



**Land Adjacent to**

**Lion Hotel, Wensley Road, Blackburn**

**Phase 2 Site Investigation Report**

**December 2017**

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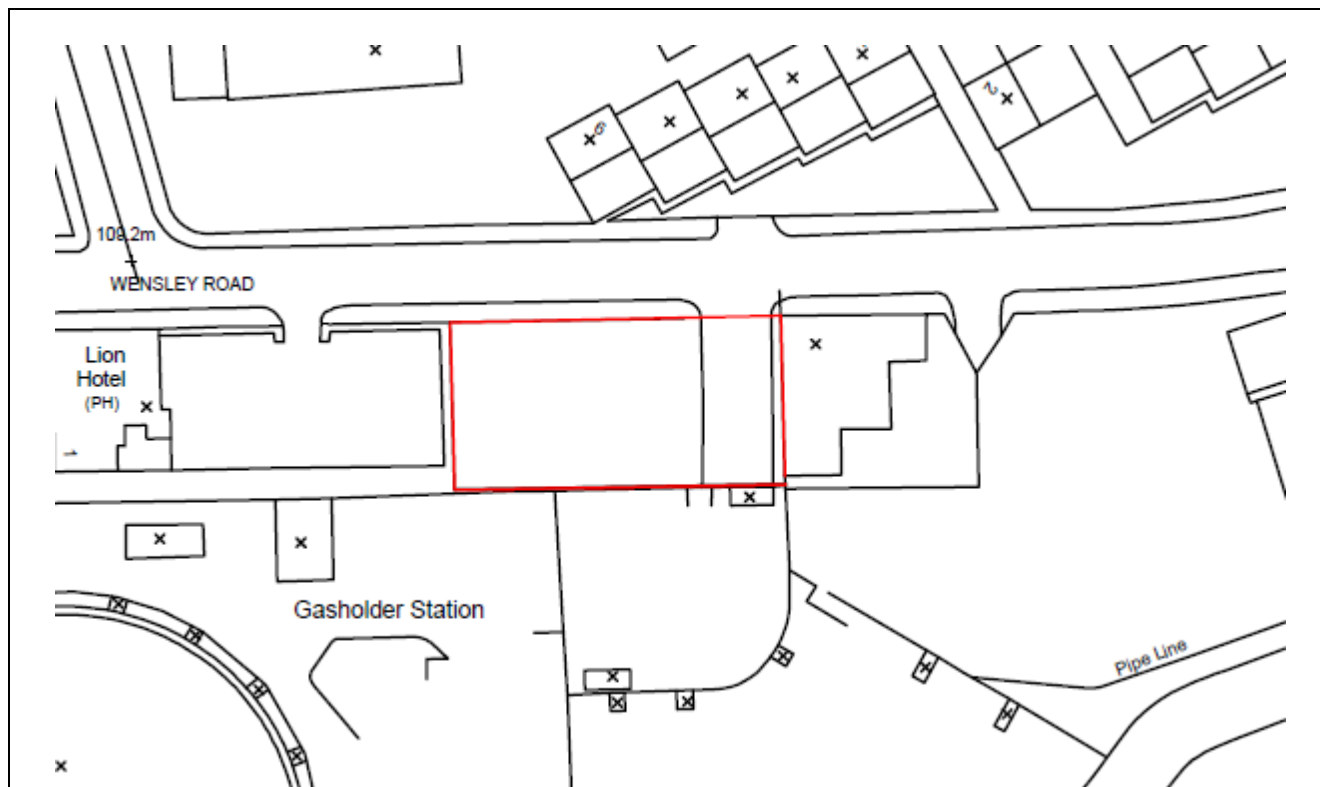
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Chevin Geoenviro Associates Ltd

# Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn

## Phase 2 Site Investigation Report



Land At 2 Enfield Avenue, Leeds Phase 1 Desk Study Report	Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn Phase 2 Site Investigation Report	<b>Site Address</b>	Land adjacent to Lion Hotel, 29 Wensley Road, Blackburn, BB2 1PX (Grid Reference: 367298,427814)
<b>Author</b>	Chevin Geoenviron Associates Ltd	<b>Contamination / Geotechnical</b>	Contamination Phase 2
<b>Work Stage</b>	Phase 2 Site Investigation (Final)	<b>Report Date</b>	December 2017
<b>Brief Description of the Report Contents</b>	Review of information to develop a site investigation design based on the CSM and facilitate the collection of samples for laboratory testing. Reporting of the laboratory results and the completion of an environmental risk assessment based on the findings of this study, the results of the contamination testing and the updated CSM. Also to provide recommendations for remediation works (as required).		

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<b>Appendix B</b>	Engineering Logs
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## Phase 2 Site Investigation Report

### **1.0 INTRODUCTION**

Chevin Geoenviron Associates Ltd (CGA) were commissioned by Mr. P. Akhtar to carry out a phase 2 site investigation for land adjacent to the Lion Hotel, 29 Wensley Road, Blackburn, BB2 1PX.

The purpose of this report is to provide factual and interpretative information required to comply with the requirements of a phase 2 site investigation and assessment of land contamination as required by the planning regime. The scope of the study is as follows:

- To provide general information on the site such as location and description;
- To summarise the environmental and historical setting of the site; e.g. landfills, permits, sensitive land uses and historical land uses;
- To form exploratory holes
- Provide factual information and descriptions of ground conditions
- To provide a quantitative risk assessment and gas risk assessment for the proposed end use of the site; and
- To provide recommendations for further works where necessary.

