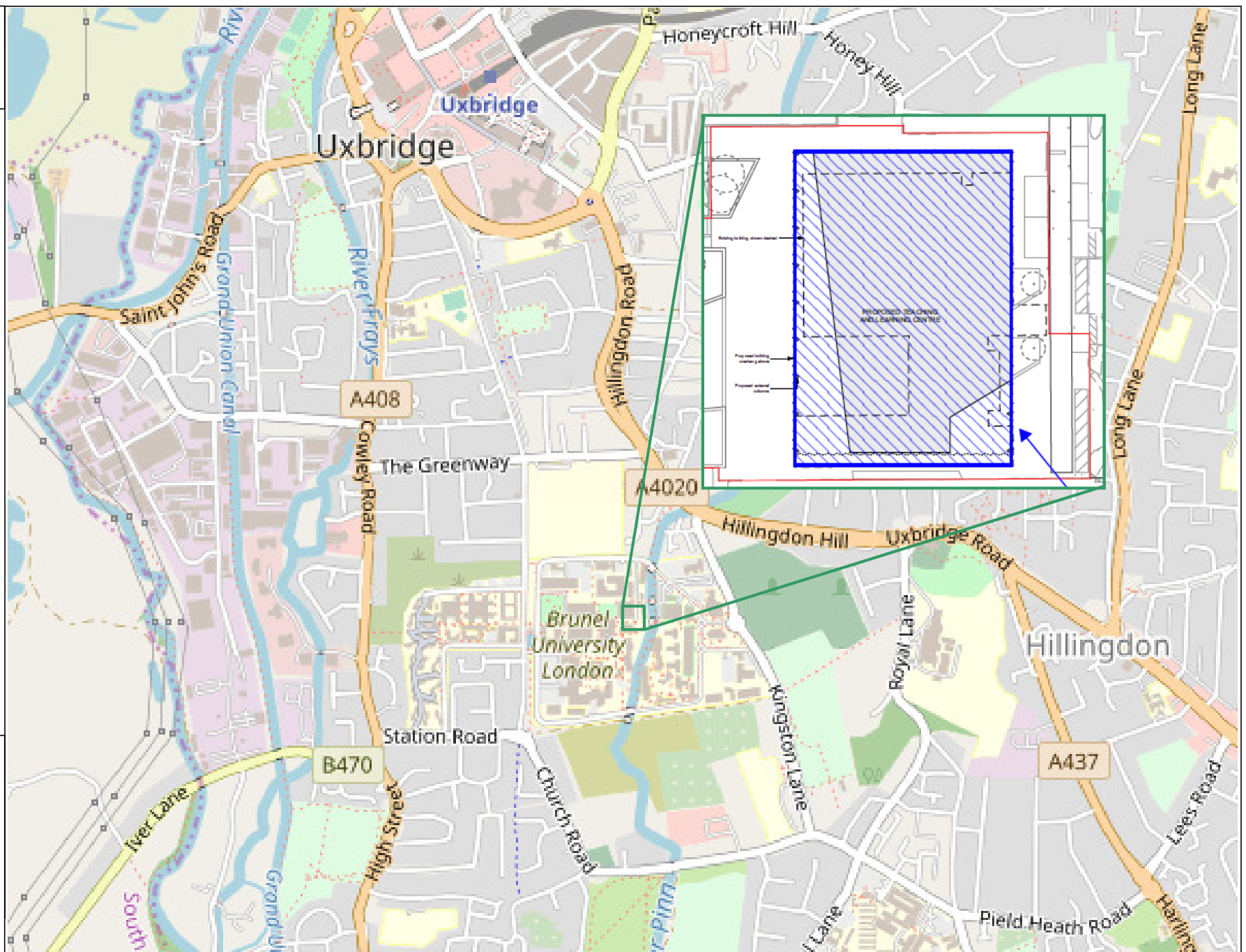
Phase I and II Geo-Environmental Assessment
Brunel University, Kingston Lane, London
Uxbridge UB8 3PH
May 2020
1CO108935p2r5

APPENDIX I - FIGURES

KEY:



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Job No. & Title:

1CO18935 –
Brunel University
Proposed TLC

Client:

Gilbert-Ash

Drawn by:

JS

Approved by:

RL

Date:

April 2020

Notes:

Taken from drawing ref:
proposed site plan and
openstreetmap.org
NOT TO SCALE

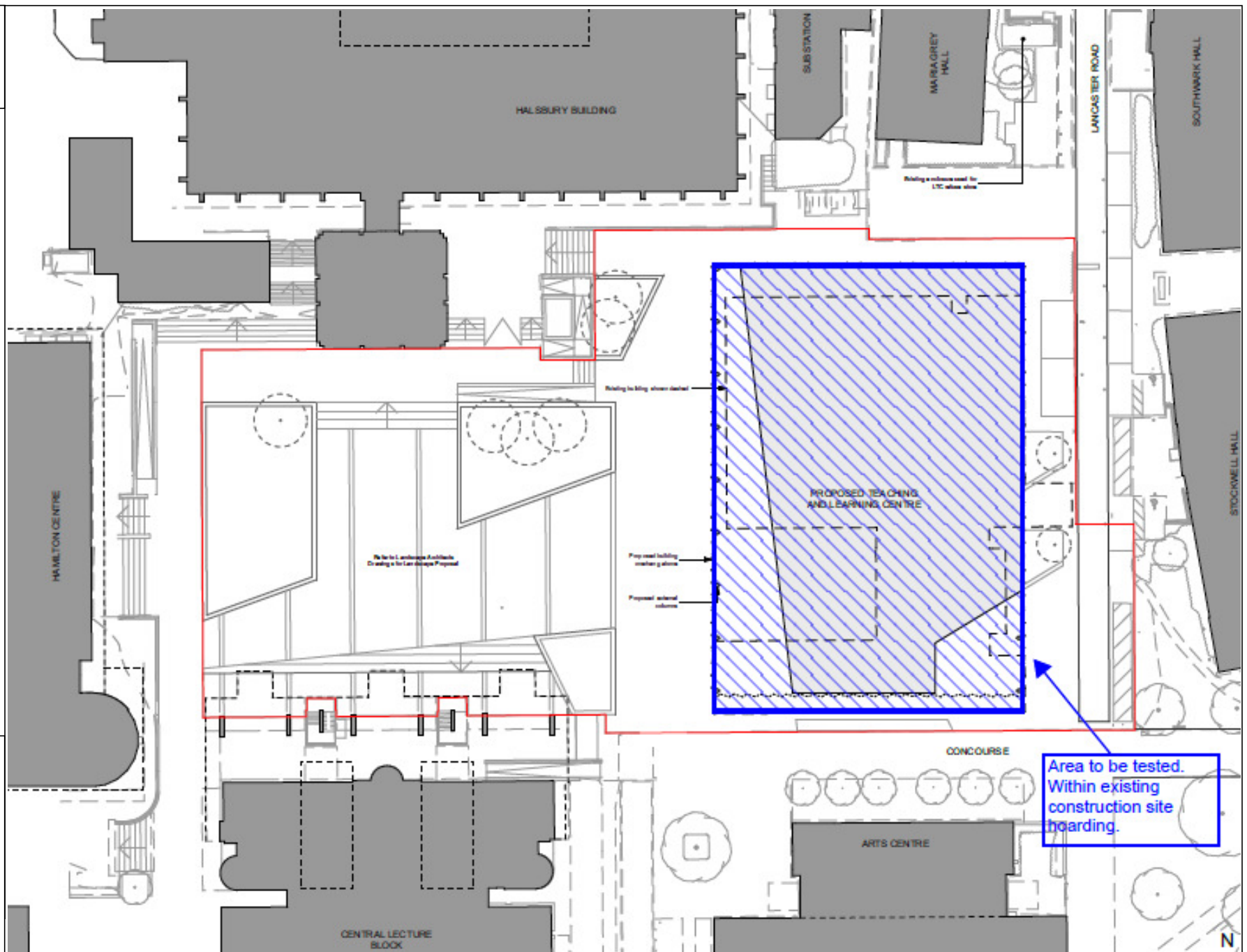
Drawing Title:

1CO1089356-001 – Site
Location Plan

KEY:



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Job No. & Title:

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Brunel University
Proposed TLC

Client:

Gilbert-Ash

Drawn by:

JS

Approved by:

RL

Date:

April 2020

Notes:

Taken from drawing ref:
proposed site plan

NOT TO SCALE

Drawing Title:

1CO108935-002 –
Proposed Development
Plan

KEY:



Trial Pit



Window Sample

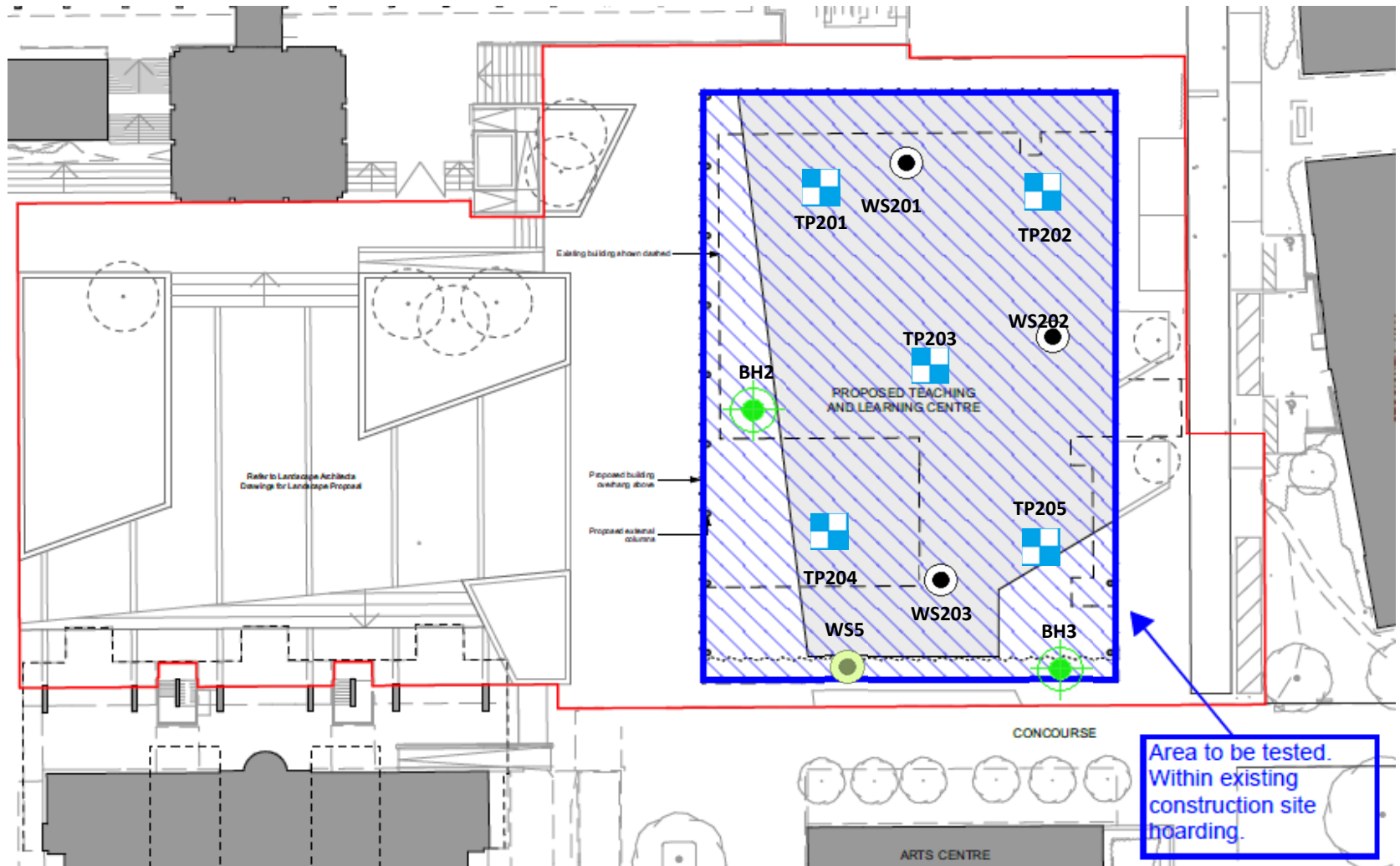


Window Sample
(2017)



