



Invicta House, Manchester

Proposed New Moxy Hotel

Phase 1 Geo-Environmental Ground Investigation

For: Khanna Enterprises (Manchester) Property Ltd.

Integra Consulting
Suite 4
14-32 Hewitt Street
Manchester
M15 4GB

Tel 0161-237-3400
Fax 0161-237-3635
Email nevilleshaw@integraconsulting.co.uk

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1.0 **INTRODUCTION**

This Phase 1 Geo-Environmental Ground Investigation Report has been prepared by Integra Consulting on behalf of Khanna Enterprises (Manchester) Property Ltd. in support of a Detailed Planning Application for a proposed hotel development at Invicta House, 2-4 Atkinson Street, Manchester, M3 3HH.

The application seeks permission for a 10-storey hotel set behind a retained existing elevation of the existing Invicta House building, following a granted planning permission for a 9-storey hotel comprising 145 No. guest rooms in 2017 (ref 116164/FO/2017). The description of development is:

'Redevelopment of Invicta House for Use Class C1 hotel development comprising guestrooms, with ground floor ancillary facilities. Partial demolition of existing building with retention and refurbishment of main facade and erection of eleven storey building (Use Class C1) to the rear.'

Instructions to proceed were received in August 2015. Desk study work was undertaken between the 10th and 24th August 2015. The walk over surveys were carried out on the 12th and 20th August 2015. A second walkover was undertaken in April 2020 following the demolition and façade retention scheme of Invicta House.

Proposed development plans are contained in Appendix 11. It should be noted that this may be subject to change or alteration.

2.0 BRIEF

The brief was to carry out a Phase 1 Geo-Environmental Ground Investigation for land at the proposed ten storey office building at Invicta House, Atkinson Street, Manchester. The proposed building occupies the entire site area. The investigation was to include the following studies:

- a) A desk study involving examination of available BGS geological maps and borehole logs, historical Ordnance Survey maps, environmental maps, previous site investigation work and accessible historical records to assess the probable geological and contaminated land conditions on and below the site.
- b) A walk over study of the site to ascertain any evidence of previous and current site uses that may have caused contamination of the ground at the site. During the walk over survey, the topography of the site was to be noted along with any land features that could give an indication of probable sub-surface features and formations.
- c) Identify probable contaminants that may be present at the site using current contaminated land guidance and potential receptors which could be at risk from potential contaminants.
- d) Develop a conceptual model for the site to assess the potential risks of contamination and to undertake a preliminary risk assessment.
- e) Determine whether further geotechnical and / or environmental (contaminated land) investigation and assessment is required.
- f) Define the scope and extent of further investigations.

A detailed report was to be provided to summarise findings and to provide recommendations.

3.0 LIMITATIONS OF INVESTIGATION WORK AND REPORT

Desk Study References

For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed that it is correct. No attempt has been made to verify this information. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

The desk study has been produced using historical Ordnance Survey maps and environmental maps available at the time the report has been produced. The environmental information used was the current information available at the time of writing but there is no absolute guarantee of accuracy.

Historical Ordnance Survey maps do not provide a comprehensive description of a site history. They provide details of the site from a date prior to the publication of the map (i.e. a snapshot in time). The period between map editions can be substantial (i.e. several decades). Not all map series are available for every date range in many areas of the UK and therefore there will be gaps in this mapped record for some sites. Potentially contaminative land uses could have been present and removed during such periods and may therefore not form a part of this particular record. In addition, there will be potentially contaminative land uses which are not identified on the map records such as small scale storage / use of hazardous materials, illegal / unlicensed waste disposal activities etc.

Different map series identify different features utilising different symbols which can result in features that remain on site being removed from maps. Some features are also not mapped for security reasons i.e. airfields and other military installations. These areas are mostly shown as blank areas on historical maps.

Site Walk Over

During the site walk over reasonable effort has been made to obtain an overview of the site conditions. However, during the site walk over no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.

Exploratory Holes

Where the spacing of exploratory holes for future intrusive investigation work has been presented as part of this report, the spacing has been determined to provide a reasonable indication of the general ground conditions and extent of land / groundwater contamination on the site but the number has ultimately been limited by commercial constraints. The ground conditions at the proposed exploratory holes are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between exploratory hole locations when preparing any assessments of the final foundation and land / groundwater remediation proposals.

Extent of Contamination Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of Japanese Knotweed or other invasive species. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification of asbestos or ACMs (Asbestos Containing Materials) this is for indicative purposes only and does not constitute or replace a full and proper surveys.

When investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The

absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence overgrown vegetation access could not be obtained to all areas. Additional contamination may be identified following the removal of hardstanding.

Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

The conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

Flooding

Flooding in this report is defined as flooding caused by the sea, ditches, rivers, streams, ponds, lakes, reservoirs and the like. It does not extend to flooding caused by surcharged piped drainage systems and investigations into flooding of this nature are excluded from this report.

Unexploded Ordnance

A Preliminary Unexploded Ordnance (UXO) Risk Assessment has been obtained for the site for the purposes of health and safety during the proposed site investigation and construction works. The recommendations made are those of the authors, 6 Alpha, and risk assessment is outside of the scope of this Phase 1 Report. Neither this report nor the Preliminary Unexploded Ordnance (UXO) Risk Assessment can confirm either the presence or absence of UXO on the site.

4.0 THIRD PARTIES

This report has been prepared for the sole use of Khanna Enterprises (Manchester) Property Ltd. It must not be copied or passed onto any third party or used for any purpose other than which it was prepared without the permission of the author. This report is copyright.