### **1.1 Terms and Conditions**

This report has been prepared for Mr. P. Akhtar in support of a planning application. The environmental information in this report has been summarised following a review of a previous phase 1 Geoenvironmental Risk Assessment carried out at the site by CGA in October 2017 and should not be used in a different context without reference to the original author.

## **2.0 SITE DETAILS**

### **2.1 Site Location**

The site is located approximately 0.7km south west of Blackburn Town Centre and centred on National Grid Reference: 367298,427814. The site is accessed by leaving Wensley Road turning south directly onto site.

A Site Location Plan is presented as Drawing No. C0140-01 in Appendix A.

### **2.2 Site Description**

The site is rectangular in shape orientated west to east and is approximately 0.07ha in size. The site consists of an open plot of land cleared of former buildings. Small spoil heaps of demolition material and topsoil were noted along the southern boundary. An electrical service cover was noted in the far north eastern corner of site. The southern and eastern boundaries are marked by stone and brick walls with the western boundary consisting of a small retaining wall leading directly to a car park associated with the Lion Hotel.

Topographically the site is generally level with a slight rise towards the south. The site is elevated above the car park of the Lion Hotel by approximately 0.8m at its highest point.

A plan showing the boundaries of the site is presented on Drawing No. C0140-02 in Appendix A.

## **3.0 GEOLOGY HYDROLOGY AND HYDROGEOLOGY**

### **3.1 Superficial & Solid Geology**

Geological mapping shows the site to be underlain by superficial deposits of Devensian Till (diamicton – land derived sediment that is unsorted to poor-sorted) and contains alluvial clay, sands and gravels. The superficial deposits are underlain by the Pennine Lower Coal Measures Formation (mudstone, siltstone and sandstone) and the Milnrow Sandstone (sandstone).



### **3.3 Hydrogeology/Hydrology**

The Groundsure report indicates superficial geology on site is classified as Secondary (Undifferentiated) Aquifer. This classification is assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

The bedrock underlying the site is classified as a Secondary A Aquifer and consists of permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The nearest surface water feature is located 49m south east of site, there is one primary river within 250m of site and this is named the River Blakewater. This river is recorded as culverted between 120 and 207m east of site.

## **4.0 HISTORICAL DEVELOPMENT OF THE SITE**

### **4.1 General Site History**

The earliest historical OS map dates from 1844 and shows the site to be within an agricultural field. The site was first shown to be occupied by residential terrace housing in 1892 with the site remaining unchanged until the site was cleared of buildings in 1978. No further land uses for the site were recorded on the historical maps of the area.

The surrounding areas generally consisted of agricultural land to the north and industrial land use to the south. Following 1892 the surrounding area was shown to generally consist of residential housing to the north with small works and rope walks to the north east and north. A cluster of 4 No. gasometers were shown directly to the south of the site with a gas works shown 60m east. The gas works was shown to be a corporation yard by 1939. A reservoir was also noted to be south of the site. Further industrial land uses were noted on the southern bank of the River Blakewater. The surrounding land use changed little over time with a reduction in the number of gasometer's being completed by 2014 when the final gasometer was no longer shown. Other notable changes in land use was the introduction of a waste destructor and its later replacement by a public refuse tip south of the River Blakewater.

## **5.0 FIELDWORK**

### **5.1 Scope of Fieldwork**

The field work was carried out on the 20<sup>th</sup> October with the scope of the fieldwork being specified by Chevin Geoenviron Associates Ltd (CGA) and undertaken in general accordance with BS 5930: 2015 and BS 10175: 2011. Soil and rock logging has been undertaken in accordance with the relevant European Standards, listed in the references for this report. CGA had responsibility for ensuring the correct setting out of exploratory holes and for determining the sampling regime.

### **5.2 Sampling Strategy**

The sampling strategy utilised a regular grid pattern to enable collection of representative made ground soil samples from the site for laboratory contamination testing.

### **5.3 Window Sampler**

A total of six Windowless Sample Boreholes were formed on 20<sup>th</sup> October 2017 and designated exploratory hole numbers WS01 to WS06. These boreholes were drilled to depths of up to 4.8m. Standard Penetration Testing (SPT) was carried out every metre to establish in-situ strength parameters.

Environmental samples were recovered from each pit for contamination laboratory testing. The depths of the samples recovered are shown on the relevant exploratory hole logs presented in Appendix B of this report.

Dual purpose ground gas and groundwater monitoring installations were installed within WS01, WS02 and WS04. The response zones were isolated within made ground (WS02) and the superficial deposits/made ground (WS01 & WS04).

### **5.4 Permeability Falling Head Test**

A falling head permeability test was carried out within window sampler WS03 from depths of 0.10m to 3.10m.

## 6.0 LABORATORY TESTING

### 6.1 Scope of Testing

All chemical (contamination) testing was scheduled by CGA and was intended to provide contamination data for the specific areas sampled. The scope of the testing was designed to enable comments regarding characterisation of potential contamination on site.

### 6.2 Contamination Testing

A total of four soil samples were sent to Concept Life Sciences of Manchester, which is registered as UKAS Testing Laboratory No. 1549.