Cable Percussive
Borehole (2017)

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Job No. & Title:
1CO108935
Brunel University –
Proposed TLC

Client:
Gilbert-Ash

Drawn by: JS
Approved by: MP
Date: April 2019

Notes:
Taken from Drawing ref:
Proposed Site Plan

Drawing Title:
1CO108935-003 –
Exploratory Hole Location
Plan



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Brunel University, Kingston Lane, London
Uxbridge UB8 3PH
May 2020
1CO108935p2r5

APPENDIX II - PHOTOGRAPHS



PLATE 1: Sample ES1 from TP201 (Amosite sheeting/board debris detected)



PLATE 2: TP201 Stockpile



PLATE 3: TP201 pit



PLATE 4: Groundwater within TP201



PLATE 5: Saturated Deposits from TP202 (ES5 @ 1.90mbgl)



PLATE 6: Groundwater within TP202



PLATE 7: Stockpile from TP203



PLATE 8: TP203 pit



PLATE 9: Concrete boulder within TP203



PLATE 10: Superficial Deposits from within TP203



PLATE 11: Stockpile from TP205



PLATE 12: TP205 pit



PLATE 13: Staining and wood fragments identified in TP204



PLATE 14: Groundwater at base of TP204



PLATE 15: Overall site view with backfilled trial pit in the foreground.



PLATE 16: WS201 – 1.00-2.00mbgl

APPENDIX III – HISTORICAL MAPS

Site Details:

HALISBURY BUILDING,
BRUNEL UNIVERSITY,
KINGSTON LANE, UXBRIDGE,
UB8 3PH

Client Ref: CO108935
Report Ref: GS-6704860
Grid Ref: 506057, 182719

Map Name: County Series

Map date: 1866

Scale: 1:2,500

Printed at: 1:2,500



Surveyed 1866
Revised 1866
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1866
Revised 1866
Edition N/A
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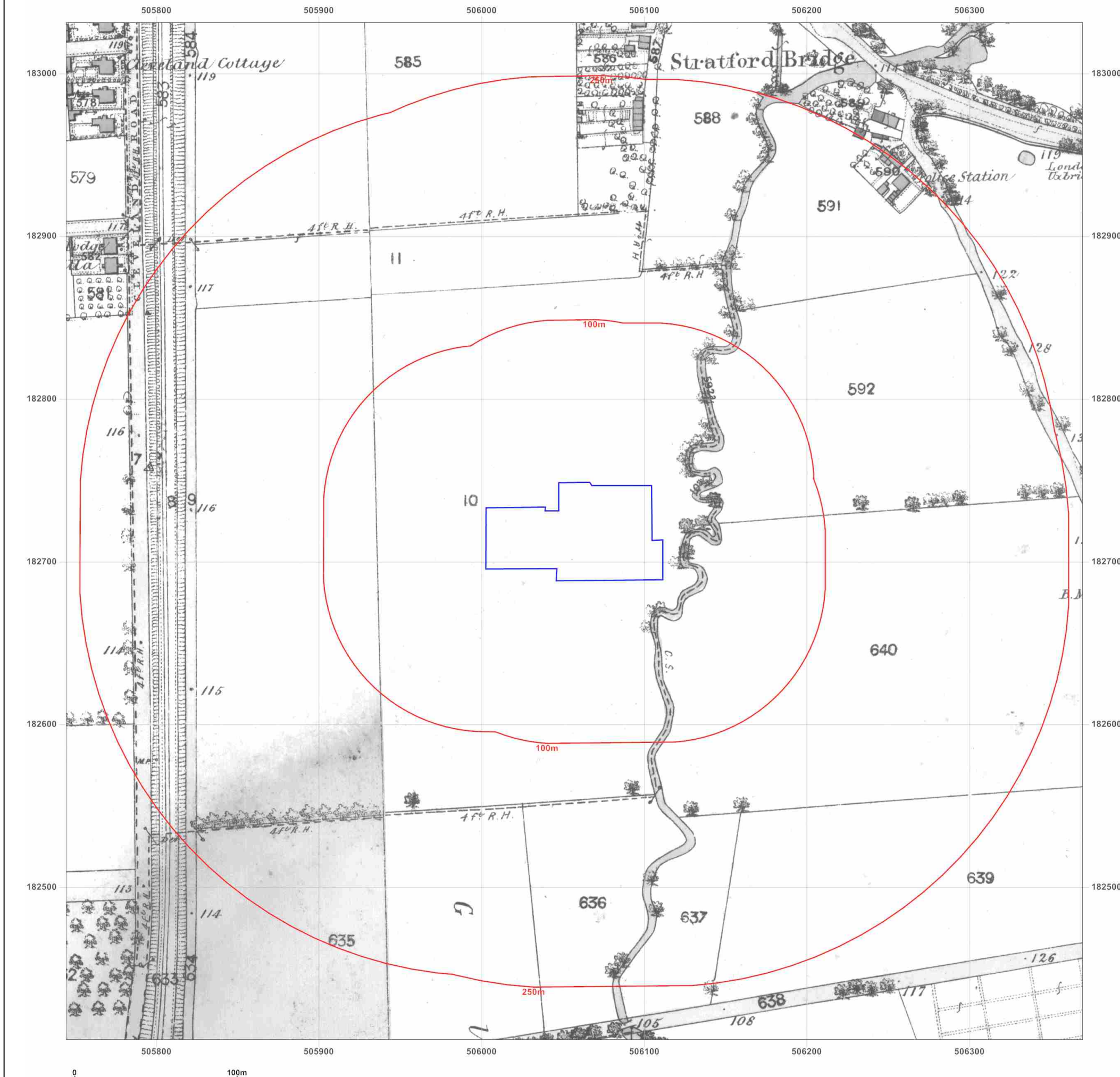


Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

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Production date: 18 March 2020

Map legend available at:
www.groundsure.com/sites/default/files/groundsure_legend.pdf



Site Details:

HALISBURY BUILDING,
BRUNEL UNIVERSITY,
KINGSTON LANE, UXBRIDGE,
UB8 3PH

Client Ref: CO108935
Report Ref: GS-6704860
Grid Ref: 506057, 182719

Map Name: County Series

Map date: 1895-1896

Scale: 1:2,500

Printed at: 1:2,500



Surveyed 1896
Revised 1896
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1895
Revised 1895
Edition N/A
Copyright N/A
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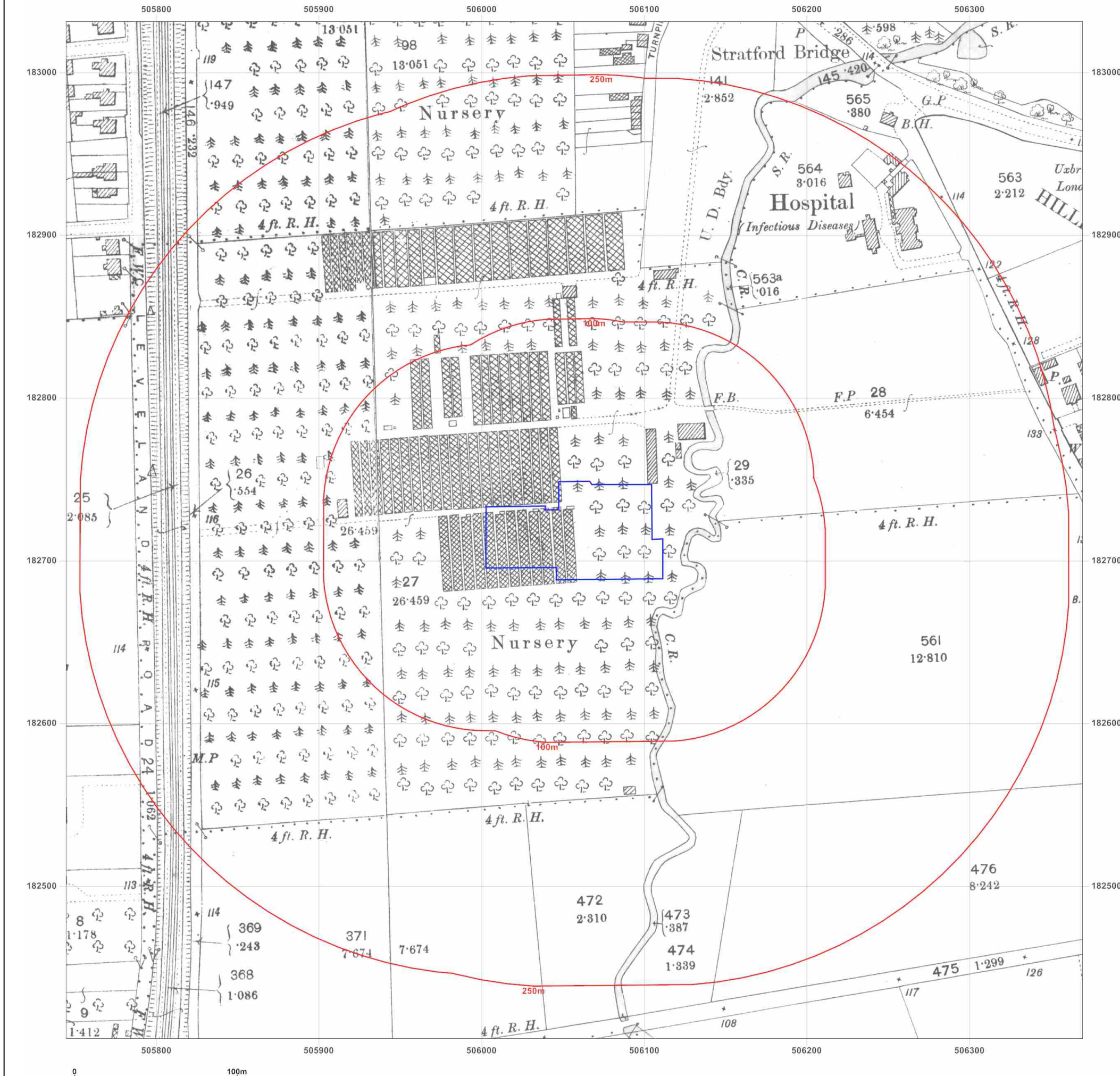


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Site Details:

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BRUNEL UNIVERSITY,
KINGSTON LANE, UXBRIDGE,
UB8 3PH

Client Ref: CO108935
Report Ref: GS-6704860
Grid Ref: 506057, 182719

Map Name: National Grid

Map date: 1963-1964

Scale: 1:2,500

Printed at: 1:2,500



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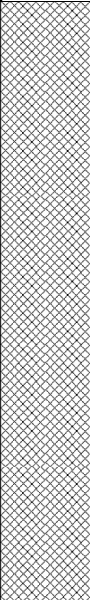
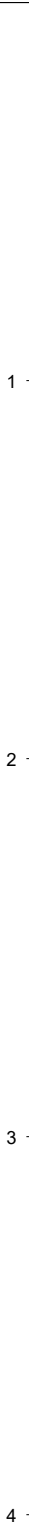
APPENDIX IV – LIMITATIONS

