PHASE I GEO-ENVIRONMENTAL DESK STUDY

Residential Accommodation
Bevington Bush
Liverpool
Merseyside
L3 6JU

24th July 2015
Report Ref: 4/5758/001

Prepared on Behalf of:

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BEVINGTON BUSH, LIVERPOOL

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EXECUTIVE SUMMARY

Client	Jam Works
Location	Located off Gardener's Row and Bevington Bush, Liverpool. OS Grid Reference 334740, 391330.
Description	The site covers an area of approximately 0.41 ha and forms an irregular shaped parcel of land which can be accessed from the north via Bevington Bush or from the south via Edgar Street, both of which are blocked by temporary concrete bollards. The site is generally flat lying but slopes gently from north to south west and is currently occupied by a derelict one storey building in the central part of the site. The building is surrounded by areas of concrete and tarmac hardstanding and soft landscaping which is roughly vegetated. The surrounding area is a mixture of residential, commercial and industrial land use with shops, light commercial premises, manufacturers and old warehouses located within close proximity of the site. An electricity substation is present adjacent to the north western corner of the site.
Development	We understand that the site is proposed to be re-developed with new residential accommodation including seven, nine and a fourteen storey building with associated car parking areas.
Site History	The site has been occupied since the 1800's with a tannery in the northern and central areas, a soap works and school in the south west and residential/small commercial premises in the south east. The soap works, school and other buildings were demolished and the tannery extended to cover the entire site during the early 1900's. It was eventually demolished in the late 1960s/early 1970s. An industrial unit was subsequently constructed in the central portion of the site during the 1980s and the site remains essentially unchanged. The surrounding area has been occupied by heavy industry including a number of saw mills, tanneries, oil refineries with several above ground tanks, sugar refineries, warehouses, factories, yards and garages all located within close proximity.
Geology	BGS records indicate that drift deposits are absent from the site with solid strata comprising sandstone of the Wilmslow Sandstone Formation in the western part of the site and sandstone of the Helsby Sandstone Formation in the eastern part of the site. Previous investigations have identified deep Made Ground up to 5.3m along with a thin layer of clay soil in some parts of the site.
Mining	Coal Authority records indicate that the site is not affected by historic coal mining activity.
Flood Risk	According to Environment Agency records the site is not located within a flood risk area.
Environmental Setting	The underlying solid strata (Wilmslow and Helsby Sandstone Formations) are classified as a Principal Aquifer, although the site is not indicated to be within a Groundwater Source Protection Zone. There are four groundwater abstraction points within 500m of the site, with the nearest one located 105m north west of the site used for industrial/public services. There are three recorded pollution incidents to controlled waters within 500m of the site with the nearest one located 95m to the west associated with unknown pollutants.
Landfilling	There are no historical or registered landfill sites recorded within 500m of the site.

Unexploded Ordnance	A UXO risk assessment was carried out as part of the Mott MacDonald desk study which identified two bomb strikes in the local area. Whilst it was acknowledged that the risk was low given the development of the site since WWII, it was stated that further detailed UXO desk study information was required to meet the requirements of CIRIA Report C681.
Previous Investigations	A factual ground investigation report has been undertaken by Geotechnics in May 2013 which identified the presence of asbestos, benzo(a)pyrene and cyanide contamination along with potential groundwater contamination in one borehole.
Further Works	A number of potential contamination sources have been identified at the site and within the surrounding area which could have caused some form of ground contamination. A detailed Phase 2 site investigation will therefore be necessary to include a contaminated land, gas risk assessment and geotechnical appraisal of the site. Full details of which are presented in Section 5 of this report.

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1.0 INTRODUCTION

1.1 Background

Clancy Consulting Limited has been instructed by Jam Works to carry out a Phase I Geo-environmental Desk Study for a site located off Gardener's Row and Bevington Bush in Liverpool. A site location plan is presented as Drawing No. 10/0726/001 in Appendix I.

The site is currently occupied by a vacant one storey brick building with areas of hardstanding and rough vegetation. We understand that the site is proposed to be redeveloped with new residential accommodation including seven, nine and a fourteen storey buildings with associated car parking areas. A proposed ground floor development layout plan is presented as Falconer Chester Hall Architects Drawing No. P14092-01-03-001 in Appendix I.

A previous desk study and a site investigation have been carried out for the site and immediate surrounding area by Mott MacDonald and Geotechnics respectively in 2013. Copies of the following reports have been supplied to Clancy Consulting:

- Phase I Geo-environmental Desk Study Report 'Liverpool Superport UTC, Bevington House, Geo-Environmental Desk Study' dated April 2013'.

- Phase II Ground Investigation Factual Report has been undertaken 'Ground Investigation at Bevington House, Factual Report, PN132910' dated May 2013.

The above documents have been used as background information during this current study and are reviewed in detail in Section 3.

1.2 Objectives

The objectives of the study are summarised below:

- Provide a review of previous Desk Study and Site Investigation reports.

- Provide a review of the sites land use history by reference to ordnance survey maps of the area.

- Assess the environmental setting, geology, hydrology, hydrogeology, mining and subsidence history of the site and surrounding area.

- Develop a detailed 'conceptual site model' with regard to potential contamination sources, pathways and receptors in accordance with the requirements of Liverpool City Council's (LCC) Screening Checklist to ensure that all contamination source, pathways and receptors have been identified.

- Provide recommendations regarding the requirement for further investigations, if required, to satisfy the Local Planning Authority.

1.3 Limitations of the Study

Clancy Consulting Limited cannot be held responsible for any omissions, misrepresentation, errors or inaccuracies with the supplied third party report information. The report is written in the context of an agreed scope of work and budget and should not be used in a different context. New information or improved practices and changes in legislation may require a reinterpretation of the report in whole or in part.

