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Contamination Gap Analysis

Waterside and Riverview, Oxford Road, Uxbridge, London UB8 1HS

On behalf of BYM Capital

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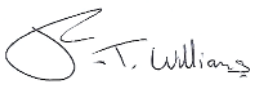
V1.01			
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1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by BYM Capital on the 2nd November 2022 to conduct a Contamination Gap Analysis on the site referred to as Waterside and Riverview, Oxford Road, Uxbridge, London UB8 1HS. The scope of the investigation was detailed within the Ground and Water Limited fee proposal (reference: GW-1390).

1.2 Aims of the Investigation

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

This report summarises the following reports, which should be read in conjunction with this report:

- Phase I Desk Study Report, produced by Ground and Water Limited (report reference: GWPR2463/DS/March 2018) (presented in Appendix B);
- Phase II Contamination Assessment Report, produced by Ground and Water Limited (report reference: GWPR3283/GIR/December 2019) (presented in Appendix C); and,
- Remediation and Validation Method Statement, produced by Ground and Water Limited (version 1.01 issued 18/12/2020).

This report references the Desk Study Reports by third parties referenced, that could be made available upon request. Ground and Water Limited cannot be held accountable from any shortcomings within these reports:

- Phase I Environmental Audit of The Uxbridge Park Estate, Uxbridge by WSP Environmental Limited, dated March 2003 (Ref: 12021154).
- A Phase I Environmental Assessment, undertaken by WSP Environmental Limited in April 2013 (report ref: 38109).

It should be noted that all of the above reports refer to the building Bridge House, which is no longer scoped into this investigation, given that extensive contamination testing and assessment was undertaken to satisfy planning conditions.

1.3 Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

Reference has been made to historical site investigations by WSP Environmental Limited. Ground and Water Limited cannot be held liable for any shortcomings.

2.0 PROJECT BACKGROUND AND PLANNING APPLICATIONS

2.1 Site Location

The site comprised a 26,350m^2 rectangular shaped plot of land, orientated in a north-east to south-west direction. The site was situated on the southern side of Oxford Road, on the far south-eastern side of the Colne Valley Regional Park. The Grand Union Canal and the River Colne ran directly along the south-eastern and western boundaries of site respectively. The site was located in north-west Uxbridge, west Greater London

2.2 Site Description

At the time of a site walkover undertaken in February 2018, the site was used as a commercial space, with three large office buildings present onsite. The offices were operated by Xerox (UK) Limited (a printing equipment supplier). On-site parking within a multi-storey car park and a ground-level car park were also provided.

The site was primarily covered with concrete and tarmac hardstanding with an outside ground-level car park noted in the eastern portion of site. The western and north-western portions of site were covered in grass soft landscaping, used as communal amenity areas with several picnic benches present.

Two electricity sub-stations were noted on site; one was located in the middle of the site within the car park and the other adjacent to the three-storey buildings within the western portion of the site. No potential sources of asbestos were observed in the existing building fabrics on site.

2.3 Proposed Development

At the time of reporting in December 2022, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Additionally, extensions were proposed off of Riverview House and Waterside House.

Four planning applications have been put forward relating to the above proposed development and have been summarised in the following table.

Summary of Planning Applications		
Planning Application	**Property**	**Description**
40050/APP/2020/999	Waterside	Change of use from commercial (office) to residential.
40050/APP/2020/1009	Riverview	Change of use from commercial (office) to residential.
40050/APP/2021/1916	Waterside	Two-storey extension
40050/APP/2021/2467	Riverview	Two-storey extension

3.0 REVIEW OF PHASE I DESK STUDY REPORT

3.1 Summary of Previous Report (report reference: GWPR2463/DS/March 2018)

3.1.1 Site Background

Geology and Radon:

The Desk Study revealed the site was situated on Alluvium overlying the bedrock deposits of the Lambeth Group. No areas of Made or Worked Ground were noted in a 250m radius of site.

A BGS borehole noted ~168m south-east of site revealed Made Ground to a depth of 0.90m bgl comprising a black/brown/blue clay soil with stones and bricks overlying a soft grey and brown silty clay, peat and a soft grey silty clay and peat to 2.60m bgl. Gravel and grey sand was then encountered to ~5.30m bgl overlying a very stiff blue/brown mottled clay for the remainder of the borehole, a depth of 9.14m bgl. Groundwater was encountered at ~2.60m bgl.

The site was not located in an area where Radon protection measures were likely to be required.

Hydrogeology and Hydrology:

The Desk Study revealed the site to be located on a Secondary A Aquifer relating to the Alluvium and the Lambeth Group.

Examination of the Environment Agency records showed that the site was not located within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water features were the River Colne and the Grand Union Canal, which ran directly along the western and eastern boundaries of site respectively.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (3-6m bgl)) and it was considered that the groundwater was flowing in a south-westerly direction, in line with local topography.

Examination of the Environment Agency records showed that the majority of the site fell within a Flood Zone 1 (an area with a low probability of river or sea flooding). However, the eastern and western boundaries which front the River Colne and Grand Union Canal were classified as a Flood Zone 3, defined as land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding.

3.1.2 Historical Mapping

Historical Land-Use of the Site:

By 1865, the site was occupied by open land and three landing / loading stages were shown at the north of the site. The site had been cleared by 1959 and by 1962, a mill was present on site. By 1972, the site took its current form with three commercial buildings present (labelled as warehouses and a depot) with associated car parking. A tank was labelled on site adjacent to the River Colne during the 1970s and 1980s. No further changes were noted on site.

Historical Land-Use of the Surrounding Area:

The earliest historic map for the site, dated 1865, revealed that the area to the north-east and east

was undeveloped but various wharfs, sawmills, a brewery, flour mill and other commercial and industrial uses were shown in the remainder of the surrounding area. Commercial and industrial expansion took place during the early 1900s with a timber yard, corn mill, a steel and barrel works and a railway terminus all present within 250m. Residential expansion also took place during this time. Commercial and industrial expansion continued in the surrounding area, particularly to the east and north-east of the site into the 1960s with an asbestos works, engineering works, printing works, warehouses and depots present by the 1980s. By the 1990s, the majority of these commercial and industrial uses were labelled as warehouses and depots. A piggery was also present to the north-west of the site. By 2010, the area to the east and south-east was labelled as an industrial estate with Fassnidge Park beyond. No further significant changes were noted in the surrounding area.

3.1.3 GroundSure Datasheets

The Groundsure Datasheetsrevealed nine on-site records and eight-two off-site records of potentially contaminative uses within a 250m radius comprising: 6 x unspecified wharfs on site (1897 to 1959), 1 x sawmill on site (1895), 1 x unspecified wharf (1897), 2 x unspecified wharf 10m south-west (1913 and 1938), 3 x unspecified commercial / industrial uses 11m and 14m south-east (1959 and 1987), 6 x timber yards between 14m and 19m south-east (1913 to 1938), 3 x steel barrel works between 17m and 19m south-east (1935 to 1938), 2 x unspecified warehouses 27m west (1974 and 1987), 1 x unspecified wharf 27m north-east (1970), 7 x unspecified works between 36m and 102m south-east (1970 and 1989), 2 x basins 40m and 93m north-east (1882), 1 x sawmill 45m south-east (1897), 1 x unspecified mill 49m south-east (1897), 2 x nurseries 52m west (1932 and 1959), 1 x brewery 71m south-east (1897), 1 x sawmill 88m east (1897), 8 x sawmills between 93m and 107m north-east (1895 to 1938), 1 x unspecified mill 97m north-east (1959), 2 x terminus between 100m and 104m south-east (1913), 2 x railway sidings 111m and 141m east (1959 and 1938), 3 x terminus between 114m and 118m east (1935 to 1938), 1 x unspecified wharf 116m south (1932), 1 x steel works 118m south (1913), 2 x unspecified works 119m north-west (1989 and 1975), 3 x corn mill between 121m and 204m north (1882 to 1912), 2 x steel barrel works 122m and 167m south (1913 and 1932), 1 x railway sidings 128m north-east (1938), 6 x mortuaries (one location) between 140m and 163m south-east (1913 to 1938), 11 x unspecified mills between 188m and 208m north (1895 to 1989), 1 x railway building 211m north-east (1938), 1 x unspecified works 218m south-east (1970), 2 x unspecified works 246m south (1974 and 1987).

Five onsite records and twenty-one off-site records of historical tanks within a 250m radius comprising: 5 x unspecified tanks on site (1975 to 1996), 10 x unspecified tanks between 35m and 80m south-east (1975 to 1996), 3 x unspecified tanks between 37m and 38m west (1981 to 1992), 6 x tanks between 78m and 88m south-east (1975 to 1996), 2 x unspecified tanks 198m north (1974 and 1987).

Thirty-seven off-site records of historical energy features within a 250m radius comprising: 5 x electricity sub-stations between 35m and 186m north-west (1974 to 1992), 9 x electricity sub-stations between 88m and 240m south-east (1975 to 1996), 19 x electricity sub-stations between 199m and 221m north (1974 to 1992), 3 x electricity sub-stations between 202m and 204m north-east (1987 to 1992).

One off site record of historical garage and motor vehicle repair features within a 250m radius: 1 x garage 114m east (1974).

Nineteen on site records and twenty-one off-site records of potentially infilled land noted within 250m of the site: 12 x canals on site (one canal) (1868 to 1959), 7 x unspecified wharfs on site (1897 to 1959), 5 x canals between 2m and 3m south-east (1882 to 1989), 2 x unspecified wharfs 10m south-west (1913 and 1938), 1 x unspecified wharf 27m north-east (1970), 7 x canals between 53m and 59m north-east (1895 to 1938), 1 x unspecified wharf 116m south (1932), 2 x canals 185m south (1900 and 1932), 1 x pond 207m south-east (1897), 2 x fish ponds 214m and 219m south-east (1868 and 1882).

Three on site records and thirty-two off-site records potentially contaminative industrial sites noted within 250m of the site comprising: 2 x electricity sub-stations on site, 1 x Xerox Ltd (industrial features) on site, 1 x tank 32m west, 1 x electricity sub-station 37m north-west, 1 x A R R I GB Ltd (consumer products) 59m south-east, 1 x Highbridge Industrial Estate (industrial features) 66m south-east, 1 x L G International Ltd (consumer products) 69m north, 1 x We Do Any Clearance (recycling services) 69m north, 2 x electricity sub-stations 73m and 78m south-east, 1 x Works (industrial features) 79m south-west, 1 x Arri Media (household office, leisure and garden) 82m south-east, 1 x Otsuka Pharmaceuticals UK Ltd (industrial products) 98m south-east, 2 x electricity sub-stations 100m and 163m south-east, 1 x depot 111m south-east, 3 x electricity sub-stations between 119m and 140m north, 1 x electricity sub-station 148m south, 1 x Union Business Park 171m south, 1 x depot 177m south-east, 1 x Coolwater4you (industrial products) 179m north-west; 1 x Thames Valley Hire Service Ltd (hire services) 179m north-west, 2 x works 180m and 205m north; 1 x landing stage 185m north-east, 1 x jetties 199m north-east, 1 x electricity sub-station 206m north, 1 x electricity sub-station 208m north-east, 1 x Denham Yacht Station 211m north-east, 1 x Tideway Adventurers Narrowboat Project (hire services) 211m north-east, 1 x E T Enterprises Ltd 232m south; and 1 x Warehouse 247m south-west.

3.1.4 Additional Data:

A previous investigation outlined in the Phase I Environmental Assessment was undertaken by WSP in April 2013 (report ref: 38109) revealed a borehole had been drilled onsite to ~11.00m bgl. Fill material was noted to a maximum depth of 2.50m bgl. The composition of the Fill material typically consisted of various amounts of clay, silt, sand and gravel of flint, brick, concrete, wood, plastic, wire and clinker. Below this Fill, superficial alluvial clay deposits comprising predominantly of clay and peat overlying flint and shell gravel were encountered proved to a maximum depth of 3.30m bgl. The soil geology of the Reading Beds was encountered beneath the alluvial deposits, and was proved to the base of each borehole. The Reading Beds are described as a brown and bluish grey clsely fissured silty clay becoming sandy with depth below 11.00m bgl. Standing groundwater levels were recorded at typical depths of between 1.50m and 2.00m bgl

The report refers to a previous Report on Ground Investigation, prepared by Weeks Site Investigation Services, dated June 1998 (ref. S.10596); a Factual Report on Gas Contamination, prepared by Upton McGougan PLC, dated October 1998 (ref: S.10596B); and a Report on Site Investigation at Highbridge Industrial Estate, prepared by Structural Soils Ltd, dated February 1997 (ref: 61171).

Previous investigations have shown the site to be free from significant site-wide contamination. Isolated areas of contamination, including slight groundwater contamination were encountered.

However, the contaminant levels identified were not considered to be of significant concern to the use of the site as an industrial park.

The Waterside House and Riverview House reportedly include a gas-resistant membrane and passive venting as a precautionary measure to mitigate the risk of ground-gas.

3.1.5 Assessment of On-Site Sources of Contamination

A summary of the on-site sources of contamination is provided within the following table. The sources to be considered further are highlighted.

Summary of On-site Sources		
On-Site Source	**Specific Contaminants**	**Risk Assessment/Scoping**
Demolition and Construction Activities (last developed in 2002)	• Heavy metals & semi-metals; • Polycyclic Aromatic hydrocarbons (PAHs); • Total Petroleum Hydrocarbons (TPHs); • Asbestos.	To be assessed further in the Phase II Site Investigation
Historical records of a mill/sawmill (last recorded during the 1960s) and warehouses/depots (last recorded in 2002)	• Heavy metals & semi-metals; • Polycyclic Aromatic hydrocarbons (PAHs); • Total Petroleum Hydrocarbons (TPHs); • Asbestos.	To be assessed further in the Phase II Site Investigation
Historical records of canals/wharfs (last recorded in 1979)	• Heavy metals & semi-metals; • Polycyclic Aromatic hydrocarbons (PAHs); • Total Petroleum Hydrocarbons (TPHs); • Asbestos.	The overall risk is deemed to be low, but the same contaminants will be assessed within the Phase II Site Investigation anyway.
On-site alluvial deposits	• Ground-gases	To be assessed further in the Phase II Site Investigation.
Historical electricity sub-stations (last recorded in 1992)	• Polychlorinated Biphenyls (PCBs)	As the electricity sub-stations were likely developed as part of the office development post 1992, it was unlikely that PCB oils were used, and therefore this risk was discounted from the Phase II Site Investigation.

3.1.6 Assessment of Offsite Sources of Contamination

A summary of the on-site sources of contamination is provided within the following table. The sources to be considered further are highlighted.

Summary of On-site Sources		
On-Site Source	**Specific Contaminants**	**Risk Assessment/Scoping**
Historical and current industrial works within a 250m radius of the site	• Heavy metals & semi-metals; • Polycyclic Aromatic hydrocarbons (PAHs); • Total Petroleum Hydrocarbons (TPHs); • Asbestos.	To be assessed further in the Phase II Site Investigation.
Historical tanks ~95m east/south-east of the site	• Heavy metals & semi-metals; • (PAHs); • Organic compounds.	Given the age of the tanks and their distance from the site, and the presence of the canal and river adjacent to the site will likely limit the migration of soil onto the site from the west and south-east. The tanks were also encountered parallel to the groundwater gradient, limiting any migration pathways to site. Therefore, this source of contamination can be discounted.
Wharf and associated features within 250m radius of the site	• Heavy metals & semi-metals; • Total Petroleum Hydrocarbons (TPHs); • (PAHs); • Solvents; • Inorganic chemicals.	Given the age of the wharfs and likely time since infilling (>45 years), it is unlikely that any residual contamination would still be present onsite and that the fill would be producing harmful levels of carbon dioxide and

Summary of On-site Sources		
On-Site Source	**Specific Contaminants**	**Risk Assessment/Scoping**
Infilled features within 250m radius of site	• Ground-gases	methane. Therefore, this source of contamination can be discounted.
Garage 114m east	• lubricant oils; • brake fluids; • Waste fluid is generated during repair work on brake systems); • Solvents (chlorinated hydrocarbons, carbon tetrachloride, paraffin and proprietary degreasing compounds); • paints (lead-based paints, zinc-rich epoxy primers, polyurethanes as decorative finishes); • gasoline; • diesel; and • paraffin	Given the distance from site and location parallel to the groundwater gradient, it is unlikely any spills or leaks would migrate onto site via the underlying soils and groundwater. The presence of the River Colne and Grand Union Canal would also likely limit any contaminant migration from the west and south-east. The garage was also encountered parallel to the groundwater gradient, limiting any migration pathways to site. Therefore, this source of contamination can be discounted.
Electricity substation 95m east	• PCBs	Given the age of the electricity sub-stations (post-1970s) and distances from the site, it was considered unlikely to pose a contamination risk from site. Therefore, the potential risk can be discounted.

3.1.7 Conceptual Site Model

The previous conceptual site model has been provided below.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs; however, the main source of ground-gas is likely to come from Alluvium deposits underlying site; however, rates for ground-gas production are generally low. • Carbon Dioxide; • Methane;	• Migration through anthropogenic & natural pathways • Inhalation • Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers;
Made Ground on-site by historic demolition and construction activities • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • PAHs; • TPHs; • Asbestos (building material, pipe lagging). Residual contamination risk from historic industrial use on-site • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).	• Direct ingestion of soil and soil derived dust; • Dermal contact of soil and soil derived dust; • Ingestion of soil with elevated concentration of determinants; • Dermal contact with impacted soils; • Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. • Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. • Via anthropogenic (man-made) pathways; and • Via Made Ground (if present), Alluvium, Lambeth Group **Due to the change in use from commercial to residential, the end-user sensitivity is increased.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers; • Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).	• Direct ingestion of soil and soil derived dust; • Dermal contact of soil and soil derived dust; • Ingestion of soil with elevated concentration of determinants; • Dermal contact with impacted soils; • Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. • Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. • Via anthropogenic (man-made) pathways; and • Via Made Ground (if present), Alluvium, Lambeth Group **Due to the change in use from commercial to residential, the end-user sensitivity is increased.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers; • Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

3.1.8 Recommendations

This section of the report will present recommendations for the further investigation of each plausible pollutant linkage identified by the Conceptual Site Model. On the basis of the Phase 1 Site Assessment the following contaminants of concern have been identified:

- Semi-metals and heavy metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc;
- Asbestos (fibrous material screen and identification if suspected material encountered);
- Polycyclic Aromatic Hydrocarbons (PAH's) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene;
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split.
- BTEX Compounds, including MTBE (used as marker compounds for VOCs);

The list above does not imply that these chemicals are present on-site or that they are likely to cause contamination issues at the site. The sampling and testing strategy must be in line with current standards.

It is understood that an Asbestos survey has been commissioned for the site. The full extent of this report must be reviewed and implemented to prevent the cross-contamination of soils onsite by poor demolition/asbestos removal practices.

The Conceptual Site Model had determined that there is a risk that levels of methane and carbon dioxide may be being produced by the Alluvium, and potentially deep Made Ground underlying, and in a close proximity, of the site. Further risk assessment is therefore recommended. A site investigation should be undertaken to determine the ground conditions across the site to in relation to possible deep Made Ground and the presence of peat in the Alluvium. Appropriate monitoring of ground-gases is likely to be required with reference to current technical guidance should such materials be

encountered. This should be reference against the gas protection measures installed and the proposed change of use.

4.0 REVIEW OF PHASE II CONTAMINATION RISK ASSESSMENT AND REMEDIATION STRATEGY

4.1 Summary of Previous Report (report reference: GWPR3283/GIR/December 2019)

4.1.1 Site Works

Site works were undertaken on the 22nd and 23rd August 2019 and comprised the drilling of 8No. Windowless Sampler Boreholes WS1 – WS3 and WS5 – WS8 to a depth of 5.45m bgl. WS4 was undertaken to 0.80m bgl. Standard Penetration Tests (SPT's) were undertaken at 1.0m intervals. 5No. groundwater/ground-gas monitoring wells were installed in WS5 at 2.50m bgl, WS3 at 3.00m bgl and WS1, WS6 and WS8 at 4.00m bgl. The construction of the wells installed can be seen tabulated below.

Combined Ground-gas and Groundwater Monitoring Well Construction				
Trial Hole	**Depth of Installation (m bgl)**	**Thickness of slotted piping with gravel filter pack (m)**	**Depth of plain piping with bentonite seal (m bgl)**	**Piping external diameter (mm)**
WS1	4.00	3.00	1.00	50
WS3	3.00	2.00	1.00	50
WS5	2.50	1.50	1.00	50
WS6	4.00	3.00	1.00	50
WS8	4.00	3.00	1.00	50

4.1.2 Soil Conditions

Made Ground

Made Ground was encountered from ground level to a depth of between 0.80 - 1.60m bgl across WS1 – WS8 and generally comprised a black to dark brown/brown to dark grey silty gravelly sand to silty sandy gravel. The sand was fine to coarse grained. The gravel was fine to coarse sub-angular to sub-rounded cement (5%), tarmac (5%), ash (10%), clinker (10%), flint (15%), concrete (15%), slate (20%) and brick (20%).

Alluvium

Alluvium was encountered from 0.80 – 1.60m bgl to a depth of 1.90 - 4.30m bgl in WS1 – WS3 and WS5 – WS8. The soils generally comprised an orange brown/brown/grey mottled gravelly sandy silty clay. The sand was fine to medium grained. The gravel was fine to medium sub-angular to subrounded flint and slate fragments. Traces of carbonaceous material were noted in WS1 from 2.90 – 3.40m bgl. Fine shell fragments were noted from 1.00 - 2.00m bgl in WS3. Wood fragments were noted from 0.90 – 1.90m bgl in WS5. Shell fragments were noted from 0.90 – 3.20m bgl and decayed wood fragments and organic odour were noted at 3.00m bgl in WS6. Shell fragments were noted from 1.60 – 2.90m bgl in WS7. Shell fragments were noted from 1.40 – 4.30m bgl in WS8.

The anthropogenic materials (concrete, plastic and brick fragments) noted from 3.40 - 4.30m bgl in WS1 may be due to backfill from shallow depth and collapse during sampling or could be Made Ground at depth.

Taplow Gravel Member

Taplow Gravel Member was encountered from 1.90 - 4.30m bgl to a depth of 5.45m bgl in WS1 – WS3 and WS5 – WS8. The soils comprised a dark brown light brown to orange to pale grey silty clayey

gravelly sand to clayey sandy gravel. The sand was fine to coarse grained. The gravel was fine to coarse sub-angular to sub-rounded flint.

4.1.3 Groundwater

Groundwater was encountered in WS7 at 2.90m bgl and WS6 and WS8 at 3.20m bgl during the intrusive investigation. During subsequent monitoring groundwater was not recorded in WS1 and only during one visit in WS3 at 1.90m bgl. WS5, WS6 and WS8 recorded groundwater during every visit at a depth of between 2.04 – 2.40m bgl.

4.1.4 Chemical Laboratory Testing

A programme of chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by DETS Limited, was undertaken on nine samples of Made Ground. The samples tested and the reason for testing can be seen tabulated below.

Methodology for Sampling Locations and Chemical Laboratory Testing			
Trial Hole	**Depth (m bgl)**	**Sampling Strategy**	**Current-Use**
WS3	0.20	Representative samples of Made Ground	Soft landscaping
WS4	0.20		Hardstanding
WS5	0.50		Soft landscaping
WS7	0.20		Soft landscaping
WS1	0.50		Soft landscaping
WS2	0.50		Hardstanding
WS8	0.50		Soft landscaping

The analysis suite is presented below and comprised:

- Semi Metals and Heavy Metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl)
- Asbestos Screen (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl)
- Polycyclic Aromatic Hydrocarbons (PAH's) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl)
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split (WS4/0.20, WS5/0.20 and WS2/0.50m bgl)
- BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) and MTBE – used as marker compounds for Volatile Organic Compounds (VOCs) split (WS4/0.20, WS5/0.20 and WS2/0.50m bgl).

Based on the proposed development, the results of the chemical laboratory testing were compared to the LQM/CIEH Suitable 4 Use Levels (S4UL) for a 'Public Open Spaces near Residential Housing (POSresi)' land-use scenario, as this was considered the most appropriate land-use scenario. The C4SL LLTC for Lead was compared to a 'Public Open Spaces near Residential Housing (POSresi)' land-use

scenario. The results showing exceedances of the representative contaminant concentrations only are presented in the table below.

Soil Guideline Values and General Acceptance Criteria Results			
Determinand	**Adopted Screening Value (mg/kg)**	**Contaminant Concentration Range (mg/kg)**	**Was the adopted screening value exceeded for relevant land-use scenario?**
Zinc	200 (Phytotoxicity)	3080	WS3/0.20m bgl
Benzo(a)anthracene	29	44.60 – 89.30	WS7/0.20m, WS8/0.20m and WS2/0.50m bgl
Chrysene	57	78	WS8/0.20m bgl
Benzo(b)fluoranthene	7.10	8.08 – 92.40	WS3/0.20m, WS5/0.20m, WS7/0.20m, WS8/0.20m and WS2/0.50m bgl
Benzo(a)pyrene	5.70	14.20 – 79.50	WS3/0.20m, WS5/0.20m, WS7/0.20m, WS8/0.20m and WS2/0.50m bgl
Dibenzo(a,h)anthracene	0.57	0.64 – 8.15	WS3/0.20m, WS4/0.20m, WS5/0.20m, WS7/0.20m, WS8/0.20m and WS2/0.50m bgl

CL:AIRE Statistical analysis was undertaken on the PAH results which revealed the exceedances were not hotspots. Therefore, the elevated levels of PAH's in the samples of Made Ground analysed are thought to pose a site wide risk.

4.1.5 Groundwater Risk Assessment Summary

Given the likely low mobility of the Zinc and the low permeability of the Alluvial clays inhibiting the PAH migration, qualitative risk assessment has indicated that the determinants noted pose no risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding. Additionally, given there is no change in the external layout or amounts of hardstanding onsite, further leachate generation is very limited.