5.0 SCOPE OF INVESTIGATION WORK

5.1 Walk Over Survey

The site was visited during warm, dry weather conditions and the objectives of the site walk over were, where applicable:

- to identify and assess visual and olfactory evidence of contamination e.g. staining of concrete / soils, odours, presence of gas protection measures etc;
- to identify locations of potential sources of contamination and assess their conditions i.e. tank location, presence / condition of secondary containment / bunds, location of fill points, process areas;
- to identify surrounding land uses and any potentially contaminating activities;
- to identify / verify the presence of potential receptors (on- and off-site) which may be affected by identified sources;
- to obtain information on activities / procedures and standards of housekeeping etc;
- to assess site access and potential investigation locations and constraints;
- to assess any visual subsurface geotechnical features / anomalies e.g. foundations, made ground, subsidence, compressibility etc;
- to record the general site topography and features.

Photographs were taken of the site during the walk over survey and these photographs are contained in Appendix 2.

5.2 Desk Study Documentation

The historical and environmental maps and information for the site has been obtained. The following documents were obtained and examined during the desk study:

- a) Site plans and an aerial photograph of the site. These are contained in Appendix 1.

b) Historical Ordnance Survey maps as follows:

Date of Publication	Scale
1745*	Not to scale
1772*	Not to scale
1794*	Not to scale
1848	1:10,560
1851*	Not to scale
1871*	Not to scale
1882	1:10,560
1892	1:2,500
1894-1896	1:10,560
1908	1:2,500
1909	1:10,560
1922-1933	1:2,500
1923	1:10,560
1931-1933	1:10,560
1938	1:10,560
1948	1:1,250
1950-1951	1:2,500
1951-1957	1:1,250
1956	1:10,560
1956-1958	1:2,500
1962-1973	1:1,250
1963-1965	1:2,500
1971	1:2,500
1972	1:10,000
1973-1988	1:1,250
1974-1975	1:1,250
1975	1:25,000
1980	1:10,000
1980-1985	1:1,250
1985	1:10,000
1986-1990	1:1,250
1989	1:10,000
1990	1:1,250
1992	1:1,250
1994	1:10,000
1994	1:1,250
1995	1:1,250
1996	1:1,250
1996	1:1,250
2006	1:10,000
2015	Variable

Maps indicated by * were supplied by Manchester Archives & Local History and reproduction has not been permitted.

- c) Environmental maps obtained through Envirocheck as follows:
- Environment Agency and hydrological map dated 1998 – 2015;
 - Groundwater vulnerability map dated 2015;
 - Sensitive land uses map dated 1997 – 2015;
 - Summary maps showing locations of recorded waste sites, industrial land use sites and hazardous substances sites in adjacent areas dated 1996 – 2015.
- d) An environmental report obtained from Landmark, the environmental database company, which provides a list of recorded past and present activities at or adjacent to the site which could have an impact on the levels of contamination in the soils and groundwater at the site. This report is contained in Appendix 5.
- e) BGS 1:10,000 solid and drift map (reference SJ89NW). The extracts have been copied under licence from the British Geological Survey – CO7/044 LSCSL. 4 No. BGS borehole logs were obtained (reference: SJ89NW 65, SJ89NW 81, SJ89NW 3739 and SJ89NW 220) located between 30m and 100m from the site. A part extract of the map covering the area under consideration and the two BGS borehole logs are contained in Appendix 6.
- f) The Coal Authority Mining Report (ref: 51000968793001). This report is contained in Appendix 7.
- g) The Indicative Atlas of Radon for England and Wales published by the British Geological Survey and the Health Protection Agency was examined to assess the probable presence or otherwise of radon gas in the ground. Extracts of the relevant maps are contained in Appendix 8.
- h) The Preliminary Unexploded Ordnance (UXO) Risk Assessment (reference: P4742) obtained from 6 Alpha, which provides details of Luftwaffe bombing targets and recorded bombing, as well as providing a UXO probability Assessment. This report is contained in Appendix 9.
- i) Previous site investigation works undertaken by Integra Consulting in 2008 and Capita Symonds in 2008 as discussed in 6.4.2 and 6.4.3.

- j) Second World War bomb maps and Manchester Building Control plans provided by Manchester Archives & Local History, detailing the proposed modifications in 1958. Reproduction of these plans was not permitted.

6.0 FINDINGS

6.1 Description of the Site

The site is roughly rectangular in shape and encompasses an area of 800m² in Manchester City Centre. The location is shown on the aerial photograph and the site location plans in Appendix 1. The Ordnance Survey national grid reference for the centre of the site is E 383520, N 398070 and it is located at the approximate post code M3 3HH.

At the time of the initial site walkover in August 2015, approximately half of the site consisted of the former Invicta House building, which occupied the southern and eastern sections of the site. The remainder of the site was occupied by hardstanding. By April 2020, Invicta House had been demolished with the exception of the façade along Atkinson Street along the southern boundary, the remainder of the site was cleared and remained unchanged. The adjacent land uses consist of further commercial buildings.

6.2 Walk Over Survey

The site was initially visited on the 12th and 20th August 2015 in warm, dry conditions. The principal observations were as follows:

Geology

Approximately half of the site consists of the existing Invicta House building, which occupies the southern and eastern sections of the site. The site is located at approximately 33m AOD. The remainder of the site comprises hardstanding parking and access areas. The hardstanding areas consist primarily of worn tarmac, with an area of Sidney Street to the north consisting of cobbles. A barrier is present that may prevent access to the carpark from Tivoli Street. However, this was not lowered at the time of the walk over.

The site is typically flat, with the western site boundary raised 2.00m above Scott Place, from which it is separated by a wooden clad retaining wall. This suggests that earthworks have been undertaken in the past, potentially associated with the construction of Invicta House. A fire escape and access area is present immediately

to the north of Invicta House and is lowered approximately 2m below the surrounding carpark level. A surface water drain is present in the cobbled surface of Sidney Street.