Testing was carried out in accordance with a combination of the 'Methods for Examination of Water and Associated Materials' (the 'Blue Book') published by H.M.S.O., documented in-house methods and other published methods, to determine the presence of the analytes listed in Tables 2.3 and 2.4 in DEFRA R&D Publication CLR8. A list of the contaminants tested for is contained within Table 1.2.

**Table 1.2 Chemical Analysis Summary Table**

Analysis	Total No. Samples
<b>SOILS</b>	
9 Metals	4
pH	6
Speciated PAH	4
Total TPH	4
Asbestos ID	4
Water Soluble Sulphate	2

The results of the contamination testing are presented in Appendix C of this report.

## **7.0 RESULTS OF THE INVESTIGATION**

### **7.1 Scope of Commentary**

The results of this investigation broadly concur with the published geology summarised in Section 3.0 of this report. The following sections are only intended to provide a summary of the ground conditions encountered during this investigation, whilst the engineering logs presented in Appendix B of this report provide a detailed description of all the strata observed.

### **7.2 Made Ground**

Made Ground was confirmed at all six locations and extended to depths of 1.10m to 2.50m. The Made Ground was seen to consist of dark brown sandy clayey gravel of concrete, brick, coal, tarmac, sandstone, rare full bricks, plastic and cobbles of sandstone. Sandstone cobbles possibly originating from old road surfacing below Made Ground in WS01 and WS02.

### **7.3 Superficial Deposits**

Superficial deposits of sandy gravelly Clays were noted beneath the Made Ground at WS01 to WS05, consisting of a firm light brown mottled grey sandy gravelly CLAY with gravel medium, sub-angular coarse grained sandstone encountered at WS01 to WS04. A firm orange mottled brown sandy Clay with rare fine gravel of sandstone noted at WS05. At WS06 beneath the Made Ground a very loose, orange to brown clayey slightly gravelly Sand was noted.

Additionally a band of very loose very sandy Gravel was noted at WS05 at a depth of 3.0m to 3.60m. Gravel was also encountered at WS06 at a depth of 3.50m to 3.90m and consisted of a very loose, grey sandy Gravel, with gravel medium to coarse subrounded sandstone.

Cobbles of Sandstone were noted at a depth of 1.10m to 1.20m at the location of WS02 as well as at the base of WS03 and WS06.

#### 7.4 Groundwater

Groundwater was encountered within gravelly sand/ sandy gravel at depths of 3.30m and 3.50m at the location of WS04 and WS06 respectively. Subsequent groundwater monitoring rounds showed the groundwater within WS04 rose to depths of 1.80m to 1.98m.

The poorly sorted superficial deposits on site and the rise in groundwater levels suggest that the gravelly sand to sandy gravel encountered within WS04 and WS06 could be forming a perched aquifer.

#### 7.5 Permeability Falling Head Test

One Falling Head Permeability Test was carried out in exploratory hole WS03 following the procedure identified within BS5930:1999. The results of the falling head test are presented in Table 1.3.

**Table 1.3 Falling Head Permeability Test Results**

Time (Minutes)	Depth (Metres Below Ground Level)
1	0.70
2	0.80
3	0.87
5	0.95
10	1.05
20	1.28
40	2.08
60	3.10

In order to calculate the permeability of the underlying soils the following equation is used (After BS5930:1999):

$$k = \frac{A}{FT}$$

Where k is the measured coefficient of permeability of the soil, A is the cross sectional area of the borehole, F is the intake factor and T is the basic time factor. Note that F and T values are taken from BS5930:1999.

For this Windowless Sample Borehole, the cross sectional area A = 0.007m<sup>2</sup>. The intake factor F is 0.2 and the basic time factor T is 36. So the calculated coefficient of permeability k for the underlying soils

assessed in WS03 is measured at  $9.722 \times 10^{-4}$  m/s. This measured coefficient of permeability is classified as being **RAPID PERMEABLE** in general civil engineering terms (classified using online sources).

## **7.6 Soakaway Drainage**

The mixed sandy gravelly clayey nature of the underlying soils would indicate that rates of soakaway drainage across the site is likely to be quite variable dependent on its location. Where the underlying soils are found to be less cohesive, the likely rate of soakaway infiltration will improve. The Falling Head Permeability Test that was carried out within WS03, indicates very good infiltration in this particular location, however it is not likely to be consistent across the whole site due to the variable composition of the underlying soils. At this stage it is therefore recommended to carry out additional soakaway testing to BRE365 in different areas of the site, to confirm its overall suitability.

## **8.0 ENVIRONMENTAL ASSESSMENT OF GROUND**

### **8.1 Scope of Sampling, Testing and Commentary**

The following assessment was performed in the context of the planning regime and considering Part 2A of the Environmental Protection Act (1990) to determine if unacceptable risks to humans, vegetation or to specific parts of the wider environment are present on the site. The risk assessment follows the source, pathway, receptor methodology, as described in Contaminated Land Report (CLR) 11, which is used to build a conceptual site model to determine the presence of any pollutant linkages at the site. Should pollutant linkages exist at the site it is deemed necessary to further develop the risk assessment by comparing contamination test results with generic or site specific assessment criteria in order to determine if an unacceptable level of risk is present at the site. If legislation or guidance changes, or the proposed end use is modified, then it will be necessary to reassess the risks which may require further sampling and testing.

We understand our brief to comprise the following items related to the contamination aspects of this investigation.