4.1.6 Ground-Gas Risk Assessment Summary

Based on the data to date a maximum Carbon Dioxide concentration of 5.5% by volume in WS1 (16/10/2019) was noted. The lowest oxygen concentration recorded was 3.1% by volume in WS6 (16/10/2019). No Hydrogen Sulphide, Carbon Monoxide or Methane was detected. No Methane as LEL was detected. A worst case low and falling pressure scenario was captured.

Out of the thirty ground-gas readings undertaken on-site, only four results were >5.0%, detailed below.

- WS3 (28/08) during pressure decreasing over 26th/27th and increasing on 29th - 5.1%
- WS6 (28/08) during pressure decreasing over 26th/27th and increasing on 29th - 5.4%
- WS1 (07/10) during steady pressure - 5.0%
- WS1 (16/10) during pressure steeply decreasing on 14th before remaining steady 15th - 17th - 5.5%

No constant or peak flow rate has been measured across all monitoring. The low permeability of the Alluvium was unlikely to allow the migration of ground-gas from off-site sources. Made Ground was encountered across the site.

The Alluvium encountered was found to range between a thickness of 1.00 – 3.00m. The gas concentrations noted appear to be associated with the natural decay of relatively shallow Made Ground or the Alluvium and not an off-site source.

The maximum GSV was calculated to be 0.0055 l/hr based on Carbon Dioxide.

This indicates the site falls within a Characteristic Situation 1 (CS1) based on BS8485 (2015). However, it is noted that where carbon dioxide concentrations exceed 5% a CS2 for the site should be considered but given out of the thirty ground-gas readings undertaken on-site, only three results were >5.0% a CS1 scenario was deemed more appropriate.

A previous site investigation revealed Waterside House and Riverview House have an existing gas-resistant membrane and passive venting as a precautionary measure. Further risk assessment could be undertaken through a detailed review of the existing buildings ground floor construction.

4.1.7 Re-evaluated Phase 2 Conceptual Site Model

The re-evaluated CSM can be seen in the following tables.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However, the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • **Carbon Dioxide – low levels identified**	• Migration through anthropogenic & natural pathways • Inhalation • Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers;
Made Ground on-site by historic demolition and construction activities • **Zinc;** • **PAHs;** • Asbestos (building material, pipe lagging).	• Direct ingestion of soil and soil derived dust; • Dermal contact of soil and soil derived dust; • Ingestion of soil with elevated concentration of determinants; • Dermal contact with impacted soils; • Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. • Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. • Via anthropogenic (man-made) pathways; and • Via Made Ground (if present), Alluvium, Lambeth Group **Due to the change in use from commercial to residential, the end-user sensitivity is increased.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers; • Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, further leachate generation is very limited.**
Residual contamination risk from historic industrial use on-site • **Zinc;** • **Combustion products (PAH's);** • Asbestos (building material, pipe lagging).		

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use.	• Direct ingestion of soil and soil derived dust; • Dermal contact of soil and soil derived dust; • Ingestion of soil with elevated concentration of	• End users of the site (residents) • Site operatives during

• **Zinc;** • **PAHs;** • Asbestos (building material, pipe lagging).	determinants; • Dermal contact with impacted soils; • Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. • Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. • Via anthropogenic (man-made) pathways; and • Via Made Ground (if present), Alluvium, Lambeth Group **Due to the change in use from commercial to residential, the end-user sensitivity is increased.**	demolition and redevelopment; • Maintenance workers; • Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, further leachate generation is very limited.**

4.2 Summary of Previous Report (report reference: GWPR3283/RMS/December 2020)

4.2.1 Summary of Remedial Concerns

Given that a Characteristic Situation 1 (CS1) was assessed to be more appropriate for the site and the presence of an existing gas-resistant membrane and passive venting below Riverview House and Waterside House, ground-gas was not considered to pose a risk to end users. Further risk assessment could be undertaken through a detailed review of the existing buildings ground floor construction.

Chemical laboratory testing revealed elevated levels of zinc, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(a)pyrene, indeno(123-sd)pyrene and dibenz(a,h)anthracene within the Made Ground above their respective C4SL LLTC for a 'Public Open Spaces near Residential Housing (POSresi)' land use scenario.

Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a 'Public Open Spaces near Residential Housing (POSresi)' land-use scenario.

Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytotoxicity threshold, specialist planting may be required, and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

Given the likely low mobility of the Zinc and the low permeability of the Alluvial clays inhibiting the PAH migration, qualitative risk assessment has indicated that the determinands noted pose no risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding.

Based on a visual appraisal of the soils, the Made Ground encountered on site was not considered physically or cosmetically suitable for use on the residential site. In addition to this, given the maximum concentration of Benzo(b)fluoranthene (92.40 mg/kg), Benzo(a)pyrene (79.50 mg/kg) and Dibenz(a,h)anthracene (8.15 mg/kg) identified in the Made Ground was over six times the relevant SGV for a 'Public Open Spaces near Residential Housing (POSresi)' Land-Use Scenario a BRE Cover System could not be applied and an engineered capping system will be required if any areas of soft landscaping are proposed.

It is understood that at the time of reporting, December 2022, there are to be no changes to the external layout and there is no soft landscaping to be included within the permitted development application for the site of Riverview House and Waterside, Oxford Road, Uxbridge UB8 1HS. Therefore, it is considered that there is no remediation required at this stage. However, if there are any changes

to the proposed development which include the introduction of soft landscaping or breaking of ground floor slabs/ existing hardstanding then remedial measures will be required.

An Asbestos Management Strategy should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination. An asbestos survey of the existing buildings is required, prior to any alterations.

5.0 GAP Analysis

5.1 Contamination Identified

Chemical laboratory testing revealed elevated levels of zinc, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(a)pyrene, indeno(123-sd)pyrene and dibenz(a,h)anthracene within the Made Ground above their respective C4SL LLTC for a 'Public Open Spaces near Residential Housing (POSresi)' land use scenario.

The proposed development has changed since the previous reports and comprises the following:

At the time of reporting in December 2022, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Additionally, extensions were proposed off of Riverview House and Waterside House.

While there will be no areas of soft landscaping as part of the proposed development, where there will be the construction of two new extensions to both Riverview and Waterside House, construction workers and site operatives will be the primary receptor.

5.1.1 As referred to in the previous reports, there is an existing gas membrane in place beneath the existing structural screed topping, which will be retained with the exception of the ground planks which are to be lifted to install the new below ground drainage. Photographs of the existing membrane, among other photographs of existing measures on-site, can be viewed within Appendix D. Re-evaluated Phase 2 Conceptual Site Model

The re-evaluated CSM can be seen in the following tables.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However, the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • **Carbon Dioxide – low levels identified**	• Migration through anthropogenic & natural pathways • Inhalation • Possible Explosive Risk **A new gas membrane will be installed as part of the proposed development to replace the existing.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers;
Made Ground on-site by historic demolition and construction activities • **Zinc;** • **PAHs;** • Asbestos (building material, pipe lagging).	• Direct ingestion of soil and soil derived dust; • Dermal contact of soil and soil derived dust; • Ingestion of soil with elevated concentration of determinants; • Dermal contact with impacted soils; • Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. • Inhalation of volatiles (indoors and outdoors) with	• Site operatives during redevelopment; • Maintenance workers; • Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, further**

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from historic industrial use on-site • **Zinc;** • **PAH's;** • Asbestos (building material, pipe lagging).	elevated concentration of determinants. • Via anthropogenic (man-made) pathways; and • Via Made Ground (if present), Alluvium, Lambeth Group **Due to the change in use from commercial to residential, the end-user sensitivity is increased, however, given there are no proposed areas of soft landscaping the primary receptors of concern are construction workers.**	**leachate generation is very limited.**

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • **Zinc;** • **PAHs;** • Asbestos (building material, pipe lagging).	• Direct ingestion of soil and soil derived dust; • Dermal contact of soil and soil derived dust; • Ingestion of soil with elevated concentration of determinants; • Dermal contact with impacted soils; • Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. • Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. • Via anthropogenic (man-made) pathways; and • Via Made Ground (if present), Alluvium, Lambeth Group **Due to the change in use from commercial to residential, the end-user sensitivity is increased, however, given there are no proposed areas of soft landscaping the primary receptors of concern are construction workers.**	• End users of the site (residents) • Site operatives during demolition and redevelopment; • Maintenance workers; • Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, further leachate generation is very limited.**

5.2 Omitted Information

5.2.1 Water Supply Pipe Risk Assessment

As part of the proposed development it is expected that new water supply pipes will be installed at the site. Water supply pipes have the potential to be exposed to contaminants in the ground that can lead to unacceptable concentrations within the drinking water. If a risk is identified, specialist pipes that are protective of the drinking water are required.

A pipe selection risk assessment should be submitted to the water supply company as part of the development based on the supplier's assessment criteria. An indication of whether there is likely to be a risk can be seen tabulated below, where the PE pipe thresholds are based on *UKWIR Contaminated Land Assessment Guidance, 2014*.

Pipe Selection Risk Assessment			
Determinand	**PE Pipe Threshold (mg/kg)**	**Laboratory Analysis Range (mg/kg)**	**Was the Threshold Exceeded?**
Total BTEX and MTBE	0.1	<2 - <5	No - LOD
Total VOCs	0.5	Not tested	No
Total SVOCs	2	Not tested	No
Phenols	2	< 2	No
TPH EC5 – EC10 (aliphatics and aromatics)	2	< 4.12	No - LOD
TPH EC10 – EC16 (aliphatics and aromatics)	10	<9 - 74	Yes

Pipe Selection Risk Assessment			
Determinand	**PE Pipe Threshold (mg/kg)**	**Laboratory Analysis Range (mg/kg)**	**Was the Threshold Exceeded?**
TPH EC16 – EC40 (aliphatics and aromatics)	500	98 - 1899	Yes
Naphthalene	5	< 0.1 – 3.04	No

The results indicate that determinands were above the threshold for the use of a PE pipe at the site and alternative pipes should be utilised.

5.3 Remedial Requirements

5.3.1 Ground-Gas Protection Measures

Previous site investigation and reporting concluded that the site was classified as CS1 and did not require specific ground-gas protection measures; however, as a precautionary measure, a ground-gas membrane and sub-floor ventilation system was placed, of which photographs can be viewed within Appendix D of their current condition.

Whilst it is not required, it is recommended that following the removal of the slab, any areas of the membrane which has been destroyed should be patched up. Where the membrane is being re-installed, it should be designed in accordance with the following:

Gas Resistant Membrane (Visqueen gas barrier or similar) meeting the criteria below):

- Sufficiently impervious to the gases (methane and carbon dioxide);
- Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- Sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab);
- Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc);
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas;
- Verified by a suitably trained Ground and Water Limited Engineer in accordance with CIRIA C735.

Gas protection measures should be suitably designed by a qualified professional following confirmation of the construction design.

Prior to Construction

Prior to construction of the buildings, the following should be undertaken:

- The decommissioning of all boreholes beneath the footprint of the building, in line with the EA guidance.
- Suitable design of ground gas protection measures.

During Construction

During construction of the structure, the following should be undertaken within each plot:

- Following the excavation and construction of foundations, a passive subfloor dispersal layer should be installed, complete with ventilation bricks.
- The subfloor dispersal layer should be verified by an appropriately trained Ground and Water Limited Engineer, and photographs obtained.
- Following installation of ventilation system, a gas resistant membrane (Visqueen Gas barrier or similar) should be installed by a suitably qualified groundworker prior to pouring of the floor slab.
- The gas resistant membrane must be visually verified in accordance with CIRIA C735, by an appropriately trained Ground and Water Limited Engineer, and photographs obtained of all components (overlaps, service entries, corners, repairs). This is required prior to pouring of the floor slab.
- The floor slab should be poured to prevent any damage or loss of integrity to the installed ground gas precautions.

Verification

- Following completion of all the verification works, outlined above, a report should be submitted to the local authority for approval. This should include as a minimum, verification photographs of the visual checks.

5.3.2 Soil Contamination

It is understood that an Asbestos survey has been commissioned for the site. The full extent of this report must be reviewed and implemented to prevent the cross-contamination of soils onsite by poor demolition/asbestos removal practices.

Given the PAH and Zinc contamination in the Made Ground soils, Construction Workers and Site Operatives must be made aware of the potential risk.

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

Toolbox talks should be given to site personal specifically identifying risks associated with this report. The contractor should also ensure that an adequate risk assessment has been undertaken based on this information.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

5.3.3 Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation (e.g. underground storage tanks). Such occurrences may be discovered during the construction phases for the redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified

person and then the Local Authority will need to be informed.

5.3.4 Water Supply Pipes

The Water Supply pipe risk assessment indicated that the use of PE pipes is inappropriate at the site due to the concentrations of TPH within the soils. It is therefore recommended that the use of Metal or Barrier pipes are implemented as part of the design in order to prevent an unacceptable risk to future receptors.

APPENDIX A: Conditions and Limitations

2 The Long Barn, Norton Farm, Selborne Road, Alton, Hampshire GU34 3NB
0333 600 1221 enquiries@groundandwater.co.uk **groundandwater.co.uk**

Registered Office: Kineton House, 31 Horse Fair, Banbury, Oxfordshire OX16 0AE Registered in England No. 07032001

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly, any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the

context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to Waterside and Riverview, Oxford Road, Uxbridge, London UB8 1HS.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

APPENDIX B: Phase 1 Desk Study (without figures and appendices)

2 The Long Barn, Norton Farm, Selborne Road, Alton, Hampshire GU34 3NB
0333 600 1221 enquiries@groundandwater.co.uk **groundandwater.co.uk**

Registered Office: Kineton House, 31 Horse Fair, Banbury, Oxfordshire OX16 0AE Registered in England No. 07032001

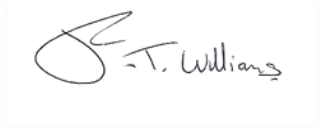
DESK STUDY REPORT

for the site at

BRIDGE HOUSE, RIVERVIEW HOUSE AND WATERSIDE, OXFORD ROAD, UXBRIDGE, MIDDLESEX, UB8 1HS

on behalf of

BYM CAPITAL LTD

Report Reference: GWPR2463/DS/MARCH 2018		Status: FINAL
Issue:	Prepared By:	Verified By:
V1.01 March 2018		
	Alice Tettmar BSc (Hons) Geotechnical and Geo-Environmental Engineer	Francis Williams MGeol (Hons) FGS CGeol CEnv AGS Director
File Reference: Ground and Water/Project Files/ GWPR2463 Bridge House, Riverview House and Waterside, Oxford Road, Uxbridge		

CONTENTS

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APPENDICES

1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by BYM Capital Ltd. on the 31st January 2018, to conduct a Desk Study on a potential redevelopment site, referred to as Bridge House, Riverview House and Waterside on Oxford Road in Uxbridge, UB8 1HS. The scope of the investigation was detailed within the Ground and Water fee proposal dated the 31/01/2018.

1.2 Aims of Investigation

This Phase 1 Desk Study was undertaken to advise the client on risk factors pertaining to the site, with special reference to former and present day potential contaminative uses and their impact on sensitive receptors. Sensitive receptors included human health, controlled waters, buildings, building materials and services.

1.3 Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A of this report.

2.0 SITE SETTING

2.1 Site Location

The site comprised a 26,350m^2, rectangular shaped plot of land, orientated in a north-east to south-west direction. The site was situated on the southern side of Oxford Road, on the far south-eastern side of the Colne Valley Regional Park. The Grand Union Canal and the River Colne ran directly along the south-eastern and western boundaries of site respectively. The site was located in north-west Uxbridge, west Greater London.

A site location plan is provided within Figure 1. A plan showing the site development area is given within Figure 2.

2.2 Site Description

A site walkover was undertaken on the 26th February 2018. A description of the site, as noted during the site walkover, is tabulated below. Photographs taken during the site walkover are included in Appendix B. An aerial view of the site showing an approximate site boundary is given in Figure 3.

Site Description Sheet: Bridge House, Riverview House and Waterside, Oxford Road, Uxbridge, Middlesex, UB8 1HS	
Use of site	At the time of the site walkover in February 2018, the site was used as a commercial space, with three large office buildings present onsite. The offices were operated by Xerox (UK) Ltd. (a printing equipment supplier). On-site parking within a multi-storey car park and a ground-level car park were also provided.
Site topography	The site was relatively flat and level.
Area topography	The site appeared to be flat and level. The River Colne ran along the western boundary of site, with the Grand Union Canal to the east.
Structures on-site	A small security hut was noted at the site entrance within the northern portion of the site. A seven-storey office block was noted in the north-eastern portion of the site. Directly to the south-west was a multi-storey car park, with adjacent ground-level parking. Two identical three-storey office buildings were noted within the western portion of the site and towards the southern end of site.
Structures off-site and surrounding land use	The surrounding area was primarily commercial, with similar style offices / commercial business parks noted around the site. The site was located between the River Colne and the Grand Union Canal, running along the eastern and western boundaries of site.
Boundary features	Northern boundary: Oxford Road (A4020 road) ran directly along the northern site boundary, adjacent to the site entrance; Eastern boundary: Low-lying shrubs and bushes with the Grand Union Canal directly beyond; Southern boundary: Large trees and shrubs; Western boundary: Large approximately 10m high mature / semi-mature trees and shrubs, with the River Colne running directly beyond.
Site covering	The site was primarily covered with concrete and tarmac hardstanding with an outside ground-level car park noted in the eastern portion of site. The western and north-western portions of site were covered in grass soft landscaping, used as communal amenity areas with several picnic benches present.
Contamination sources on-site	Two electricity sub-stations were noted on site; one was located in the middle of the site within the car park and the other adjacent to the three-storey buildings within the western portion of the site. No potential sources of asbestos were observed in the existing building fabrics on site.
Contamination sources off-site	None noted. An Esso petrol station was noted approximately 450m west of site.
Vegetation on-site	The majority of the vegetation on site was located along the western and eastern boundaries, along the River Colne and Grand Union Canal, comprising bushes and shrubs. Large approximately 10m high mature / semi-mature trees and shrubs were noted in western and north-western portions of the site, in the communal area of soft landscaping.
Vegetation off-site	Vegetation off-site was primarily localised along the River Colne to the east. Little vegetation was present in other directions due to the mainly commercial use of the surrounding area.
Services	Manholes and evidence of surface water mitigation measures including site drainage were noted across the site.

2.3 Proposed Development

At the time of reporting in March 2018, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Ancillary car parking, cycle storage and waste and recycling storage were also to be provided. A proposed development plan can be seen in Figure 4.

2.4 Geology

The BGS Geological Map for the Uxbridge area (Beaconsfield Sheet No. 255) indicated that the site is situated on Alluvium overlying the bedrock deposits of the Lambeth Group. No areas of Made or Worked Ground were noted in a 250m radius of site.

Alluvium - London

Alluvium in the Thames valley consists largely of silty clays and clayey silts with locally developed beds of fine to coarse grained sand mainly less than 1m thick but locally up to 4m. There are also sporadic beds with scattered pebbles and granules. Interbedded peat occurs in the east of the Thames valley. The total thickness of peat beds exceeds 2m in large areas between the confluence of the rivers Thames and Lea and Tilbury.

Lambeth Group

The Lambeth Group (formerly known as the Woolwich and Reading Beds) is a sedimentary complex comprising a basal bed (the Upnor Formation also known as the Bottom Bed) composed of glauconitic sand, sandy clay and gravel (well-rounded flint pebbles), with laterally variable sand and clay above. In the eastern part of the area the basal bed is mostly overlain by a shelly grey sandy clay or silty sand and laminated beds (Woolwich Formation). At the top of the sedimentary complex is the Reading Formation, which is made up of multi-coloured mottled clays and silty clays.

Lignite, or brown coal, a carbonaceous rock composed of plant remains which has not been subject to the same intensity of heat and pressure as has ordinary coal, is occasionally found within the Lambeth Group, as are individual logs and groups of logs indicating the position of a former log jam, which was covered by sand and clay at the time of deposition.

2.5 Hydrogeology and Hydrology

An examination of the Environment Agency website and data within the Groundsure Environmental Insight Report (presented in Appendix D) revealed the site to be located on a Secondary A Aquifer relating to the Alluvium and the Lambeth Group.

Secondary aquifers include a wide range of drift deposits with an equally wide range of water permeability and storage capacities. Secondary (A) Aquifers consist of deposits with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

Examination of the Environment Agency records showed that the site was not located within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water features were the River Colne and the Grand Union Canal, which ran directly along the western and eastern boundaries of site respectively.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (3-6m bgl)) and it was considered that the groundwater was flowing in a south-westerly direction, in line with local topography.

Examination of the Environment Agency records showed that the majority of the site fell within a Flood Zone 1 (an area with a low probability of river or sea flooding). However, the eastern and western boundaries which front the River Colne and Grand Union Canal were classified as a Flood Zone 3, defined as land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding.

2.6 Radon

BRE 211 (2015) Map 5 of the London, Sussex and West Kent area indicated that the site was located within a Radon Affected Area, as between 1% and 3% of properties were above the Action Level. The Groundsure report stated that mandatory protection measures against the ingress of radon were not likely to be required at the site.

3.0 HISTORICAL REVIEW

3.1 Historical Map Review

The objective of this search was to report on the history of the site and its environs from available County Series and Ordnance Survey maps and aerial photography, dated from 1865 to 2014, and downloaded from GroundSure Environmental Insight. Only features considered to have a potential contaminative impact on the site and usually within a notional 250m radius of the site boundaries are discussed. Any distances quoted for features remote from the site have been scaled from the maps and are only approximate. The historical maps referred to are given within Appendix C. The implications of the map search are discussed later within this report.

Environmental Significance of Data from Historical Maps

Date	Scale	Site	Environs
1865 to 1877	1:1,000 1:2,500 1:10,560	The site was occupied by open land, comprising a field. Three unlabelled structures, which appeared to be landing / loading stages were shown at the north of the site (2 adjacent to the river to the north and 1 north of the canal to the south).	The river and canal were not labelled but were shown on the western and eastern site boundaries. High Bridge was labelled immediately north. Osbourne and Crown Wharfs were shown immediately south of the canal to the north-east of the site and an adjacent steam saw mill was labelled. Adjacent unlabelled buildings were present adjacent to the saw mill from 35m to greater than 250m north-east of the site. A brewery was shown 150m east and a flour mill was labelled from 125m east. Two basins were labelled from 25m and 100m north-east of the site, adjacent to unlabelled buildings which appeared to be for commercial or industrial use. The area to the north-east and east was predominantly agricultural land, while the areas to the east and north-east appeared to be used for commercial or industrial use. The town of Uxbridge was present from 250m to the east and south-east.
1881 to 1900	1:2,500 1:10,560	No changes on site were noted.	A towing path was labelled along the eastern site boundary adjacent to the canal. The nearby watercourses were labelled the Grand Junction Canal and River Colne. By 1899, Way´s Wharf was labelled 50m north-east and Buckingham Wharf was shown 100m east. An inn was present 50m north-east and a tan yard was shown 200m east. Additional saw mills were present from 100m north-east and a corn mill was present 125m north-west.
1912 to 1920	1:2,500 1:10,560	No changes on site were noted.	By 1912, a timber yard was shown to the east of the site, immediately south of Osbourne Wharf and the saw mill. Additional units appeared to have been constructed to the east of the site within the commercial and industrial area around the wharfs. A Great Western Railway terminus was shown 100m north-east of the site. A mortuary was labelled approximately 150m south-east and residential properties were present from 250m south-east which formed part of the major residential expansion taking place in and around Uxbridge during this period. By 1920, a steel barrel works was labelled 250m south.
1932 to 1938	1:2,500 1:10,560	No changes on site were noted.	By 1932, the timber yard to the east of the site had expanded significantly to the south-east and the corn mill to the north-west was no longer labelled. The area of open land immediately west of the site was labelled as a recreation ground (war memorial) and Willowbank nursery was present from 50m west. Fassnidge recreation ground, which included a bandstand, putting green, bowling green and tennis courts, was present 100m south-east.
1959 to 1963	1:2,500 1:10,560	The site had been cleared by 1959 and by 1962, a mill with four adjacent structures and a crane were present at the centre of the site. An unlabelled structure was also present to the north.	The entire area to the east and south-east, comprising the former timber yard, brewery and saw mills was now labelled as several works. Osbourne and Crown Wharfs remained labelled to the east and a chimney was labelled 85m east. Residential expansion to the south-east from 200m from the site boundary had taken place. Three Ways Wharf was labelled 100m north-east and additional works were shown from 50m south-east.

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Environmental Significance of Data from Historical Maps			
Date	**Scale**	**Site**	**Environs**
1967 to 1974	1:1,250 1:10,560 1:10,000	By 1972, the site took its current form with three commercial buildings present (Bridge House labelled at the north and the remaining buildings labelled as warehouses) and what appeared to be car parking areas.	By 1967, the nursery to the west was no longer labelled. Osbourne Farm was shown 100m north-west by 1967. Osbourne and Crown Wharfs had been infilled and Crown Wharf was no longer labelled. Additional works had been constructed to the east and south-east of the site, including an asbestos works (Fleet Works) was labelled within 50m of the south-east site boundary, engineering works, a printing works and warehouses. A box and pallet factory was labelled 100m north-east within Three Ways Wharf. By 1972, a cinema was labelled 250m north-east.
1975 to 1981	1:1,250 1:2,500 1:10,000	A tank was labelled on site adjacent to the River Colne and the warehouse at the south of the site was labelled as a depot.	The works 50m east was labelled as an enamel works. Various tanks and a hopper were labelled adjacent to the asbestos, printing and engineering works to the east and an electricity sub-station was shown 95m east. A garage was shown 125m north-east. Colne Works 150m east was labelled as a confectionary works.
1987 to 1992	1:1,250 1:2,500 1:10,000	No changes on site were noted.	The buildings to the east of the site were now labelled as works and warehouses. A warehouse was labelled to the south-west of the site, south of the River Colne. Clearance of some commercial and industrial units in the surrounding area had taken place and many residential properties had been constructed.
2002	1:10,000	No changes on site were noted.	Osbourne Farm to the north-west was labelled as a piggery. No changes were noted to have taken place in the surrounding area.
2010 to 2014	1:10,000	No changes on site were noted.	By 2010, the area to the east and south-east of the site was labelled as an industrial estate with Fassnidge Park beyond. No further significant changes were noted in the surrounding area.