Invicta House is a 19th Century brick building over 3 storeys. In addition, the majority of the building envelope is underlain by basements, with the exception of the northernmost section. The floor levels of the basements are approximately 1.20m below street level at the western end, deepening to approximately 2.20m below street level at the eastern end. These are accessed via a gated area approximately 3m wide at the front of the building. Consequently, the ground floor is elevated by approximately 1m above street level. A first and second floor are also present. All the floors including the basements are entirely occupied by office space. The boiler and utility room could not be accessed during the survey and is located in the basement in the corner of the 'L' on the carpark side. All of the internal areas appear to have been recently refurbished. Doorways are typically less than 1m wide with numerous narrow corridors.

Contaminated Land

The present use of the site is as offices and the current tenants are not considered a potential source of contamination. No other evidence of historic contaminative activity, such as bunds or tanks, was observed. The retaining wall is evidence of historic landscaping and there is the potential that material was imported onto the site for this purpose.

Photographs taken during the walk over survey are contained in Appendix 2

April 2020

A second site walkover was undertaken in April 2020 following the demolition of the former Invicta House and the façade retention scheme. With the exception of the existing façade along the southern boundary, the previous building has been completely demolished and the site remains relatively unchanged. Photos taken in April 2020 are included below:



Figure 1; Photos showing the site (photo 1) taken from the south western corner and the remaining Invicta House façade along the southern boundary (photo 2)

6.3 Site History

The site development history has been researched with reference to historical maps, street plans and other secondary sources of historical documentation. These are included in Appendix 3 to this report and the principal observations are summarised below. These have been divided into the history of the site and the history of the wider study area.

On Site

The site has a limited development history. At the time of the earliest available historic map in 1745 Atkinson Street was known as Cupid's Alley and consisted of what appear to be small terraced houses. By 1772 the site was occupied by part of a larger, undesignated building located primarily to the west of the site. The building to the east of the site later known as the High Court Registry building on Deansgate was present by 1794. By 1831 a long thin area of buildings along Tivoli Street may also have extended onto the northern part of the site. The map of 1851 names the building to the west as Ashley's Silk Finishing Mill, followed by Hampsons Hat Factory and Thompstone's Chemical Works respectively.

Between 1851 and 1871 the on site buildings were demolished and the existing Invicta House building was constructed, covering the majority of the site envelope at this time. The next detailed historic map of the site in 1908 does not record any industrial land uses on site or in the locations of the former silk mill, hat factory or chemical works. However, industrial land uses and works are typically noted in such

maps, and this combined with the small site area, central location of the site and the presence of nearby office or commercial buildings - such as the High Court Registry building which abutted the site to the east – suggests that an office or commercial usage is probable. Between 1923 and 1932 the plot abutting to the west was redeveloped as an auction house.

A desk study of historic bombing maps provided by Manchester Archives & Local History indicate 3 No. incendiary comb strikes on the site in 1940, but record that the on site buildings were not damaged or demolished.

By 1958 Invicta House had been converted to become a branch of the car component and spares company, Edmunds Walker and Co Ltd. Their occupation of the building at this time was confirmed by Manchester street directories of the time. However, it is not clear whether manufacturing occurred on site. An examination of Building Control plans for the site from this year indicated that a planning application was made and approved for a 'glazed roof over yard' at the site, following the demolition of on site sheds and stables. It is not clear whether the proposed alterations were ever completed however, as historic maps record the building continued to occupy the majority of the site until reduced to the present L-shaped building at some point between 1980 and 1986, following which usage of part of the site as a car park is anticipated to have begun. From this date there is no evidence for significant alterations until the present day.

Businesses known anecdotally to have been tenants at Invicta House in recent years are office based only.

Off site History

At the time of the earliest available historic maps in 1745 the surrounding land was already developed as part of Manchester City Centre. Known potentially contaminative historic developments in the surrounding 200m are limited to the following.

Dates From	Dates To	Features	Distance and Direction
Before 1851	1851 - 1908	Silk Mill	10m West
Before 1851	1851 - 1908	Hat Factory	30m West
Before 1851	1851 - 1908	Chemical Works	50m West
Before 1908	1951 - 1956	Printing Works	200m East
Before 1908	1963 - 1988	Deansgate Goods Station	150m South
Before 1908	1951 - 1955	Alport Works ('Chandelier etc' and 'Lead Works')	150m South West
1908 - 1922	1963 - 1971	Printing Works	80m North
1922 - 1948	1963 - 1971	Soap Works	125m North
1922 - 1948	1951 - 1957	Electrical Substation	90m North
1922 - 1948	1951 - 1957	Engineering Works	90m North West
1922 - 1948	1978 - 1951	Garage	90m East
1922 - 1948	1963 - 1971	Engineering Works (Plumbing)	120m West
1975 - 1980	Present	Electrical Substation	200m North East

Several other non-specific or undesignated works and warehouses were also present in the study area during the period for which records are available.

6.4 Geology

The BGS 1:10,000 geological map of the area (SJ89NW) indicates that the site is underlain by superficial Glacio-fluvial deposits consisting of sands and gravels, underlain in turn by bedrock of either the Manchester Marls formation or Chester Pebble Beds Formation. This potential variation is due to the location of the site on or near the West Manchester Fault. Nearby notes on the map state 'boreholes show made ground and terrace deposits up to 8m thick on red sandstone' and 'gravel up to 5.8 on red sandstone.'

An extract of the geological map is contained within Appendix 6.