- Compare laboratory test results with generic assessment criteria

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- Determine a conceptual site model and identify any pollutant linkages at the site
- Determine the level of risk posed by environmental hazards on site to human health, vegetation, controlled waters and structures
- Make recommendations for further work or remediation strategies

Soil samples were recovered in accordance with current industry practice and were sent to Concept Life Sciences to be analysed for the determinants listed in section 6.0 of the factual part of this report.

The results of these analyses are included in Appendix C of this report.

### **8.2 Human Health Assessment**

UK guidance recommends that a risk based approach is taken for the assessment of contaminated land and as such, DEFRA have introduced the CLEA methodology, SGV's and Category 4 Screening Values (C4SL). The CLEA methodology is a deterministic risk assessment model that estimates the long term exposure to contaminants in the soil for children and adults and predicts the amount of contaminant to which a person might be exposed based on a given soil concentration. By comparison with relevant health criteria on tolerable or acceptable intakes of various contaminants the model was used by DEFRA and the Environment Agency to generate SGV's and C4SL's.

At the time of writing this report the DEFRA and Environment Agency has not published SGV's/C4SL using the CLEA 1.071 software for all anthropogenic toxic substances with C4SL's for further contaminants due to be produced at some point in the future. As such, it was necessary to use other methods to generate target concentrations for contaminants of concern on site.

In order to generate generic assessment criteria which are protective of human health, for use in human health risk assessment, where CLEA SGV's and C4SL's are not available the Environment Agency recommends the use of the CLEA 1.071 software in conjunction with advice found on the GOV.UK CLEA web pages. Accordingly, the Chartered Institute of Environmental Health (CIEH) in partnership with Land Quality Management (LQM) derived a set of Generic Assessment Criteria Values following the approach set out in the DEFRA research project SP1010, C4SL. The GAC for missing contaminants of concern were calculated using the CLEA 1.06 software released in July 2009 and termed Suitable 4 Use Levels (S4UL's). The input parameters used for calculating each S4UL value are listed in the substance specific chapters of

the reference document associated with the S4UL's, namely 'The LQM/CIEH S4ULs for Human Health Risk Assessment (Land Quality Press, 2015).

The current view of the Environment Agency is that the C4SL's are considered to be a trigger value at which an exceedance may cause concern for human health and generally requiring further investigation and/or assessment. This report has utilised the C4SL's and CIEH/LQM S4UL's derived using the UK technical documents.

The DEFRA C4SL and LQM/CIEH S4UL's for a commercial land use has been selected as this matches the proposed future land use.

### **8.3 Gas Risk Assessment**

Although the risks from landfill gas are as likely to affect human health, they are considered in this section as they will contribute to the design of any structures on site. The assessment of gas risk will be carried out using the methods outlined in BS 8485:2015.

### **8.4 Controlled Waters Assessment**

As a means of determining if levels of contamination in the made ground at the site are protective of surrounding water resources a risk estimation based on the development proposals was carried out.

### **8.5 Statistical Analysis and Site Zoning**

Best practice guidance published by CL:AIRE/CIEH for statistical analysis of contaminated soils recommends the use of two statistical tests for normally distributed and skewed data sets. These tests are the one sample t-test as used in the CLR7 statistical guidance document for normally distributed data and a method based on the one-sided Chebychev Theorem for skewed data. The outcome of the appropriate test is then applied to the Null Hypothesis or the Alternative Hypothesis.

Null Hypothesis:

"Is the level of contamination in the natural soils above 1.0m the same as or higher than the level of the screening values. "

Alternative Hypothesis:



“The level of contamination in the natural soils above 1.0m is lower than the screening values.”

It should be noted that the guidance document points out that statistical analysis of samples collected using a targeted or judgmental sampling strategy should avoid being used to infer about conditions in un-sampled locations. The sampling strategy for this site investigation has been based on the most appropriate sampling design required to gather geoenvironmental information.

Statistical analysis of the laboratory data was not carried out due to the low levels of contamination.

## 9.0 DISCUSSION OF RESULTS

### 9.1 Human Health Hazards

The analytical results shown in Table 1.3 indicate that the made ground contains low levels of contamination when compared with the commercial land use generic assessment criteria.

**Table 1.3 Comparison of Soil Test Results with Residential with Gardens C4SL/S4UL**

Determinant	Assessment Criteria (mg/kg)		Recorded Concentrations Across The Site (mg/kg)	
	C4SL Screening Levels	S4UL Generic Assessment Criteria	Highest Recorded Value	Location of Highest Recorded Value
<b>Metals, semi- metals and non-metals</b>				
Arsenic	640	640	27	WS02 ES01
Cadmium	220	190	3	WS05 ES01
Copper	NC	68000	170	WS05 ES01
Chromium Total	33	33	37	WS02 ES01
Lead	1100	NC	700	WS05 ES01
Mercury (elemental)	NC	25.8	<1	All
Nickel	NC	980	50	WS05 ES01
Selenium	NC	12000	<3	All
Zinc	NC	730000	660	WS05 ES01
PAH (total)	NC	NC	190	WS02 ES01
TPH (total)	NC	NC	450	WS05 ES01