4.0 GROUNDSURE DATASHEETS

4.1 GroundSure Datasheets

GroundSure Environmental and Geological Datasheets were obtained for the site. Unless the data indicates a significant risk, only information within a 250m buffer zone has been included. A copy of the GroundSure Datasheets is presented in Appendix D and a summary is given below and overleaf.

Environmental Significance of Data Search	
Source	**Type / On site or nearest distance from site / date**
Historical Industrial Sites	
Potentially Contaminative Uses identified from 1:10,000 scale mapping	**Nine on site records and eighty-two off-site records noted within 250m of the site:** **6 x unspecified wharfs on site (1897 to 1959);** **1 x sawmill on site (1895);** **1 x unspecified wharf (1897);** **2 x unspecified wharf 10m south-west (1913 and 1938);** **3 x unspecified commercial / industrial uses 11m and 14m south-east (1959 and 1987);** **6 x timber yards between 14m and 19m south-east (1913 to 1938);** **3 x steel barrel works between 17m and 19m south-east (1935 to 1938);** **2 x unspecified warehouses 27m west (1974 and 1987);** **1 x unspecified wharf 27m north-east (1970);** **7 x unspecified works between 36m and 102m south-east (1970 and 1989);** **2 x basins 40m and 93m north-east (1882);** **1 x sawmill 45m south-east (1897);** **1 x unspecified mill 49m south-east (1897);** **2 x nurseries 52m west (1932 and 1959);** **1 x brewery 71m south-east (1897);** **1 x sawmill 88m east (1897);** **8 x sawmills between 93m and 107m north-east (1895 to 1938);** **1 x unspecified mill 97m north-east (1959);** **2 x terminus between 100m and 104m south-east (1913);** **2 x railway sidings 111m and 141m east (1959 and 1938);** **3 x terminus between 114m and 118m east (1935 to 1938);** **1 x unspecified wharf 116m south (1932);** **1 x steel works 118m south (1913);** **2 x unspecified works 119m north-west (1989 and 1975);** **3 x corn mill between 121m and 204m north (1882 to 1912);** **2 x steel barrel works 122m and 167m south (1913 and 1932);** **1 x railway sidings 128m north-east (1938);** **6 x mortuaries (one location) between 140m and 163m south-east (1913 to 1938);** **11 x unspecified mills between 188m and 208m north (1895 to 1989);** **1 x railway building 211m north-east (1938);** **1 x unspecified works 218m south-east (1970); and** **2 x unspecified works 246m south (1974 and 1987).**
Historical Tanks identified from 1:1,250 and 1: 2,500 scale mapping	**Five on site records and twenty-one off-site records noted within 250m of the site:** **5 x unspecified tanks on site (1975 to 1996);** **10 x unspecified tanks between 35m and 80m south-east (1975 to 1996);** **3 x unspecified tanks between 37m and 38m west (1981 to 1992);** **6 x tanks between 78m and 88m south-east (1975 to 1996); and** **2 x unspecified tanks 198m north (1974 and 1987).**

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Environmental Significance of Data Search Cont'd	
Source	**Type / On site or nearest distance from site / date**
Historical Industrial Sites Cont'd	
Historical Energy Features identified from 1:1,250 and 1: 2,500 scale mapping	**Thirty-seven off-site records noted within 250m of the site: 5 x electricity sub-stations between 35m and 186m north-west (1974 to 1992); 9 x electricity sub-stations between 88m and 240m south-east (1975 to 1996); 19 x electricity sub-stations between 199m and 221m north (1974 to 1992); and 3 x electricity sub-stations between 202m and 204m north-east (1987 to 1992).**
Historical petrol and fuel stations identified from 1:1,250 and 1: 2,500 scale mapping	No records on site or within 250m of the site.
Historical Garage and Motor Vehicle Repair features identified from 1:1,250 and 1: 2,500 scale mapping	**One off site record noted within 250m of the site: 1 x garage 114m east (1974).**
Potentially Infilled Land identified from 1:10,000 scale mapping	**Nineteen on site records and twenty-one off-site records noted within 250m of the site: 12 x canals on site (one canal) (1868 to 1959); 7 x unspecified wharfs on site (1897 to 1959); 5 x canals between 2m and 3m south-east (1882 to 1989); 2 x unspecified wharfs 10m south-west (1913 and 1938); 1 x unspecified wharf 27m north-east (1970); 7 x canals between 53m and 59m north-east (1895 to 1938); 1 x unspecified wharf 116m south (1932); 2 x canals 185m south (1900 and 1932); 1 x pond 207m south-east (1897); and 2 x fish ponds 214m and 219m south-east (1868 and 1882).**
Environmental Permits, Incidents and Registers	
Industrial Sites holding licences and / or authorisations	
Records of historic IPC Authorisations	No records on site or within 250m of the site.
Records of Part A (1) and IPPC Authorised Activities	No records on site or within 250m of the site.
Records of Red List Discharge Consents	No records on site or within 250m of the site.
Records of List 1 and List 2 Dangerous Substances Inventory Sites	**Two off-site records noted within 250m of the site: 1 x Electro Hi-tech Ltd Unit D 2 Riverside Drive 235m south (List 1) unnamed substance; and 1 x Electro Hi-tech Ltd Unit D 2 Riverside Way 235m south (List 1) unnamed substance.**
Records of Part A (2) and Part B Activities and Enforcements	No records on site or within 250m of the site.
Records of Category 3 or 4 Radioactive Substances Authorisations	No records on site or within 250m of the site.
Records of Licensed Discharge Consents	**Eight off-site records noted within 250m of the site: 2 x Braybourne Close 188m north-east. Sewage discharges - Pumping station. Temporary consents (1989) and surrendered under EPR (2010); 1 x The Lock House 221m north-east. Sewage discharges – final / treated effluent. New issued under EPR (2010); 1 x Apex Works 222m north-west. Trade discharges - cooling water. Revoked (1968); 1 x Premises, Willowbank 222m north-west. Trade discharges - cooling water. Revoked (1975); 1 x Riverside way 240m south. Sewage discharges - pumping station. Temporary consents (1989) and surrendered under EPR (2010); and 1 x Rockingham Road 241m south. Trade discharges - cooling water. Revoked (1971).**

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Environmental Significance of Data Search Cont'd	
Source	**Type / On site or nearest distance from site / date**
Environmental Permits, Incidents and Registers Cont'd	
Records of Water Industry Referrals (potentially harmful discharges to the public sewer)	**One off-site record noted within 250m of the site:** **1 x Electro Hi-tech Ltd 285m south-west (2010).**
Records of Planning Hazardous Substance Consents and Enforcements	No records on site or within 250m of the site.
Dangerous or Hazardous Sites	
Records of COMAH & NIHHS sites	No records on site or within 250m of the site.
Environment Agency Recorded Pollution Incidents	
Records of National Incidents Recording System, List 1 and 2	**Six off-site records noted within 250m of the site:** **1 x contaminated water 49m north-east (List 2): water impact - category 3, land impact - category 4, air impact - category 4 (2001);** **1 x grey water 155m north-west (List 2): water impact - category 3, land impact - category 4, air impact - category 3 (2001);** **1 x crude sewage 176m north-west (List 2): water impact - category 3, land impact - category 4, air impact - category 4 (2003;** **1 x soils and clay 219m north (List 2): water impact - category 2, land impact - category 4, air impact - category 4 (2002); and** **2 x chemically contaminated run-off 222m north (List 2): water impact - category 4, land impact - category 3, air impact - category 4 (2002).**
Sites Determined as Contaminated Land under Part 2A EPA 1990	
Records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990	No records on site or within 250m of the site.
Landfill and other Waste Sites	
Landfill Sites	
Records of Environment Agency Registered Landfill Sites	No records on site or within 250m of the site.
Records of Environment Agency Historic Landfill Sites	No records on site or within 250m of the site.
Records of BGS / DoE non-operational landfill sites	No records on site or within 250m of the site.
Records of Landfills in Local Authority and Historical Mapping	No records on site or within 250m of the site.
Records of Operational and Non-Operational Waste Treatment, Transfer or Disposal Sites	No records on site or within 250m of the site.
Records of Environment Agency Licensed Waste Sites	No records on site or within 250m of the site.
Current Land Uses	
Records of Potentially Contaminative Industrial Sites within 250m of the site	**Three on site records and thirty-two off-site records noted within 250m of the site:** **2 x electricity sub-stations on site;** **1 x Xerox Ltd (industrial features) on site;** **1 x tank 32m west;** **1 x electricity sub-station 37m north-west;** **1 x A R R I GB Ltd (consumer products) 59m south-east;** **1 x Highbridge Industrial Estate (industrial features) 66m south-east;** **1 x L G International Ltd (consumer products) 69m north;** **1 x We Do Any Clearance (recycling services) 69m north;** **2 x electricity sub-stations 73m and 78m south-east;** **1 x Works (industrial features) 79m south-west;**

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Environmental Significance of Data Search Cont'd	
Source	**Type / On site or nearest distance from site / date**
Current Land Uses Cont'd	
	1 x Arri Media (household office, leisure and garden) 82m south-east; **1 x Otsuka Pharmaceuticals UK Ltd (industrial products) 98m south-east;** **1 x depot 111m south-east;** **2 x electricity sub-stations 100m and 163m south-east;** **3 x electricity sub-stations between 119m and 140m north;** **1 x electricity sub-station 148m south;** **1 x Union Business Park 171m south;** **1 x depot 177m south-east;** **1 x Coolwater4you (industrial products) 179m north-west;** **1 x Thames Valley Hire Service Ltd (hire services) 179m north-west;** **2 x works 180m and 205m north;** **1 x landing stage 185m north-east;** **1 x jetties 199m north-east;** **1 x electricity sub-station 206m north;** **1 x electricity sub-station 208m north-east;** **1 x Denham Yacht Station 211m north-east;** **1 x Tideway Adventurers Narrowboat Project (hire services) 211m north-east;** **1 x E T Enterprises Ltd 232m south; and** **1 x Warehouse 247m south-west.**
Records of Petrol and Fuel Sites	No records on site or within 250m of the site.
Records of National Grid Underground Electricity Cables	No records on site or within 250m of the site.
Records of National Grid Gas Transmission Pipelines	No records on site or within 250m of the site.
Geology	
Artificial Ground and Made Ground	No records on site or within 50m of the site.
Superficial Ground and Drift Geology	**One record noted within a 50m radius of the site:** **1x Alluvium (Clay, Silt, Sand and Gravel)**
Bedrock and solid Geology	**One record noted within a 50m radius of the site:** **1 x Lambeth Group (Clay, Silt and Sand),**
Hydrogeology and Hydrology	
Groundwater Abstraction Licences	
Records of Aquifer within Superficial Deposits	**Two records on site and one off-site records noted within 250m of the site:** **2 x Secondary A Aquifers on site;** **1 x Principal Aquifer 178m south-east.**
Records of Aquifer within Bedrock Deposits	**Two records on site and one off-site records noted within 250m of the site:** **2 x Secondary A Aquifers on site.** **1 x Unproductive Strata 198m east.**
Records for Groundwater Abstraction Licences	No records on site or within 250m of the site.
Records for Surface Water Abstraction Licences	No records on site or within 250m of the site.
Records for Potable Water Abstraction Licences	No records on site or within 250m of the site.
Source Protection Zones	
Records for Source Protection Zones	No records on site or within 250m of the site.
Records of Source Protection Zones within Confined Aquifer	No records on site or within 250m of the site.
Records for Groundwater Vulnerability and Soil Leaching Potential	**Two records on site and no off-site records noted within 250m of the site:** **2 x Major Aquifers with High Leaching Potential on site (HU and H1).**

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Environmental Significance of Data Search Cont'd	
Source	**Type / On site or nearest distance from site / date**
Source Protection Zones Cont'd	
Records for Environment Agency Information on Biological Quality	No records on site or within 500m of the site.
Records for Environment Agency Information on Chemical Quality	No records on site or within 500m of the site.
Records for Detailed River Network entries	**Twenty-six off-site records noted within 250m of the site:** **1 x River Colne - primary river 15m south-west;** **1 x canal - Grand Union Canal Regent's Canal 6m south-east;** **2 x River Colne - primary river 6m and 12m north-west;** **1 x Drain - tertiary river 6m south-west;** **2 x River Colne - primary river 8m and 13m west;** **2 x River Colne - primary river 25m south-west;** **6 x River Colne - primary river between 27m and 102m north-east;** **4 x River Colne - primary river between 62m and 242m north;** **3 x unnamed rivers - primary river between 157m and 164m north-east;** **1 x canal - Grand Union Canal Regent's Canal 157m north-east;** **1 x Fray's River - primary river 170m east;** **2 x Fray's River - primary river and culvert 174m and 194m south-east; and** **1 x unnamed - primary river 191m north.**
Records for surface water features	**One on site record and eleven off-site records noted within 250m of the site:** **1 x water feature on site** **2 x water feature 1m and 189m south-east;** **1 x water feature 7m south-west;** **3 x water feature 14m, 16m and 190m north-east;** **1 x water feature 137m north;** **3 x water feature 141m, 192m and 208m north-west; and** **1 x water feature 167m east.**
Flooding	
Records for Environment Agency indicative Zone 2 floodplain	**One on-site record and four off-site records noted within 250m of the site:** **1 x fluvial / tidal model on site;** **1 x fluvial / tidal model 137 north-west;** **1 x fluvial / tidal model between 151m south-east;** **1 x fluvial / tidal model 159m north-west; and** **1 x fluvial / tidal model 194m south-west.**
Records for Environment Agency indicative Zone 3 floodplain	**Two on-site records and two off-site records noted within 250m of the site:** **2 x fluvial models on site;** **1 x fluvial model 16m north-east; and** **1 x fluvial model 183m south-east.**
What is the Risk of Flooding from Rivers and the Sea (RoFRaS) Rating for the Site?	**Eleven on-site records and sixteen off-site records noted within 250m of the site:** **4 x low flood rating on site;** **4 x medium flood ratings on site;** **1 x high flood rating on site;** **3 x very low ratings on site;** **1 x high flood rating 1m north;** **4 x medium flood ratings between 13m and 41m west;** **3 x low flood ratings between 16m and 39m north-east;** **3 x medium flood ratings between 17m and 29m north-west;** **2 x low flood ratings 21m north-west;** **1 x very low flood rating 22m west;** **1 x very low flood rating 36m north-west;** **1 x low flood rating 42m south-west; and** **1 x very low flood rating 44m south-east.**

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Environmental Significance of Data Search Cont'd	
Source	**Type / On site or nearest distance from site / date**
Source Protection Zones Cont'd	
Records for Flood Defences	**Two off-site records noted within 250m of the site: 1 x flood defence 185m south-east; and 1 x flood defence 236m north.**
Records for Areas Benefiting from Flood Defences	No records on site or within 250m of the site.
Records for Areas Used for Flood Storage	No records on site or within 250m of the site.
Are there any British Geological Survey groundwater flooding susceptibility flood areas within 50m of the boundary of the study site?	**Yes, relating to Superficial Deposits Flooding.**
What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?	**Potential at surface.**
What is the British Geological Survey confidence rating in this result?	**Moderate confidence rating.**
Designated Environmentally Sensitive Sites	
Records of Sites of Special Scientific Interest (SSSI)	No records on site or within 250m of the site.
Records of National Nature Reserves (NNR)	No records on site or within 250m of the site.
Records of Special Areas of Conservation (SAC)	No records on site or within 250m of the site.
Records of Special Protection Areas (SPA)	No records on site or within 250m of the site.
Records of RAMSAR sites	No records on site or within 250m of the site.
Records of Ancient Woodland	No records on site or within 250m of the site.
Records of Local Nature Reserves (LNR)	No records on site or within 250m of the site.
Records of World Heritage Sites	No records on site or within 250m of the site.
Records of Environmentally Sensitive Areas	No records on site or within 250m of the site.
Records of Areas of Outstanding Natural Beauty	No records on site or within 250m of the site.
Records of National Parks (NP)	No records on site or within 250m of the site.
Records of Nitrate Sensitive Areas	No records on site or within 250m of the site.
Records of Nitrate Vulnerable Zones	**One on site record and no off-site records noted within 250m of the site: 1 x existing on site.**
Records of Green Belt	**Two off-site records noted within 250m of the site: 1 x London Area Greenbelt (South Bucks District) 6m north-west; and 1 x London Area Greenbelt (Hillingdon London Borough) 36m south-west.**

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Geological Significance of Data Search	
Source	**Type / On site or nearest distance from site / date**
Artificial Ground	
Are there any records of Artificial / Made Ground with 500m of the site boundary?	No records on site or within 250m of the site.
Are there any records relating to permeability of artificial ground within the study site boundary?	No records on site or within 250m of the site.
Superficial Deposits and Landslips	
Records of Superficial Deposits / Drift Geology	**One on site record and two off-site records noted within 250m of the site: 1 x Alluvium (Clay, Silt, Sand and Gravel) on site; 1 x Lynch Hill Gravel Member (Sand and Gravel) 178m south-east; and 1 x Taplow Gravel Member (Sand and Gravel) 203m south-east.**
Are there any records relating to permeability of superficial ground within the study site boundary?	**Two on site records and no off-site records noted within 250m of the site: 2 x Intergranular Flow with very low to high permeability on site.**
Are there any records of landslip within a 500m radius?	No records on site or within 250m of the site.
Are there any records relating to permeability of landslips within the study site boundary?	No records on site or within 250m of the site.
Bedrock, Solid Geology & Faults	
Records of Bedrock / Solid Geology	**One record on site and one off-site record noted within 250m of the site: 1 x Lambeth Group (Clay, Silt and Sand) on site; and 1 x London Clay Formation (Clay, Silt and Sand) 198m east.**
Are there any records relating to permeability of bedrock ground within 500m of the study site boundary?	**Two records noted on site: 2 x Mixed Flow with very low to moderate permeability.**
Records of Faults	No records on site or within 250m of the site.
Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so, what percentage of homes are above the Action Level?	**The property is in a Radon Affected Area, as between 1% and 3% of properties are above the Action Level.**
Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	**No radon protective measures are necessary.**
Ground Workings	
Historical Surface Ground Working Features from small scale mapping	**Twelve on site and twenty off-site records noted within 250m of the site: 11 x canal on site; 1 x unspecified wharf on site; 4 x canals between 2m and 3m south-east (1913 to 1989); 2 x unspecified wharf 10m south-west (1913 and 1938); 1 x unspecified wharf 27m north-east (1970); 3 x canals 59m north-east (1895 to 1938); 1 x unspecified wharf 116m south (1932); 6 x mortuaries between 140m and 163m south-east (1913 to 1955); 2 x canals 185m south (1897 and 1932); and 1 x fish pond 214m south-east (1864).**
Historical Underground Working Features from small scale mapping	No records on site or within 250m of the site.
BGS Current Ground Workings	No records on site or within 250m of the site.

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Geological Significance of Data Search	
Source	**Type / On site or nearest distance from site / date**
Mining, Extraction & Natural Cavities	
Historical Mining areas	No records on site or within 250m of the site.
Coal Mining areas	No records on site or within 250m of the site.
Are there JPB Mining areas within 1000m of the site boundary?	No records on site or within 1km of the site.
Non-Coal Mining areas	**One off-site record noted within 250m of the site: 1 x Chalk mine 178m south-east.**
Non-Coal Mining cavities	No records on site or within 250m of the site.
Natural Cavities	No records on site or within 250m of the site.
Brine Extraction areas	No records on site or within 250m of the site.
Gypsum Extraction areas	No records on site or within 250m of the site.
Tin Mining areas	No records on site or within 250m of the site.
Clay Mining areas	No records on site or within 250m of the site.
Natural Hazard Findings	
Shrink-Swell Clay	**2 x Moderate hazards on site; 1 x very low hazard 46m north-east.**
Landslides	**2 x Very Low hazard on site.**
Ground Dissolution of Soluble Rocks	**2 x Negligible hazard on site.**
Compressible Deposits	**2 x Moderate hazard on site.**
Collapsible Deposits	**2 x Negligible hazard on site.**
Running Sands	**2 x Low hazard on site.**
Borehole Records	
BGS recorded boreholes	**Eight on site records and five off-site records noted within 250m of the site: 8 x Rank Xerox, Oxford Road WS1, WS6, WS3, WS5, WS7, WS8 and WS2, drilled length 1m on site; 1 x 145m south-east, drilled length 35.05m (High Street, Uxbridge); 1 x 168m south-east, drilled length 9.14m (High Street, Uxbridge BH1); 1 x 184m south-east, drilled length 6.56m (Waterworks Uxbridge); 1 x 324m east, drilled length 12m (Uxbridge Court House, Uxbridge); and 1 x 235m south, drilled length 35.81m (Hurdle Yard, Uxbridge).**
Estimated Background Soil Chemistry	
Records of background estimated soil chemistry	**On site record: Arsenic: 15-25mg/kg, Cadmium: <1.8mg/kg, Chromium: 90-120mg/kg, Nickel: 15-30mg/kg and Lead: 100-200mg/kg;**
Railways and Tunnels	
Tunnel records	None within a 250m radius.
Historical Railway and Tunnel Feature records	**Twelve off-site records within 250m of the site: 2 x railway sidings 26m and 103m south-east (1934 and 1914); 1 x railway 103m south-east (1914); 5 x railway sidings between 111m and 159m east (1934 to 1962); 3 x railway sidings between 128m and 194m north-east (1932 to 1938); and 1 x railway 181m north-east (1932).**
Historical Railways records	**Two off-site record noted within 250m of the site: 1x abandoned 107m east; and**
	1 x historical 107m east.
Active Railways records	None within a 250m radius.
Railway Project records	None within a 250m radius.

5.0 PLANNING DATABASE AND ONLINE REVIEW

5.1 Online Planning Database

A review of the London Borough of Hillingdon Planning Database revealed there are several planning applications for the site that are relevant to this Desk Study.

Planning Applications on the Site from London Borough of Hillingdon Planning Database			
Application No./ Date	**Address**	**Proposed**	**Decision**
40050/APP/2017/3358 15/11/2017	Bridge House Oxford Road Uxbridge UB8 1HS	Prior Approval application for the change of use of Bridge House from office accommodation (Class B1) to 76 residential units (Class C3) together with ancillary car parking, cycle storage and recycling storage.	Approved
40050/APP/2017/2438 04/09/2017	Bridge House, Riverview House & Waterside House Oxford Road Uxbridge UB8 1HS	Prior Approval Application for the change of use of Bridge House, Riverview House and Waterside House from office accommodation (Class B1) to 237 residential units (15 x Studio and 224 x 1-Bed) together with ancillary car parking, cycle storage and waste and recycling storage.	Approved
40050/APP/2016/852 07/06/16	Bridge House, Denbridge Ind. Estate Oxford Road Uxbridge	Demolition of existing office building (Use Class B1(a) and multi-storey car park and redevelopment of the site to provide a new office (Use Class B1(a) building, associated multi-storey car park and ancillary cafe unit (Use Class A1/A3).	Approval

No information pertinent to this Desk Study was revealed through the study of the online document database for these planning applications.

5.2 BGS Borehole Geoindex

A BGS borehole noted ~168m south-east of site revealed Made Ground to a depth of 0.90m bgl comprising a black/brown/blue clay soil with stones and bricks overlying a soft grey and brown silty clay, peat and a soft grey silty clay and peat to 2.60m bgl. Gravel and grey sand was then encountered to ~5.30m bgl overlying a very stiff blue/brown mottled clay for the remainder of the borehole, a depth of 9.14m bgl. Groundwater was encountered at ~2.60m bgl.

A previous investigation outlined in the Phase I Environmental Assessment was undertaken by WSP in April 2013 (report ref: 38109) revealed a borehole had been drilled onsite to ~11.00m bgl. Fill material was noted to a maximum depth of 2.50m bgl. The composition of the Fill material typically consisted of various amounts of clay, silt, sand and gravel of flint, brick, concrete, wood, plastic, wire and clinker. Below this Fill, superficial alluvial clay deposits comprising predominantly of clay and peat overlying flint and shell gravel were encountered proved to a maximum depth of 3.30m bgl. The soil geology of the Reading Beds was encountered beneath the alluvial deposits, and was proved to the base of each borehole. The Reading Beds are described as a brown and bluish grey clsely fissured silty clay becoming sandy with depth below 11.00m bgl. Standing groundwater levels were recorded at typical depths of between 1.50m and 2.00m bgl

5.3 Internet Search

An Internet search revealed no information pertinent to the desk study.

5.4 Previous Invesigaton

Phase I Environmental Audit of The Uxbridge Park Estate, Uxbridge by WSP Environmental Ltd for Allard Ryan Consulting, dated March 2003 (Ref: 12021154).

The report refers to a previous Report on Ground Investigation, prepared by Weeks Site Investigation Services, dated June 1998 (ref. S.10596); a Factual Report on Gas Contamination, prepared by Upton McGougan PLC, dated October 1998 (ref: S.10596B); and a Report on Site Investigation at Highbridge Industrial Estate, prepared by Structural Soils Ltd, dated February 1997 (ref: 61171).

Previous investigations have shown the site to be free from significant site-wide contamination. Isolated areas of contamination, including slight groundwater contamination were encountered.

However, the contaminant levels identified were not considered to be of significant concern to the use of the site as an industrial park.

The Waterside House and Riverview House reportedly include a gas-resistant membrane and passive venting as a precautionary measure to mitigate the risk of ground-gas.

A Phase I Environmental Assessment, undertaken by WSP Environmental Ltd in April 2013 (report ref: 38109).

The site comrpised three large commerical office buildings; Bridge House to the north, Waterside House in the centre of site and Riverview House located on the southern potion of site. A three-storey car parking was noted in the centre of the site, with external parking noted at various points across the site.

A 3,640 litre diesl above ground storage tank (AST) used to power an onsite generator was located within an enclosure to the south of the multi-storey car park. However, no history of leaks and spillages were noted by a site representative and now evidence of gross contamination was noted during the site reconnasence.