6.4.1 BGS Borehole Logs

There were no BGS Borehole logs available on site. However, 4 No. BGS Borehole logs were available off site within a radius of 100m.

SJ89NW 65

This borehole was undertaken 30m to the east of the site at an unspecified date by the Manchester Corporation. This recorded made ground to a depth of 3.66m bgl underlain by sandstone to termination at a depth of 12.80m bgl. The presence or absence of groundwater is not indicated.

SJ89NW 81

This borehole was undertaken 50m to the south of the site at an unspecified date by the Manchester Corporation. This recorded:

- Gravel and sand to a depth of 0.91m bgl, underlain by:
- Red loam to a depth of 3.35m bgl, underlain by:
- Grey loam to a depth of 7.47m bgl, underlain by:
- Blue clay to a depth of 9.45m bgl, underlain by:
- Hard red marl to termination at a depth of 10.82.

The presence or absence of groundwater is not indicated.

SJ89NW 3739

This borehole was undertaken 60m to the north of the site in 1983 by Manchester City Council City Engineer and Surveyors Department and recorded:

- Bituminous surfacing to 0.05m bgl, underlain by:
- Setts to 0.20m bgl, underlain by:
- Concrete to 0.40m bgl, underlain by:
- Made ground: Clay, gravel, bricks etc to a depth of 0.70m bgl, underlain by:
- Compact, very silty and gravelly, fine to medium sand to a depth of 2.85m bgl, underlain by:
- Very dense, reddish brown, fine to medium grained sandstone with occasional pebbles to termination at a depth of 4.50m bgl.

Groundwater was not recorded.

SJ89NW 220

This borehole was undertaken 100m to the north west of the site in 1934 by the British Geological Survey. It should be noted that the borehole was dug from the bottom of cellar floor at a depth of 2.70m bgl: this has been included in the depths stated below. The findings were as follows:

- Cellar to 2.70m bgl, underlain by:
- Gravel to 5.20m bgl, underlain by:
- Red sandstone to 42.40m bgl, underlain by:
- Red marl to 44.20m bgl, underlain by:
- Sandy marl to 45.10m bgl, underlain by:
- Marly sandstone to 49.10m bgl, underlain by:
- Mottled marl to 56.40m bgl, underlain by:
- Marly sandstone to 59.40m bgl, underlain by:
- Sandstone to 64.30m bgl, underlain by:
- Marl to a depth of 67.40m bgl, underlain by:
- Marly sandstone to a depth of 71.0m bgl, underlain by:
- Red sandstone to a depth of 85.30m bgl, underlain by:
- Grey sandstone to a depth of 89.0m bgl, underlain by:
- Red and grey sandstone to a depth of 123.70m bgl, underlain by
- Red and green mottled marls to termination at a depth of 139.30m bgl.

Groundwater was encountered with a standing level of 21.00m bgl.

6.4.2 Previous Site Investigation Works - Geotechnical

Previous site investigation works were undertaken at the adjacent property, 184 to 186 Deansgate, in May 2008 by Integra Consulting. This consisted of 3 No. hand dug inspection pits, predominantly for the purpose of exposing and documenting the foundations of the existing building. These recorded dense sand deposits to termination at depths of up to 1.07m bgl, alongside the building foundations.

A further site investigation was carried out by Capita Symonds in August 2008, on the formerly landscaped area immediately to the north of the site and now known as 1 Hardman Street. These works consisted of 5 No. window sample holes and 1 No. combination shell and auger and open rotary hole to a depth of 10.00m.

The investigation concluded that the site was typically underlain by:

- Made ground to depths of between 1.90m and 3.20m bgl, underlain by:
- Natural sand or highly weathered sandstone to a depth of 4.00m bgl, underlain by:
- Weathered sandstone of the Sherwood Sandstone formation to termination at a depth of 10.00m bgl.

Groundwater was not encountered during the excavation. However, groundwater in the combined shell and auger and open rotary hole subsequently stabilised at depths of between 3.11m and 3.15m bgl two weeks after excavation.

6.4.3 Previous Site Investigation – Contaminated Land

As part of the site investigation carried out in May 2008 by Integra Consulting, testing for VOCs (Volatile Organic Compounds) was undertaken on 3 No. samples of the made ground deposits and recorded no concentrations above the relevant human health GACs (Generic Assessment Criteria).

The site investigation carried out by Capita Symonds in August 2008 stated that concentrations of all tested determinands were found to be below their relevant GACs for the commercial land use scenario. Furthermore, no visual or olfactory evidence of contamination was identified during excavation.

6.5 Mining

The site lies outside a recognised coal or mining area. Coal Measures are anticipated to be present beneath the site at depth of at least 250m bgl. However, the desk study has identified no evidence of historic coal mining in the study area and the Coal Authority Mining Report (reference: 51000968793001) states that the site is outside the zone of likely physical influence of any past, present, proposed or licensed coal workings. No nearby features relating to mining are recorded in historic maps.

The site lies outside the Cheshire Brine Subsidence Compensation area. No evidence of sandstone quarrying on the site has been identified, although the potential for small scale or unrecorded extraction prior to historical records cannot be discounted.

The Coal Authority Mining Report is included in Appendix 7.

6.6 Hydrology and Hydrogeology

Environmental data relevant to the site and its immediate surrounding area has been obtained from sources available in the public domain. In addition, an environmental report was obtained from Landmark, the commercial suppliers of environmental data. The Landmark report and associated maps that have been inspected are presented in Appendices 4 and 5 and the principal observations in relation to waters and flooding can be summarised as follows:

Flooding

- The site is located within an area designated as Flood Zone 1.