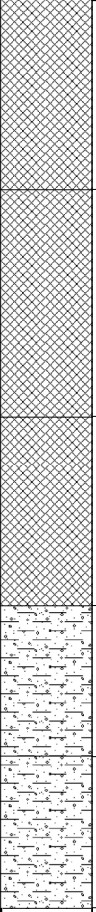
1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between EnsafE and the Client as indicated in Section 1.3.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
6. In addition to the above EnsafE note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.
7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently there may be conditions present not revealed by this investigation.
11. EnsafE cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by EnsafE is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by EnsafE in this connection without their explicit written agreement there to by EnsafE.
12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



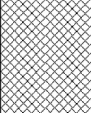
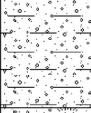
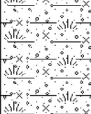
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May 2020
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APPENDIX V – EXPLORATORY HOLE LOGS

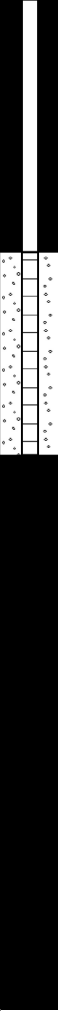
   			Trial Pit Log			Borehole No. TP201 Sheet 1 of 1			
Project Name: Brunel University			Proj. ID: 1CO108935		Easting: Northing:		Hole Type TP		
Location: Brunel University London, Uxbridge			Plant: JCB 3CX		Level (m AOD): Final Depth (m): 1.80		Scale: 1:20		
Client: BDP			Crew: Tara Plant Hire Ltd		Start Date: 12/03/2020 End Date: 12/03/2020		REC Engineer: AB		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30 - 0.40	ES1				Brown clayey sandy GRAVEL. Sand is fine to coarse. Gravel is angular to round fine to coarse flint, slate, plastic, concrete, brick and metal. [MADE GROUND]		
		0.60 - 0.70	ES2						..From 0.50mbgl: Medium cobble content. Cobbles are angular to subrounded flint, metal and concrete.
		1.00 - 1.10	ES3						
		1.50	ES4						
		1.70	ES5						
				1.60			Light brown slightly clayey sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint. Cobbles are subrounded flint. [SUPERFICIAL DEPOSITS]		
				1.80			End of Borehole at 1.80m		
Remarks: Location cleared for buried services using Cable Avoidance Tool [CAT]. Groundwater was encountered at 1.60mbgl. Location terminated due to pit instability and backfilled with arisings and made safe upon completion. Stability: Unstable							Pit Dimensions Length: 1.80 Width: 0.65 Depth: 1.80		

   		Trial Pit Log			Borehole No. TP202 Sheet 1 of 1					
Project Name: Brunel University		Proj. ID: 1CO108935		Easting: Northing:		Hole Type TP				
Location: Brunel University London, Uxbridge		Plant: JCB 3CX		Level (m AOD): Final Depth (m): 2.40		Scale: 1:20				
Client: BDP		Crew: Tara Plant Hire Ltd		Start Date: 12/03/2020 End Date: 12/03/2020		REC Engineer: AB				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.30 - 0.40	ES1		0.50			Greyish brown slightly clayey GRAVEL with medium cobble content. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, ceramic, slate, concrete, breeze block, plastic and occasional suspected ACM fragments. Cobbles are subangular to rounded flint, ceramic and brick. [MADE GROUND]	1	
		0.60 - 0.70	ES2					Yellowish brown slightly sandy clayey GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint and occasional concrete and brick. [MADE GROUND]		
		1.30 - 1.40	ES3					Dry and friable brown slightly sandy gravelly CLAY with medium cobble content and low boulderer content. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, slate, cement and wood. Cobbles are angular to subangular flint, concrete and brick. Boulders are angular to subangular paving slabs and concrete. [MADE GROUND]		
		1.70 - 1.80	ES4					Stiff light brown slightly sandy very gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint. [SUPERFICIAL DEPOSITS]		
		2.10 - 2.20	ES5					Soft to firm brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subrounded to rounded fine to medium flint. [SUPERFICIAL DEPOSITS]		
					2.40			End of Borehole at 2.40m	2	
									3	
									4	
Remarks: Location cleared for buried services using Cable Avoidance Tool [CAT]. Groundwater was encountered at 1.50mbgl. Location terminated due to pit instability and backfilled with arisings and made safe upon completion. Stability: Unstable								Pit Dimensions Length: 1.85 Width: 0.68 Depth: 2.40		

   			Trial Pit Log			Borehole No. TP203 Sheet 1 of 1			
Project Name: Brunel University			Proj. ID: 1CO108935		Easting: Northing:		Hole Type TP		
Location: Brunel University London, Uxbridge			Plant: JCB 3CX		Level (m AOD): Final Depth (m): 2.50		Scale: 1:20		
Client: BDP			Crew: Tara Plant Hire Ltd		Start Date: 12/03/2020 End Date: 12/03/2020		REC Engineer: AB		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30 - 0.40	ES1		0.50		Greyish brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, wood, ceramic, concrete, slate, plastic and glass. [MADE GROUND]		
		0.60 - 0.70	ES2				Dry and friable light brown slightly sandy very gravelly CLAY. With medium cobble content. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, concrete and relic wires. Cobbles are subangular to subrounded flint and concrete. [MADE GROUND]		
		0.90 - 1.00	ES3				Soft to firm light brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]		
	▼	1.40 - 1.50	ES4		1.90		<i>..From 1.20mbgl: Becomes very gravelly. Gravels are angular to rounded fine to coarse flint, brick, concrete and occasional ceramic.</i> <i>..Between 1.40 and 1.90mbgl: occasional boulders. Angular to subangular concrete boulders.</i>		
		2.00 - 2.10	ES5				Soft to firm brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subrounded to rounded fine to medium flint. [SUPERFICIAL DEPOSITS]		
		2.30 - 2.40	ES6				<i>..From 2.20mbgl: Becomes mottled dark grey with rare gravel.</i>		
				2.50			End of Borehole at 2.50m		
Remarks: Location cleared for buried services using Cable Avoidance Tool [CAT]. Groundwater was encountered at 1.50mbgl. Location terminated due to pit instability and backfilled with arisings and made safe upon completion. Stability: Unstable								Pit Dimensions Length: (m) Width: Depth: 2.50	