An asbestos report had been completed in August 2004 and April 2006 by Blues Consulting Ltd. Various forms of ACM (Asbestos Containing Materials) were present with the ground floor and roofing of Bridge House. However, evidence of removal had been supplied between 19th Feburary 2007 – 5th April 2008.

The site was found to be situated on Alluvium overlying the Lambeth Group, both of which were classified as a Secondary A Aquifer.

A review of the available historic maps revealed that in 1866 the site comprised undeveloped land that was first developed into a timber yard in 1938. By 1962 the timber yard became a mill. This remained the case until 1973 whereby the mill had been redeveloped into two large unspecified warehouses and depots. A structure labelled “Bridge House” was noted in the northern area of the site, which has remained since. By 1974, a tank was noted onsite. Between 1992 and 2006 the warehouses, depot and tank were cleared and two further commerical properties were constructed onsite.

The surrounding area (250m radius) was found to have a long industrial history, with various works, factories, mills, brewerys, garages and railway sidings to have been active at a point in the last 100

years. However, it was found the majority had been redeveloped into commerical and residential use.

The report concluded that although the current use of site did not create a contamination risk, the historic activity onsite such as the mill, timber yard, warehouses, depot and tank may pose a risk. Therefore, this source of contamination is likely to be low/medium and cannot be discounted. Should the site continue to be used as commerical use, no contaminated land assessment were required. However, a change of use to residential will require further risk assesment.

6.0 SUMMARY OF FINDINGS

The findings of the Phase 1 Desk Study are summarised in this section of the report:

Current Site Use:
The site comprised a 26,350m^2, rectangular shaped plot of land, orientated in a north-east to south-west direction. The site was situated on the southern side of Oxford Road, on the far south-eastern side of the Colne Valley Regional Park. The site was located in north-west Uxbridge, a town in the western London.

At the time of the site walkover in February 2018, the site contained three large office buildings operated by Xerox (UK) Ltd. On-site parking within a multi-storey car park and a ground-level car park were also provided. The site was relatively flat and level, with the eastern and western boundaries sloping down to the River Colne and Grand Union Canal. A small security hut was noted at the site entrance within the northern portion of the site with a seven-storey office block to the north-eastern portion of the site. Directly to the south-west was a multi-storey car park, with adjacent ground-level parking. Two identical three-storey office buildings were noted within the western portion of the site and towards the southern end of site.

The site was primarily covered with concrete and tarmac hardstanding with an outside ground-level car park noted in the eastern portion of site. The western and north-western portions of site were covered in grass soft landscaping, used as communal amenity areas with several picnic benches present. The majority of the vegetation on site was located along the western and eastern boundaries, along the River Colne and Grand Union Canal, comprising bushes and shrubs. Large approximately 10m high mature / semi-mature trees and shrubs were noted in western and north-western portions of the site, in the communal area of soft landscaping

Two electricity sub-stations were noted on site; one was located in the middle of the site within the car park and the other adjacent to the three-storey buildings within the western portion of the site.

Current Use of Surrounding Area:
The surrounding area was primarily commercial, with similar style offices / commercial business parks noted around the site. The site was located between the River Colne and the Grand Union Canal, running along the eastern and western boundaries of site. Vegetation off-site was primarily localised along the River Colne to the east. Little vegetation was present in other directions due to the mainly commercial use of the surrounding area.

Geology and Radon:
The Desk Study revealed the site was situated on Alluvium overlying the bedrock deposits of the Lambeth Group. No areas of Made or Worked Ground were noted in a 250m radius of site.

A BGS borehole noted ~168m south-east of site revealed Made Ground to a depth of 0.90m bgl comprising a black/brown/blue clay soil with stones and bricks overlying a soft grey and brown silty clay, peat and a soft grey silty clay and peat to 2.60m bgl. Gravel and grey sand was then encountered to ~5.30m bgl overlying a very stiff blue/brown mottled clay for the remainder of the borehole, a depth of 9.14m bgl. Groundwater was encountered at ~2.60m bgl.

The site was not located in an area where Radon protection measures were likely to be required.

Hydrogeology and Hydrology:
The Desk Study revealed the site to be located on a Secondary A Aquifer relating to the Alluvium and the Lambeth Group.

Examination of the Environment Agency records showed that the site was not located within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water features were the River Colne and the Grand Union Canal, which ran directly along the western and eastern boundaries of site respectively.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (3-6m bgl)) and it was considered that the groundwater was flowing in a south-westerly direction, in line with local topography.

Examination of the Environment Agency records showed that the majority of the site fell within a Flood Zone 1 (an area with a low probability of river or sea flooding). However, the eastern and western boundaries which front the River Colne and Grand Union Canal were classified as a Flood Zone 3, defined as land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding.

Historical Land-Use of the Site:
By 1865, the site was occupied by open land and three landing / loading stages were shown at the north of the site. The site had been cleared by 1959 and by 1962, a mill was present on site. By 1972, the site took its current form with three commercial buildings present (labelled as warehouses and a depot) with associated car parking. A tank was labelled on site adjacent to the River Colne during the 1970s and 1980s. No further changes were noted on site.

Historical Land-Use of the Surrounding Area:
The earliest historic map for the site, dated 1865, revealed that the area to the north-east and east was undeveloped but various wharfs, saw mills, a brewery, flour mill and other commercial and industrial uses were shown in the remainder of the surrounding area. Commercial and industrial expansion took place during the early 1900s with a timber yard, corn mill, a steel and barrel works and a railway terminus all present within 250m. Residential expansion also took place during this time. Commercial and industrial expansion continued in the surrounding area, particularly to the east and north-east of the site into the 1960s with an asbestos works, engineering works, printing works, warehouses and depots present by the 1980s. By the 1990s, most of these commercial and industrial uses were labelled as warehouses and depots. A piggery was also present to the north-west of the site. By 2010, the area to the east and south-east was labelled as an industrial estate with Fassnidge Park beyond. No further significant changes were noted in the surrounding area.

Groundsure Datasheets:
The Groundsure Datasheets, presented in Appendix D of this report, revealed nine on-site records and eight-two off-site records of potentially contaminative uses within a 250m radius comprising: 6 x unspecified wharfs on site (1897 to 1959), 1 x sawmill on site (1895), 1 x unspecified wharf (1897), 2 x unspecified wharf 10m south-west (1913 and 1938), 3 x unspecified commercial / industrial uses 11m and 14m south-east (1959 and 1987), 6 x timber yards between 14m and 19m south-east (1913 to 1938), 3 x steel barrel works between 17m and 19m south-east (1935 to 1938), 2 x unspecified warehouses 27m west (1974 and 1987), 1 x unspecified wharf 27m north-east (1970), 7 x unspecified works between 36m and 102m south-east (1970 and 1989), 2 x basins 40m

and 93m north-east (1882), 1 x sawmill 45m south-east (1897), 1 x unspecified mill 49m south-east (1897), 2 x nurseries 52m west (1932 and 1959), 1 x brewery 71m south-east (1897), 1 x sawmill 88m east (1897), 8 x sawmills between 93m and 107m north-east (1895 to 1938), 1 x unspecified mill 97m north-east (1959), 2 x terminus between 100m and 104m south-east (1913), 2 x railway sidings 111m and 141m east (1959 and 1938), 3 x terminus between 114m and 118m east (1935 to 1938), 1 x unspecified wharf 116m south (1932), 1 x steel works 118m south (1913), 2 x unspecified works 119m north-west (1989 and 1975), 3 x corn mill between 121m and 204m north (1882 to 1912), 2 x steel barrel works 122m and 167m south (1913 and 1932), 1 x railway sidings 128m north-east (1938), 6 x mortuaries (one location) between 140m and 163m south-east (1913 to 1938), 11 x unspecified mills between 188m and 208m north (1895 to 1989), 1 x railway building 211m north-east (1938), 1 x unspecified works 218m south-east (1970), 2 x unspecified works 246m south (1974 and 1987).

Five onsite records and twenty-one off-site records of historical tanks within a 250m radius comprising: 5 x unspecified tanks on site (1975 to 1996), 10 x unspecified tanks between 35m and 80m south-east (1975 to 1996), 3 x unspecified tanks between 37m and 38m west (1981 to 1992), 6 x tanks between 78m and 88m south-east (1975 to 1996), 2 x unspecified tanks 198m north (1974 and 1987).

Thirty-seven off-site records of historical energy features within a 250m radius comprising: 5 x electricity sub-stations between 35m and 186m north-west (1974 to 1992), 9 x electricity sub-stations between 88m and 240m south-east (1975 to 1996), 19 x electricity sub-stations between 199m and 221m north (1974 to 1992), 3 x electricity sub-stations between 202m and 204m north-east (1987 to 1992).

One off site record of historical garage and motor vehicle repair features within a 250m radius: 1 x garage 114m east (1974).

Nineteen on site records and twenty-one off-site records of potentially infilled land noted within 250m of the site: 12 x canals on site (one canal) (1868 to 1959), 7 x unspecified wharfs on site (1897 to 1959), 5 x canals between 2m and 3m south-east (1882 to 1989), 2 x unspecified wharfs 10m south-west (1913 and 1938), 1 x unspecified wharf 27m north-east (1970), 7 x canals between 53m and 59m north-east (1895 to 1938), 1 x unspecified wharf 116m south (1932), 2 x canals 185m south (1900 and 1932), 1 x pond 207m south-east (1897), 2 x fish ponds 214m and 219m south-east (1868 and 1882).

Three on site records and thirty-two off-site records potentially contaminative industrial sites noted within 250m of the site comprising: 2 x electricity sub-stations on site, 1 x Xerox Ltd (industrial features) on site, 1 x tank 32m west, 1 x electricity sub-station 37m north-west, 1 x A R R I GB Ltd (consumer products) 59m south-east, 1 x Highbridge Industrial Estate (industrial features) 66m south-east, 1 x L G International Ltd (consumer products) 69m north, 1 x We Do Any Clearance (recycling services) 69m north, 2 x electricity sub-stations 73m and 78m south-east, 1 x Works (industrial features) 79m south-west, 1 x Arri Media (household office, leisure and garden) 82m south-east, 1 x Otsuka Pharmaceuticals UK Ltd (industrial products) 98m south-east, 2 x electricity sub-stations 100m and 163m south-east, 1 x depot 111m south-east, 3 x electricity sub-stations between 119m and 140m north, 1 x electricity sub-station 148m south, 1 x Union Business Park 171m south, 1 x depot 177m south-east, 1 x Coolwater4you (industrial products) 179m north-west; 1 x Thames Valley Hire Service Ltd (hire services) 179m north-west, 2 x works 180m and 205m north; 1 x landing stage 185m north-east, 1 x jetties 199m north-east, 1 x electricity sub-station 206m north, 1 x electricity sub-station 208m north-east, 1 x Denham Yacht Station 211m north-

east, 1 x Tideway Adventurers Narrowboat Project (hire services) 211m north-east, 1 x E T Enterprises Ltd 232m south; and 1 x Warehouse 247m south-west.

Additional Data:
A previous investigation outlined in the Phase I Environmental Assessment was undertaken by WSP in April 2013 (report ref: 38109) revealed a borehole had been drilled onsite to ~11.00m bgl. Fill material was noted to a maximum depth of 2.50m bgl. The composition of the Fill material typically consisted of various amounts of clay, silt, sand and gravel of flint, brick, concrete, wood, plastic, wire and clinker. Below this Fill, superficial alluvial clay deposits comprising predominantly of clay and peat overlying flint and shell gravel were encountered proved to a maximum depth of 3.30m bgl. The soil geology of the Reading Beds was encountered beneath the alluvial deposits, and was proved to the base of each borehole. The Reading Beds are described as a brown and bluish grey clsely fissured silty clay becoming sandy with depth below 11.00m bgl. Standing groundwater levels were recorded at typical depths of between 1.50m and 2.00m bgl

The report refers to a previous Report on Ground Investigation, prepared by Weeks Site Investigation Services, dated June 1998 (ref. S.10596); a Factual Report on Gas Contamination, prepared by Upton McGougan PLC, dated October 1998 (ref: S.10596B); and a Report on Site Investigation at Highbridge Industrial Estate, prepared by Structural Soils Ltd, dated February 1997 (ref: 61171).

Previous investigations have shown the site to be free from significant site-wide contamination. Isolated areas of contamination, including slight groundwater contamination were encountered.

However, the contaminant levels identified were not considered to be of significant concern to the use of the site as an industrial park.

The Waterside House and Riverview House reportedly include a gas-resistant membrane and passive venting as a precautionary measure to mitigate the risk of ground-gas.

Proposed Development:
At the time of reporting in March 2018, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats) under permitted development rights. Ancillary car parking, cycle storage and waste and recycling storage were also proposed. A proposed site plan can be seen in Figure 4.

7.0 PHASE 1 RISK ASSESSMENT

7.1 Conceptual Site Model

A Conceptual Site Model (CSM) is provided in Section 7.8 of this report. A diagrammatic representation of the model can be seen in Figure 5 of this report.

7.2 Contaminant Source-Pathway-Receptor Model

For an environmental risk to be present there must be a source of contamination, a receptor or receptors, and a pathway for contaminants to migrate or be absorbed. Where a pathway exists between the source and receptor then it is called a "pollutant linkage".

7.3 Potential On-site Sources of Contaminants

The Phase 1 Desk Study revealed the following on-site sources of contamination:

- The review of the historical maps between 1959 and 2002 revealed a number of structures and buildings onsite had been constructed and subsequently demolished. The most recent office development was completed by 2002 and has remained the same since (as noted in the site walkover)

  Construction activities were likely to have created a capping of Made Ground containing demolition debris. Building materials used in the late 19th and early 20th Century may have included asbestos for partitions and insulative lagging. Lead, cadmium and other heavy metal-based paints may also have been used. During the demolition process, it is likely that removal of any harmful building materials would have been uncontrolled and quantities of asbestos and traces of heavy metals from paints and dyes may be present in the near surface soils around the footprints of the old building. Fires may have taken place on the site as part of the demolition process to remove waste. Potential pollutants such as carcinogenic PAHs in the tars produced by combustion of timber and other materials may be present in the near surface soils. Oil spills may have also occurred over time.

- A former mill was present at the site during the 1960s before it was cleared to facilitate the construction of the warehouses and depot on site in the 1970s. The warehouses remained onsite until 2002, whereby they were demolished to create the office development. A tank associated with the warehouses was also present during the 1970s and 1980s. It is assumed that this tank was used for either water or fuel storage.

  The Groundsure datasheets (presented in Appendix D of this report) revealed 1 record of a sawmill onsite (1895) and 5 unspecified tanks on site (1975 – 1996).

  Contaminants may include heavy metals, semi-metals, the products of complete and incomplete combustion (PAH's), petroleum hydrocarbons and building products such as asbestos.

  The redevelopment of the warehouses into the current office development may have removed some of the gross-contamination from the sub-surface soils. However, given the long industrial history of the site, and the unknown nature of the works, some residual contamination may still remain and therefore cannot be fully discounted.

- The Groundsure datasheets, presented in Appendix D of this report, revealed six potentially contaminative uses onsite comprising: 6 x unspecified wharfs on site (1897 to 1959) and

nineteen records of potentially infilled land onsite comprising: 12 x canals (1868 to 1959) and 7 x unspecified wharfs (1897 to 1959).

It is unlikely that the canal would pose a contamination risk as it is still present as the Grand Union Canal and therefore, would not have been infilled.

Likely contaminants associated with a wharf could include metals and semi-metals; asbestos; oil/fuel hydrocarbons, PAHs, solvents and inorganic chemicals *(Department of the Environment Industry Profile, Docks and Docklands 1996).*

The wharfs may have been infilled with putrescible material, which may be producing ground-gases such as carbon dioxide and methane.

Given the age of the wharfs, time since infilling (>55 years) and likely small-scale nature of the activity, it is unlikely that any residual contamination would still be present onsite and that the fill would be producing harmful levels of carbon dioxide and methane. **The overall risk is deemed to be low.**

- The Desk Study revealed the site was located on Alluvium overlying the Lambeth Group.

  Alluvial deposits rich in organic matter can produce ground-gases with Carbon Dioxide concentrations exceeding 5% and Methane concentration around 1%. The flow rates and gas generation rates associated with such deposits is generally low.

  The alluvium deposits in the site environments have shown to include peat. However, the shallow groundwater would likely limit ground-gas production.

  Given the deposits are located directly underlying the proposed development, a ground-gas risk onsite cannot be discounted.

- The site walkover, undertaken in February 2018, noted two electricity sub-stations on-site; one was located in the middle of the site within the car park and the other adjacent to the three-storey buildings within the western portion of the site.

  High-voltage electricity sub-stations may be a potential source for Polychlorinated Biphenyls (PCBs), especially in pre-1970's sub-stations. PCB oils and other cable/transformer oils, together with a series of waxes are commonly used in mainly high voltage applications. PCBs are generally toxic; however, newer (post-1970's) forms of non-toxic oils and waxes have replaced the use of PCBs. All cable oils are extremely viscous and adhere strongly to soil particles and do not tend to migrate far from the point of leakage or spillage.

  The electricity sub-stations were likely to have been developed as part of the office development and were not noted on the latest high resolution historical map (post 1992). Therefore, the risk of PCB oils being used was very low. Therefore, unless disturbed by demolition, clearance or site redevelopment, it was concluded that the potential risk of encountering PCBs on the site was negligible. This source has therefore been **discounted.**

7.4 Potential Off-site Sources of Contaminants

The Phase 1 Desk Study revealed the following off-site sources of contamination:

- The review of the historical maps revealed a number of historic industrial works and current industrial works within a 250m radius from site including a printing works, an asbestos works and an engineering works, a timber yard, steel barrel works, warehouses and depots, historical saw mills and mills, a nursery, a brewery and a garage.

  The Groundsure datasheets revealed a number of potentially contaminative uses within a 250m radius comprising: 3 x unspecified commercial / industrial uses 11m and 14m south-east (1959 and 1987), 6 x timber yards between 14m and 19m south-east (1913 to 1938), 3 x steel barrel works between 17m and 19m south-east (1935 to 1938), 2 x unspecified warehouses 27m west (1974 and 1987), , 7 x unspecified works between 36m and 102m south-east (1970 and 1989), 2 x basins 40m and 93m north-east (1882), 1 x sawmill 45m south-east (1897), 1 x unspecified mill 49m south-east (1897), 2 x nurseries 52m west (1932 and 1959), 1 x brewery 71m south-east (1897), 1 x sawmill 88m east (1897), 8 x sawmills between 93m and 107m north-east (1895 to 1938), 1 x unspecified mill 97m north-east (1959), 2 x terminus between 100m and 104m south-east (1913), 2 x railway sidings 111m and 141m east (1959 and 1938), 3 x terminus between 114m and 118m east (1935 to 1938), , 1 x steel works 118m south (1913), 2 x unspecified works 119m north-west (1989 and 1975), 3 x corn mill between 121m and 204m north (1882 to 1912), 2 x steel barrel works 122m and 167m south (1913 and 1932), 1 x railway sidings 128m north-east (1938), 6 x mortuaries (one location) between 140m and 163m south-east (1913 to 1938), 11 x unspecified mills between 188m and 208m north (1895 to 1989), 1 x railway building 211m north-east (1938), 1 x unspecified works 218m south-east (1970), 2 x unspecified works 246m south (1974 and 1987).

  Contaminants associated with such industrial works include metals and semi-metals; asbestos; oil/fuel hydrocarbons, PAHs, solvents and inorganic chemicals *(R&D Publication CLR8, 2002).* Fill imported to site from such industries may have contained such materials; however, attenuation of volatile hydrocarbons during excavation, transport and deposition is likely.

  Due to historic nature of both the site and its surrounding areas and the use of the canal between the industrial sites, it cannot be guaranteed that no fill was transported for use or waste disposal onsite. If this was the case, the redevelopment of site into the current office development may have removed some gross-contamination from the sub-surface soils. However, some residual contamination may still remain and therefore cannot be fully discounted.

  There is the potential for these facilities to impact the underlying soils and groundwater quality at the site and for contaminants contained in spilt products (via leaks or spills) to migrate onto the site and have a negative impact. However, given the high permeability of the underlying strata promoting vertical migration and rapid dissolution, it is unlikely that they would affect the soil and groundwater quality on site. Additionally, the presence of the canal and river adjacent to the site will likely limit the amount of migration of soil contamination onto the site from the west and south-east. For these reasons and given the majority of the works are parallel to the groundwater gradient, migrating contamination from these works can be **discounted.**

- The review of the historical maps (1975 – 1981) revealed a number of tanks were constructed ~95m east/south-east of site. Details on the contents of the tanks are not provided but are likely to relate to water or fuel storage.

  The Groundsure Datasheets, presented in Appendix D of this report, revealed twenty-one off-site records of historical tanks within a 250m radius comprising: 10 x unspecified tanks between

35m and 80m south-east (1975 to 1996), 3 x unspecified tanks between 37m and 38m west (1981 to 1992), 6 x tanks between 78m and 88m south-east (1975 to 1996), 2 x unspecified tanks 198m north (1974 and 1987). The Groundsure Datasheets did not record any pollution incidents relating to spills from these tanks.

The potential contaminants associated with a tank may include heavy metals, semi-metals, the products of complete and incomplete combustion (PAH's), petroleum hydrocarbons and building products such as asbestos.

Given the age of the potential tanks and their likely removal and the distance from the site (35m to 80m), it is unlikely contaminants would have migrated onto site. Additionally, the presence of the canal and river adjacent to the site will likely limit the amount of migration of soil contamination onto the site from the west and south-east. The tanks were also encountered parallel to the groundwater gradient, limiting any migration pathways to site. Therefore, this source of contamination can be **discounted.**

- The Groundsure Datasheets, presented in in Appendix D of this report, revealed twenty-one off-site records of potentially infilled land noted within 250m of the site comprising: 5 x canals between 2m and 3m south-east (1882 to 1989), 2 x unspecified wharfs 10m south-west (1913 and 1938), 1 x unspecified wharf 27m north-east (1970), 7 x canals between 53m and 59m north-east (1895 to 1938), 1 x unspecified wharf 116m south (1932), 2 x canals 185m south (1900 and 1932), 1 x pond 207m south-east (1897), 2 x fish ponds 214m and 219m south-east (1868 and 1882).

  It is unlikely that the canal would pose a contamination risk as it is still present as the Grand Union Canal and therefore, would not have been infilled.

  Likely contaminants associated with a wharf could include metals and semi-metals; asbestos; oil/fuel hydrocarbons, PAHs, solvents and inorganic chemicals *(Department of the Environment Industry Profile, Docks and Docklands 1996).* Additionally, the wharfs and ponds may have been infilled with putrescible material, which may be producing ground-gases such as carbon dioxide and methane.

  Given the age of the wharfs and likely time since infilling (>45 years), it is unlikely that any residual contamination would still be present onsite and that the fill would be producing harmful levels of carbon dioxide and methane. Therefore, this source of contamination can be **discounted.**

- The Groundsure datasheets, presented in Appendix D of this report, revealed one off site record of historical garage and motor vehicle repair features within a 250m radius: 1 x garage 114m east (1974).

  Potential sources of contamination associated with vehicle repair and testing servicing centres, petrol stations and works of unspecified use include: lubricant oils; brake fluids (constitute mainly of polymerised glycols and ethers. Waste fluid is generated during repair work on brake systems); solvents (chlorinated hydrocarbons, carbon tetrachloride, paraffin and proprietary degreasing compounds); paints (lead-based paints, zinc-rich epoxy primers, polyurethanes as decorative finishes); gasoline, diesel, paraffin *(Department of the Environment Industry Profile, Road vehicle fuelling, service and repair: garages and filling stations 1996).*

Given the distance from site and location parallel to the groundwater gradient, it is unlikely any spills or leaks would migrate onto site via the underlying soils and groundwater. The presence of the River Colne and Grand Union Canal would also likely limit any contaminant migration from the west and south-east. The garage was also encountered parallel to the groundwater gradient, limiting any migration pathways to site. Therefore, this source of contamination can be discounted.

- The historical maps between 1975 – 1981 revealed an electricity sub-station was constructed 95m east of site.

  The Groundsure Datasheets, presented in Appendix D of this report, revealed thirty-seven off-site records of historical energy features within a 250m radius comprising: 5 x electricity sub-stations between 35m and 186m north-west (1974 to 1992), 9 x electricity sub-stations between 88m and 240m south-east (1975 to 1996), 19 x electricity sub-stations between 199m and 221m north (1974 to 1992), 3 x electricity sub-stations between 202m and 204m north-east (1987 to 1992).

  High-voltage electricity sub-stations may be a potential source for Polychlorinated Biphenyls (PCBs), especially in pre-1970's sub-stations. PCB oils and other cable/transformer oils, together with a series of waxes are commonly used in mainly high voltage applications. PCBs are generally toxic; however, newer (post-1970's) forms of non-toxic oils and waxes have replaced the use of PCBs. All cable oils are extremely viscous and adhere strongly to soil particles and do not tend to migrate far from the point of leakage or spillage.

  Given the age of the electricity sub-stations (post-1970s) and distances from the site (>35m), it was considered unlikely to pose a contamination risk from site. Therefore, the potential risks can be **discounted.**

7.5 Potential Pathways for Contaminant Migration from Off-site Sources

Anthropogenic (or artificial) pathways for contaminants migration can be present in the form of land drains etc. Leaking sewage supply pipes and site drainage could also provide pathways for potential contaminant migration. Granular backfill to trenches for cables, gas pipes, water pipes etc. can also provide pathways for movement of mobile contaminants and contaminated groundwater.

The Desk Study revealed the site is situated on Alluvium overlying the bedrock deposits of the Lambeth Group. No areas of Made or Worked Ground were noted in a 250m radius of site.

A BGS borehole noted ~168m south-east of site revealed Made Ground to a depth of 0.90m bgl comprising a black/brown/blue clay soil with stones and bricks overlying a soft grey and brown silty clay, peat and a soft grey silty clay and peat to 2.60m bgl. Gravel and grey sand was then encountered to ~5.30m bgl overlying a very stiff blue/brown mottled clay for the remainder of the borehole, a depth of 9.14m bgl. Groundwater was encountered at ~2.60m bgl.