Surface Water

- The nearest surface water feature is the River Irwell, a Primary river located 328m to the north west of the site, designated River Quality E (Poor).

Hydrogeology

- The site is underlain by bedrock which is classed as a Principal (Major) Aquifer overlain by high permeability superficial drift deposits of high leaching potential designated as a Secondary A (Minor) Aquifer.
- There are 10 No. groundwater abstraction points within 1km, the nearest located 283m to the northwest of the site. These are associated with industrial (non-potable) uses.
- The site is not within a Source Protection Zone.

Pollution Incidents to Controlled Waters

There were 2 No. recorded pollution incidents to controlled waters within 500m of the site:

- 410m to the north of the site in 1993 relating to the discharge of sewage to the River Irwell;
- 417m to the north of the site in 1992 relating to the discharge of an unknown pollutant to the River Irwell.

6.7 Hazardous Installations, Landfill and Waste

The following information relating to hazardous installations, landfill and waste obtained from the Landmark report, published information and the walk over survey can be summarised as follows:

- There is 1 No. Local Authority Pollution Prevention and Control (LAPPC) located within 250m of the site: this is located 213m to the north of the site and relates to dry cleaning.
- There are no Registered Waste Transfer Sites located within 250m of the site.
- There are no active or recorded historical landfills located within 500m of the site.
- Due to the extensively developed nature of the surrounding area there are numerous Contemporary Trade Directory Entries within the vicinity of the site. None of these are considered notable from a contaminative point of view, with the exception of Granada Dry Cleaner's Ltd, located 213m to the north of the site.

6.8 Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies in an area where <1% of homes are above the action level and BRE 211 'Guidance on Protective Measures for New Buildings' indicates the site to be in an area where no radon protection is required.

Map 13 of the Indicative Atlas of Radon in England and Wales and Map 13 of BRE 211 'Guidance on Protective Measures for New Buildings' contain information on the region in which the site is located and are presented in Appendix 8.

6.9 Unexploded Ordnance

In the Preliminary Unexploded Ordnance (UXO) Risk Assessment (reference: P4742), 6 Alpha state that, while no Heavy Explosive bomb strikes were recorded within the site envelope, an Incendiary Bomb strike was recorded on site and

additional Incendiary bomb strikes were recorded in the vicinity. The site is located close to historic Luftwaffe primary bombing targets, the nearest of which was the historic Central Station located 45m to the south east of the site.

The site is designated by Alpha 6 a UXO Probability Assessment of 3, indicating a medium possibility of UXO encounter. Consequently the report recommended the commissioning of a Detailed UXO Threat & Risk Assessment.

The findings of the risk assessment were corroborated by a desk study of historic bombing maps provided by Manchester Archives & Local History, which indicate 3 No. incendiary bomb strikes on the site, but do not record that the on site buildings were damaged or demolished. It is anticipated, but cannot be relied upon, that the contradiction regarding how many were dropped on site or off site nearby has come about through measuring differences.

The Preliminary Unexploded Ordnance (UXO) Risk Assessment is contained in Appendix 9.

7.0 CONCLUSIONS

7.1 General

The site has been occupied by the present Invicta House, a commercial and office building including basements, since the late 19th Century. The remainder of the site is occupied by hardstanding.

7.2 Geology

On the basis of the previous site investigations and BGS information, the underlying ground conditions beneath the site are expected to be as follows:

- Granular MADE GROUND to approximate foundation or basement depth (minimum of 1.20m bgl), underlain by:
- Natural SANDS & GRAVELS (Highly weathered sandstone) to depths of between 3.00m and 7.00m bgl, underlain by:
- SANDSTONE (Chester Pebble Beds) to a depth of at least 10.00m bgl, underlain by:
- Alternating SANDSTONE and MARL to an unknown depth.

Obstructions in the form of walls and foundation elements can be anticipated, both in the parts of the site occupied by the present Invicta House building, as well as in the car park, which was also occupied with buildings until the 1980's.

The site is not considered to be within the zone of influence of any potential mine workings, although the potential for unrecorded or small scale extraction cannot be discounted. No evidence of nearby mining activities was identified on historic maps.

It is recommended that exploratory holes are constructed at the site to determine the ground conditions with a greater degree of certainty with respect to the proposed development and to explore the possibility of subterranean historical features / obstructions. These intrusive works will also aid in the design of the proposed development, foundations, drainage, services and external areas.

A retaining wall of approximately 2.00m in height is present on the western boundary of the site. Consequently it is recommended that the stability of this

feature and its suitability for earthworks be independently assessed and / or surveyed by an appropriate engineer, depending on the detail of the final proposed development.

7.3 Contaminated Land Legislative Framework

Environmental risks are assessed in accordance with Contaminated Land (England) (Amendment) Regulations (2012), Part IIA of the Environmental Protection Act 1990, and Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, DEFRA (2012). Part IIA provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

- (a) Significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted and the potential pathways between them. For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source - a substance that is capable of causing pollution or harm;
- A receptor - something which could be adversely affected by the contaminant; and
- A pathway - a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

The Environment Agency Contaminated Land Report CLR 11 Model Procedures for the Management of Land Contamination provides the technical framework for structured decision making about land contaminations. CLR 11 advocates a phased approach to risk assessment comprising:

- Preliminary Risk Assessment (PRA) - desk study and qualitative assessment.

- Generic Quantitative Risk Assessment (GQRA) - assessment of contaminant concentrations against generic assessment criteria.
- Detailed Quantitative Risk Assessment (DQRA) - detailed site specific risk assessment and development of site-specific assessment criteria.