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Determinant	Assessment Criteria (mg/kg)		Recorded Concentrations Across The Site (mg/kg)	
	C4SL Screening Levels	S4UL Generic Assessment Criteria	Highest Recorded Value	Location of Highest Recorded Value
Naphthalene	NC	190	2.1	WS02 ES01
Acenaphthylene	NC	86.1	<1.0	WS02 / WS05
Acenaphthene	NC	57	5.7	WS02 ES01
Fluorene	NC	30.9	4.2	WS02 ES01
Phenanthrene	NC	22000	31	WS02 ES01
Anthracene	NC	520000	7.1	WS02 ES01
Fluoranthene	NC	23000	34	WS02 ES01
Pyrene	NC	54000	29	WS02 ES01
Benzo(a)anthracene	NC	170	14	WS02 ES01
Chrysene	NC	350	16	WS02 ES01
Benzo(b)fluoranthene	NC	44	12	WS02 ES01
Benzo(k)fluoranthene	NC	1200	11	WS02 ES01
Benzo(a)pyrene	NC	35	11	WS02 ES01
Indeno(1,2,3-c,d)Pyrene	NC	500	4.8	WS02 ES01
Dibenzo(a,h)anthracene	NC	3.5	2.6	WS02 ES01
Benzo(g,h,i)perylene	NC	3900	4.7	WS02 ES01
<b>Others</b>				
Sulphate (g/l)	NC	NC	<0.01	WS03 ES02
pH	NC	NC	8.1	WS03 ES02
Asbestos ID	<0.001% fibres		Not Detected	All
<b>NOTES:</b>				
(1) C4SL/LQM S4UL 2015 for commercial land use scenario at 1% organic matter content				
(2) NC = No criterion.				

## 9.2 Vegetation Hazards

The risks to future vegetation has not been considered due to the development proposals consisting of hard standing and building footprint with no landscaped areas.

## 9.3 Controlled Water

The site is to be covered in 100% hard standing which will minimise potential leaching of contaminants within the made ground on site. No visual or olfactory evidence of hydrocarbon contamination of the groundwater on site was noted during the 6 No. ground gas/groundwater monitoring rounds.



system proposed by Wilson and Card in CIRIA Report 149.

Following the completion of four ground gas monitoring rounds the accumulative worst case Gas Screening Values (GSV) for the site was calculated using the highest gas values and flow rate. The GSV for the site has been calculated to be 0.32 l/hr.

The calculated GSV for the site shows there to be a very low level of risk. However, the level of risk has been increased to low due to concentrations of carbon dioxide being recorded above 5%. It is therefore recommended to install Characteristic Situation 2 (CS2) gas prevention measures to mitigate the potential risks from ground gases.

## 10.0 CONCEPTUAL SITE MODEL

### 10.1 Introduction

The information obtained from the CGA phase 1 report as well as this investigation has been collated and evaluated to develop a refined Conceptual Model for the site.

The site has been assessed in line with current UK guidelines, namely the Contaminated Land (England) Regulations 2000 and Part IIA of the Environmental Protection Act 1990 and follows the procedures set out in the Environmental Agency 'Model Procedures for the Management of Land Contamination – Contamination Land Report (CLR).11'.

CLR.11 provides the technical framework for structured decision making about land contamination and builds on previous work carried out under the Contaminated Land Research Programme of the former Department of the Environment. CLR 11 has adopted and refined the methodology and terminology that has been used in contaminated land risk assessment for a number of years.

CLR.11 defines the three essential elements to any risk:

- A contaminant **source** - a substance that is in, on or under land and has the potential to cause harm or to cause pollution of controlled waters.

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- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property or a water body.
- A **pathway** - a route or means by which a receptor can be exposed to, or affected by a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of source-pathway-receptor is described as a **pollutant linkage**.

This report presents a Phase 2 Conceptual Model and Quantitative Risk Assessments for the site, based on the proposed end use of commercial.

**10.2 Hazard Identification**

**10.2.1 Potential Contamination Sources**

Following the ground investigation and subsequent laboratory testing low levels of contamination were recorded on site. However, ground gas monitoring recorded slightly elevated levels of carbon dioxide within monitoring wells located on the boundary of the site and the former gasometers to the south. The source of ground gas production is therefore considered likely to be associated with the offsite former gasometers directly to the south of the site.

The CGA phase 1 report identified additional potential off site sources of ground gas & groundwater contamination to be the adjacent scrap yard or former gas works to the east. No evidence of significant ground gas or groundwater contamination from these sources was recorded.

A summary of potentially significant sources of contamination are presented in Table 1.5 below.

**Table 1.5 Summary of Contaminant Sources & Contaminants**

Structure / Process	Contaminants Present on Site
<b>On-site</b>	
Made Ground (S1)	No elevated levels of contamination identified.
<b>Off-site</b>	
Backfilled Gasometer pits. (S2)	Carbon Dioxide, Methane

### 10.2.2 Potential Receptors

The following are considered as potential receptors in relation to the current and proposed use of the site.

- **Future Commercial users** – Proposed MOT garage and office;
- **Utility / Construction / Demolition / Site Investigation workers** – Workers undertaking routine / non-routine work involving ground disturbance works and maintenance of below ground services (assuming workers are only wearing standard construction / utility worker PPE);
- **Controlled Waters** – Secondary A Aquifer & River Blakewater 49m south east.
- **New Potable Water Supply Pipe** – Permeation of PAH through alkathene pipes into drinking water.
- **Proposed Structures** – Ground gas entering structures.