A previous investigation outlined in the Phase I Environmental Assessment was undertaken by WSP in April 2013 (report ref: 38109) revealed a borehole had been drilled onsite to ~11.00m bgl. Fill material was noted to a maximum depth of 2.50m bgl. The composition of the Fill material typically consisted of various amounts of clay, silt, sand and gravel of flint, brick, concrete, wood, plastic, wire and clinker. Below this Fill, superficial alluvial clay deposits comprising predominantly of clay and peat overlying flint and shell gravel were encountered proved to a maximum depth of 3.30m

bgl. The soil geology of the Reading Beds was encountered beneath the alluvial deposits, and was proved to the base of each borehole. The Reading Beds are described as a brown and bluish grey clsely fissured silty clay becoming sandy with depth below 11.00m bgl. Standing groundwater levels were recorded at typical depths of between 1.50m and 2.00m bgl.

The Alluvium deposits are thought likely to act as migration pathway due to their likely high permeability.

The bedrock deposits of the Lambeth Group are thought likely to act as migration pathway due to their likely moderate permeability.

Any potential Made Ground soils were also likely to act as a migration pathway for contaminants. Surface water runoff of contaminants was a potential migration pathway.

7.5 Potential Receptors

At the time of reporting in March 2018, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats) under permitted development rights. Ancillary car parking, cycle storage and waste and recycling storage were also proposed.

The potential receptors are presented below and comprise:

Human Health

- End users of the site (residents);
- Site operatives during demolition, development and future maintenance works; and
- Neighbours and members of the public.

Groundwater

The Desk Study revealed the site to be located on a Secondary A Aquifer relating to the Alluvium and the Lambeth Group.

Examination of the Environment Agency records showed that the site did not fall within a Groundwater Source Protection Zone as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water features were the River Colne and the Grand Union Canal, which ran directly along the western and eastern boundaries of site respectively.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (3-6m bgl)) and it was considered that the groundwater was flowing in a south-westerly direction, in line with local topography.

Examination of the Environment Agency records showed that the majority of the site fell within a Flood Zone 1 (an area with a low probability of river or sea flooding). However, the eastern and western boundaries which front the River Colne and Grand Union Canal were classified as a Flood Zone 3, defined as land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding.

Based on the above, the potential receptors are presented below and comprise:

- Secondary A Aquifer;
- River Colne and Grand Union Canal, running directly along western and eastern boundaries.

7.7 Contaminant Absorption Pathways

At the time of reporting in March 2018, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats) under permitted development rights. Ancillary car parking, cycle storage and waste and recycling storage were also proposed.

The potential pathways for contaminant absorption by receptors are as follows:

Human Health – Residential Flats with Communal Gardens: **Soil Contamination**

- Direct ingestion of soil and soil derived dust;
- Dermal contact of soil and soil derived dust;
- Ingestion of soil with elevated concentration of determinants;
- Dermal contact with impacted soils;
- Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants.
- Inhalation of volatile organic compounds (indoors and outdoors) with elevated concentration of determinants.

Previous intrusive site investigations did not reveal any gross contamination across the site. However, further risk assessment in necessary as the change to residential use will increase end-user sensitivity.

Ground-gas:

- Inhalation;
- Explosive risk;
- Migration via anthropogenic & natural pathways.

A previous investigation detailed within the Phase I Environmental Assessment (undertaken by WSP Environmental Ltd in April 2003, report ref: 38109), revealed the Waterside House and Riverview House reportedly included a gas-resistant membrane and passive venting as a precautionary measure to mitigate the risk of ground gas.

Risk Assessment is required to ensure that the gas measures installed are sufficient for a change of use to the more sensitive receptor.

~~**Groundwater**~~

- ~~Surface water runoff;~~
- ~~Via anthropogenic (man-made) pathways; and~~
- ~~Via Made Ground (if present), Alluvium, Lambeth Group~~

No changes are proposed to the external site layout, meaning no changes to the existing risk to groundwater. Therefore, a groundwater risk assessment is not considered necessary.

7.8 Tabulated Conceptual Site Model

The tabulated Conceptual Site Model developed as part of this Desk Study is outlined overleaf.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • Carbon Dioxide; • Methane;	Migration through anthropogenic & natural pathways Inhalation Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers;
Made Ground on-site by historic demolition and construction activities • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Lambeth Group	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**
Residual contamination risk from historic industrial use on-site • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).		

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); Asbestos (building material, pipe lagging).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Lambeth Group	End users of the site (members of the public and employees) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

7.9 Recommendations and Phase 2 Objectives

This section of the report will present recommendations for the further investigation of each plausible pollutant linkage identified by the Conceptual Site Model. On the basis of the Phase 1 Site Assessment the following contaminants of concern have been identified:

- Semi-metals and heavy metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc;
- Asbestos (fibrous material screen and identification if suspected material encountered);
- Polycyclic Aromatic Hydrocarbons (PAH's) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene;
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split.
- BTEX Compounds, including MTBE (used as marker compounds for VOCs);

The list above does not imply that these chemicals are present on-site or that they are likely to cause contamination issues at the site. The sampling and testing strategy must be in line with current standards.

An **Asbestos Management Strategy** should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.

Human Health – Ground/Bio-Gases:

The Conceptual Site Model had determined that there is a risk that levels of methane and carbon dioxide may be being produced by the Alluvium, and potentially deep Made Ground underlying, and in a close proximity, of the site. Further risk assessment is therefore recommended. A site investigation should be undertaken to determine the ground conditions across the site to in relation to possible deep Made Ground and the presence of peat in the Alluvium. Appropriate monitoring of ground-gases is likely to be required with reference to current technical guidance should such materials be encountered. This should be reference against the gas protection measures installed and the proposed change of use.

7.10 Discovery Strategy

There is the potential for contamination, unidentified as part of the Desk Study to be encountered on site. An example could potentially be an underground storage tank, not identified during the Desk Study, for which there are no historical or contemporary evidence or records. Such occurrences may be discovered during the investigation for the development of the site. There is also the possibility that military equipment, shells or armoury could be encountered on site during the historic use of the site and immediate area by the British Army.

Groundworkers should report any evidence of contamination or any military use to the Site Manager. Evidence of contamination may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emissions. Upon discovery, advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

Should a new source of contamination be suspected or identified then the Local Authority will need to be informed.

APPENDIX A
Conditions and Limitations

The ground is a product of continuing natural and artificial processes. Thus, the ground will exhibit a variety of characteristics that vary with time and from place to place across the site. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared based on information, data and materials, which were available at the time of writing. Any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid, considering changes in regulation and practice, or additional information obtained regarding the site.

Any recipient must consider any other factors apart from the report of which they and their experts and advisers are or should be aware of. The information, data, conclusions, opinions and judgements set out in the report may relate to specific contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous ground activities. The ground conditions have been sampled or monitored in recorded locations and testing for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment / contaminated land considerations.

The conclusions and recommendations relate to the site known as Bridge House, Riverview House and Waterside, Oxford Road, Uxbridge, Middlesex, UB8 1HS.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and / or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and / or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text, this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

APPENDIX B
Site Photographs

APPENDIX C
Historical Maps

APPENDIX D
GroundSure EnviroInsight and GeoInsight Datasheets

APPENDIX C: Phase 2 Contamination Assessment Report (without figures and appendices)

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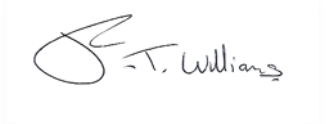
CONTAMINATION ASSESSMENT REPORT

for the site at

BRIDGE HOUSE, RIVERVIEW HOUSE AND WATERSIDE, OXFORD ROAD, UXBRIDGE, MIDDLESEX, UB8 1HS

on behalf of

RADCLIFFES CONSTRUCTION CONSULTANTS LTD

Report Reference: GWPR3283/GIR/December 2019		Status: FINAL
Issue:	Prepared By:	Verified By:
V1.01 December 2019		
	Natasha Kearl Bsc. (Hons) Geotechnical/Geo-environmental Engineer	Francis Williams M.Geol. (Hons) FGS CGeol. CEnv AGS Director
File Reference: Ground and Water/Project Files/ GWP3283 Bridge House Riverview House and Waterside Ground Investigation Report		

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EXECUTIVE SUMMARY	
Proposed Development	At the time of reporting in December 2019, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Ancillary car parking, cycle storage and waste and recycling storage were also to be provided. A proposed development plan can be seen in Figure 4.
Geology	The BGS Geological Map for the Uxbridge area (Beaconsfield Sheet No. 255) indicated that the site is situated on Alluvium overlying the bedrock deposits of the Lambeth Group. The Taplow Gravel Member was noted ~300m south-east. No areas of Made or Worked Ground were noted in a 250m radius of site.
Ground Conditions	The ground conditions encountered within the trial holes constructed on the site did not generally conform to that anticipated from examination of the geology map. A capping of Made Ground was noted to overlie soils of Alluvium overlying the Taplow Gravel Member. Made Ground was encountered from ground level to a depth of between 0.80 - 1.60m bgl across WS1 – WS8 and generally comprised a black to dark brown/brown to dark grey silty gravelly sand to silty sandy gravel. Alluvium was encountered from 0.80 – 1.60m bgl to a depth of 1.90 - 4.30m bgl in WS1 – WS3 and WS5 – WS8. Taplow Gravel Member was encountered from 1.90 - 4.30m bgl to a depth of 5.45m bgl in WS1 – WS3 and WS5 – WS8.
Contamination	Chemical laboratory testing revealed elevated levels of zinc, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(a)pyrene, indeno(123-sd)pyrene and dibenz(a,h)anthracene within the Made Ground above their respective C4SL LLTC for a **'Public Open Spaces near Residential Housing (POSresi)'** land use scenario. An elevated concentration of Zinc was noted in one sample of Made Ground with a value of 3080mg/kg in WS3/0.20m bgl above the phytotoxicity threshold trigger value of 1000mg/kg. Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a **'Public Open Spaces near Residential Housing (POSresi)'** land-use scenario.
Remediation	Complete removal of Made Ground from the site has not been considered given the cost implications and given that a simple capping system could be adopted. This would prevent needless lorry movements and prevent waste unnecessarily being sent to landfills with only a finite capacity. The maximum concentration of Benzo(b)fluoranthene (92.40 mg/kg), Benzo(a)pyrene (79.50 mg/kg) and Dibenz(a,h)anthracene (8.15 mg/kg) identified in the Made Ground was over six times the relevant SGV for a "Public Open Spaces near Residential Housing (POSresi)" Land-Use Scenario a BRE Cover System could not be applied. In order to sever the direct soil ingestion and outdoor dermal contact exposure pathways consideration should be given to the placement of certified clean imported Sub-soil and Topsoil in all areas of soft landscaping with a marker layer at the base. This would create a clean capping over the Made Ground. Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytoxicity threshold, specialist planting may be required, and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

<table>
<tr><td></td><td>A total 300mm clean capping layer is recommended. This will need to include a 150mm thick anti-dig layer/anti-capillarity comprising gap graded certified clean material (could be recycled crushed concrete) at base and 150mm of clean soils with a geotextile membrane between the two. The top 150mm will need to comprise Topsoil in order to act as a growing medium for plants.

Any remedial works undertaken on the site will need to be inspected and independently validated by a Ground and Water Limited Engineer. All remedial excavations will need to be inspected, documented and photographed.</td></tr>
<tr><td>Waste Classification</td><td>Based on a risk phase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive and undertaken by Ground and Water Limited, 5No. samples of Made Ground (WS4/0.20m, WS5/0.20m, WS7/0.20m, WS1/0.50m, and WS8/0.50m bgl) were tested and were classified as NON-HAZARDOUS. 1No. sample of Made Ground (WS3/0.20m bgl) was classified as Hazardous Waste due to the levels of Zinc and 1No. sample of Made Ground (WS2/0.50m bgl) was classified as Hazardous Waste due to the levels of TPHs. The results of the Hazard Waste Assessment can be seen in Appendix G.

Please note that the above samples of Made Ground that were classified as Inert would not likely be accepted as Inert waste due to landfill regulations and the other samples that are classified as not conforming to Inert Waste Landfill.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM3, therefore producing an initial classification in accordance with the guidance, landfill operators have their own assessment tools and can often come to different conclusions. As a result, some landfill operators could refuse to take apparently suitable waste. It is recommended that the receiving landfill views the results of this assessment and the chemical laboratory results to determine their own classification.

Following this initial waste hazard assessment, a Full WAC Solid Suite Test with single batch leachate were undertaken on one sample of the Made Ground (WS3/0.20m bgl) to determine which landfill category the waste conformed to. The results of the WAC tests can be seen summarised below and the full results in Appendix C.

<table>
<tr><th colspan="2">Summary of WAC Tests</th></tr>
<tr><th>Trial Hole</th><th>Classification</th></tr>
<tr><td>WS3/0.20m bgl</td><td>Does not conform to Inert Waste Landfill due to the levels of PAHs</td></tr>
</table>
</td></tr>
</table>

1.0 INTRODUCTION

1.1 General

Ground and Water Limited were instructed by Radcliffes Construction Consultant Ltd, on the 14th August 2019 to conduct a Contamination Assessment on a redevelopment site at Bridge House, Riverview House And Waterside, Oxford Road, Uxbridge, Middlesex, UB8 1HS. The scope of the investigation was detailed within the Ground and Water Limited fee proposal ref: GWQ4864, dated 20th August 2019.

1.2 Aims of the Investigation

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

Included within the fee proposal was an allowance to undertake chemical laboratory testing in soil samples recovered from the site to enable recommendations for the safe redevelopment of the site and protection of site workers, end-users and the public from any potential contamination identified within the Ground and Water Limited Desk Study Report (ref. GWPR2463/DS/March 2018). This Ground Investigation Report must be read in conjunction with the Desk Study Report.

The Desk Study report also recommended a ground-gas risk assessment was necessary given the low risk of ground-gas identified.

The techniques adopted for the investigation were chosen considering the requirements of the client, anticipated ground conditions, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

1.3 Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A.

2.0 SITE SETTING

2.1 Site Location

The site comprised a 26,350m^2 rectangular shaped plot of land, orientated in a north-east to south-west direction. The site was situated on the southern side of Oxford Road, on the far south-eastern side of the Colne Valley Regional Park. The Grand Union Canal and the River Colne ran directly along the south-eastern and western boundaries of site respectively. The site was located in north-west Uxbridge, west Greater London. A general site location is given within Figure 1. A plan showing the site development area is given within Figure 2.

2.2 Site Description

A site walkover was undertaken on the 26th February 2018. A description of the site, as noted during the site walkover, is tabulated below. Photographs taken during the site walkover are included in Appendix B. An aerial view of the site showing an approximate site boundary is given in Figure 3.

Site Description Sheet: Bridge House, Riverview House and Waterside, Oxford Road, Uxbridge, Middlesex, UB8 1HS	
Use of site	At the time of the site walkover in February 2018, the site was used as a commercial space, with three large office buildings present onsite. The offices were operated by Xerox (UK) Ltd. (a printing equipment supplier). On-site parking within a multi-storey car park and a ground-level car park were also provided.
Site topography	The site was relatively flat and level.
Area topography	The site appeared to be flat and level. The River Colne ran along the western boundary of site, with the Grand Union Canal to the east.
Structures on-site	A small security hut was noted at the site entrance within the northern portion of the site. A seven-storey office block was noted in the north-eastern portion of the site. Directly to the south-west was a multi-storey car park, with adjacent ground-level parking. Two identical three-storey office buildings were noted within the western portion of the site and towards the southern end of site.
Structures off-site and surrounding land use	The surrounding area was primarily commercial, with similar style offices / commercial business parks noted around the site. The site was located between the River Colne and the Grand Union Canal, running along the eastern and western boundaries of site.
Boundary features	Northern boundary: Oxford Road (A4020 road) ran directly along the northern site boundary, adjacent to the site entrance; Eastern boundary: Low-lying shrubs and bushes with the Grand Union Canal directly beyond; Southern boundary: Large trees and shrubs; Western boundary: Large approximately 10m high mature / semi-mature trees and shrubs, with the River Colne running directly beyond.
Site covering	The site was primarily covered with concrete and tarmac hardstanding with an outside ground-level car park noted in the eastern portion of site. The western and north-western portions of site were covered in grass soft landscaping, used as communal amenity areas with several picnic benches present.
Contamination sources on-site	Two electricity sub-stations were noted on site; one was located in the middle of the site within the car park and the other adjacent to the three-storey buildings within the western portion of the site. No potential sources of asbestos were observed in the existing building fabrics on site.
Contamination sources off-site	None noted. An Esso petrol station was noted approximately 450m west of site.
Vegetation on-site	The majority of the vegetation on site was located along the western and eastern boundaries, along the River Colne and Grand Union Canal, comprising bushes and shrubs. Large approximately 10m high mature / semi-mature trees and shrubs were noted in western and north-western portions of the site, in the communal area of soft landscaping.
Vegetation off-site	Vegetation off-site was primarily localised along the River Colne to the east. Little vegetation was present in other directions due to the mainly commercial use of the surrounding area.
Services	Manholes and evidence of surface water mitigation measures including site drainage were noted across the site.

2.3 Proposed Development

At the time of reporting in December 2019, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Ancillary car parking, cycle storage and waste and recycling storage were also to be provided. A proposed development plan can be seen in Figure 4.

2.4 Geology

The BGS Geological Map for the Uxbridge area (Beaconsfield Sheet No. 255) indicated that the site is situated on Alluvium overlying the bedrock deposits of the Lambeth Group. The Taplow Gravel Member was noted ~300m south-east. No areas of Made or Worked Ground were noted in a 250m radius of site.

Alluvium - London

Alluvium in the Thames valley consists largely of silty clays and clayey silts with locally developed beds of fine to coarse grained sand mainly less than 1m thick but locally up to 4m. There are also sporadic beds with scattered pebbles and granules. Interbedded peat occurs in the east of the Thames valley. The total thickness of peat beds exceeds 2m in large areas between the confluence of the rivers Thames and Lea and Tilbury.

Taplow Gravel Member

The Taplow Gravel Member is part of a complex series of River Terrace Deposits formed by the River Thames and its tributaries. These terraces represent ancient floodplain deposits that became isolated as the river cut downwards to lower levels. The Taplow Gravel Formation is largely encountered along the Thames valley and in the lower parts of the Brent, Wandle, Lea, Cray and Darent valleys and is found at an elevation generally above the current river.

The composition of the River Terrace Gravels varies greatly, depending on the source material available in the river's catchment. Deposits generally consist of sands and gravels of roughly bedded flint or chert commonly in a matrix of silts and clays.

Lambeth Group

The Lambeth Group (formerly known as the Woolwich and Reading Beds) is a sedimentary complex comprising a basal bed (the Upnor Formation also known as the Bottom Bed) composed of glauconitic sand, sandy clay and gravel (well-rounded flint pebbles), with laterally variable sand and clay above. In the eastern part of the area the basal bed is mostly overlain by a shelly grey sandy clay or silty sand and laminated beds (Woolwich Formation). At the top of the sedimentary complex is the Reading Formation, which is made up of multi-coloured mottled clays and silty clays.

Lignite, or brown coal, a carbonaceous rock composed of plant remains which has not been subject to the same intensity of heat and pressure as has ordinary coal, is occasionally found within the Lambeth Group, as are individual logs and groups of logs indicating the position of a former log jam, which was covered by sand and clay at the time of deposition.

2.5 Hydrogeology and Hydrology

The Desk Study revealed the site to be located on a Secondary A Aquifer relating to the Alluvium and the Lambeth Group.

Secondary aquifers include a wide range of drift deposits with an equally wide range of water

permeability and storage capacities. Secondary (A) Aquifers consist of deposits with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

Examination of the Environment Agency records showed that the site was not located within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water features were the River Colne and the Grand Union Canal, which ran directly along the western and eastern boundaries of site respectively.

From analysis of hydrogeological and topographical maps groundwater was anticipated to be encountered at shallow to moderate depth (3-6m bgl)) and it was considered that the groundwater was flowing in a south-westerly direction, in line with local topography.

Examination of the Environment Agency records showed that the majority of the site fell within a Flood Zone 1 (an area with a low probability of river or sea flooding). However, the eastern and western boundaries which front the River Colne and Grand Union Canal were classified as a Flood Zone 3, defined as land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding.

2.6 Radon

BRE 211 (2015) Map 5 of the London, Sussex and West Kent area indicated that the site was located within a Radon Affected Area, as between 1% and 3% of properties were above the Action Level. The Groundsure report stated that mandatory protection measures against the ingress of radon were not likely to be required at the site.

2.7 Phase 1 Review

The Conceptual Site Model developed in the report ref: GWPR2463/DS/March 2018 can be seen overleaf. A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. The report recommends, additional risk assessment is required to ensure gas measures are sufficient for the change of use given the potential risk of ground-gas identified. This includes the low risk of ground-gas production from deep Made Ground and infilled Wharfs, in addition to the primary source of ground-gas suggested to be from Alluvium deposits underlying site. However, rates for ground-gas production are considered to be generally low.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • Carbon Dioxide; • Methane;	Migration through anthropogenic & natural pathways Inhalation Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers;
Made Ground on-site by historic demolition and construction activities • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Lambeth Group	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services.
Residual contamination risk from historic industrial use on-site • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).		**Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); Asbestos (building material, pipe lagging).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Kempton Park Gravel Member, Lambeth Group (if present)	End users of the site (members of the public and employees) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

3.0 FIELDWORK

3.1 Scope of Works

Site works were undertaken on the 22nd and 23rd August 2019 and comprised the drilling of 8No. Windowless Sampler Boreholes WS1 – WS3 and WS5 – WS8 to a depth of 5.45m bgl. WS4 was undertaken to 0.80m bgl. Standard Penetration Tests (SPT's) were undertaken at 1.0m intervals.

5No. groundwater/ground-gas monitoring wells were installed in WS5 at 2.50m bgl, WS3 at 3.00m bgl and WS1, WS6 and WS8 at 4.00m bgl. The construction of the wells installed can be seen tabulated below.

Combined Ground-gas and Groundwater Monitoring Well Construction				
Trial Hole	**Depth of Installation (m bgl)**	**Thickness of slotted piping with gravel filter pack (m)**	**Depth of plain piping with bentonite seal (m bgl)**	**Piping external diameter (mm)**
WS1	4.00m	3.00m	1.00m	50mm
WS3	3.00m	2.00m	1.00m	50mm
WS5	2.50m	1.50m	1.00m	50mm
WS6	4.00m	3.00m	1.00m	50mm
WS8	4.00m	3.00m	1.00m	50mm

The approximate locations of the trial holes are given on Figure 5.

Prior to commencing the ground investigation, a walkover survey was carried out to identify the presence of underground services and drainage. Where underground services/drainage were suspected and/or positively identified, exploratory positions were relocated away from these areas.

As a further precautionary measure, the positions were hand scanned with a Cable Avoidance Tool (CAT scanner) to minimise the risk to services.

Upon completion of the site works, the trial holes were backfilled and made good/reinstated in relation to the surrounding area.

3.2 Sampling Procedures

Small disturbed samples were recovered from the trial holes at the depths shown on the trial hole records. Soil samples were generally retrieved from each change of strata and/or at specific areas of concern. Samples were also taken at approximately 0.5m intervals during broad homogenous soil horizons.

A selection of samples were despatched for geotechnical testing purposes.

A programme of chemical laboratory testing, scheduled by Ground and Water Limited and carried out by DETS Limited, was undertaken on samples recovered from the trial holes. The testing schedule and suite for Phase I was based on the Conceptual Site Model developed within the Ground and Water Limited Desk Study Report (ref. GWPR2463/DS/March 2018) or the revised CSM within this report.

4.0 ENCOUNTERED GROUND CONDITIONS

4.1 Soil Conditions

The exploratory holes were logged by Natasha Kearl, of Ground and Water Limited generally in accordance with BS EN 14688 'Geotechnical Investigation and Testing – Identification and Classification of Soil'.

The ground conditions encountered within the trial holes constructed on the site did not generally conform to that anticipated from examination of the geology map. A capping of Made Ground was noted to overlie soils of Alluvium overlying the Taplow Gravel Member.

The ground conditions encountered during the investigation are described in this section. All trial hole logs can be seen in Appendix B and the trial hole location plan can be viewed in Figure 5.

For the purposes of discussion the succession of conditions encountered in the trial holes in descending order can be summarised as follows:

Made Ground (WS1 – WS8)
Alluvium (WS1 – WS3 and WS5 – WS8)
Taplow Gravel Member (WS1 – WS3 and WS5 – WS8)

Made Ground

Made Ground was encountered from ground level to a depth of between 0.80 - 1.60m bgl across WS1 – WS8 and generally comprised a black to dark brown/brown to dark grey silty gravelly sand to silty sandy gravel. The sand was fine to coarse grained. The gravel was fine to coarse sub-angular to sub-rounded cement (5%), tarmac (5%), ash (10%), clinker (10%), flint (15%), concrete (15%), slate (20%) and brick (20%).

Alluvium

Alluvium was encountered from 0.80 – 1.60m bgl to a depth of 1.90 - 4.30m bgl in WS1 – WS3 and WS5 – WS8. The soils generally comprised an orange brown/brown/grey mottled gravelly sandy silty clay. The sand was fine to medium grained. The gravel was fine to medium sub-angular to sub-rounded flint and slate fragments. Traces of carbonaceous material were noted in WS1 from 2.90 – 3.40m bgl. Fine shell fragments were noted from 1.00 - 2.00m bgl in WS3. Wood fragments were noted from 0.90 – 1.90m bgl in WS5. Shell fragments were noted from 0.90 – 3.20m bgl and decayed wood fragments and organic odour were noted at 3.00m bgl in WS6. Shell fragments were noted from 1.60 – 2.90m bgl in WS7. Shell fragments were noted from 1.40 – 4.30m bgl in WS8.