Each of these phases follows the same basic steps but adds site specific details and further certainty into the assessment as the stages progress. The basic steps are:

- Hazard Identification and hazard assessment- development or refinement of the source-pathway-receptor conceptual model, and identification of potential pollutant linkages.
- Risk Estimation- qualitative risk estimation predicting magnitude and probability of potential consequences that may arise as a result of a hazard.
- Risk Evaluation- deciding whether a risk is unacceptable.

The key to the classification is that the designation of risk is based upon the consideration of both:

- (a) The magnitude of the potential consequence (i.e. severity). [takes into account both the potential severity of the hazard and the sensitivity of the receptor]
- (b) The magnitude of probability (i.e. likelihood). [takes into account both the presence of the hazard and receptor and the integrity of the pathway]

Generic Quantitative Risk Assessment (GQRA) will utilise generic assessment criteria (GAC) for the purposes of screening allowable concentrations in comparison to the measured site concentrations. The GAC are defined based on the critical receptors identified at the site. Receptors are considered in relation to:

- Human health receptors (e.g. site users) via measured solid concentrations
- The water environment (e.g. groundwater and surface water) via measured leachate / water concentrations

Additional receptors may be relevant dependent on the site e.g. flora/fauna, water supply pipes, buried concrete.

The GAC adopted for assessment of soils in relation to Human Health are based on published Soil Guideline Values (SGV) in 2009 for those compounds for which published criteria are available for varying scenarios (residential, commercial, allotment). In the absence of SGVs the following GAC defining documents are adopted - LQM/CIEH S4ULs (2015), CL:AIRE Soil GAC for Human Health Assessment (2010) and Category 4 Screening Levels (C4SL's) (2014).

GACs for waters must be selected to assess potential risks to the identified environmental receptors. There are numerous UK and European guidelines for waters based on the site situation and different receptors. GACs utilised include - The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009 (Part 7:Groundwater Threshold Values), UK Drinking Water Standards (2000), Environmental Quality Standards, World Health Organisation concentrations, Environment Agency guidance concentrations and United States Environmental Protection Agency – Region 9 GACs.

7.4 Sources of Contamination and Probable Contaminants

As discussed in Section 6.3, the principal potential source of on site contamination is the historic car component and spares company, Edmunds Walker and Co Ltd. While it is not clear whether industrial activities were carried out on site, activities of a potentially contaminative nature associated with motor engineering works include painting, welding, soldering, cutting and plating works. Subsequently there is the potential for the presence of TPH (total petroleum hydrocarbons), metals, solvents, PAHs (Polycyclic Aromatic Hydrocarbons) and VOCs. Electrical equipment may have used PCBs (Polychlorinated Biphenyls) as dielectric fluids.

The risk of contamination of the site through the infiltration of fuel and mineral oils during the site's period of usage as a carpark is considered negligible due to the provision of hardstanding across the site. Potentially significant off site sources are limited to the 19th Century silk mill, hat factory and chemical works.

A further potential contaminative source is any made ground deposits present on site, such as those that may have arisen from earlier demolition operations or

imported onto the site for the purposes of landscaping. ACMs may be present in the event that these were utilised in the construction or refurbishment of Invicta House.

It should also be noted that the site investigation carried out by Capita Symonds in August 2008 on the plot immediately to the north stated that concentrations of all tested determinands were found to be below their relevant GACs (Generic Assessment Criteria) for the commercial land use scenario. No visual or olfactory evidence of contamination was identified during excavation. Furthermore the site investigation carried out in May 2008 by Integra Consulting identified no elevated concentrations of VOCs. These results are considered relevant to the site due their close proximity and similar usage history.

With respect to a chemical testing suite, it is proposed to undertake an extensive chemical testing suite including metals, semi-metals, inorganics, total petroleum hydrocarbons in the form of speciated bandings, and VOCs, PCBs and PAHs. Asbestos identification and, if appropriate, asbestos quantification testing should be undertaken on the underlying made ground deposits. This suite is considered to encompass the range of potential contaminants associated with a motor engineering works as well as any made ground importation, oil infiltration or contamination migration from off site sources that may have occurred.

Finally, it should be noted that potentially contaminative unrecorded historic activities may have occurred and in this event, further contaminative sources may be present.

7.5 Pathways for Contamination

Controlled Water

Section 7.2 concluded that the site is anticipated to be underlain by made ground deposits and highly weathered bedrock to depths between 3.00m and 7.00m to termination, underlain by weathered sandstone and marl bedrock to an unknown depth. All of these deposits are anticipated to be of a granular, permeable nature and will permit vertical migration of any leachable contamination to the underlying aquifers. Given the necessary mobility and water interaction a potential pathway could also be created through the construction of boreholes or piled foundations, or

in the event that historic drainage is present. Consequently, care should be taken during construction in respect to the formation of vertical pathways - e.g. through the construction of piled foundations – if contaminative sources are recorded.

However, pollution linkage will be dependent on contamination coming into contact with water – either through the presence of groundwater at the depth of the made ground deposits, or through infiltration. On the basis of the proposed development received at the time of writing, the latter is not considered significant due to the expectation that the proposed building will occupy all of the site, with no proposed areas of soft landscaping. The presence, depth and range of variation of groundwater on site should be confirmed by the site investigation and subsequent monitoring.

Potential pathways to the River Irwell, the nearest surface water receptor, are not considered to be present due to the significant distance separating it from the site. While significant surface run off is probable in the proposed development, the presence of significant areas of impermeable hardstanding will prevent surface water coming into contact with any of the identified contaminative sources.

Consequently, the most significant potential pathway to controlled waters would be created by the presence of ground water in, or near, the depth of the made ground deposits. The identification of ground water and historic drainage, will be a priority of any Phase 2 investigation.