Clancy Consulting Limited reserve the right to amend either conclusions or recommendations in light of any further information that may become available. The report is provided for the sole use of Jam Works for the objectives discussed previously only, and is confidential to them.

The report may not be relied upon by any other party without prior written consent of Clancy Consulting Limited. Those using this information in subsequent assessments or evaluations do so at their own risk.

2.0 DESK STUDY

2.1 Sources of Information

Background information was sought from the following sources:

- Ordnance Survey historical maps (selected copies included in Appendix II).
- British Geological Survey (BGS) Sheets (Appendix III).
- Environment Agency Groundwater Vulnerability Maps (Appendix IV).
- Environmental datasheets (Appendix V).
- Local Authority enquiries / liaison (Appendix VI).
- A review of existing desk study and site investigation information.

2.2 Site Setting and Description

The site is located off Gardener's Row in Liverpool at OS grid reference 334740, 391330 and covers an area measuring approximately 0.41 hectares. The site forms an irregular shaped parcel of land bound to the north by Bevington Bush and an empty parcel of land currently occupied by containers and skips, and to the south by Edgar Street and a St John's Ambulance depot. To the west the site is bound by Gardner's Row and a number of warehouses and to the east by soft grassed landscaping. Access to the site is from the north via Bevington Bush or from the south via Edgar Street, both of which are blocked by temporary concrete bollards.

The site is generally flat, sloping gently down from north to south west and is currently occupied by a derelict one storey building in the central part of the site. Around the building there are areas of concrete and tarmac hardstanding and soft landscaping with rough vegetation. Evidence of fly tipping was observed during previous site walkovers along with vegetation growing through the concrete hardstand areas.

The surrounding area is a mixture of residential, commercial and industrial usage with shops, light commercial manufacturers and old warehouses located within close proximity of the site. An electricity sub-station is located adjacent to the north western corner of the site boundary.

The existing site layout is presented in Appendix I as Survey Operations Topographical Survey Drawing No. 15B083/001.

2.3 Site History

In order to investigate the development history and previous land uses at the site and surrounding area, historical Ordnance Survey (OS) maps were examined. Selected copies of the maps are presented in Appendix II.

The Table below is not intended to provide a comprehensive review of all the changes which have occurred at the site and instead provides a summary of the most salient points relating to the development history of the site. The most significant historical land uses are highlighted in bold text for ease of reference.

Table 1 – Site History

Date(s)	Site	Surrounding Land
1893	The majority of the central and northern parts of the site are shown to be occupied by a **tannery** with a **soap works** and a **school** in the south western corner. A small number of buildings likely to be residential or commercial properties are shown in the south eastern corner of the site.	Bevington Bush road runs around the northern and eastern boundaries of the site. The surrounding area is mixed **residential** and industrial with a **brewery** and a **sugar refinery** located 20m and 100m to the north respectively. A **brewery** and a **saw mill** are shown 90m and 120m to the north east along with a **timber yard**, **oil mill**, **saw mill** and **tannery,** several **soap works, saccharine works** and general **engineering works** 100m to 200mm to the north west and west of the site. A disused **iron foundry** is present 100m south west of the site and a **tabacco factory** 150m to the south east.
1908	The soap works located in the south western corner are no longer shown although the buildings remain.	A **saw mill** has been built 40m west along with several warehouses and an **ink works** beyond. The brewery 40m to the north of the site has been replaced by the **Bovington House Hotel** and the area south of the site has been further developed with residential properties. A '**hide store'** and **'bone store**' are shown to the south west. The soap works previously shown to the west and south west are no longer present.
1927	The tannery has been extended and now covers the entire site. The school in the south west is no longer present.	No significant changes.
1954-1955	The site is named **Bevington Bush Tannery**.	The Bevington Bush Hotel has been renamed as **Arden House**. A **builder's store**, **oil works** and four **oil refineries** are now shown 40m, 70m and 80m to the west of the site respectively. A number of **above ground tanks** are shown 150m to the west of the site associated with the oil works. The '**city tannery'** is shown 180m to the north west with an **oil refining works** 170m to the south west and a **garage** 60m to the south. The tobacco factory 150m south east of the site is now shown as a **corporation yard**.
1961-1965	The tannery is now labelled as **works**.	The oil works and refineries to the west are now shown as 'factory' or 'works'. The 'city tannery' to the north west is now disused. The hide store and bone store are no longer present.
1968-1976	The tannery buildings have been **demolished** and the site is now shown to be **vacant.**	An **electricity sub-station** is located immediately to the north western site boundary. The residential buildings south of the site have been **demolished** and a **warehouse** has been constructed immediately to the south. The Saw Mill 40m west of the site has been replaced by a **transport depot**. A **polythelene factory** is present 120m north west of the site with a **bottling works** 120m to the south west and a **chemical works** 240m to the west.
1983-1989	A **building** (use unknown) has been built in the central part of the site.	The garage and warehouse south of the site have been **demolished** and replaced with new **highways infrastructure**. The corporation yard to the south east has been redeveloped with Liverpool John Moores University campus. Many of the depots/works/warehouses to the south west have been **demolished.**
1993-1995	No significant changes.	**St John Ambulance Centre** is shown 20m south of the site. Arden House to the north is

Date(s)	Site	Surrounding Land
		no longer present and the site has been **demolished** and **cleared**.
2006-2012	No significant changes.	No significant changes.