The anthropogenic materials (concrete, plastic and brick fragments) noted from 3.40 - 4.30m bgl in WS1 may be due to backfill from shallow depth and collapse during sampling or could be Made Ground at depth.

Taplow Gravel Member

Taplow Gravel Member was encountered from 1.90 - 4.30m bgl to a depth of 5.45m bgl in WS1 – WS3 and WS5 – WS8. The soils comprised a dark brown light brown to orange to pale grey silty clayey gravelly sand to clayey sandy gravel. The sand was fine to coarse grained. The gravel was fine to coarse sub-angular to sub-rounded flint.

For details of the composition of the Made Ground, Alluvium and Taplow Gravel Member reference

must be made to the trial hole logs within Appendix B.

4.2 Roots Encountered

The depth of root penetration observed within each trial hole is tabulated below.

Depth of Root Penetrated Soils Observed Within Trial Holes		
Trial Hole	**Depth of Fresh Root Penetration (m bgl)**	**Depth of Dark Brown/Black Friable Rootlets (m bgl)**
WS1	None	None
WS2	0.80	None
WS3	None	None
WS4	0.80	None
WS5	0.20	None
WS6	None	None
WS7	0.50	None
WS8	0.50	None

It must be noted that the chance of determining actual depth of root penetration through a narrow diameter borehole is low. Roots may be found to greater depths at other locations on the site, particularly close to trees and/or trees that have been removed both within the site and its close environs.

4.3 Groundwater Conditions

Groundwater was encountered in WS7 at 2.90m bgl and WS6 and WS8 at 3.20m bgl during the intrusive investigation. A summary of groundwater depths encountered in WS1, WS3, WS5, WS6 and WS8. during the ground-gas monitoring visits can be summarised below and overleaf:

Depth of Groundwater Strikes/Standing Groundwater Within Trial Holes			
Trial Hole	**Date**	**Depth of Groundwater (m bgl)**	**Depth of Standpipe (m bgl)**
WS1	28/08/2019	Dry	3.30
WS3		Dry	1.91
WS5		2.34	2.63
WS6		2.11	3.24
WS8		2.22	3.65
WS1	06/09/2019	Dry	3.40
WS3		Dry	2.02
WS5		2.40	2.75
WS6		2.16	3.35
WS8		2.24	3.71
WS1	16/09/2019	Dry	3.43
WS3		Dry	2.01
WS5		2.40	2.76
WS6		2.18	3.35
WS8		2.36	3.70

Cont'd overleaf:

Con't from previous page:

Depth of Groundwater Strikes/Standing Groundwater Within Trial Holes			
Trial Hole	**Date**	**Depth of Groundwater (m bgl)**	**Depth of Standpipe (m bgl)**
WS1	23/09/2019	Dry	3.43
WS3		Dry	2.01
WS5		2.40	2.75
WS6		2.15	3.35
WS8		2.32	3.71
WS1	07/10/2019	Dry	3.43
WS3		1.90	2.02
WS5		2.27	2.75
WS6		2.10	3.71
WS8		2.17	3.60
WS1	16/10/2019	Dry	3.42
WS3		Dry	2.02
WS5		2.3	2.75
WS6		2.18	3.35
WS8		2.1	3.71
WS1	19/11/2019	Dry	3.44
WS3		Dry	2.01
WS5		2.31	2.75
WS6		2.33	3.22
WS8		2.15	3.70
WS1	26/11/2019	Dry	3.43
WS3		Dry	1.99
WS5		2.28	2.75
WS6		2.04	3.34
WS8		2.20	3.64
WS1	02/12/2019	Dry	3.43
WS3		Dry	2.01
WS5		2.28	2.75
WS6		2.11	3.32
WS8		2.18	2.67

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. Exact groundwater levels may only be determined through long term measurements from monitoring wells installed on-site.

The site investigation was conducted in August 2019, when groundwater levels should be at their lowest to December 2019, when groundwater levels should be rising towards their annual maximum (highest elevation). The long-term groundwater elevation might increase at some time in the future due to seasonal fluctuation in weather conditions. Isolated pockets of groundwater may be perched within any Made Ground found at other locations around the site.

4.4 Obstructions

WS4 could not be taken further than 0.80m bgl due to the density of the Brick Fill encountered.

No other artificial or natural sub-surface obstructions were noted during construction of the remaining trial holes.

5.0 IN-SITU AND LABORATORY GEOTECHNICAL TESTING

5.1 In-Situ Geotechnical Testing

5.1.1 Standard Penetration Tests (SPT's)

Standard Penetration Testing was undertaken within WS1 – WS3 and WS5 – WS8 at 1.00m intervals. The results of the SPT's have not been amended to take into account hammer efficiency, rod lengths and overburden pressure in accordance with Eurocode 7. The test results are presented within Appendix B.

Windowless Sampler Boreholes provide samples of the ground for assessment but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50 mm and an inside diameter of 35 mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5 kg falling through a distance of 760 mm. The sample tube is driven 150 mm into the ground and then the number of blows needed for the tube to penetrate each 75 mm up to a depth of 450 mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

The cohesive soils of the Alluvium were classified based on the table below.

Undrained Shear Strength from Field Inspection/ SPT "N" Blow Counts Cohesive Soils (EN ISO 14688-2:2004 & Stroud (1974))		
Classification	**Undrained Shear Strength (kPa)**	**Field Indications**
Extremely High	>300	-
Very High	150 – 300	Brittle or very tough
High	75 – 150	Cannot be moulded in the fingers
Medium	40 – 75	Can be moulded in the fingers by strong pressure
Low	20 – 40	Easily moulded in the fingers
Very Low	10 – 20	Exudes between fingers when squeezed in the fist
Extremely Low	<10	-

The granular soils of the Made Ground and Taplow Gravel Member were classified based on the table below.

Correlation between SPT "N" Blow Counts and granular classification.	
Classification	**Equivalent SPT Blow Counts (N1)**
Extremely Dense	>58
Very Dense	42 – 58
Dense	25 – 42
Medium Dense	8 – 25
Loose	3 – 8
Very Loose	0 – 3

An interpretation of the in-situ geotechnical testing results is given in the table overpage.

In-Situ Geotechnical Testing Results Summary					
Strata	**SPT "N" Blow Counts**	**Undrained Shear Strength kPa (based on Stroud, 1974)**	**Soil Type**		**Trial Hole**
			Cohesive	**Granular**	
Made Ground (granular soils)	21 - 31	-	-	Medium - Dense	WS1 (0.00 – 1.30m bgl) WS2 (0.00 – 1.40m bgl) WS7 (0.00 – 1.60m bgl) WS8 (0.00 – 1.40m bgl)
Alluvium	11 – 21 4– 22 15- 25 31 12 – 31 11 – 14 1 - 24	55 – 105 20 – 110 75 – 125 155 60 – 155 55 – 70 5 - 120	Medium – High Low – High High Very High Medium - Very High Medium Extremely Low - High	-	WS1 (1.30 – 4.30m bgl) WS2 (1.40 – 4.30m bgl) WS3 (0.80 – 2.90m bgl) WS5 (1.90 – 3.30m bgl) WS6 (0.90 – 3.20m bgl) WS7 (1.60 – 4.20m bgl) WS8 (1.40 – 4.30m bgl)
Taplow Gravel Member (cohesive)	18 – 31 3 - 5	90 - 155 15 - 25	High – Very High Very Low - Low		WS5 (1.90 – 3.30m bgl) WS7 (4.20 – 5.45m bgl)
Taplow Gravel Member (granular)	2 3 1 – 9 3 – 4 2 – 5 1 - 2	-	-	Very Loose – Loose*	WS1 (4.30 – 5.45m bgl) WS2 (4.30 – 5.45m bgl) WS3 (2.90 – 5.45m bgl) WS5 (3.30 – 5.45m bgl) WS6 (3.20 – 5.45m bgl) WS8 (3.30 – 5.45m bgl)

It must be noted that field measurements of undrained shear strength are dependent on a number of variables including disturbance of sample, method of investigation and also the size of specimen or test zone etc.

*The low SPTs indicating loose soils of the Taplow Gravel Member are likely due to the presence of shallow groundwater.

The test results are presented on the trial hole logs within Appendix B.

6.0 CONTAMINATION RISK ASSESSMENT

6.1 Results of the Phase 1 Risk Assessment (Conceptual Site Model)

The tabulated Conceptual Site Model developed by the Ground and Water Desk Study (ref. GWPR2463/DS/March 2018) is reproduced in this section and can be seen below.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • Carbon Dioxide; • Methane;	Migration through anthropogenic & natural pathways Inhalation Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers;
Made Ground on-site by historic demolition and construction activities • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants.	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services.
Residual contamination risk from historic industrial use on-site • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); • Asbestos (building material, pipe lagging).	**Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Lambeth Group	**Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc); • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • Organic compounds (fuel oils, ash, tar); Asbestos (building material, pipe lagging).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Kempton Park Gravel Member, Lambeth Group (if present)	End users of the site (members of the public and employees) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

6.2 Sampling Locations

The methodology for the sampling locations of site works can be seen tabulated below. A trial hole location plan is given within Figure 5.

Trial Hole	Sampling Strategy	Existing Use
WS1	Targeted Sampling Strategy.	Soft landscaping
WS2		Hard landscaping
WS3		Soft landscaping
WS4		Hard landscaping
WS5		Soft landscaping
WS6		
WS7		
WS8		

The area investigated was ~25,318m^2 and with eight sampling locations during the current phase, given an unknown hotspot shape, the sampling density means that a hotspot with an area of approximately 4747.12m^2 and a radius of approximately ~38.8m would be encountered (CLR 4).

Sampling depths were chosen to reflect the receptor of concern, human health and typically comprised a surface or near surface sample and at approximately 0.5m depth. The human health receptors relevant to the sampling depths were as follows:

Near surface samples	Direct ingestion, dermal contact and dust inhalation. Protection of end-users and maintenance workers e.g. Landscape Gardeners. Protection of shallow rooted plants Perched Water/Surface Water Run-off
>0.5m below ground level	Protection of deep-rooted plants

The depth of soil sampling can be seen within the trial hole logs presented in Appendix B.

6.3 Chemical Laboratory Testing – Human Health Risk Assessment

A programme of chemical laboratory testing, scheduled by Ground and Water Limited, and carried out by DETS Limited, was undertaken on nine samples of Made Ground (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl). The samples tested and the reason for testing can be seen tabulated below.

Methodology for Sampling Locations and Chemical Laboratory Testing			
Trial Hole	**Depth (m bgl)**	**Sampling Strategy**	**Current-Use**
WS3	0.20	Representative samples of Made Ground.	Soft landscaping
WS4	0.20		Hard landscaping
WS5	0.50		Soft landscaping
WS7	0.20		
WS1	0.50		
WS2	0.50		Hard Landscaping
WS8	0.50		Soft landscaping

The analysis suite is presented below and comprised:

- Semi Metals and Heavy Metals incl. Arsenic, Cadmium, Chromium (incl. Hexavalent Chromium), Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl)
- Asbestos Screen (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl)
- Polycyclic Aromatic Hydrocarbons (PAH's) incl. Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene (WS3/0.20, WS4/0.20, WS5/0.20, WS7/0.20, WS1/0.50, WS2/0.50, WS8/0.20m bgl)
- Fuel Oils – Speciated TPH including full aliphatic/aromatic split (WS4/0.20, WS5/0.20 and WS2/0.50m bgl)
- BTEX compounds (Benzene, Toluene, Ethylbenzene, Xylene) and MTBE – used as marker compounds for Volatile Organic Compounds (VOCs) split (WS4/0.20, WS5/0.20 and WS2/0.50m bgl).

The chemical laboratory results are presented in Appendix C.

6.3.1 Soil Assessment Criteria

The derivation of Soil Assessment Criteria used within this report can be seen within Appendix D.

6.3.2 Determination of Representative Contamination Concentration

At the time of reporting in December 2019, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Ancillary car parking, cycle storage and waste and recycling storage were also to be provided. A proposed development plan can be seen in Figure 4.

Therefore, the results of the chemical laboratory testing were compared to the LQM/CIEH Suitable 4 Use Levels (S4UL) for a **'Public Open Spaces near Residential Housing (POSresi)'** land-use scenario, as this was considered the most appropriate land-use scenario. The C4SL LLTC for Lead was compared to a **'Public Open Spaces near Residential Housing (POSresi)'** land-use scenario. The results showing comparison of the representative contaminant concentrations are presented in the table overleaf.

Where no LQM/CIEH S4UL/C4SL LLTC was available for a particular determinant then preliminary reference was made to the laboratory detection limit of the determinant. If a positive concentration was noted then further risk assessment was undertaken.

For Cyanide, where no SGC/GAC or C4SL LLTC was available a Site Specific Assessment Criteria of 10mg/kg was adopted. This is based on ICRCL 59/83, TCL, ATRISK (SOIL) Screening Value and Dutch Intervention Value (ranging from 20 – 34mg/kg). Therefore, a SSAC of ~10mg/kg is considered conservative.

Where a contaminant of concern's LQM/CIEH S4UL/GAC/C4SL LLTC varies according to the Soil's Organic Matter (SOM), the SOM recorded for each soil sample was used to derive the appropriate SGV/GAC. The SOM of WS4/0.20m was 1.1% and WS5/0.20m bgl was 1.5% so the 1.0% SOM scenario was used. The SOM of WS3/0.20m was 3.6%, WS7/0.20m was 2.9%, WS8/0.50m was 2.5%, WS1/0.50m was 4.5%, WS2/0.50m was 5.5% bgl so the 2.5% SOM scenario was used.

Double plot analysis indicated that the majority PAH's encountered were from predominantly a combustion source, within the urban background source and may be associated fragments of coal. One sample was from combustion soot source and one from a petroleum combustion source. None of the PAH's appeared to be from a Coal Tar/Creosote, source and therefore the benzo(a)pyrene S4UL was considered suitable for use. The PAH double ratio analysis can be seen in Appendix E.

Soil Guideline Values and General Acceptance Criteria Results	
Substance	**Sample Location Where available LQM/CIEH S4UL/, CSL4 LLTC or GAC were exceeded for relevant land-use scenario**
	"Public Open Spaces near Residential Housing (POSresi)" Land-Use Scenario
Arsenic	None
Boron	None
Cadmium	None
Chromium (III)	None
Hexavalent Chromium (VI)	None
Copper	None
Lead	None
Mercury (Elemental)	None
Nickel	None
Selenium	None
Vanadium	None
Zinc	**WS3/0.20m bgl (3080 mg/kg)**
Cyanide (Total)	None
Total Phenol	None
Naphthalene	None
Acenapthylene	None
Acenapthene	None
Fluorene	None
Phenanthrene	None
Anthracene	None
Fluoranthene	None
Pyrene	None
Benzo(a)anthracene	**WS7/0.20m (44.60mg/kg), WS8/0.20m (89.30mg/kg), and WS2/0.50m bgl (54.00mg/kg)**
Chrysene	**WS8/0.20m (78mg/kg)**
Benzo(b)fluoranthene	**WS3/0.20m (18.80mg/kg), WS5/0.20m (8.08mg/kg), WS7/0.20m (39.60mg/kg), WS8/0.20m (92.40mg/kg) and WS2/0.50m bgl (77.50mg/kg)**
Benzo(k)fluoranthene	None
Benzo(a)pyrene	**WS3/0.20m (14.20mg/kg), WS7/0.20m (31.60mg/kg), WS8/0.20m (79.50mg/kg) and WS2/0.50m bgl (58.5mg/kg)**
Indeno(1,2,3-cd)pyrene	None
Dibenz(a,h)anthracene	**WS3/0.20m (1.83mg/kg), WS4/0.20m (0.64mg/kg), WS5/0.20m (0.85mg/kg), WS7/0.20m (4.19mg/kg), WS8/0.20m (8.15mg/kg), WS2/0.50m(6.83mg/kg)**
Benzo(ghi)perylene	None
TPH C5 – C6 (aliphatic)	None
TPH C6 – C8 (aliphatic)	None
TPH C8 - C10 (aliphatic)	None
TPH C10 - C12 (aliphatic)	None
TPH C12 - C16 (aliphatic)	None
TPH C16 - C21 (aliphatic)	None
TPH C21 - C34 (aliphatic)	None
TPH C5 – C7 (aromatic)	None
TPH C7 – C8 (aromatic)	None
TPH C8 – C10 (aromatic)	None
TPH C10 – C12 (aromatic)	None
TPH C12 – C16 (aromatic)	None
TPH C16 - C21 (aromatic)	None
TPH C21 - C35 (aromatic)	None
Benzene	None
Toluene	None
Ethylbenzene	None
Xylene (o, m & p)	None
MTBE	None
Asbestos Screen	None

All chemical laboratory test results from the samples of Made Ground tested (WS3/0.20m, WS4/0.20m, WS5/0.20m, WS7/0.20m, WS1/0.50m, WS2/0.50m and WS8/0.50m bgl) were compared to CSL4 LLTC for a **"Public Open Spaces near Residential Housing (POSresi)"** scenario.

Chemical laboratory testing revealed elevated levels of zinc, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(a)pyrene, indeno(123-sd)pyrene and dibenz(a,h)anthracene within the Made Ground above their respective C4SL LLTC for a **'Public Open Spaces near Residential Housing (POSresi)'** land use scenario.

An elevated concentration of Zinc was noted in one sample of Made Ground with a value of 3080mg/kg in WS3/0.20m bgl above the phytotoxicity threshold trigger value of 1000mg/kg.

Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a **'Public Open Spaces near Residential Housing (POSresi)'** land-use scenario.

Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytoxicity threshold, specialist planting may be required and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

6.4 CLAIRE Statistical Analysis

CLAIRE statistical analysis of the results of contamination testing from phase 1 of sampling was carried out targeting the contaminants identified as posing an unacceptable risk to end-users (PAH's).

The Made Ground encountered was considered to be of the same population, therefore statistical analysis on all results obtained was deemed appropriate.

CLAIRE statistical analysis looks at the distribution of contaminants across the site to determine if overall levels exceed the critical criteria and whether there are outliers within the sample population which can be treated as hotspots.

CLAIRE statistical analysis of the distribution of elevated levels of PAH's within the Made Ground analysed revealed the concentrations had a normal distribution, no outliers with the mean of the sample population below the LQM/CIEH S4UL and the Upper Confidence Limit of the sample population above the LQM/CIEH S4UL. Therefore, the elevated levels of PAH's in samples of Made Ground analysed are thought to pose a risk across the site.

The results of the analysis can be seen in Appendix F. A précis of the results is tabulated overleaf.

Soil Guideline Values and General Acceptance Criteria Results			
Substance	Outliers Present	Upper Confidence Limit of Sample Population (mg/kg)	Does the Upper Confidence Limit of the Sample Population Exceed the C4SL LLTC Public Open Spaces near Residential Housing (POSresi)
Benzo(a)anthracene	NO	102.36	29mg/kg Yes
Chrysene	NO	78.00	57mg/kg Yes
Benzo(b)fluoranthene	NO	82.16	7.20mg/kg Yes
Benzo(a)pyrene	NO	79.89	5.70mg/kg Yes
Dibenzo(a,h)anthracene	NO	6.37	0.58mg/kg Yes

6.5 Groundwater Risk Assessment

The Desk Study revealed the site to be located on a Secondary A Aquifer relating to the Alluvium and the Lambeth Group.

Examination of the Environment Agency records showed that the site was not located within a Groundwater Source Protection Zone (SPZ) as classified in the Policy and Practice for the Protection of Groundwater.

The nearest surface water features were the River Colne and the Grand Union Canal, which ran directly along the western and eastern boundaries of site respectively.

Based on the underlying geology, comprising low permeability deposits, it is considered likely that perched groundwater will be encountered at shallow depths within the Made Ground and could be encountered within any cohesive layers identified within the deposits, such as Silt or Clay horizons. The actual groundwater table was considered to be present at depth (3.00 – 6.00m), within the Alluvium. The groundwater was anticipated to be broadly flowing in a south-westerly direction, in accordance with local topography and local water features.

Groundwater was encountered in WS7 at 2.90m bgl and WS6 and WS8 at 3.20m bgl during the intrusive investigation. A summary of groundwater depths encountered in WS1, WS3, WS5, WS6 and WS8. during the ground-gas monitoring visits can be summarised overleaf:

Depth of Groundwater Strikes/Standing Groundwater Within Trial Holes			
Trial Hole	**Date**	**Depth of Groundwater (m bgl)**	**Depth of Standpipe (m bgl)**
WS1	28/08/2019	Dry	3.30
WS3		Dry	1.91
WS5		2.34	2.63
WS6		2.11	3.24
WS8		2.22	3.65
WS1	06/09/2019	Dry	3.40
WS3		Dry	2.02
WS5		2.40	2.75
WS6		2.16	3.35
WS8		2.24	3.71
WS1	16/09/2019	Dry	3.43
WS3		Dry	2.01
WS5		2.40	2.76
WS6		2.18	3.35
WS8		2.36	3.70
WS1	23/09/2019	Dry	3.43
WS3		Dry	2.01
WS5		2.40	2.75
WS6		2.15	3.35
WS8		2.32	3.71
WS1	07/10/2019	Dry	3.43
WS3		1.90	2.02
WS5		2.27	2.75
WS6		2.10	3.71
WS8		2.17	3.60
WS1	16/10/2019	Dry	3.42
WS3		Dry	2.02
WS5		2.3	2.75
WS6		2.18	3.35
WS8		2.1	3.71
WS1	19/11/2019	Dry	3.44
WS3		Dry	2.01
WS5		2.31	2.75
WS6		2.33	3.22
WS8		2.15	3.70
WS1	26/11/2019	Dry	3.43
WS3		Dry	1.99
WS5		2.28	2.75
WS6		2.04	3.34
WS8		2.20	3.64
WS1	02/12/2019	Dry	3.43
WS3		Dry	2.01
WS5		2.28	2.75
WS6		2.11	3.32
WS8		2.18	2.67

Examination of the Environment Agency records showed that the majority of the site fell within a Flood Zone 1 (an area with a low probability of river or sea flooding). However, the eastern and western boundaries which front the River Colne and Grand Union Canal were classified as a Flood Zone 3, defined as land having a 1 in 100 or greater annual probability of river flooding; or land having a 1 in 200 or greater annual probability of sea flooding.

Given the likely low mobility of the Zinc and the low permeability of the Alluvial clays inhibiting the PAH migration, qualitative risk assessment has indicated that the determinants noted pose no risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding. Additionally, given there is no change in the external layout or amounts of hardstanding onsite, groundwater is not considered to be a potential receptor.

6.6 Ground-Gas Risk Assessment

The Groundsure Datasheets found nineteen records of potentially infilled land onsite comprising: 12 x canals (1868 to 1959) and 7 x unspecified wharfs (1897 to 1959). The Groundsure Datasheets, revealed twenty-one off-site records of potentially infilled land noted within 250m of the site comprising: 5 x canals between 2m and 3m south-east (1882 to 1989), 2 x unspecified wharfs 10m south-west (1913 and 1938), 1 x unspecified wharf 27m north-east (1970), 7 x canals between 53m and 59m north-east (1895 to 1938), 1 x unspecified wharf 116m south (1932), 2 x canals 185m south (1900 and 1932), 1 x pond 207m south-east (1897), 2 x fish ponds 214m and 219m south-east (1868 and 1882). It is unlikely that the canal would pose a contamination risk as it is still present as the Grand Union Canal and therefore, would not have been infilled.

The Desk Study and intrusive investigation revealed the site was located on Alluvium. Alluvial deposits rich in organic matter can produce ground-gases with Carbon Dioxide concentrations exceeding 5% and Methane concentration around 1%.

It is possible that fill from the wharfs and the Alluvium present underlying the site would be producing harmful levels of carbon dioxide and methane. Putrescible material within the fill (Made Ground) may create ground-gases such as methane and carbon dioxide. Made Ground is likely to be shallow and uncapped and consequently ground-gas will preferentially migrate to surface.

In order to assess the ground-gas risk combined ground-gas and groundwater monitoring wells were installed within WS1, WS3, WS5, WS6 and WS8 to 2.50 – 4.00m bgl. The construction of the well installed can be seen tabulated below.

Combined Ground-gas and Groundwater Monitoring Well Construction				
Trial Hole	**Depth of Installation (mbgl)**	**Thickness of slotted piping with gravel filter pack (m)**	**Depth of plain piping with bentonite seal (m bgl)**	**Piping external diameter (mm)**
WS1	4.00m	3.00m	1.00m	50mm
WS3	3.00m	2.00m	1.00m	50mm
WS5	2.50m	1.50m	1.00m	50mm
WS6	4.00m	3.00m	1.00m	50mm
WS8	4.00m	3.00m	1.00m	50mm

Ground-gas monitoring has been undertaken on six occasions to date. The results of the ground-gas monitoring can be seen tabulated below and overleaf. The ground-gas monitoring was undertaken using an LMSXi landfill gas analyser.