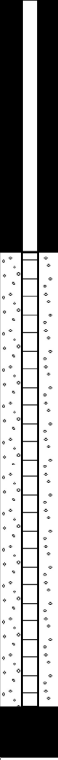
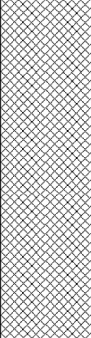
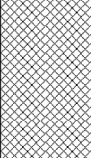
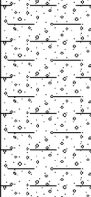
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Location: Brunel University London, Uxbridge		Plant: JCB 3CX		Level (m AOD): Final Depth (m): 2.00		Scale: 1:20				
Client: BDP		Crew: Tara Plant Hire Ltd		Start Date: 12/03/2020 End Date: 12/03/2020		REC Engineer: AB				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.15 - 0.25	ES1		0.30			Greyish brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse brick, flint, ceramic, glass, breezeblock, cement and plastic. [MADE GROUND]	1	
		0.40 - 0.50	ES2							Yellowish brown clayey slightly sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]
		0.70 - 0.80	ES3							Yellowish brown slightly clayey sandy GRAVEL with low cobble content. Sand is fine to coarse. Gravel is subrounded to fine to coarse flint. Cobbles are subrounded flint. [SUPERFICIAL DEPOSITS]
		1.30 - 1.40	ES4		1.50			Very stiff brown mottled dark grey slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subrounded fine to coarse flint. [SUPERFICIAL DEPOSITS] <i>..Between 1.75 and 1.85mbgl: Dark grey to black staining and wood fragments. No odour.</i>		
		1.60 - 1.70	ES5							
		1.75 - 1.85	ES6							
		1.90 - 2.00	ES7							
				2.00			End of Borehole at 2.00m	2		
								3		
								4		
Remarks: Location cleared for buried services using Cable Avoidance Tool [CAT]. Groundwater was encountered at 1.50mbgl. Location terminated due to pit instability and backfilled with arisings and made safe upon completion. Stability: Unstable								Pit Dimensions (m) Length: Width: Depth: 2.00		

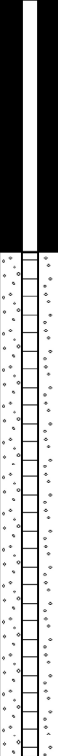
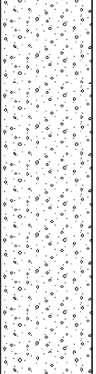
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Project Name: Brunel University		Proj. ID: 1CO108935		Easting: Northing:		Hole Type TP			
Location: Brunel University London, Uxbridge		Plant: JCB 3CX		Level (m AOD): Final Depth (m): 2.00		Scale: 1:20			
Client: BDP		Crew: Tara Plant Hire Ltd		Start Date: 12/03/2020 End Date: 12/03/2020		REC Engineer: AB			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15 - 0.25	ES1		0.30		Greyish brown slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse brick, flint, ceramic, cloth, glass, concrete and wood. [MADE GROUND]	1	
		0.40 - 0.50	ES2				Soft to firm brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]		
		0.70 - 0.80	ES3						
		1.10 - 1.20	ES4						
	▼	1.50 - 1.60	ES5			1.40	Soft to firm yellowish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]		
		1.80 - 1.90	ES6			1.70	Yellowish brown sandy GRAVEL with medium cobble content. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint. Cobbles are subangular to subrounded flint. [SUPERFICIAL DEPOSITS]		
					2.00		End of Borehole at 2.00m	2	
								3	
								4	
Remarks: Location cleared for buried services using Cable Avoidance Tool [CAT]. Groundwater was encountered at 1.55mbgl. Location terminated due to pit instability and backfilled with arisings and made safe upon completion. Stability: Unstable							Pit Dimensions Length: (m) Width: Depth: 2.00		

   		Borehole Log		Borehole No. WS201 Sheet 1 of 1					
Project Name: Brunel University		Proj. ID: 1CO108935		Easting: Northing:					
Location: Brunel University London, Uxbridge		Plant: Archway Dart		Level (m AOD): Final Depth (m): 4.00					
Client: BDP		Crew: Borehole Solutions (North) Ltd		Start Date: 13/03/2020 End Date: 13/03/2020					
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.40 - 0.50	ES1		0.30		 Greyish brown gravelly SAND. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, concrete, ceramic, brick and glass. [MADE GROUND]	1	
		0.70 - 0.80	ES2				 Dry and friable brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, ceramic and concrete. [MADE GROUND]		
		1.40 - 1.50	ES3		1.00		 Brown slightly sandy clayey GRAVEL. Sand is fine coarse. Gravel is angular to rounded fine to coarse flint. [MADE GROUND]		
		1.90 - 2.00	ES4		1.80		 Stiff brown mottled grey silty slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]	2	
		2.50 - 2.60	ES5				..From 2.20mbgl: Becomes grey and brown mottled with no gravel.		
		3.50 - 3.60	ES6		2.70		 Stiff grey CLAY. [LONDON CLAY FORMATION] ..Between 2.80 and 2.90mbgl: Mudstone.	3	
			4.00		 End of Borehole at 4.00m	4			
								5	
								6	

Remarks:
 Location cleared for buried services using Cable Avoidance Tool [CAT]. Service inspection pit advanced to 1.20mbgl. Groundwater encountered at 1.70mbgl. Location installed with a ground gas monitoring standpipe finished with a flush fitting cover.