### 10.2.3 Potential Contamination Pathways

The following are considered plausible contamination pathways given the nature of the site and the potential contaminative sources identified, and assuming a continued current use.

- Dermal contact and ingestions of soils;
- Inhalation of dust/fibres and vapours;
- Leaching of PAH and migration off site;
- Ingestion of contaminated drinking water;
- Ingress of gases into structures.

### 10.2.4 Quantitative Risk Assessment

By considering the sources, pathways and receptors, an assessment of the environmental risks is made with reference to the significance and degree of the risk. This assessment is based on consideration of whether the source contamination can reach a receptor and hence whether it is of major or minor significance.

An initial conceptual model of the source-pathway-receptor linkages has been developed based on the information derived from the CGA phase 1 report and this study. The Conceptual Site Model has been

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used to identify Relevant Pollutant Linkages for the current and proposed end uses which have been assessed quantitatively and qualitatively using CIRIA 552 guidance, as described below in Table 1.6 and Table 1.7.

**Table 1.6 Methodology for Assessing Consequence of Harm**

Consequence	Criteria
Severe	Short term (acute) risk to Human Health likely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Short term risk of pollution of sensitive water resource. Catastrophic damage to buildings / property.
Moderate	Chronic damage to Human Health likely, over a long term, to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Pollution of sensitive water resources.
Mild	Health effects to Human Health that are unlikely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings / structures / services or the environment.
Negligible	Non-permanent health effects to Human Health that are unlikely to result in “significant harm” as defined by the Environmental Protection Act 1990, Part IIa. Those that are easily prevented by means such as personal protective clothing. Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve.

**Table 1.7 Methodology for Assessing Likelihood of Consequence Occurring**

Probability	Criteria
Almost Certain	Circumstances are such that an event either appears very likely in the short term and almost inevitable over the long term or there is evidence of currently harm occurring.
Likely	Circumstances are such that an event, whilst not inevitable, is possible in the short term and is likely to occur over the long term.
Unlikely	Circumstances are such that it is possible an event could occur but it is by no means certain to occur even over a longer period, and it is less likely in the shorter term.
Very Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable even in the medium to long term.
Extremely Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are highly improbable even in the long term.

The risk assessment table and apportioned scores presented in Table 1.8 are in general accordance with CIRIA 552. The main exception is that irreversible risks to human health are considered to have a severe

# Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn

## Phase 2 Site Investigation Report

consequence irrespective of whether the effects are chronic or acute in nature. The risks are scored from 0 to 48 with increasing significance with increasing scores.

**Table 1.8 Summary of Risk scoring**

Consequence Probability	Severe (4)	Moderate (3)	Mild (2)	Negligible (1)
Almost Certain (12)	Very High Risk (48)	High Risk (36)	Moderate Risk (24)	Low Risk (12)
Likely (9)	High Risk (36)	Moderate Risk (27)	Moderate/ Low Risk (18)	Low Risk (9)
Unlikely (6)	Moderate Risk (24)	Moderate/ Low Risk (18)	Low Risk (12)	Very Low Risk (6)
Very Unlikely (3)	Low Risk (12)	Low Risk (9)	Very Low Risk (6)	Very Low Risk (3)
Extremely Unlikely (0)	Very Low Risk (0)	Very Low Risk (0)	Very Low Risk (0)	Very Low Risk (0)

The categories of risk are defined as follows:

**Very High Risk:** There is a probability that severe harm is almost certain to arise to a designated receptor from an identified source, or there is evidence that severe harm to a designated receptor is currently occurring.

**High Risk:** There is a probability that severe harm is likely to arise to a designated receptor from an identified source, or there is a probability that moderate harm is almost certain to arise.

**Low Risk:** There is a possibility that harm could arise to a designated receptor from an identified source, but it is likely that this harm, if realised, would be mild at worst.

**Very Low Risk:** There is a very low possibility that harm could arise to the receptor, but it is likely that this harm, if realised, would be mild at worst.

In accordance with CLR11, professional judgement has been employed to evaluate the risk on a qualitative basis using available information.

A summary of the pollution linkages are provided in Table 1.9.



# Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn

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**Table 1.9 Revised Phase 2 Conceptual Site Model**

Area / Structure	Pollutants (Chemicals of Concern)	Critical Receptor	Pathway	Potential Consequence of Complete S-P-R Linkage	Potential Likelihood of Complete S-P-R Linkage	Risk Score and Equivalent CIRIA Risk Classification	Remedial Option(s) / Next steps	Comments
Made Ground (S1)	No Elevated Contamination	Future adult user of MOT garage & office	Direct contact & ingestion of soils / Dust inhalation & ingestion	Negligible	Very Unlikely	Very Low Risk (3)	No Further Assessment Required	Low levels of contamination with proposed ground covering of tarmacadam and concrete provides a protective barrier against contact with contamination.
		Current site users		Mild	Very Unlikely	Very Low Risk (6)	No Further Assessment Required	Land used for car parking and possible dog walking with relatively low levels of contamination.
		Ground disturbance workers		Mild	Unlikely	Low Risk (12)	Ensure PPE is Worn	Standard PPE and site hygiene rules should be applied to mitigate potential risks for ground workers and reduce the risk to VERY LOW.
		Secondary (A) Aquifer & River Blakewater	Leaching / dissolution from contaminated soil followed by migration	Mild	Very Unlikely	Very Low Risk (6)	No Further Assessment Required	Relatively low levels of contamination with proposed ground covering of tarmacadam and concrete provides an impermeable barrier minimising leaching.
		Potable water supply pipes	Permeation of organic contaminants	Mild	Likely	Moderate / Low Risk (18)	Further Assessment Required	New potable water pipes may be at risk if laid within made ground. Recommend consultation with United Utilities Plc.
		New office accommodation.	Ingress of ground gases and vapours into structures	Mild	Likely	Low Risk (12)	Further Assessment Required	Low flow rates with elevated CO2. Characteristic Situation (CS2) ground gas prevention measures are required.