Ground-gas Monitoring from Wells										
Date	**Trial Hole**	**O_2 (%)**	**LEL (%)**	**CH_4 (%)**	**CO_2 (%)**	**H2S (ppm)**	**CO (ppm)**	**Flow Rate (litre/hr)**	**Groundwater (m BGL)**	**VOC (ppm)**
28/08/2019 PM Weather: Broken Clouds, strong winds. Pressure over previous 48hours: Decreasing over 26th and 27th and gradually increasing 29th	Atmosphere (1013mb)	14.4	0	0	0.0	0	0	-	-	-
	WS1	15	0	0	3.4	0	0	0	Dry	3.30
	WS3	7.9	0	0	5.1	0	0	0	Dry	1.91
	WS5	17.1	0	0	2.1	0	0	0	2.34	2.63
	WS6	13.5	0	0	5.4	0	0	0	2.11	3.24
	WS8	6.3	0	0	2.1	0	0	0	2.22	3.65
07/10/2019 PM Weather: Partly Sunny. Pressure over previous 48hours: Steady through 5th, 6th and 8th.	Atmosphere (1008mb)	20.5	0	0	0.0	0	0	-	-	-
	WS1	14.5	0	0	5.0	0	0	0	Dry	3.43
	WS3	9.0	0	0	0.8	0	0	0	1.90	2.02
	WS5	16.4	0	0	2.4	0	0	0	2.27	2.75
	WS6	15.1	0	0	2.0	0	0	0	2.10	3.71
	WS8	15.7	0	0	2.0	0	0	0	2.17	3.60
16/10/2019 PM Weather: Partly Sunny. Pressure over previous 48hours: Steeply decreasing over 14th and steady through 15th and 17th.	Atmosphere (1008mb)	20.6	0	0	0.0	0	0	-	-	-
	WS1	13.5	0	0	5.5	0	0	0	Dry	3.42
	WS3	11.6	0	0	0.5	0	0	0	Dry	2.02
	WS5	15.7	0	0	2.7	0	0	0	2.3	2.75
	WS6	3.1	0	0	4.8	0	0	0	2.18	3.35
	WS8	17.6	0	0	0.8	0	0	0	2.1	3.71

Cont'd overleaf:

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Ground-gas Monitoring from Wells										
Date	**Trial Hole**	**O_2 (%)**	**LEL (%)**	**CH_4 (%)**	**CO_2 (%)**	**H2S (ppm)**	**CO (ppm)**	**Flow Rate (litre/hr)**	**Groundwater (m BGL)**	**VOC (ppm)**
19/11/2019 AM Weather: Ice Fog. Pressure over previous 48 hours: Gentle rise on the 17th and steady through 18th; falling gently on 20th.	Atmosphere (1010)	20.5	0	0	0.1	0	0	-	-	-
	WS1	19.1	0	0	1.2	0	0	0	Dry	3.44
	WS3	15.0	0	0	1.1	0	0	0	Dry	2.01
	WS5	18.9	0	0	1.8	0	0	0	2.31	2.75
	WS6	10.1	0	0	3.7	0	0	0	2.33	3.22
	WS8	18.0	0	0	1	0	0	0	2.15	3.70
26/11/2019 PM Weather: Partly Sunny. Pressure over previous 48 hours: Steady through 24th and 25th, remaining steady on 27th.	Atmosphere (989)	19.7	0	0	0	0	0	-	-	-
	WS1	19.9	0	0	0.2	0	0	0	Dry	3.43
	WS3	20.0	0	0	0.2	0	0	0	Dry	1.99
	WS5	20.0	0	0	0.1	0	0	-0.1	2.28	2.75
	WS6	20.1	0	0	0.1	0	0	-0.1	2.04	3.34
	WS8	20.1	0	0	0.1	0	0	0	2.20	3.64
02/12/2019 AM Weather: Sunny. Pressure over previous 48 hours: Steady over 30th and rising gently over 1st, and gently falling on 3rd.	Atmosphere (1028)	20.1	0	0	0.1	0	0	-	-	-
	WS1	20.3	0	0	0.1	0	0	0	Dry	3.43
	WS3	20.3	0	0	0.1	0	0	0	Dry	2.01
	WS5	20.3	0	0	0.1	0	0	0	2.28	2.75
	WS6	20.2	0	0	0.1	0	0	0	2.11	3.32
	WS8	20.2	0	0	0.1	0	0	-0.2	2.18	2.67

6.6.1 Data Quality

A review was made of the quality of the available data for the site, which can be viewed in the table overleaf. CIRIA Report C665 (2007) and BS 8485:2007 stress the need for risk assessments to be based on good quality data and give guidance as to best practice in this respect.

Review of Data Quality			
Data Type	**Current Situation**	**UK Practice**	**Recommendation**
Geological and hydro-geological conditions	With regard to the ground-gas risk assessment the data from the Desk Study and logged trial holes is good.	CIRA C665 & C659, Wilson and Card (1999) and BS 8485:2007 recommend that geology and hydrogeology be fully understood.	**No further action required.**
Monitoring period	The monitoring has been undertaken on a total of six occasions over a 5 month period in August 2019 – December 2019. Monitoring has been undertaken during a period of relatively stable high pressure and falling low to moderate pressure.	CIRIA C665 recommends prolonged monitoring over a range of weather conditions. Wilson and Card (1999) recommend that for less than 12 months monitoring the protective measures should be made more conservative.	The six sets of gas readings taken to date have shown concentrations of methane below the detection limits of the gas analyser (0.1%). Carbon Dioxide concentrations ranged from 0.1-5.5%. No methane, LEL, hydrogen sulphide or carbon monoxide was detected. **No further monitoring required.**
Gas data sets	Borehole flow velocity has been measured on each monitoring occasion.	Borehole flow velocity and borehole gas volume (carbon dioxide and methane) required for gas flux categorisation. Modified Wilson and Card classification, CIRIA C665 (2007).	Flow rates have been monitored on all 6No. visits undertaken to date. Monitoring revealed no positive flows. **No further monitoring required.**

Based on the documentation presented in "BS 8485:2007, Code of practice for the characterization and remediation from ground gas in affected developments", the Data Category for the site could be characterised as **"adequate"** given that six monitoring rounds have been undertaken.

6.6.2 Risk Assessment

CIRIA Report 665 gives tables of Characteristic Situations for protection from ground-gas for buildings, including commercial and residential structures. These were developed from a survey of UK practice and thus empirically reflect UK practice, rather than being derived by risk analysis of site-specific gas data.

Based on the data to date a maximum Carbon Dioxide concentration of 5.5% by volume in WS1 (16/10/2019) was noted. The lowest oxygen concentration recorded was 3.1% by volume in WS6 (16/10/2019). No Hydrogen Sulphide, Carbon Monoxide or Methane was detected. No Methane as LEL was detected.

Out of the thirty ground-gas readings undertaken on-site, only three results were >5.0%.

No constant or peak flow rate has been measured across all monitoring.

The low permeability of the Alluvium was unlikely to allow the migration of ground-gas from off-site sources. Made Ground was encountered across the site.

The Alluvium encountered was found to range between a thickness of 1.00 – 3.00m.

The gas concentrations noted appear to be associated with the natural decay of relatively shallow Made Ground and not an off-site source.

Based on the documentation presented in "BS 8485:2015, Code of practice for the characterization and remediation from ground-gas in affected developments", the hazardous gas flow rate (Qhg) should be calculated using:
Qhg=Chg/100 * q

Where:

Chg is the measured hazardous gas concentration (in percentage volume-by-volume);

q is the flow rate (in litres per hour) of combined gases found by direct measurement.
If gas borehole flow was not detectable, it should be assumed to be at the detection limit of the equipment used.

Based on a flow rate of 0.1 l/hr (detection limit of the gas analyser), the Qhg for Carbon Dioxide was calculated to be:

Qhg (l/hr) = 5.5/100 * 0.1 (detection limit)

Qhg for Carbon Dioxide = 0.0055 l/hr

This indicates the site falls within a Characteristic Situation 1 (CS1) based on BS8485 (2015). However, it is noted that where carbon dioxide concentrations exceed 5% a CS2 for the site should be considered, but given out of the thirty ground-gas readings undertaken on-site, only three results were >5.0% a CS1 scenario was deemed more appropriate.

A previous site investigation revealed Waterside House and Riverview House have an existing gas-resistant membrane and passive venting as a precautionary measure. Further risk assessment could be undertaken through a detailed review of the existing buildings ground floor construction.

6.7 Re-Evaluated Phase 2 Conceptual Site Model

Following completion of the Phase 2 Site Investigation, the CSM within Section 6.1 of this report was re-evaluated and can be seen below and overleaf. The plausible pollutant linkages remaining after risk assessment are shown and where risk assessment has indicated no unacceptable risk to sensitive receptors, the pollutant linkages have been crossed out.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • **Carbon Dioxide; low levels identified.** • ~~Methane;~~	Migration through anthropogenic & natural pathways Inhalation Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers;
Made Ground on-site by historic demolition and construction activities • ~~Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc);~~ • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • ~~Organic compounds (fuel oils, ash, tar);~~ • ~~Asbestos (building material, pipe lagging~~).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Lambeth Group	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**
Residual contamination risk from historic industrial use on-site • ~~Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc);~~ • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • ~~Organic compounds (fuel oils, ash, tar);~~ • ~~Asbestos (building material, pipe lagging).~~		

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • ~~Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc);~~ • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • ~~Organic compounds (fuel oils, ash, tar);~~ • ~~Asbestos (building material, pipe lagging).~~	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Kempton Park Gravel Member, Lambeth Group (if present)	End users of the site (members of the public and employees) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

Given that a Characteristic Situation 1 (CS1) was more appropriate for the site and the presence of an existing gas-resistant membrane and passive venting below Riverview House And Waterside House ground-gas was not considered to pose a risk to end users. Further risk assessment could be undertaken through a detailed review of the existing buildings ground floor construction.

Chemical laboratory testing revealed elevated levels of zinc, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(a)pyrene, indeno(123-sd)pyrene and dibenz(a,h)anthracene within the Made Ground above their respective C4SL LLTC for a **'Public Open Spaces near Residential Housing (POSresi)'** land use scenario.

Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a **'Public Open Spaces near Residential Housing (POSresi)'** land-use scenario.

Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytoxicity threshold, specialist planting may be required, and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

Given the likely low mobility of the Zinc and the low permeability of the Alluvial clays inhibiting the PAH migration, qualitative risk assessment has indicated that the determinants noted pose no risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding.

Based on a visual appraisal of the soils, the Made Ground encountered on site was not considered physically or cosmetically suitable for use on the residential site. In addition to this, given the maximum concentration of Benzo(b)fluoranthene (92.40 mg/kg), Benzo(a)pyrene (79.50 mg/kg) and Dibenz(a,h)anthracene (8.15 mg/kg) identified in the Made Ground was over six times the relevant SGV for a **"Public Open Spaces near Residential Housing (POSresi)"** Land-Use Scenario a BRE Cover System could not be applied. Therefore a remediation strategy was deemed necessary which was outlined in section 7 below.

7.0 DEVELOPMENT OF A REMEDIATION STRATEGY

7.1 Option Appraisal

This section of the report will discuss the options available following completion of the Site Investigation and Risk Assessment with respect to soil and groundwater contamination.

We have assessed that the contamination noted does not pose a risk to groundwater and therefore remediation is solely necessary with respect to human health.

7.1.1 Residential Development

The distribution of Zinc and PAHs within the Made Ground was revealed to have a normal distribution, no outliers with the mean of the sample population below the LQM/CIEH S4UL and the Upper Confidence Limit of the sample population above the LQM/CIEH S4UL.

Based on the results of the contamination testing to date and a visual appraisal of the soils the following remediation options are available.

Risk Assessment has indicated that the determinants noted pose no unacceptable risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding. However, given the risks posed to end-users remediation is necessary for areas of soft landscaping.

- Complete removal of Made Ground from the site has not been considered given the cost implications and given that a simple capping system could be adopted. This would prevent needless lorry movements and prevent waste unnecessarily being sent to landfills with only a finite capacity.

- Based on a visual appraisal of the soils, the Made Ground encountered on site was not considered physically or cosmetically suitable for use on the residential site. In addition to this, given the maximum concentration of Benzo(b)fluoranthene (92.40 mg/kg), Benzo(a)pyrene (79.50 mg/kg) and Dibenz(a,h)anthracene (8.15 mg/kg) identified in the Made Ground was over six times the relevant SGV for a **"Public Open Spaces near Residential Housing (POSresi)"** Land-Use Scenario a BRE Cover System could not be applied.

- Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytoxicity threshold, specialist planting may be required, and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

- In order to sever the direct soil ingestion and outdoor dermal contact exposure pathways consideration should be given to the placement of certified clean imported Sub-soil and Topsoil in all areas of soft landscaping with a marker layer at the base. This would create a clean capping over the Made Ground.

  A total 300mm clean capping layer is recommended. This will need to include a 150mm thick anti-dig layer/anti-capillarity comprising gap graded certified clean material (could be recycled crushed concrete) at base and 150mm of clean soils with a geotextile membrane between the two. The top 150mm will need to comprise

Topsoil in order to act as a growing medium for plants.

7.2 Remediation Method Statement

At the time of reporting in December 2019, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). Ancillary car parking, cycle storage and waste and recycling storage were also to be provided. A proposed development plan can be seen in Figure 4.

The following remedial methodology should be undertaken based on the elevated levels of determinants noted:

Pre-Construction:

- Following the reduced dig, the void created must be visually inspected by an independent and suitably qualified person to verify the removal of the Topsoil/Made Ground. Excavations may cease at shallower depth where natural soils are encountered.

- The voids created should be measured and photographed.

- Stockpiled contaminated Made Ground, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.

- Materials to be removed off-site must be classified by carrying out Waste Acceptance Produce (WAP) testing. A registered contractor must undertake the removal of waste. Full liaison must be made with the Environment Agency prior to the removal of any material and must be conducted to meet their full approval.

Post-Construction:

- The following final capping systems are to be placed in areas of soft landscaping:

A total 300mm clean capping layer will be required within areas of soft landscaping. This will need to include a 150mm thick anti-dig layer/anti-capillarity comprising gap graded certified clean material (could be recycled crushed concrete) at base and 150mm of clean soils with a geotextile membrane between the two. The top 150mm will need to comprise Topsoil in order to act as a growing medium for plants.

- Reduced dig should be taken to 300mm below the finished soft landscaped area. Then a suitable and certified anti-dig layer or geotextile should be installed. The reduced dig levels and the anti-dig layer / geotextile will need to be verified and photographed by a Ground and Water Ltd Engineer, before the placement of the capping soils.

- Installation of suitable and certified imported Topsoil. The final capping system will need to be checked by a Ground and Water Ltd Engineer after completion of soft landscaping areas.

- Stockpiled contaminated Made Ground, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.

- Materials to be removed off-site must be classified by carrying out Waste Acceptance Produce (WAP) testing. A registered contractor must undertake the removal of waste. Full liaison must be made with the Environment Agency prior to the removal of any material and must be conducted to meet their full approval.

- The Topsoil will need to be certified before being imported onsite and ideally placed in stockpiles on site. These stockpiles should be clear of Made Ground or any contaminated soils. Additional verification of any imported soil will need to occur onsite, once received, to validate the accompanying lab certificate. Any samples taken from a stockpile of imported soil or placed soil should be at a rate of one sample per 50m3 of material and be tested for semi-metals, heavy metals, speciated PAH's, speciated TPH and asbestos.

Validation;

- Following completion of all the remediation and validation works, outlined above, a report should be submitted to the local authority for approval.

7.3 Validation Strategy

Any remedial works undertaken on the site will need to be inspected and independently validated by a Ground and Water Limited Engineer. All remedial excavations will need to be inspected, documented and photographed.

7.4 Waste Produced

Remediation of the Made Ground is likely to produce waste which will require classification and then recycling or removal from site.

Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal all waste must be classified as;

- Inert;
- Non-hazardous, or;
- Hazardous.

The Environment Agency's Hazardous Waste Technical Guidance (WM3) document outlines the methodology for classifying wastes. Once classified the waste can be removed to the appropriately licensed facilities, with some waste requiring pre-treatments prior to disposal.

Hazardous waste requires pre-treatment prior to removal. The site may need to be registered as a Hazardous waste producer should such waste be removed from the site.

Based on a risk phase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive and undertaken by Ground and Water Limited, 5No. samples of Made Ground (WS4/0.20m, WS5/0.20m, WS7/0.20m, WS1/0.50m, and WS8/0.50m bgl) were tested and were classified as **NON-HAZARDOUS.** 1No. sample of Made Ground (WS3/0.20m bgl) was classified as **Hazardous Waste** due to the levels of Zinc and 1No. sample of Made Ground (WS2/0.50m bgl) was classified as **Hazardous Waste** due to the levels of TPHs. **The results of the Hazard Waste Assessment can be seen in Appendix G.**

Please note that the above samples of Made Ground that were classified as Inert would not likely be accepted as Inert waste due to landfill regulations and the other samples that are classified as not conforming to Inert Waste Landfill.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM3, therefore producing an initial classification in accordance with the guidance, landfill operators have their own assessment tools and can often come to different conclusions. As a result, some landfill operators could refuse to take apparently suitable waste. It is recommended that the receiving landfill views the results of this assessment and the chemical laboratory results to determine their own classification.

Following this initial waste hazard assessment, a Full WAC Solid Suite Test with single batch leachate were undertaken on one sample of the Made Ground (WS3/0.20m bgl) to determine which landfill category the waste conformed to. The results of the WAC tests can be seen summarised below and the full results in Appendix C.

Summary of WAC Tests	
Trial Hole	**Classification**
WS3/0.20m bgl	Does not conform to Inert Waste Landfill due to the levels of PAHs

7.5 Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation. For example, there may have been underground storage tanks (UST's) not identified during the Desk Study and/or Ground Investigation for which there is no historical or contemporary evidence.

Such occurrences may be discovered during the demolition and construction phases of any redevelopment of the site.

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

7.6 Duty of Care

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust were generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

APPENDIX A
Conditions and Limitations

The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to Bridge House, Riverview House And Waterside,

Oxford Road, Uxbridge, Middlesex, UB8 1HS.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

APPENDIX B
Fieldwork Logs

APPENDIX C
Chemical Laboratory Test Results

APPENDIX D
Soil Assessment Criteria

APPENDIX E
PAH Double Ratio Spreadsheet

APPENDIX F
CLAIRE Statistics

APPENDIX G
Waste Hazard Assessment

APPENDIX D: Remediation Method Statement (without figures and appendices)

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Remediation and Validation Method Statement for the site at

BRIDGE HOUSE, RIVERVIEW HOUSE AND WATERSIDE, OXFORD ROAD, UXBRIDGE UB8 1HS

Version: 1.01, Issued 18/12/2020

1. Introduction

This Method Statement has been produced to set out the procedures required to deal with the elevated levels of contaminants identified for the proposed development on site at the GWPR3283 Bridge House, Riverview House and Waterside, Oxford Road, Uxbridge UB8 1HS.

The results of previous phases of intrusive works and chemical laboratory testing were provided in the Ground and Water Limited Ground Investigation reports:

- Ground and Water Limited Desk Study Report (ref. GWPR2463/DS/March 2018);
- Ground and Water Limited Contamination Assessment Report (ref. GWPR3283/CAR/December 2019).

This Remediation and Validation Method Statement must be read in conjunction with the above Ground and Water Limited reports.

2. Background

The site comprised a 26,350m^2 rectangular shaped plot of land, orientated in a north-east to south-west direction. The site was situated on the southern side of Oxford Road, on the far south-eastern side of the Colne Valley Regional Park. The Grand Union Canal and the River Colne ran directly along the south-eastern and western boundaries of site respectively. The site was located in north-west Uxbridge, west Greater London. A general site location is given within Figure 1. A plan showing the site development area is given within Figure 2.

At the time of reporting in December 2020, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). A

proposed development plan can be seen in Figure 4.

3. Conceptual Site Model

Following all the phases of contamination testing on-site, the CSM for the site was updated in section 6.7 of the Contamination Assessment Report (GWPR3283/CAR/December 2019) and can be seen reproduced overleaf. The plausible pollutant linkages remaining after risk assessment are shown and where risk assessment has indicated no unacceptable risk to sensitive receptors, the pollutant linkages have been crossed out.

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential On-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Low Risk of ground-gas production from deep Made Ground and infilled Wharfs. However the main source of ground-gas is likely to come from Alluvium deposits underlying site. However, rates for ground-gas production are generally low. • **Carbon Dioxide; low levels identified.** • ~~Methane;~~	Migration through anthropogenic & natural pathways Inhalation Possible Explosive Risk **A previous site investigation revealed Waterside House and Riverview House included a gas-resistant membrane and passive venting as a precautionary measure. However, additional risk assessment is required to ensure gas measures are sufficient for change of use.**	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers;
Made Ground on-site by historic demolition and construction activities • ~~Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc);~~ • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • ~~Organic compounds (fuel oils, ash, tar);~~ • ~~Asbestos (building material, pipe lagging~~).	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Lambeth Group	End users of the site (residents) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**
Residual contamination risk from historic industrial use on-site • ~~Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc);~~ • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • ~~Organic compounds (fuel oils, ash, tar);~~ • ~~Asbestos (building material, pipe lagging).~~		

Tabulated Conceptual Site Model – Plausible Pollutant Linkages Only		
Potential Off-site Sources	**Potential Absorption Pathways**	**Potential Receptors**
Residual contamination risk from potential fill transported onto site from historic industrial use. • ~~Heavy metals & semi-metals (incl. Arsenic, Cadmium, Chromium, Lead etc);~~ • Combustion products (PAH's, benzo(a)pyrene, fluoranthene, dibenz(a,h)anthracene); • ~~Organic compounds (fuel oils, ash, tar);~~ • ~~Asbestos (building material, pipe lagging).~~	Direct ingestion of soil and soil derived dust; Dermal contact of soil and soil derived dust; Ingestion of soil with elevated concentration of determinants; Dermal contact with impacted soils; Inhalation of impacted dust (indoors and outdoors) with elevated concentration of determinants. Inhalation of volatiles (indoors and outdoors) with elevated concentration of determinants. **Due to the change in use from commercial to residential, the end-user sensitivity is increased.** Via anthropogenic (man-made) pathways; and Via Made Ground (if present), Alluvium, Kempton Park Gravel Member, Lambeth Group (if present)	End users of the site (members of the public and employees) Site operatives during demolition and redevelopment; Maintenance workers; Building materials and services. **Due to no change in the external layout or amounts of hardstanding onsite, groundwater is not considered a potential receptor**

Given that a Characteristic Situation 1 (CS1) was assessed to be more appropriate for the site and the presence of an existing gas-resistant membrane and passive venting below Riverview House And Waterside House, ground-gas was not considered to pose a risk to end users. Further risk assessment could be undertaken through a detailed review of the existing buildings ground floor construction.

Chemical laboratory testing revealed elevated levels of zinc, benzo(a)anthracene, chrysene, benzo(b)flouranthene, benzo(a)pyrene, indeno(123-sd)pyrene and dibenz(a,h)anthracene within the Made Ground above their respective C4SL LLTC for a '**Public Open Spaces near Residential Housing (POSresi)'** land use scenario.

Chemical laboratory testing of the Made Ground revealed no other elevated levels of determinants above the guideline levels for a **'Public Open Spaces near Residential Housing (POSresi)'** land-use scenario.

Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytoxicity threshold, specialist planting may be required, and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

Given the likely low mobility of the Zinc and the low permeability of the Alluvial clays inhibiting the PAH migration, qualitative risk assessment has indicated that the determinands noted pose no risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding.

Based on a visual appraisal of the soils, the Made Ground encountered on site was not considered physically or cosmetically suitable for use on the residential site. In addition to this, given the maximum concentration of Benzo(b)fluoranthene (92.40 mg/kg), Benzo(a)pyrene (79.50 mg/kg) and Dibenz(a,h)anthracene (8.15 mg/kg) identified in the Made Ground was over six times the relevant SGV for a **'Public Open Spaces near Residential Housing (POSresi)'** Land-Use Scenario a BRE Cover System could not be applied.

It is understood that at the time of reporting, December 2020, there are to be no changes to the external layout and there is no soft landscaping to be included within the permitted development application for the site of Bridge House, Riverview House and Waterside, Oxford Road, Uxbridge UB8 1HS. Therefore, it is considered that there is no remediation required at this stage. However, if there are any changes to the proposed development which include the introduction of soft landscaping then the remediation strategy outlined in Section 4 below should be followed.

4.0 Remediation Method Statement

The following Sections only apply to the areas of soft landscaping at the site, not the Permitted Development for the change of use of Bridge House, Riverview House and Waterside House.

At the time of reporting in December 2020, the proposed development comprised the change of use of Bridge House, Riverview House and Waterside House from office accommodation to 237No. residential units (15 x studio flats and 224 x 1-bedroom flats). A proposed development plan can be seen in Figure 4.

The distribution of Zinc and PAHs within the Made Ground was revealed to have a normal distribution, no outliers with the mean of the sample population below the LQM/CIEH S4UL and the Upper Confidence Limit of the sample population above the LQM/CIEH S4UL.

Based on the results of the contamination testing to date and a visual appraisal of the soils the following remediation options are available.

Risk Assessment has indicated that the determinands noted pose no unacceptable risk to groundwater and therefore the Made Ground can remain under areas of permanent hardstanding. However, given the risks posed to end-users remediation is necessary for areas of soft landscaping.

Complete removal of Made Ground from the site has not been considered given the cost implications and given that a simple capping system could be adopted. This would prevent needless lorry movements and prevent waste unnecessarily being sent to landfills with only a finite capacity.

Based on a visual appraisal of the soils, the Made Ground encountered on site was not considered physically or cosmetically suitable for use on the residential site. In addition to this, given the maximum concentration of Benzo(b)fluoranthene (92.40 mg/kg), Benzo(a)pyrene (79.50 mg/kg) and Dibenz(a,h)anthracene (8.15 mg/kg) identified in the Made Ground was over six times the relevant SGV for a “Public Open Spaces near Residential Housing (POSresi)” Land-Use Scenario a BRE Cover System could not be applied.

Based on the elevated level of Zinc (WS3/0.20m), in excess of its respective phytoxicity threshold, specialist planting may be required, and the advice of a suitably experienced horticulturalist should be obtained should any soft landscaping be implemented.

In order to sever the direct soil ingestion and outdoor dermal contact exposure pathways consideration should be given to the placement of certified clean imported Sub-soil and Topsoil in all areas of soft landscaping with a marker layer at the base. This would create a clean capping over the Made Ground.

A total 300mm clean capping layer is recommended overlying a geotextile membrane. The top 150mm will need to comprise clean Topsoil in order to act as a growing medium for plants overlying 150mm of clean sub-soil.

The following remedial methodology should be undertaken based on the elevated levels of determinands noted:

4.1 Pre-construction Remediation of Made Ground:

An **Asbestos Management Strategy** should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination. An **asbestos survey** of the existing buildings is required, prior to any alterations / demolition.

Following the reduced dig, the void created must be visually inspected by an independent and suitably qualified person to verify the removal of the Topsoil/Made Ground. Excavations may cease at shallower depth where natural soils are encountered.