2.4 Geology

The 1:50,000 British Geological Survey (BGS) map for the area (Sheet 096, Liverpool) indicates that drift deposits are absent from the site with solid strata comprising sandstone of the Wilmslow Sandstone Formation in the western part of the site and sandstone of the Helsby Sandstone Formation in the eastern part of the site.

There is a BGS historical borehole located approximately 40m north of the site which confirms that the sandstone bedrock is present with no or very shallow deposits of Glacial Till recorded Further boreholes located 40m to the west of the site record up to 3.50m of Made Ground overlying Glacial Till (clay) deposits to 4.70m. These deposits were underlain by weathered sandstone.

A previous ground investigation undertaken on the site by Geotechnics in 2013 identified Made Ground between 1.80m (in the south eastern part of the site) and 5.30m (eastern part of the site) overlying soft to very stiff clay or loose to medium dense sand up to 4.0m over weathered sandstone. The Geotechnics report is reviewed in greater detail in Section 3.2.

Copies of the geological plans are attached in Appendix III.

2.5 Soil Geochemistry

According to the BGS National Geoscience Information Service no elevated background concentrations of arsenic, cadmium, lead or nickel are anticipated in the natural soils beneath the site. However, elevated concentrations of chromium in the natural soils should be anticipated.

2.6 Mining & Ground Stability

According to Coal Authority records the site does not lie in an area which has been affected by coal mining.

There are no BGS recorded mineral sites within 1km of the site.

2.7 Hydrogeology

According to the Environment Agency Groundwater Vulnerability Map (Sheet 16, West Cheshire) the sandstone strata (Wilmslow and Helsby Formations) are classified as a Principal Aquifer.

The site is not located within a Groundwater Source Protection Zone.

There are four groundwater abstraction points within 500m of the site, with the nearest one located 105m north west of the site used for industrial/public services.

There are three recorded pollution incidents to controlled waters within 500m of the site with the nearest one located 95m to the west associated with unknown pollutants. Two of them located 407m south and 412m south of the site relate to accidental leakages of solvents and oils. All incidents were deemed to be Category 3 (minor incidents) and took place in the early 1990's. These are unlikely to have had any impact on the development site given their classification as 'minor incidents' and distance from the site.

Copies of the hydrological site sensitivity maps are included in Appendix IV.

2.8 Hydrology

The nearest surface water course is the Leeds-Liverpool Canal located 639m north west of the site.

There are no surface water abstractions within 1km of the site.

There are no discharge consents within 500m of the site.

There are two substantial surface water pollution incidents recorded within 1km of the site located 413m east and 819m west of the site, both relating to Category 4 (no impact) incidents. Again, these are not considered to have the potential to affect the site given the distance involved.

2.9 Flood Risk

According to Environment Agency records the site is not in an area liable to flooding.

2.10 Radon Risk Potential

The Radon Guidance on protective measures for new dwellings indicates that the site is not in an area affected by radon. Basic radon gas protective measures are therefore not required.

2.11 Landfill Sites

There are no historical or registered landfill sites recorded within 500m of the site.

Two licensed waste management facilities are recorded within 500m of the site. They are located 182m and 262m to the north west associated with household/commercial/industrial transfer stations and physico-chemical treatment facilities respectively.

There are four waste treatment and disposal sites within 500m, with the nearest ones located 119m to the north west and 312m to the west, associated with construction/demolition materials and hydrocarbon fuel and waste oils respectively.

2.12 Industrial Land Uses

The surrounding area is a mixture of residential and commercial usage with a number of shops and light commercial manufacturers located within close proximity of the site. These include electrical engineers, garage services, crane hire and service, tyre dealers, telecommunications equipment and systems, sheet metal works, marine equipment and supplies, screen process printers, brewers, fork lift trucks etc. Many of these entries are however inactive.

Six Local Authority Pollution Prevention and Control permits are recorded within 500m of the site, with the nearest one located 150m to the north west relating to mobile screening and crushing processes.

A comprehensive list of the waste management and industrial premises located within 1km of the site are presented in the Environmental Datasheets in Appendix V.

Additionally, there are seven radioactive substances noted at 248m south east of the site, all located at Liverpool Hope University; their use is not specified.

2.13 Sensitive Land Uses

There are no sensitive land uses recorded within 1km of the site.

3.0 REVIEW OF EXISTING INFORMATION

3.1 Mott MacDonald Phase I Desk Study – April 2013

A Phase I Geo-environmental Desk Study report has been previously prepared by Mott MacDonald in April 2013. The report was carried out on a larger plot of land which included the current study site and a parcel of land located immediately to the north.

The Desk Study identified a number of potential sources of contamination from historic land uses including asbestos within Made Ground deposits resulting from demolition activities, PCB contamination associated with the electricity substation, organic and inorganic 'hotspots' from the former tannery and soap works and off-site sources from former industrial works.

Potential pollutant linkages were identified for both environmental and human health receptors. The pathways identified include direct contact (ingestion/inhalation), lateral and vertical migration and migration through utilities with the main receptors including the future end users, construction workers and the underlying Principal Aquifers.

It was argued that if the site was covered by hardstanding the risk to end users would be considered low with a moderate to high risk for construction workers. Comments are also made concerning the provision of clean cover in landscaped areas in order to reduce the risk of end users coming into contact with underlying soils. The risk to the underlying aquifer is considered high due to the presence of sandstone bedrock outcropping on-site.

It is noted in the report that ground gas generation potential is considered to be low given the anticipated general lack of Made Ground across the site. However, it goes on to say that if contamination hotspots or off-site gas sources are present then a risk could be perceived to be present. As such, a gas risk assessment is recommended to fully assess the risk.