### **10.3 Discussion of Risks**

The risk assessment presented in the above sections and summarised within the CSM presented in Table 1.9 above has shown that a Contaminant Linkages between, ground gases and the proposed building on site is present. The following sections provide a discussion of the environmental risks based on the ground investigation and laboratory data as well as the desk study information.

#### **10.3.1 Human Health**

##### **Commercial users**

The laboratory testing indicates the made ground on site to contain low level of contamination below the assessment criteria (C4SL/S4UL) for a commercial land use. Furthermore, no landscaped areas have been proposed with the site to be covered in 100% hard standing or building footprint. Therefore, the level of risk has been assessed to be **VERY LOW** with no further assessment of human being required.

##### **Utility / Construction / Demolition / Site Investigation (i.e. Ground Disturbance) Workers**

The probability of contact with contaminated soils increases for workers involved with ground excavation (e.g. during development, site investigation or maintenance works). Due to the presence of lead, PAH and TPH we would recommend the use of standard PPE and site hygiene rules be applied when carrying out excavations. Following the implementation of these recommendations and the assumption that appropriate PPE will be worn the risks to site operatives will be reduced from moderate to **VERY LOW**.

#### **10.3.2 Controlled Waters**

A theoretical pollution linkage exists between the contaminants within made ground at the site and controlled waters. However, the risks would be greatly reduced following the development of the site within includes covering the site with 100% hard standing or building footprint. This final ground covering would likely have the effect of minimising infiltration and potential leaching of contaminants. As such the risks to the underlying aquifer and surface water (River Blakewater) has been assessed to be **VERY LOW**.

### 10.3.3 Structures Ground Gases/Vapours

The level of risk from ground gases has been shown to be **LOW** due to slightly elevated levels of carbon dioxide recorded at a highest concentration of 7.9 % and a worst case flow rate of 0.4 l/h. It is recommended that Characteristic Situation 2 (CS2) gas prevention measures be incorporated into the building design as detailed in BS8485: 2015.

### 10.3.4 Potable Water Supply Pipes

Due to the presence of PAH and TPH at the location of WS02 the possibility that PAH may penetrate alkathene drinking water supply pipes is thought to be likely. Therefore, the risks to new potable water pipes is considered to be **MODERATE to LOW**. However, it is recommended to consult with the statutory water supplier in order to ascertain their requirements.

## 11.0 HAZARDOUS WASTE

The laboratory testing shows relatively low levels of contamination within made ground soil, with excavated soils considered suitable for reuse in areas of proposed hard standing only.

Should made ground soils require disposal off site the results of the contamination testing show the made ground at the location of WS02 is classified as HAZARDOUS waste due to PAH and TPH being recorded above 100mg/kg and 500mg/kg respectively.

Where this made ground is to be excavated it is recommended to segregate the hazardous material and dispose of to a suitably licensed landfill site.

The remainder of the made ground tested has been classified as NON-HAZARDOUS waste due to the relatively low levels of contamination.

Should excavated soils be disposed of off site it is recommended to carry out a Waste Acceptance Criteria (WAC) test prior to transportation to the landfill.

## 12.0 CONCLUSIONS

The site investigation and review of desk study information has shown the site has a layer of made ground consisting of clayey gravel of concrete, brick, coal, tarmac, sandstone, rare full bricks, plastic and cobbles of sandstone extending to depths of 1.10m to 2.50m. The laboratory testing for the site recorded the level of contaminants within the made ground to be relatively low with all laboratory results being below the assessment criteria for a commercial land use.

Potential theoretical risks from contaminants on site to the River Blakewater 49m south east and the underlying Secondary A Aquifer are highly likely to be significantly reduced following the redevelopment of the site which will prevent leaching of contaminants by covering the site with 100% hard standing/building footprint. Perched groundwater was recorded at the location of WS04 and WS06

The risks from ground gas was shown to be low, however, slightly elevated levels of carbon dioxide at concentrations of 7.9% increased the risk to moderate to low and require mitigating by installing BS8485:2015, CS2 gas prevention measures.

The overall risk to the future users of the proposed MOT grange and controlled waters was therefore assessed to be **MODERATE to LOW**.

## 13.0 RECOMMENDATIONS

Following the completion of this report we can confirm the below recommendations;

- a. Following completion of the foundation and floor design BS8485:2015, CS2 gas prevention measures are recommended to be proposed and submitted to the Local Planning Authority for approval.
- b. We would suggest that no further ground gas monitoring is required on site due to the low flow rates recorded at all location during each monitoring round.

- c. Where made ground from the location of WS02 (hazardous waste) is to be excavated for disposal off site, it is recommended to segregate the hazardous material and dispose of to a suitably licensed landfill site.