The voids created should be measured and photographed.

Stockpiled contaminated Made Ground, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.

Materials to be removed off-site must be classified by carrying out Waste Acceptance Produce (WAP) testing. A registered contractor must undertake the removal of waste. Full liaison must be made with the Environment Agency prior to the removal of any material and must be conducted to meet their full approval.

4.2 Post-Construction Remediation of Made Ground:

The following final capping systems are to be placed in areas of soft landscaping:

A total 300mm clean capping layer is recommended overlying a geotextile membrane. The top 150mm will need to comprise clean Topsoil in order to act as a growing medium for plants overlying 150mm of clean sub-soil.

Reduced dig should be taken to 300mm below the finished soft landscaped area. Then a suitable and certified anti-dig layer or geotextile should be installed. The reduced dig levels and the anti-dig layer / geotextile will need to be verified and photographed by a Ground and Water Ltd Engineer, before the placement of the capping soils.

Installation of suitable and certified imported Topsoil and Sub-soil. The final capping system will need to be checked by a Ground and Water Ltd Engineer after completion of soft landscaping areas.

Stockpiled contaminated Made Ground, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.

Materials to be removed off-site must be classified by carrying out Waste Acceptance Produce (WAP) testing. A registered contractor must undertake the removal of waste. Full liaison must be made with the Environment Agency prior to the removal of any material and must be conducted to meet their full approval.

The Topsoil will need to be certified before being imported onsite and ideally placed in stockpiles on site. These stockpiles should be clear of Made Ground or any contaminated soils. Additional verification of any imported soil will need to occur onsite, once received, to validate the accompanying lab certificate. Any samples taken from a stockpile of imported soil or placed soil should be at a rate of one sample per $50m^3$ of material and be tested for semi-metals, heavy metals, speciated PAH's, speciated TPH and asbestos.

4.3 Validation

Following completion of all the remediation and validation works, outlined above, a report should be submitted to the local authority for approval.

4.4 Waste Removal:

Remedial excavations on-site are likely to produce waste which will require classification and then recycling or removal from site.

Materials to be removed off-site must be classified by carrying out Waste Acceptance Produce (WAP) testing. WAP Testing was undertaken by Ground and Water *GWPR3283/CAR/December 2019* concluded the sampled locations to be NON-HAZARDOUS.

A registered contractor must undertake the removal of waste. Full liaison must be made with the Environment Agency prior to the removal of any material and must be conducted to meet their full approval.

Any Hazardous waste destined to Landfill will need to be pre-treated prior to disposal.

Stockpiled contaminated Made Ground, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.

4.8 Imported Materials:

Any soil which is to be imported onto the site must undergo chemical analysis to prove that it is suitable for the purpose for which it is intended. Imported soils as part of the garden and soft landscaping remediation works must be sourced from a likely clean donor site so that minimal testing will be sufficient to characterise it. The Topsoil supplier should provide evidence that no propagules of Japanese knotweed are present within the donor site.

Once confirmed as not coming from an industrial site any Subsoil or Topsoil should be screened chemically and physically to ensure they are suitable for use. This includes checking the source site to ensure there are no indications that the donor site contains relict industrial items, invasive weeds, physical items (glass, rebar, UXO etc).

The Topsoil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, either prior to placing (ideally) or after placing, to ensure that the human receptor cannot come into contact with compounds that could be detrimental to human health. The compounds that are to be tested for are those given in the LQM CIEH Generic Assessment Criteria, which can be viewed in Appendix B of this report.

Additional verification of any imported soil will be required, once received, to validate the accompanying laboratory certificate. Any samples taken from a stockpile of imported soil or placed soil should be tested for asbestos, semi-metals, heavy metals, arsenic, cyanide, speciated PAH's and speciated TPH. The chemical screening criteria to use should be S4UL's, GACs or SGVs or other agreed criteria based on CLEA. In the case of phytotoxins such as Cu and Zn, BS3882 should be followed. No soil containing free phase hydrocarbons should be imported, or visual evidence of contamination. Any measurable level of asbestos within the imported Topsoil/Subsoil will not be acceptable.

The Topsoil or Subsoil must be logged, described and tested in their final resting place once they've been allowed to settle and their depth checked.
The laboratory assigned the testing should be UKAS accredited and the actual analyses method should be an MCERTS one (if a MCERTS method exists); to retain this accreditation the data should be supplied as received from the laboratory with the cover sheets confirming whether there are any deviations.

Photographic evidence should be included within the validation report which shows the depth of imported soil placed in any garden areas.

4.9 Validation Strategy

Any remedial works undertaken on the site will need to be inspected and independently validated by a Ground and Water Limited Engineer. All remedial excavations will need to be inspected, documented and photographed.

The following stages will need to be independently validated and documented during the remedial works:

- Reduced dig levels;
- Installation of geotextile membrane;
- Installation of sub-soil and topsoil.

Following completion of all the remediation and validation works outlined above, a report should be submitted to the local authority for approval.

Full liaison must be made with the statutory authority, prior to the implementation of this method statement and/or the removal of any material from site. All works must be undertaken to meet their full approval.

5.0 Health and Safety

All site operatives shall maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

Mobile telephones will be held by designated personnel and these would be used to contact the emergency services in the event of an emergency.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust were generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

All works associated with construction/remediation will need to take into account the potential for asbestos cement and fibres within the Made Ground.

An **Asbestos Management Strategy** should be put in place to ensure that any potentially asbestos containing materials are identified and removed from site in a suitable manner to

prevent cross-contamination. An **asbestos survey** of the existing buildings is required, prior to any alterations / demolition.

The following Figures and Appendices accompany this Method Statement:

Figure 1	Site Location Plan
Figure 2	Site Development Area
Figure 3	Aerial View of Site
Figure 4	Proposed Development - Plan View
Figure 5	Trial Hole Location Plan

Appendix A	Soils Assessment Criteria

APPENDIX A
Soil Assessment Criteria

APPENDIX E: Drawings of Existing Buildings

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Registered Office: Kineton House, 31 Horse Fair, Banbury, Oxfordshire OX16 0AE Registered in England No. 07032001

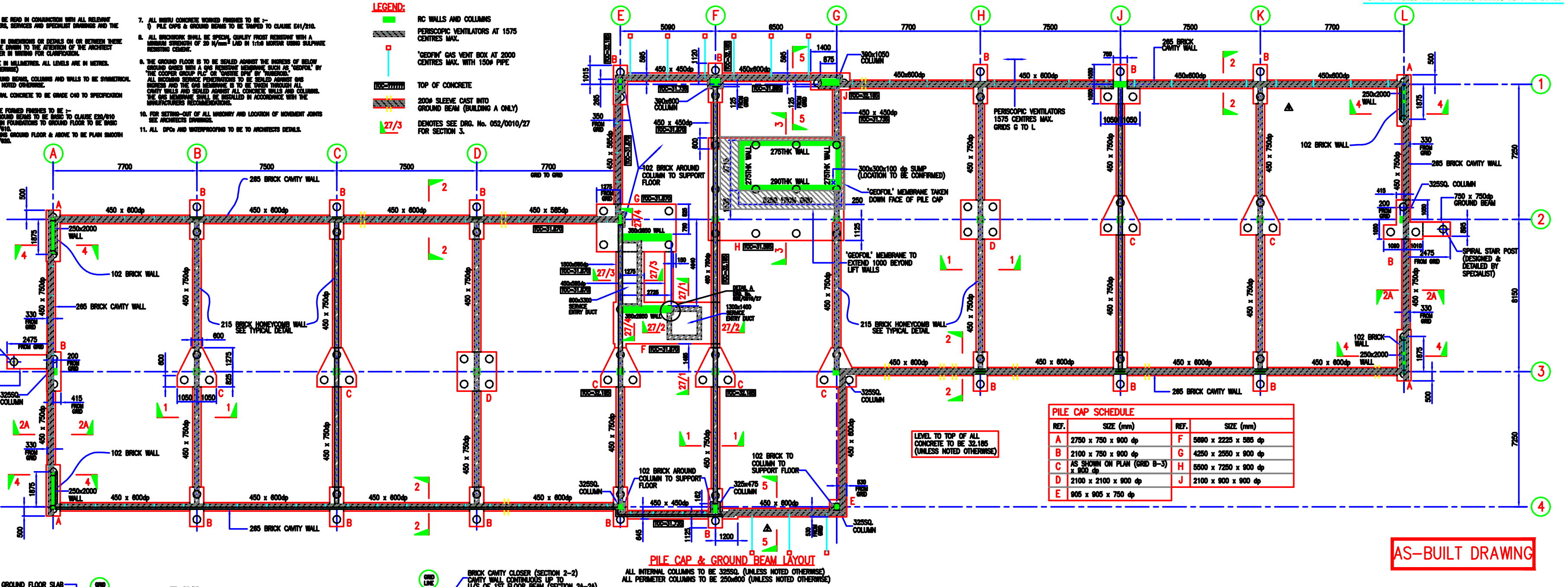
DO NOT SCALE THIS DRAWING, PRINT, PLOT OR DISK.

NOTES:

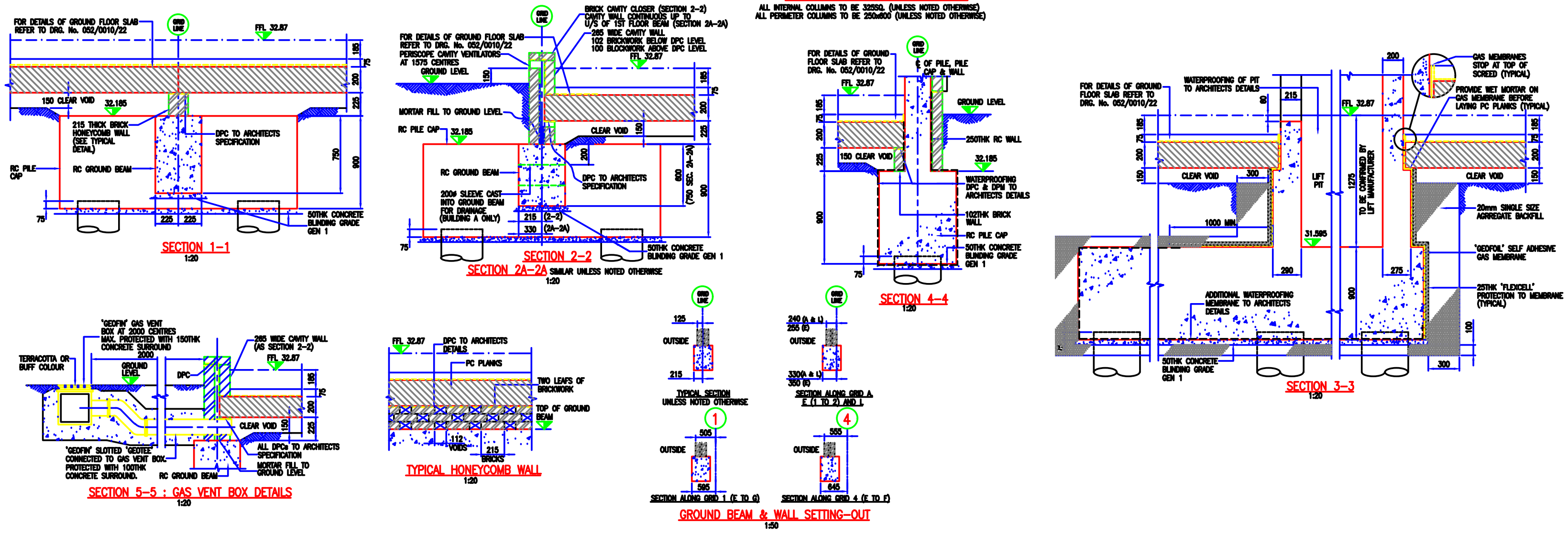
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS, SERVICES AND SPECIALIST DRAWINGS AND THE SPECIFICATION.
2. ANY DISCREPANCIES IN DIMENSIONS OR DETAILS ON OR BETWEEN THESE DRAWINGS SHOULD BE DRAWN TO THE ATTENTION OF THE ARCHITECT AND OR THE ENGINEER IN WRITING FOR CLARIFICATION.
3. ALL DIMENSIONS ARE IN MILLIMETRES. ALL LEVELS ARE IN METRES. (UNLESS SHOWN OTHERWISE)
4. ALL PILE CAPS, GROUND BEAMS, COLUMNS AND WALLS TO BE SYMMETRICAL ABOUT GRID UNLESS NOTED OTHERWISE.
5. ALL INSITU STRUCTURAL CONCRETE TO BE GRADE C40 TO SPECIFICATION CLAUSE E10/130.
6. ALL INSITU CONCRETE FORMED FINISHES TO BE :-
   i) PILE CAPS & GROUND BEAMS TO BE BASIC TO CLAUSE E20/610
   ii) WALLS & COLUMN FOUNDATIONS TO GROUND FLOOR TO BE BASIC TO CLAUSE E20/610.
   ii) WALLS & COLUMNS GROUND FLOOR & ABOVE TO BE PLAIN SMOOTH TO CLAUSE E20/620.
7. ALL INSITU CONCRETE WORKED FINISHES TO BE :-
   i) PILE CAPS & GROUND BEAMS TO BE TAMPED TO CLAUSE E41/210.
8. ALL BRICKWORK SHALL BE SPECIAL QUALITY FROST RESISTANT WITH A MINIMUM STRENGTH OF 20 N/mm^2 LAID IN 1:1:6 MORTAR USING SULPHATE RESISTING CEMENT.
9. THE GROUND FLOOR IS TO BE SEALED AGAINST THE INGRESS OF BELOW GROUND GASES WITH A GAS RESISTANT MEMBRANE SUCH AS 'GEOFOIL' BY 'THE COOPER GROUP PLC' OR 'GASTITE DPM' BY 'RUBEROID.' ALL INCOMING SERVICE PENETRATIONS TO BE SEALED AGAINST GAS INGRESS AND THE GAS MEMBRANE IS TO BE TAKEN THROUGH ALL CAVITY WALLS AND SEALED AGAINST ALL CONCRETE WALLS AND COLUMNS. THE GAS MEMBRANE SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
10. FOR SETTING-OUT OF ALL MASONRY AND LOCATION OF MOVEMENT JOINTS SEE ARCHITECTS DRAWINGS.
11. ALL DPCs AND WATERPROOFING TO BE TO ARCHITECTS DETAILS.

LEGEND:

- RC WALLS AND COLUMNS
- PERISCOPIC VENTILATORS AT 1575 CENTRES MAX.
- 'GEOFIN' GAS VENT BOX AT 2000 CENTRES MAX. WITH 150Ø PIPE
- TOP OF CONCRETE
- 200Ø SLEEVE CAST INTO GROUND BEAM (BUILDING A ONLY)
- 27/3 DENOTES SEE DRG. No. 052/0010/27 FOR SECTION 3.



PILE CAP SCHEDULE			
REF.	SIZE (mm)	REF.	SIZE (mm)
A	2750 x 750 x 900 dp	F	5690 x 2225 x 585 dp
B	2100 x 750 x 900 dp	G	4250 x 2550 x 900 dp
C	AS SHOWN ON PLAN (GRID B-3) x 900 dp	H	5500 x 7250 x 900 dp
D	2100 x 2100 x 900 dp	J	2100 x 900 x 900 dp
E	905 x 905 x 750 dp		



AS-BUILT DRAWING

Revision	Suff	App	Date
AS BUILT	5		
ADDITIONAL GAS VENT BOXES ADDED ALONG GRID 1 TO SUIT ARCHITECTS LATEST INFO.	4	DS	20.4.99
REVISIONS INDICATED THUS	3	DS	12.1.99
BUILDING B PILE CAPS ON GRID J-1 & L-2 REVISED TO SUIT EXISTING PILES. SERVICE ENTRY DUCTS REVISED TO SUIT M&E LATEST INFO. REVISIONS INDICATED THUS	2	DS	2.12.98
CONSTRUCTION ISSUE. RENUMBERED AND RETITLED (1 No. DRAWING FOR BOTH BUILDINGS). SETTING-OUT REVISED TO SUIT ARCHITECTS LATEST INFO. SERVICE ENTRY DUCT REVISED TO SUIT M & E LATEST INFO. REVISIONS INDICATED THUS	1	DS	21.10.98
REDRAWN AND RETITLED	B	-	2.10.98
REVISIONS AS INDICATED THUS	A	-	26.6.98

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UPTON McGOUGAN
CONSULTING ENGINEERS

Project
XEROX
DENBRIDGE
UXBRIDGE

Drawing Title
BUILDING B
PILE CAP AND GROUND BEAM LAYOUT

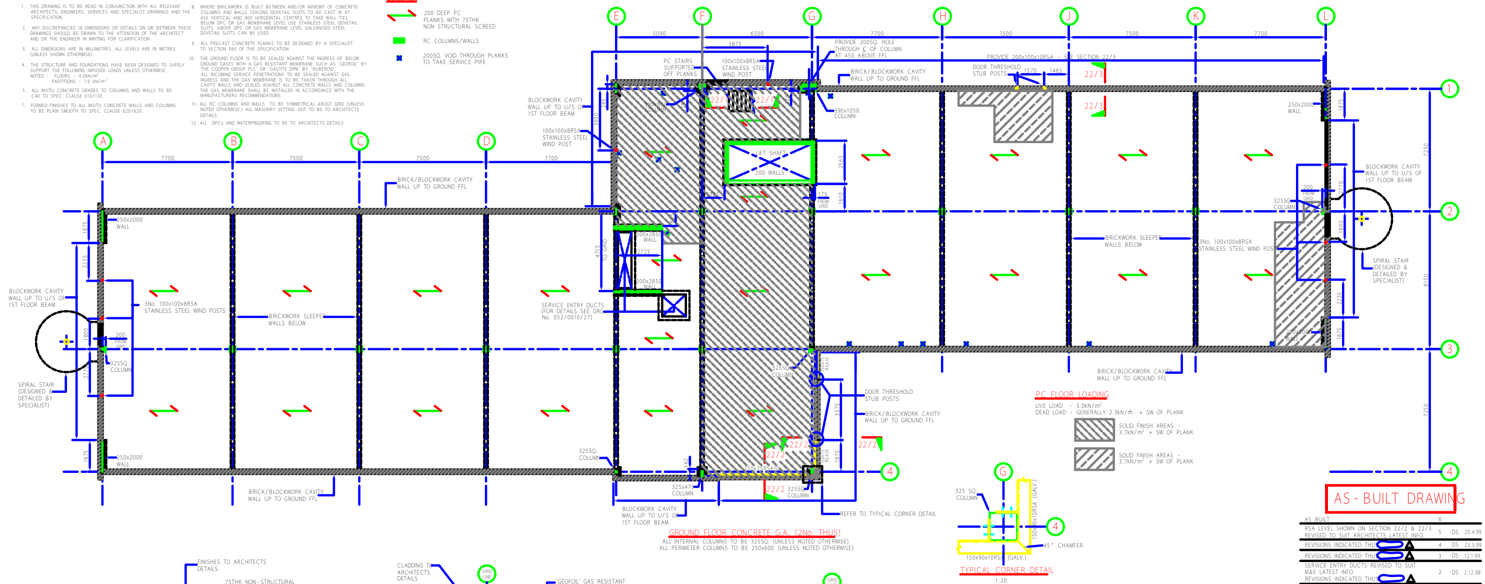
Drawn	Date	Checked	Date
JT	JUNE 98	DS	21.10.98

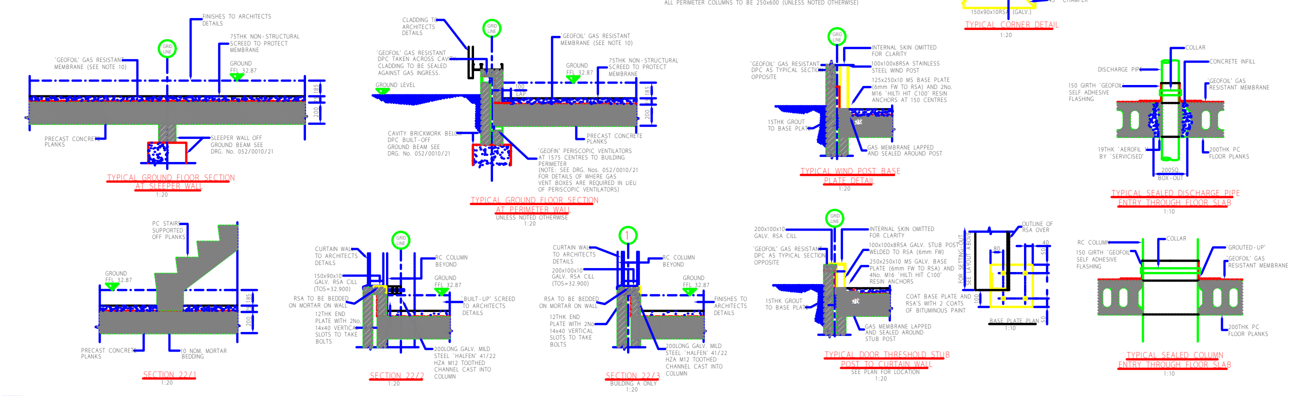
Scale
1:100 (AT EXTENDED A1 SIZE)

Drawing Number: 052/0010/21/B
Rev: 5

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS, SERVICES AND SPECIALIST DRAWINGS AND THE SPECIFICATION.
2. ANY DISCREPANCIES IN DIMENSIONS OR DETAILS ON OR BETWEEN THESE DRAWINGS SHOULD BE DRAWN TO THE ATTENTION OF THE ARCHITECT AND OR THE ENGINEER IN WRITING FOR CLARIFICATION.
3. ALL DIMENSIONS ARE IN MILLIMETRES. ALL LEVELS ARE IN METRES. (UNLESS SHOWN OTHERWISE)
4. THE STRUCTURE AND FOUNDATIONS HAVE BEEN DESIGNED TO SAFELY SUPPORT THE FOLLOWING IMPOSED LOADS UNLESS OTHERWISE NOTED:- FLOORS - 4.0kN/m² PARTITIONS - 1.0 kN/m²
5. ALL INSITU CONCRETE GRADES TO COLUMNS AND WALLS TO BE C40 TO SPEC. CLAUSE E10/130.
7. FORMED FINISHES TO ALL INSITU CONCRETE WALLS AND COLUMNS TO BE PLAIN SMOOTH TO SPEC. CLAUSE E20/620.
8. WHERE BRICKWORK IS BUILT BETWEEN AND/OR INFRONT OF CONCRETE COLUMNS AND WALLS 100LONG DOVETAIL SLOTS TO BE CAST IN AT 450 VERTICAL AND 900 HORIZONTAL CENTRES TO TAKE WALL TIES. BELOW DPC OR GAS MEMBRANE LEVEL USE STAINLESS STEEL DOVETAIL SLOTS. ABOVE DPC OR GAS MEMBRANE LEVEL GALVANISED STEEL DOVETAIL SLOTS CAN BE USED.
9. ALL PRECAST CONCRETE PLANKS TO BE DESIGNED BY A SPECIALIST TO SECTION E60 OF THE SPECIFICATION.
10. THE GROUND FLOOR IS TO BE SEALED AGAINST THE INGRESS OF BELOW GROUND GASES WITH A GAS RESISTANT MEMBRANE SUCH AS 'GEOFOIL' BY 'THE COOPER GROUP PLC' OR 'GASTITE DPM' BY 'RUBEROID.' ALL INCOMING SERVICE PENETRATIONS TO BE SEALED AGAINST GAS INGRESS AND THE GAS MEMBRANE IS TO BE TAKEN THROUGH ALL CAVITY WALLS AND SEALED AGAINST ALL CONCRETE WALLS AND COLUMNS. THE GAS MEMBRANE SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
11. ALL RC COLUMNS AND WALLS TO BE SYMMETRICAL ABOUT GRID (UNLESS NOTED OTHERWISE.) ALL MASONRY SETTING-OUT TO BE TO ARCHITECTS DETAILS.
12. ALL DPCs AND WATERPROOFING TO BE TO ARCHITECTS DETAILS.





AS - BUILT DRAWING

Revision	Suff	App	Date
AS BUILT	6		
RSA LEVEL SHOWN ON SECTION 22/2 & 22/3 REVISED TO SUIT ARCHITECTS LATEST INFO.	5	DS	20.4.99
REVISIONS INDICATED THUS	4	DS	23.3.99
REVISIONS INDICATED THUS	3	DS	12.1.99
SERVICE ENTRY DUCTS REVISED TO SUIT M&E LATEST INFO. REVISIONS INDICATED THUS	2	DS	2.12.98
CONSTRUCTION ISSUE. PC PLANK THICKNESSES REVISED TO SUIT ARCHITECTS LATEST INFO. SERVICE DUCT REVISED TO SUIT M & E LATEST INFO. REVISIONS INDICATED THUS	1	DS	21.10.98
REVISIONS AS INDICATED THUS	C	-	5.10.98
REVISIONS AS INDICATED THUS TO SUIT ARCHITECTS LATEST LAYOUT	B	-	10.9.98
REVISIONS AS INDICATED THUS	A	-	26.6.98

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Project
XEROX
DENBRIDGE
UXBRIDGE

Drawing Title
BUILDING A
GROUND FLOOR
CONCRETE G.A.

Drawn	Date	Checked	Date
DJS	JUNE 98	DS	21.10.98

Scale: 1:100 UNLESS NOTED OTHERWISE (AT EXTENDED A1 SIZE)

Drawing Number: 052/0010/22/A Rev: 6

APPENDIX F: Site Walkover Photographs

2 The Long Barn, Norton Farm, Selborne Road, Alton, Hampshire GU34 3NB
0333 600 1221 enquiries@groundandwater.co.uk **groundandwater.co.uk**

Registered Office: Kineton House, 31 Horse Fair, Banbury, Oxfordshire OX16 0AE Registered in England No. 07032001

Photograph showing existing membrane and airbrick

Photograph showing membrane spanning along the outside of the foundation

Photograph showing gas vent remote from the property

Photograph showing an example of the damage caused by the removal of the slab