The Desk Study also assesses the risk from buried unexploded ordnance and a UXO risk assessment was procured from 6 Alpha Associates. The preliminary risk assessment identified two bomb strikes in the area. Due to potentially shallow bedrock and subsequent development of the site post war, it was noted that the UXO risk is low but further detailed UXO desk study was recommended to meet the requirements of CIRIA Report C681.

An intrusive ground investigation to assess geotechnical and geo-environmental risks at the site was recommended, and a preliminary site investigation was therefore completed by Geotechnics on behalf of Mott MacDonald.

3.2 Geotechnics Site Investigation Report – May 2013

A factual ground investigation report has been undertaken by Geotechnics for Mott MacDonald in May 2013, which included both the current site and the site to the north.

The site investigation (undertaken on the current study site) included the drilling of two window sample boreholes (WS05 and WS06) to depths up to 4.40m along with the drilling of two rotary boreholes (BHR02 and BHR02A) to depth of 16.0m and 10.32m respectively.
A number of other window sample boreholes (WS04A to WS04D) were terminated within the upper 1.0m due to the presence of concrete obstructions. One further borehole (WS04E) was terminated at 1.0m bgl due to groundwater inflow and possible hydrocarbon contamination.

The intrusive investigation identified Made Ground to depths between 1.80m (WS06) and 5.30m (BHR02) underlain by natural sand and clay deposits in WS05, WS06 and BHR02 overlying

weathered sandstone bedrock at depths ranging from 3.70m to 4.00m. In BHR02A superficial deposits were absent and weathered sandstone bedrock was encountered directly under the Made Ground deposits at 5.30m.

Laboratory testing identified chrysotile and amosite asbestos in WS04, WS06 and BHR02 at various depths within the Made Ground. Additionally, elevated concentrations of benzo(a)pyrene and cyanide were present in WS04. No PCBs or hydrocarbon contamination was found in the samples tested from WS04 (near the electricity sub-station).

It is unclear if any groundwater testing was carried out from the ingress experienced in WS04E to confirm whether hydrocarbons were present.

Three of the exploratory locations within the current site boundary were installed with monitoring wells (WS05, WS06 and BHR02). Only one of three gas monitoring visits scheduled by Geotechnics has been made available to us. The results show the presence of carbon dioxide up to 4.6% and low flow gas rates (maximum of 0.6 l/hr).

The Geotechnics report is not considered adequate to fully assess the site and further more detailed investigations will be required.

3.3 Regulatory Liaison

Clancy Consulting has contacted Liverpool City Council (LCC) Contaminated Land Officer to determine if the desk based study and site investigation reports carried out by Mott MacDonald and Geotechnics in 2013 are suitable for planning purposes.

LCC responded to say that the Mott MacDonald report is unsuitable for the purpose of assessing the risks to human health and controlled waters, and would not satisfy the requirements of the Contaminated Land Condition. It was acknowledged that the Mott MacDonald report was initially intended to form part of a feasibility study, rather than planning.

More specifically the following points were specifically mentioned regarding the Mott MacDonald desk study report:

- The report refers to contamination ‘hotspots’ from historic land uses and it is noted that this should be replaced with the word ‘potential’.

- Construction workers and controlled waters are not included as potential contamination receptors. .

- The asbestos contamination source should be also attributed to demolition waste and should include the nearby residents and members of the public as receptors via airborne dispersion pathways.

- Controlled waters and the construction workers should also be included as receptors of the potential contamination associated with the existing substation.

Clancy Consulting has ordered an environmental search report from LCC although this is still awaited. Once it has been received this report will be updated and re-issued.

4.0 PHASE 1 RISK ASSESSMENT

4.1 General

The "suitable for use" approach is adopted for the assessment of contaminated land and remedial measures are only undertaken where unacceptable risk to human health or the environment can be proven when taking into account the proposed use of the site and environmental setting.

A risk assessment process should be carried out to determine potential hazards to human health and the environment and be based on the "source" "pathway" "receptor" principal. For a potential risk to be present there must be a viable pollutant linkage whereby a contamination source may impact upon a receptor. The absence of one or more of these key components (source, pathway or receptor) prohibits a viable pollution linkage being formed.

4.2 Preliminary Conceptual Site Model

A Preliminary Conceptual Site Model and Risk Assessment has been developed to identify potential contamination sources, migration pathways and receptors within the study area. This was carried out in accordance with CLR11 "Model Procedures for the Management of Land Contamination" (2004) and CIRIA Report C552 "Contaminated Land Risk Assessment – A Guide to Good Practice" (2001).

For a risk to be present there must be a viable pollutant linkage whereby a contamination source can impact on a receptor via a pathway. To carry out the risk assessment an estimate must be made of the potential severity of the risk and the likelihood of the risk occurring. The following Tables set out the criteria for this principal.

Table 2 - Severity of Risk

Severity	Description
Severe	Acute risk to human health likely to result in 'significant harm' i.e. very high concentrations of contamination or ground gases. Catastrophic damage to building i.e. by explosion from high gassing sites or VOC concentrations. Major pollution of controlled waters i.e. surface watercourses and Principal aquifers, source protection zones. Short term damage to ecosystems.
Medium	Long term risk to human health likely to result in 'significant harm' i.e. elevated concentrations of contaminants or ground gases. Pollution of sensitive controlled watercourses i.e. Principal or Secondary Aquifers. Significant effects on sensitive ecosystems or species.
Mild	Pollution of non-sensitive waters i.e. smaller surface watercourses or unproductive strata. Significant damage to crops, buildings, structures or services i.e. by explosion from sites with medium gassing potential, elevated concentrations of contaminants.
Minor	Non-permanent human health effects i.e. requirement for protective equipment during site works to mitigate health effects. Damage to non-sensitive ecosystems or species. Minor damage to buildings, structures or services.