   			Borehole Log			Borehole No. WS202 Sheet 1 of 1					
Project Name: Brunel University			Proj. ID: 1CO108935		Easting: Northing:		Hole Type WS				
Location: Brunel University London, Uxbridge			Plant: Archway Dart		Level (m AOD): Final Depth (m): 3.00		Scale: 1:30				
Client: BDP			Crew: Borehole Solutions (North) Ltd		Start Date: 13/03/2020 End Date: 13/03/2020		REC Engineer: AB				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		0.30	ES1		1.35		Dry and friable brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint, brick, plastic, ceramic, metal, glass, cement and wood. [MADE GROUND]	1			
		0.60 - 0.70	ES2								
		1.10 - 1.20	ES3								
		1.80	ES4								
		2.30 - 2.40	ES5								
		2.90 - 3.00	ES6								
					2.00		Stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint and occasional brick and glass. [MADE GROUND]	2			
					2.80					Yellowish brown slightly clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]	3
				3.00							
End of Borehole at 3.00m								4			
								5			
								6			
Remarks: Location cleared for buried services using Cable Avoidance Tool [CAT]. Service inspection pit advanced to 1.20mbgl. Groundwater encountered at 2.10mbgl. Location Installed with a ground gas monitoring standpipe finished with a flush fitting cover.											
											

   			Borehole Log			Borehole No. WS203 Sheet 1 of 1			
Project Name: Brunel University			Proj. ID: 1CO108935		Easting: Northing:		Hole Type WS		
Location: Brunel University London, Uxbridge			Plant: Archway Dart		Level (m AOD): Final Depth (m): 3.00		Scale: 1:30		
Client: BDP			Crew: Borehole Solutions (North) Ltd		Start Date: 13/03/2020 End Date: 13/03/2020		REC Engineer: AB		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10 - 0.20	ES1		0.30		Dry and friable greyish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to rounded fine to coarse brick, flint, concrete, ceramic, plastic and glass. [MADE GROUND]	1	
		0.50 - 0.60	ES2				Brown slightly sandy very clayey GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to coarse brick and flint. [MADE GROUND]		
		1.00 - 1.10	ES3		1.50		Yellowish brown sandy GRAVEL. Sand is fine to coarse. Gravel is angular to rounded fine to coarse flint. [SUPERFICIAL DEPOSITS]	2	
		1.70 - 1.80	ES4						
		2.30 - 2.40	ES5						
		2.70 - 2.80	ES6						
				3.00		End of Borehole at 3.00m		3	
								4	
								5	
								6	

Remarks:
 Location cleared for buried services using Cable Avoidance Tool [CAT]. Service inspection pit advanced to 1.20mbgl.
 Groundwater encountered at 1.55mbgl. Location Installed with a ground gas monitoring standpipe finished with a flush fitting cover.





Phase I and II Geo-Environmental Assessment
Brunel University, Kingston Lane, London
Uxbridge UB8 3PH
May 2020
1CO108935p2r5

APPENDIX VI – CHEMICAL LABORATORY RESULTS



Ross Lawton

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Analytical Report Number : 20-92945

Replaces Analytical Report Number : 20-92945, issue no. 1

Additional analysis undertaken.

Project / Site name:	Brunel Uni - Former John Crank Building	Samples received on:	16/03/2020
Your job number:	1CO108935	Samples instructed on:	16/03/2020
Your order number:	008243	Analysis completed by:	30/03/2020
Report Issue Number:	2	Report issued on:	30/03/2020
Samples Analysed:	5 soil samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-92945

Project / Site name: Brunel Uni - Former John Crank Building

Your Order No: 008243

Lab Sample Number	1474229	1474230	1474231	1474232	1474233
Sample Reference	TP202	TP203	TP201	WS202	TP204
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.30-0.40	0.60-0.70	0.30-0.40	0.30	1.75-1.85
Date Sampled	12/03/2020	12/03/2020	12/03/2020	13/03/2020	12/03/2020
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	9.8	9.4
Total mass of sample received	kg	0.001	NONE	1.1	1.1

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Amosite	-	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	0.814	-	-	-	-
Asbestos Quantification (Stage 3)	%	0.001	ISO 17025	< 0.001	-	-	-	-
Asbestos Quantification Total (stages 2+3)	%	0.001	ISO 17025	0.814	-	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.8	9.2	8.8	10.2	8.6
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	1500	900	740	5600	670
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.76	0.45	0.37	2.8	0.33
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	760	450	371	2820	335
Organic Matter	%	0.1	MCERTS	0.5	0.3	0.1	0.9	0.7
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	0.0026	0.0016	< 0.0010	0.0053	0.0038

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.30	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.33	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.51	< 0.05	< 0.05	3.2	2.0
Anthracene	mg/kg	0.05	MCERTS	0.16	< 0.05	< 0.05	1.1	0.71
Fluoranthene	mg/kg	0.05	MCERTS	0.77	0.47	0.28	4.3	3.4
Pyrene	mg/kg	0.05	MCERTS	0.74	0.42	0.27	3.5	2.8
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.37	0.19	0.11	2.1	2.0
Chrysene	mg/kg	0.05	MCERTS	0.62	0.29	0.27	2.2	2.0
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.60	0.24	< 0.05	2.5	2.1
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.23	0.22	< 0.05	0.74	0.97
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.34	< 0.05	< 0.05	1.8	1.7
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.79	0.69
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.91	0.76

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	4.34	1.83	0.93	23.7	19.0
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Analytical Report Number: 20-92945