Human Health

The pathways along which contamination could potentially reach the targets on site during use and after completion of development works are detailed in 'Updated Technical Background to the CLEA Model' (Environment Agency; 2009) and can be summarised as follows:

- a) Ingestion of soil directly and indoor dust *1*2
- b) Inhalation of soil dust (indoor and outdoor) *2
- c) Dermal contact with soil (indoor and outdoor) *2
- d) Inhalation of soil vapours (indoor and outdoor)
- e) Oral background*2
- f) Inhalation background*2

**1 Treated as one pathway*

**2 Pathway impeded for current / proposed on site occupants and only considered representative for site workers*

The conceptual model for proposed commercial developments defined in the updated technical background to the CLEA model states that those sites that involve 100% hard cover are not regarded to be of concern due to the lack of an exposure pathway. The only exception to this is the soil vapour pathway which is only applicable for certain determinands such as VOCs. Consequently, the presence of human health pathways will be dependent on both the presence of contaminative sources and the nature of the contamination. In the event that only non-volatile contaminants are identified (such as metals and most PAHs), no pathways relevant to human health will be present for the general public and occupants of the proposed eight storey office building.

This will not however, be the case for construction workers involved in the proposed development. This receptor therefore, will be the determining factor in the risk assessment.

7.6 Receptors of Contamination

Potential receptors identified include the following:

- a) Site occupants;
- b) Construction workers;
- c) The general public;
- d) Groundwater contained within the Principal (Major) Aquifer and the overlying Secondary A (Minor) Aquifer;
- e) Subsurface plastic e.g. potable plastic water pipes;
- f) Building fabric e.g. concrete foundations etc;

7.7 Conceptual Model for Human Health Risk Assessment

The only potential historic contaminative source identified in Section 7.4 is the made ground deposits anticipated on site due to historic demolition and any landscaping work that may have occurred.

At the time of writing it is anticipated that the proposed development will occupy the significant majority of the site, with any remaining areas occupied by hardstanding. Therefore, only the inhalation (soil vapour) pathway will be present on site with respect to site occupants and the general public, which is only relevant for volatile contaminants.

A broader range of pathways will be present for construction workers during the development, and consequently this receptor will be the limiting factor for risk assessment, in the event that a contaminative source is identified.

On this basis, the potential pollution linkages on site are considered to constitute a low risk to human health risk receptors. Specifically, construction workers are anticipated to be the most sensitive potential human health risk receptor in the event that a source is identified and consequently the adoption of standard precautions including appropriate PPE (Personal Protective Equipment) is advised.

A conceptual model in the form of a linkage table for the purposes of a preliminary risk assessment for human health has been produced as a result of the probable contaminants, pathways and receptors identified in Sections 7.4, 7.5 and 7.6 above as follows.

Contaminant	Pathway	Receptor	Risk
Arsenic	Ingestion of contaminated soil and dust (indoor and outdoor)	Construction workers only	Low
Barium			
Chromium total / ⁵⁺	Dermal contact with contaminated soil (outdoor and indoor)	Construction workers only	Low
Vanadium	Inhalation of contaminated dust (indoor and outdoor)	Construction workers only	Low
Beryllium			
Cadmium			
Copper			
Lead			
Nickel			
Zinc			
Boron			
Selenium			
Mercury			
Cyanide			
Sulphate	Direct contact with building fabric	Fabric of buildings on and off site	Low
Cyanide			
pH			
Total Petroleum Hydrocarbons	Inhalation of contaminated dust (indoor and outdoor)	Construction workers only	Low
Polycyclic Aromatic Hydrocarbons	Dermal contact with contaminated soil (outdoor and indoor)	Construction workers only	Low
	Inhalation of soil vapours (indoors and outdoors)	Human occupants & construction workers	Low
	Permeation	Subterranean plastic service pipes	Low to Moderate
Asbestos	Inhalation of contaminated dust (indoor and outdoor)	Construction workers only	Low

The conceptual site model is illustrated in Appendix 10.

7.7.1 Conceptual Model for Ground Gas Risk Assessment

The only ground gas sources that have been identified by the desk study are the on site made ground deposits, which are of unknown constituents and quantity.

Utilising the guidance stipulated in BS8485 (2015), CIRIA 665 (2007) and CIRIA 552 (2001), the probability and consequence of the identified potential ground gas sources at the development are considered to result in a very low level of risk. However, it is considered prudent to undertake ground gas monitoring for a period of at least 1 month to confirm this regime. Alternatively, following the observations of the site investigation, it may be considered more appropriate to assess the risk posed by potential ground gas using the numerical approach for low risk sites specified in CL:AIRE Research Bulletin 17 (2012).

A conceptual model in the form of a linkage table for the purposes of a preliminary risk assessment for ground gas has been produced as a result of the probable contaminants, pathways and targets identified above as follows.

Source	Pollutant	Pathways	Receptors	Risk
Potential made ground deposits (unknown constituents and quantity)	Methane / Carbon dioxide / Hydrogen Sulphide	Ingress and accumulation Migration, ingress and accumulation	Human occupant	Very Low
			Building and Structures	Very Low
			Site Workers	Very Low

If any previously unrecorded potential ground gas sources are recorded during the site investigation works, for instance organic soils (peat), then further appropriate ground gas monitoring will naturally be undertaken.

The conceptual site model is illustrated in Appendix 10.

7.8 Conceptual Model For Waters Risk Assessment

The only potential contaminative source identified in Section 7.4 is the potential made ground deposits.

Additionally, sensitive receptors are present: these are the underlying Principal (Major) aquifer in the bedrock, and the overlying Secondary A (Minor) aquifer in the superficial deposits. No surface water receptors are considered to be present within an influencing distance.