Table 3 - Probability of Risk Occurring

Probability	Description
High Likelihood	Pollutant linkage may be present that appears very likely in the short term and risk is almost certain to occur in long term or evidence of harm to receptor exists.
Likely	Pollutant linkage may be present and is likely that the risk will occur over the long term.
Low Likelihood	Pollutant linkage may be present and there is a possibility of the risk occurring although no certainty that it will do so.
Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur even in the long term are improbable.

Table 4 - Comparison of Risk & Probability

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

The following potential contamination sources have been identified:

- Made Ground associated with historical uses including tannery, soap works, housing and other works. Made Ground deposits are anticipated to be encountered on the site associated with the historical buildings. Significant ground contamination is possible and could include heavy metals, hydrocarbons, PAHs and acetone. Any Made Ground located at the site is also considered a potential source of hazardous ground gas.

- Possible hide and leathers derived from former site use as a tannery are potential sources of anthrax contamination on site.

- Asbestos contamination resulting from demolition of historical buildings over the years on site. Confirmed by laboratory testing during Geotechnics investigation in three locations.

- Elevated concentrations of benzo(a)pyrene and cyanide in Geotechnics investigation.

- Possible groundwater contamination observed in WS04E in Geotechnics investigation.

- Fly-tipped material on site. Possible source of contaminants including asbestos.

- The electricity sub-station adjacent to the site has potential for mineral oils and PCB contamination locally, though no elevated concentrations identified in Geotechnics report.

- Deep Made Ground up to 5.3m identified in Geotechnics investigation along with carbon dioxide up to 4.6% recorded during gas monitoring visit – hazardous ground gas.

- Off-site sources of contamination from historical industrial activities including, oil refineries, saw mills, soap works and brewery. These are considered possible sources of leachable / mobile inorganic and organic contaminants as well as hazardous ground gas.

Potential pollutant pathways include:

- Dermal contact.
- Inhalation of particulates.
- Airbourne dispersion of asbestos fibres.
- Migration of leachable contaminants.
- Migration of hazardous ground gases into new structures.
- Acidic ground conditions affecting building infrastructure.

The following contamination receptors have been identified:

- Future site users.

- Construction workers.
- Nearby residents and members of the public.
- Controlled waters (Principal Aquifer).
- Buildings and infrastructure.

A summary of potential pollutant linkages and perceived risks for this site are outlined in the Table below:

Table 5 - Pollutant Linkages & Perceived Risk

Sources of Contamination	Pathways	Receptors	Risk
Inorganic and organic contaminants, asbestos and anthrax associated with Made Ground from existing and historical buildings on site including tannery, soap works and other works. Migration of inorganic and organic contaminants associated with historical industry on site and in surrounding area including saw mill, brewery, oil refinery, tannery, polyethylene factory, and electricity sub-station. Possible groundwater contamination identified in previous investigation. Asbestos identified in previous investigation. Potential generation of hazardous gas from Made Ground on site and in local area from historical land uses.	Inhalation and dermal contact of soil particles during site construction works and by future end users.	Current site users	Low/Moderate
		Future site users	Low/Moderate
		Construction workers during development	Moderate
		Nearby occupants	Low
	Potential movement of mobile contaminants through underlying strata to controlled waters. Migration of ground gases into proposed new structures at the site.	Principal Aquifer	Moderate/High
		Future Site Users	Moderate
		Construction Workers During Development	Low/Moderate
		Building Infrastructure	Low/Moderate

In summary the site has been occupied since the 1800's, with a tannery in the northern and central areas, a soap works and school in the south west and residential / small commercial premises in the south east. The soap works, school and other buildings were demolished and the tannery extended to cover the entire site during the early 1900's. It was eventually demolished in the late 1960s / early 1970s. An industrial unit was subsequently constructed in the central portion of the site during the 1980s and the site remains essentially unchanged.

The surrounding area has been occupied by heavy industry including a number of saw mills, tanneries, oil refineries with several above ground tanks, sugar refineries, warehouses, factories, yards and garages all located within close proximity.

The previous investigation undertaken by Geotechnics has identified the presence of asbestos, benzo(a)pyrene and cyanide contamination along with potential groundwater contamination in one borehole. The Geotechnics report is not considered adequate to fully assess the site and further more detailed investigations will be required.

Given the history of the site and surrounding area it is considered plausible that further ground contamination will be present beneath the site. Made Ground has been identified up to 5.30m bgl and further investigation will be required to characterise the extent and nature of these deposits. The presence of the tannery has not been considered in the previous investigation and the possible presence of leathers, hides and ultimately anthrax spores should be assessed during any future investigations.

In addition to the above, an electricity sub-station is located adjacent to the north western site boundary and localised mineral oil and PCB contamination could exist from leakages. A small number of samples from a nearby location were tested for PCBs during the 2013 site investigation and did not identify any elevated concentrations; however, further assessment will be required.

The historical industrial sites (saw mills, tanneries, oil and sugar refineries etc) located within 250m of the site should also be considered as potential sources of mobile / leachable contaminants.

Hazardous ground gas monitoring carried out on one occasion during the previous investigation identified the presence of carbon dioxide and positive gas flow rates. A number of potential ground gas sources have been identified, including deep filled ground at the site. As such, additional gas risk assessment is recommended.

Drift deposits beneath the site are typically either very shallow or completely absent with solid sandstone bedrock present at depths between 3.70m and 5.30m bgl.