Project / Site name: Brunel Uni - Former John Crank Building

Your Order No: 008243

Lab Sample Number	1474229	1474230	1474231	1474232	1474233
Sample Reference	TP202	TP203	TP201	WS202	TP204
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.30-0.40	0.60-0.70	0.30-0.40	0.30	1.75-1.85
Date Sampled	12/03/2020	12/03/2020	12/03/2020	13/03/2020	12/03/2020
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	1.5	1.3	1.5	< 1.0	3.4
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	21	18	19	21	20
Barium (aqua regia extractable)	mg/kg	1	MCERTS	100	90	80	110	110
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.1	1.0	0.85	0.95	1.2
Boron (water soluble)	mg/kg	0.2	MCERTS	1.8	1.4	0.8	1.2	2.0
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	28	28	25	26	36
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	25	23	35	28
Lead (aqua regia extractable)	mg/kg	1	MCERTS	51	28	33	91	120
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	41	37	35	26	35
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	3.5	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	48	47	44	44	54
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	56	59	47	130	280

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	16
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	110
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	260
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4	< 8.4	< 8.4	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	380
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10	< 10	< 10	380

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	3.3	6.3
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	< 10	23	78
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	< 10	< 10	57	100
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	< 8.4	< 8.4	< 8.4	30	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	84	180
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	< 10	< 10	< 10	110	180



Analytical Report Number **20-92945**

Project / Site name: **Brunel Uni - Former John Crank Building**

Your Order No: **008243**

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

"The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by Gravimetric (Stage 2) Method (%)	Asbestos by PCM (stage 3) Method (%)	Total % Asbestos in Sample
1474229	TP202	0.30	133	Sheeting/Board Debris	Amosite	0.814	< 0.001	0.814

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

Analytical Report Number : 20-92945

Project / Site name: Brunel Uni - Former John Crank Building

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1474229	TP202	None Supplied	0.30-0.40	Brown clay and sand with gravel.
1474230	TP203	None Supplied	0.60-0.70	Brown clay and sand with gravel.
1474231	TP201	None Supplied	0.30-0.40	Brown clay and sand with gravel and brick.
1474232	WS202	None Supplied	0.30	Brown clay and sand with gravel.
1474233	TP204	None Supplied	1.75-1.85	Brown clay with gravel.

Analytical Report Number : 20-92945

Project / Site name: Brunel Uni - Former John Crank Building

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Asbestos Quantification - PCOM	Asbestos quantification by PCOM and fibre counting method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L0738-PL	W	MCERTS
Fraction of Organic Carbon in soil	Determination of fraction of organic carbon in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphénylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE

Iss No 20-92945-2 Brunel Uni - Former John Crank Building 1CO108935

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The results included within the report are representative of the samples submitted for analysis.

Page 6 of 8

Analytical Report Number : 20-92945

Project / Site name: Brunel Uni - Former John Crank Building

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
WS202		S	20-92945	1474232	b	BTEX and MTBE in soil (Monoaromatics)	L073B-PL	b
WS202		S	20-92945	1474232	b	TPHCWG (Soil)	L088/76-PL	b

**Alasdair Brooke**

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Analytical Report Number : 20-94013

Project / Site name:	Brunel University - TLC	Samples received on:	20/03/2020
Your job number:	1CO108935	Samples instructed on:	20/03/2020
Your order number:	008269	Analysis completed by:	27/03/2020
Report Issue Number:	1	Report issued on:	27/03/2020
Samples Analysed:	3 water samples		

Signed: *A. Czerwińska*

Agnieszka Czerwińska

Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.



Analytical Report Number: 20-94013

Project / Site name: Brunel University - TLC

Your Order No: 008269

Lab Sample Number				1480057	1480058	1480059		
Sample Reference				WS201	WS202	WS203		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				None Supplied	None Supplied	None Supplied		
Date Sampled				20/03/2020	20/03/2020	20/03/2020		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

General Inorganics

pH	pH Units	N/A	ISO 17025	9.2	8.1	9.2		
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	6.8	15	1.4		
Sulphate as SO ₄	mg/l	0.045	ISO 17025	756	948	444		

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	1.7	< 1.0	< 1.0		
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		

Total PAH

Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16		
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Heavy Metals / Metalloids

Antimony (dissolved)	µg/l	0.4	ISO 17025	0.9	< 0.4	0.4		
Arsenic (dissolved)	µg/l	0.15	ISO 17025	4.53	0.63	2.20		
Barium (dissolved)	µg/l	0.06	ISO 17025	41	57	39		
Beryllium (dissolved)	µg/l	0.1	ISO 17025	< 0.1	< 0.1	< 0.1		
Boron (dissolved)	µg/l	10	ISO 17025	26	110	63		
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	< 0.02	0.03		
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0		
Chromium (dissolved)	µg/l	0.2	ISO 17025	0.2	< 0.2	1.7		
Copper (dissolved)	µg/l	0.5	ISO 17025	6.5	2.6	8.4		
Lead (dissolved)	µg/l	0.2	ISO 17025	0.5	< 0.2	< 0.2		
Mercury (dissolved)	µg/l	0.05	ISO 17025	0.12	< 0.05	< 0.05		
Nickel (dissolved)	µg/l	0.5	ISO 17025	3.3	2.3	1.8		
Selenium (dissolved)	µg/l	0.6	ISO 17025	6.1	5.8	7.0		
Vanadium (dissolved)	µg/l	0.2	ISO 17025	1.0	< 0.2	0.5		
Zinc (dissolved)	µg/l	0.5	ISO 17025	1.1	5.0	4.0		



Analytical Report Number: 20-94013

Project / Site name: Brunel University - TLC

Your Order No: 008269

Lab Sample Number				1480057	1480058	1480059		
Sample Reference				WS201	WS202	WS203		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				None Supplied	None Supplied	None Supplied		
Date Sampled				20/03/2020	20/03/2020	20/03/2020		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10		

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C35 - C44	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic (C5 - C44)	µg/l	10	NONE	< 10	< 10	< 10		

U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number : 20-94013

Project / Site name: Brunel University - TLC

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
TPH in (Water)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding.	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.