Section 7.5 identified the principal pathway of concern to be the vertical migration pathway to the underlying aquifers, due to the permeable nature of the anticipated made ground, sand and sandstone deposits. Boreholes, piled foundations or historic drainage could pose further potential pathways to this aquifers. However, it should be noted that the proposed development is anticipated to encompass the entire area of the site with the proposed building and associated hardstanding, preventing infiltration from coming into contact with the made ground deposits. In which case, high or variable groundwater would be required for linkage to occur. Groundwater depth monitoring will be conducted following the site investigation.

Leachate testing of solid samples will be undertaken to identify any leachable contamination present in the superficial strata. In the event that contaminative sources are identified, shallow groundwater sampling will enable confirmation of whether shallow groundwater has been significantly affected.

Finally it should be noted that any risk is dependent on the identification of a significant contaminative source, the likelihood of which is considered low.

In this context, the potential pollution linkages are considered to result in a low level of risk.

A conceptual model in the form of a linkage table for the purposes of a preliminary risk assessment for controlled waters has been produced as a result of the probable contaminants, pathways and targets identified in Sections 7.4, 7.5 and 7.6 above as follows.

Contaminant	Pathway	Receptor	Risk
Arsenic Barium Chromium Vanadium Beryllium Cadmium Copper Lead Mercury Nickel Zinc Boron Selenium Total Petroleum Hydrocarbons PAHs PCBs VOCs pH Cyanide	Vertical migration through permeable granular strata, boreholes, piled foundations and potential historic drainage	Principal (Major) Aquifer and Secondary A (Minor) Aquifer	Low

The conceptual site model is illustrated in Appendix 10.

7.9 Preliminary Risk Assessment Summary

Human Health

There is a low potential risk to human health due to the provision of hardstanding across the entire site. Construction workers are anticipated to comprise the most sensitive human health risk receptor. However, further appraisal will be required following completion of intrusive works including chemical testing to identify the presence of a contaminative source.

There is a very low risk of potential ground gas issues at the site due to the potential presence of made ground deposits.

Controlled Waters / Groundwater

The only potential contaminative source identified on site is the made ground deposits. Potential pathways to the underlying aquifers are present, including through permeable strata, and through potential historic drainage, piling and drilling activities. However, infiltration will be prevented due to the provision of hardstanding areas across the proposed development.

Consequently, it is considered that there is a low risk of pollution to controlled waters.

It is proposed to validate these assertions by leachate and solid contamination testing of the on site materials, in addition to site investigation works to identify any historic drainage that may be present. Any suspected contamination of groundwater may be further assessed through groundwater chemical testing.

7.10 Scope of Phase 2 Intrusive Geo-Environmental Ground Investigation

As a result of the preliminary risk assessment, a Phase 2 intrusive environmental ground investigation should be carried out to determine the ground conditions beneath the site, locate potential historic drainage, and determine the concentrations of any contaminants in the ground if required. This investigation should include the installation of exploratory holes with monitoring wells across the site, enabling ground gas and groundwater depth monitoring. Samples of soil should be collected and an MCERTS accredited laboratory should undertake chemical composition tests to determine contamination levels, including testing for ACMs.

8.0 **RECOMMENDATIONS**

- 8.1 As a result of the information gathered from this report, there is a low risk to human health and controlled waters, due to the history of usage by a car component and spares company, and the presence of potential made ground deposits on site, which are of unknown extents and constituents. Consequently a Phase 2 Intrusive Environmental Ground Investigation is proposed, including appropriate chemical testing of site materials.
- 8.2 Due to the presence of insignificant ground gas sources, it is concluded that there is a very low risk of potential issues relating to ground gas across the site in accordance with BS8485 (2015) and CIRIA 665 (2007). To quantify the extent of risks, it is recommended that ground gas monitoring is undertaken for a minimum of 1 month along with groundwater monitoring. Alternatively, following the observations of the site investigation, it may be considered more appropriate to assess the risk posed by potential ground gas using the numerical approach for low risk sites specified in CL:AIRE Research Bulletin 17 (2012). Following a review of BRE 211 and HPA / BGS radon reports, no radon protective measures are required at the post development site.
- 8.3 From the results of the Phase 2 work, a Phase 3 numerical risk assessment report may be required and the conceptual models refined accordingly.
- 8.4 The scope of any physical site remediation works to remove soils and groundwater that are contaminated to an unacceptable extent should be determined and appropriate recommendations summarised in the Phase 3 report.
- 8.5 Due to geotechnical requirements, site investigation works should be undertaken across the entire site envelope including sufficient rotary holes, window sample holes, hand dug inspection pits and associated geotechnical laboratory tests. These works will enable the designing of foundations and underground drainage by establishing the actual ground conditions at the site. They will also allow the investigation of suspected subsurface features, obstructions and historic drainage.

- 8.6 A retaining wall of approximately 2.00m in height is present along the western boundary of the site. At the time of writing it is not known whether this feature will be removed, altered or retained in the proposed development. Consequently, it is recommended that the stability of this feature be appropriately assessed by a qualified person.
- 8.7 6 Alpha has designated the site with a UXO Probability Assessment of 3, indicating a medium possibility of a UXO encounter. Consequently the report recommended the commissioning of a Detailed UXO Threat & Risk Assessment. The desk study concluded that the site was bombed during the Second World War. Consequently, it is recommended by 6 Alpha that all standard precautions relating to such sites are taken during site investigation and construction works.
- 8.8 It should be noted that, if any visual or olfactory evidence of contamination is encountered during site investigation or construction work, then the Local Authority Environmental Health Officer and Environment Agency should be contacted immediately in order to agree any necessary remediation measures.