The underlying solid strata are classified as a Principal Aquifer, although the site is not indicated to be within a Groundwater Source Protection Zone. There are four groundwater abstraction points within 500m of the site, with the nearest one located 105m north west of the site used for industrial/public services.

The nearest surface water course is the Leeds-Liverpool Canal located 639m north west of the site. There are no surface water abstractions within 1km.

Given the general absence of drift deposits beneath the site and the presence of a Principal Aquifer the environmental setting of the site is considered to be of “high” sensitivity.

The proposed development will comprise a new residential accommodation, and we would therefore consider this site to be of “moderate” to “high” sensitivity in terms of human health.

Any future investigations will need to take account of the asbestos present at the site and suitable precautions will need to be implemented to protect the health and safety of site personnel and members of the public. Such measures will include the provision of a water bowser to dampen down working areas and reduce dust generation and the provision of P3 type face masks to site personnel.

A UXO risk assessment was carried out as part of the Mott MacDonald desk study which identified two bomb strikes in the local area. Whilst it was acknowledged that the risk was low given the development of the site since WWII, it was stated that further detailed UXO desk study information was required to meet the requirements of CIRIA Report C681.

5.0 CONCLUSIONS & RECOMMENDATIONS

The Phase 1 Risk Assessment and Preliminary Conceptual Site Model have identified potential contamination sources, pathways and receptors and a detailed Phase 2 investigation will be required comprising the following:

- A ground investigation should be carried out to fully characterise the nature and depth of the Made Ground soils present beneath the site. This should be done by drilling of boreholes or where possible excavation of trial pits across the site.

- A number of obstructions were recorded during the Geotechnics investigations which are likely due to relic foundations and slabs. A hydraulic breaker will be required to break out any obstructions in order to fully investigate the site.

- Provision of water bowser and P3 type face masks during any future investigations to prevent exposure to potential asbestos fibres.

- Soil samples should be recovered and submitted for chemical testing to comprise a minimum suite of analysis including pH and metals, asbestos identification, speciated PAH, speciated TPH and acetone. If any suspected leathers or hides are identified then samples will also require testing for anthrax.

- Further targeted investigation should be carried out in areas where asbestos and possible groundwater contamination has been recorded during previous investigations. Any positive results for asbestos should be scheduled for water absorption and quantification testing to assess waste classification and risk to human health.

- Further testing in area of sub-station for PCBs and mineral oils.

- Chemical testing of fly-tipped material to determine waste classification prior to removal from site.

- The ground investigation should allow for excavations/boreholes to be taken through any Made Ground soils and into the underlying natural strata with in-situ testing carried out to provide adequate recommendations for foundation design.

- Given the size of the proposed development (up to 11 storeys) rotary coring into the sandstone bedrock may be required in order to assist with detailed foundation and structural design.

- We would recommend the installation of a minimum of three gas monitoring wells with provision for an initial 6 monitoring visits carried out over a 3 month period in accordance with CIRIA Report C665.

- Provision of further detailed UXO risk assessments to conform to the requirements of CIRIA C681.

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APPENDIX I

DRAWINGS

Birmingham 0121 200 7800 . Glasgow 0141 222 1720 . Liverpool 0151 227 5300 . London 020 3077 0970 . Manchester 0161 613 6000 . Newcastle 0191 221 0702 . Norwich 01603 305190 . Prestwick 01292 475375 . Reading 0118 941 7888

Client	JAM WORKS
Project	BEVINGTON BUSH, LIVERPOOL
Title	SITE LOCATION PLAN
Office	ALTRINCHAM
Discipline	GEO-ENVIRONMENTAL

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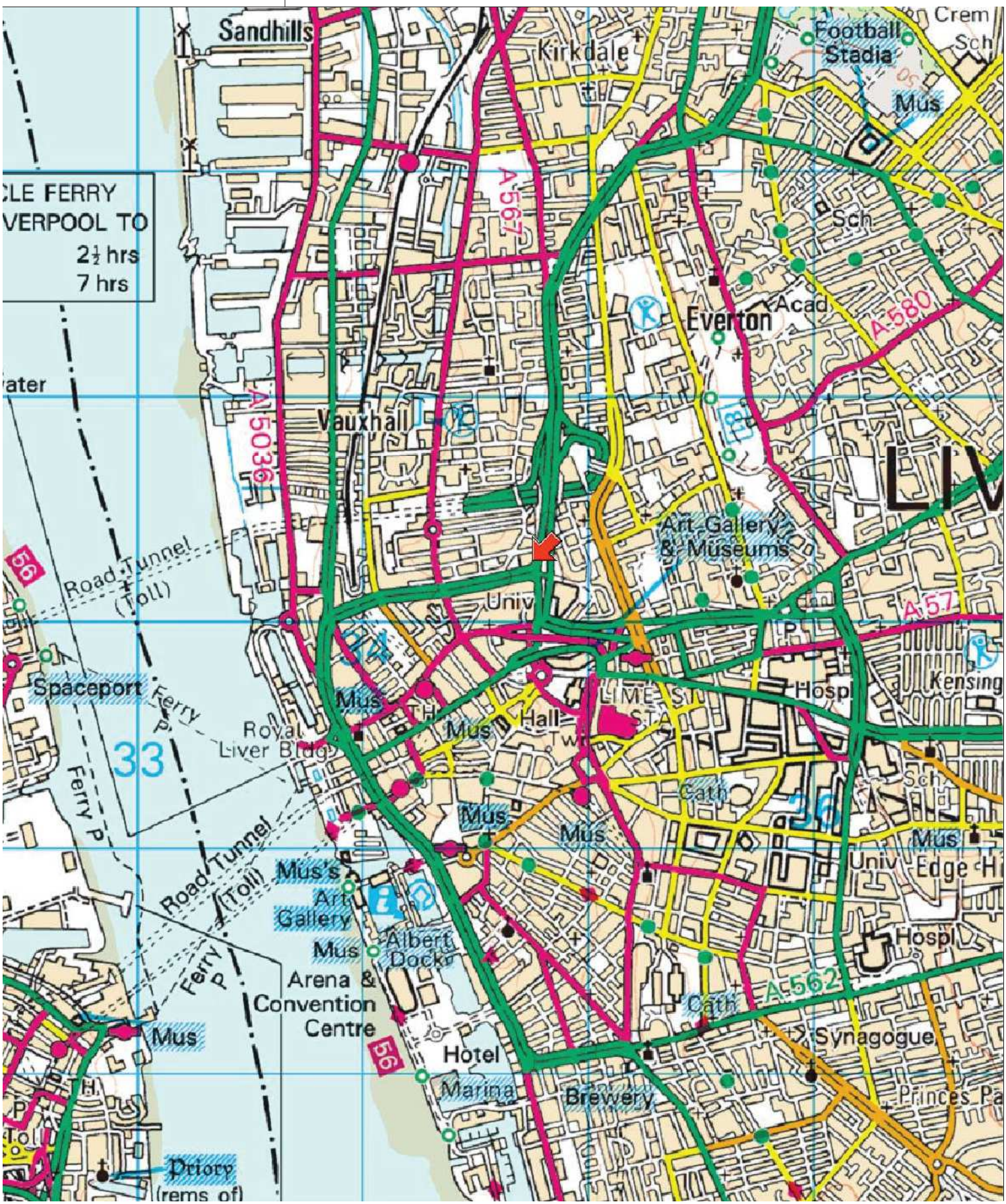

REV	DATE	DESCRIPTION	BY	CHK.	APP.
Rev	Date	Description	By	Check	App.

Drawn	DK	Date	MAY 2015
Checked	NR	Scale @ A4	1:35,000
Approved	NR	Status	

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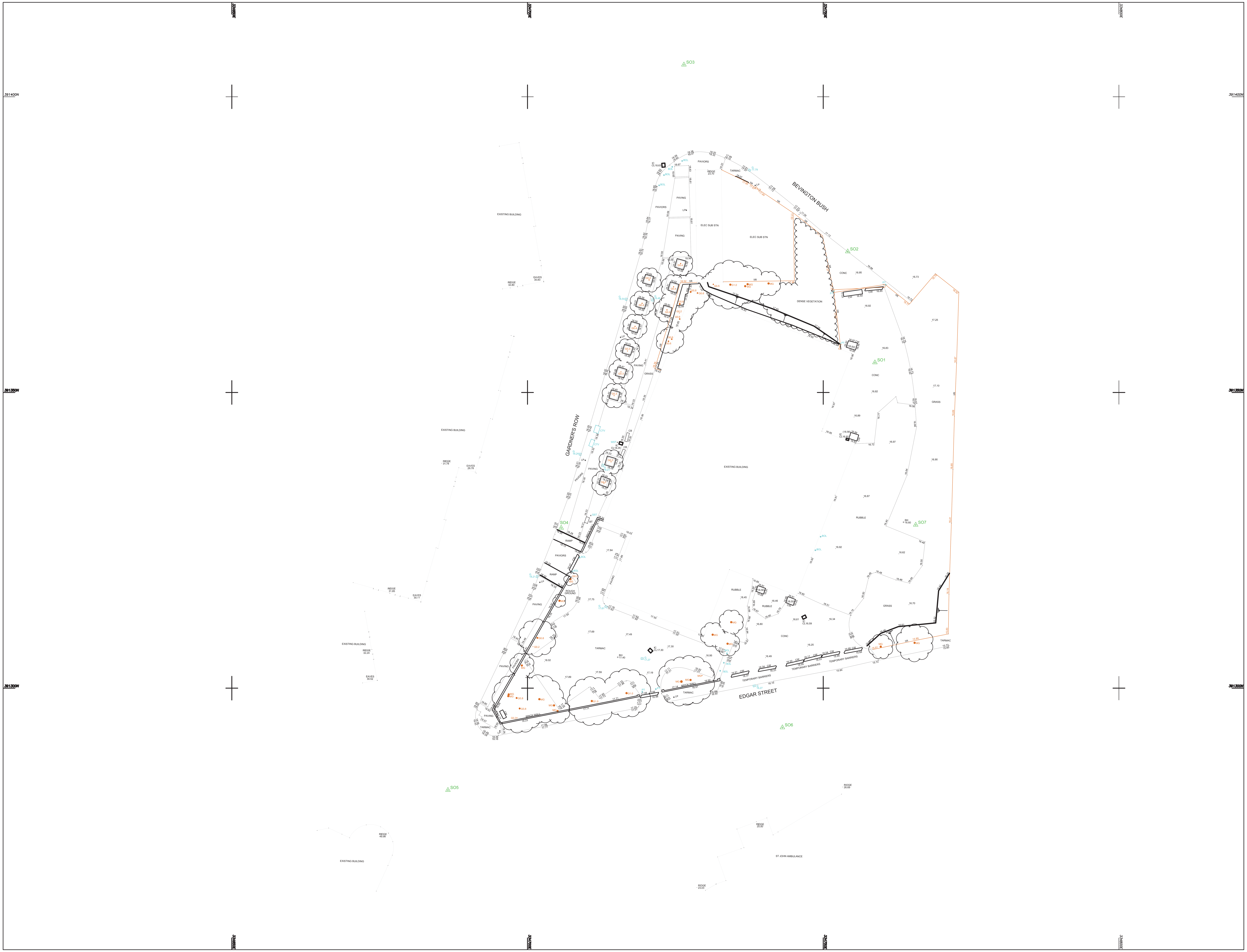
Job number	Drawing number	Revision
10/0726	001	A



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Note:

The survey is plotted on a plane local Grid. Orientation to National Grid. All levels relate to Ordnance Datum, achieved using the OS National GPS Network.

Survey Control Markers established for Mapping purposes only and should not be used for Construction without the written approval of Survey Operations Ltd.

Levels in parenthesis indicate top of walls.

SURVEY STATIONS			
Name	Easting	Northing	Height
SO1	334758.74	391355.06	16.86
SO2	334754.14	391373.82	17.00
SO3	334726.44	391405.41	18.91
SO4	334705.69	391327.09	18.30
SO5	334686.55	391282.76	18.75
SO6	334743.10	391293.35	16.34
SO7	334765.64	391327.60	16.60

STANDARD REFERENCE & ABBREVIATIONS

(AR)........Assumed Route
AB..........Air Brick
AV..........Air Valve
B/W.........Barbed Wire
BAR.........Barrier
BB..........Belisha Beacon
BH..........Borehole
BL..........Bed Level
BOL.........Bollard
BS..........Bus Stop
BT Box......British Telecom Box
BT..........British Telecom IC
BRTW........Brick Retaining Wall
BW..........Brick Wall
C/B.........Close Boarded
C/I.........Corrugated Iron
C/P.........Chestnut Paling
CB..........Control Box
CBW.........Concrete Block Wall
CCTV........Closed Circuit TV
CD..........Cable Duct
CEL.........Cellar Light
CH/L........Chain Link
CHY.........Chimney
CL..........Cover Level
CM..........Cable Marker
COL.........Column
CONC........Concrete
CP..........Catch Pit
CRTW........Concrete Retaining Wall
CTV.........Cable Television
CUL.........Culvert
CW..........Concrete Block Wall
DC..........Drainage Channel
DPC.........Damp Proof Course
DR..........Drain
DSW.........Dry Stone Wall
ECP.........Electricity Cable Pit
EIC.........Electricity Inspection Cover
EJ..........Expansion Joint
EJB.........Electricity Junction Box
EL SUB STN..Electricity Sub Station
EL..........Eaves Level
ELB.........Electricity Box
EP..........Electricity Pole
ER..........Earth Rod
ETL.........Electricity Transmission Line
FB..........Flower Bed
FH..........Fire Hydrant
FL..........Floor Level
FP..........Flagpole
G*.*........Girth (of tree)
G...........Gulley
GAB.........Gabion
GIP.........Gas Inlet Pipe
GMKR........Gas Marker
GST.........Gas Stop Tap (Domestic)
GSV.........Gas Stop Valve (Mains)
HSE.........Housing
Ht..........Height
HV..........High Voltage
I/R.........Iron Railing
IC..........Inspection Cover
IL..........Invert Level
IP..........Inlet Pipe
KO..........Kerb Outlet
LB..........Letter Box
LP..........Lamp Post
MG..........Multi-Girth
MH..........Manhole
MKR.........Marker
MP..........Mooring Point
NP..........Street Name Plate
O/H.........Overhead
O/P.........Open Paling
OE..........Overhead Electric Wire
OP..........Outfall Pipe
OSBM........Ordnance Survey Bench Mark
OT..........Overhead Telecom Wire
P/C.........Post & Chain
P/R.........Post & Rail
P/W.........Post & Wire
PAV.........Paving
PB..........Pillar Box
PC..........Pedestrian Crossing
PP..........Petrol Pump
PT..........Post or Pillar
RE..........Rodding Eye
RS..........Road Sign
RTW.........Retaining Wall
RWP.........Rain Water Pipe
SAP.........Sapling
SL..........Sump Level
SoL.........Soffit Level
SP..........Sign Post
SPL.........Springing Level
SRTW........Stone Retaining Wall
SV..........Stop Valve (unspecified)
SVP.........Soil Vent Pipe
SW..........Stone Wall
TAC.........Tactile Paving
TB..........Traffic Bollard
TBM.........Temporary Bench Mark
TCB.........Telephone Call Box
TFR.........Taken From Records
TIE.........Anchor Point (Masts/Poles)
TL..........Traffic Light
TLB.........Traffic Light Control Box
TM..........Ticket Machine
TMC.........Tarmac
TP..........Telecommunications Pole
TPIT........Trial Pit
TS..........Trash Screen
U/C.........Under Construction
U/G.........Underground
UTL.........Unable to Lift (MH,IC etc)
UTS.........Unable to Survey
VDP.........Vehicle Detector Pad
VP..........Vent Pipe
W/M.........Wire Mesh
WL..........Water Level
WM..........Water Meter
WO..........Wash Out
WP..........Waste Pipe
WST.........Water Stop Tap (domestic)
WSV.........Water Stop Valve (mains)

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Client
Falconer Chester Hall

Drawing Title
Topographical Survey of Land at:
Bevington House
Liverpool

Scale(s)	1:200	Surveyor	DC
Date	MAR 15	Drawn	AS
Job Number	15B083	Checked	MH

Sheet Size & Drg Number & Revision
A0 15B083/001

FALCONER CHESTER HALL

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Project Title
Bevington Bush/ Gardner's Row, Liverpool

Drawing Title
Ground Floor Plan

Client
Jamworks

Drawn By
JC

Date
16.07.2015

Scale
1:200 @ A1

Project No.
P14-092

Drawing No.
02-01-001

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