## 14.0 REFERENCES

- BS 5930: (2015): Code of Practice for Site Investigation. British Standards Institution
- BS 10175: (2011): Code of Practice for the Investigation of Potentially Contaminated Sites. British Standards Institution
- BS 8485: (2015); Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings
- CL:AIRE (2013) SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination
- DEFRA and Environment Agency (2004) Model Procedures for the Management of Land Contamination, R&D Publication CLR11.
- Environment Agency (2009) CLEA Software (Version 1.06) Handbook, Scientific Report SC050021/SR4
- Environment Agency (2009) Updated technical background to the CLEA Model, Scientific Report SC050021/SR3
- Environment Agency (2000) Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination, R&D Technical Report P5-066/TR.
- Ministry of Agriculture, Fisheries and Food (1998) Code of Good agricultural Practice for the Protection of Soil. MAFF Publications, London
- Nathanail, C.P., McCafferey, C., Gillett, A., Ogden, R.C., and Nathanail, J.F. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.

Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn  
Phase 2 Site Investigation Report

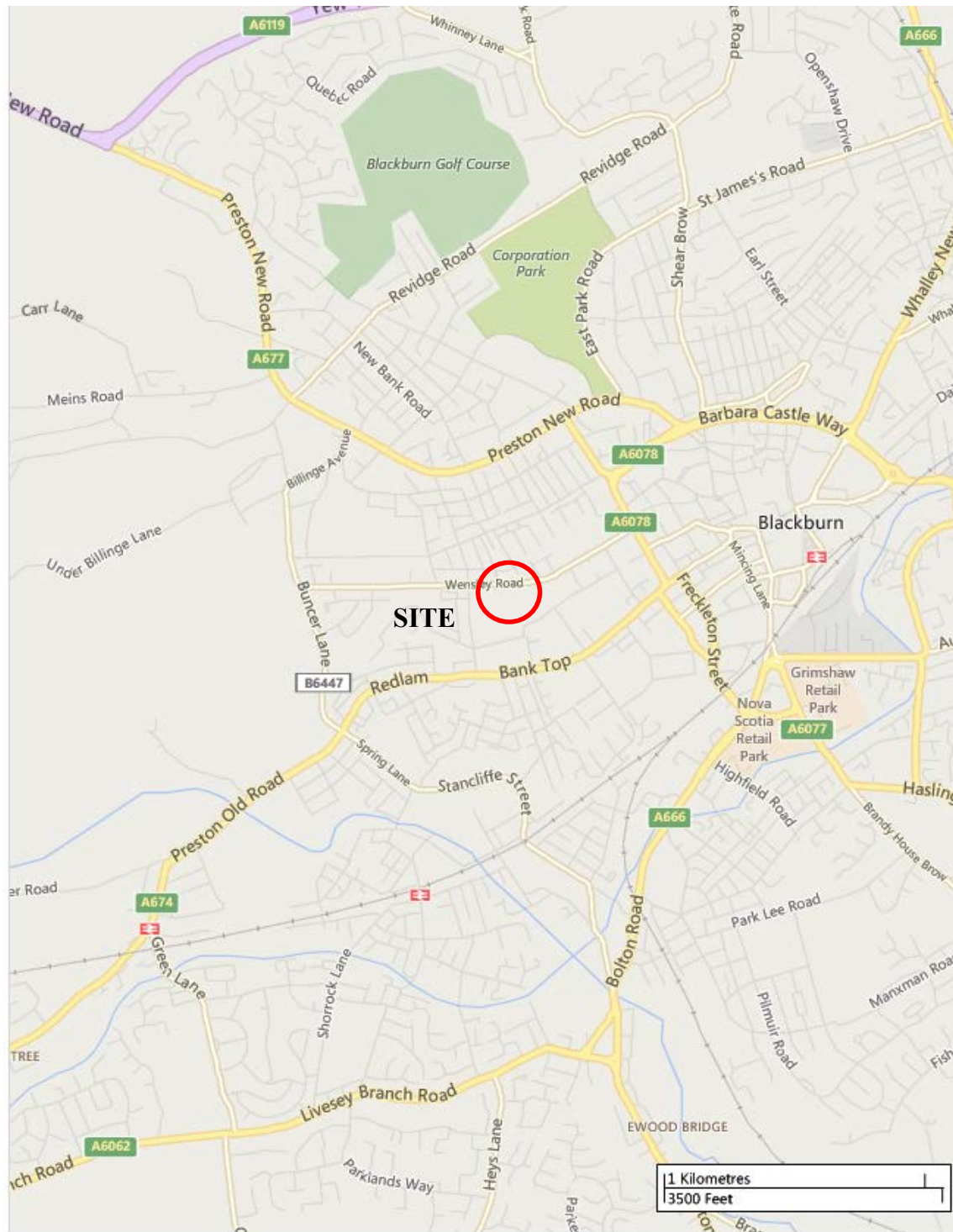
**Appendices**

Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn  
Phase 2 Site Investigation Report

**Figures and Drawings**

**Appendix A – Site Location Plan**





**Chevin Geoviro Associates LTD**

**Tel: 01943 470363**

**E-mail info@chevin-ltd.co.uk**

**Geo-environmental Consultancy  
Ground Technologies & Investigation & Remediation**

**Project :  
Land Adjacent to  
The Lion Hotel, Wensley Road, Blackburn**

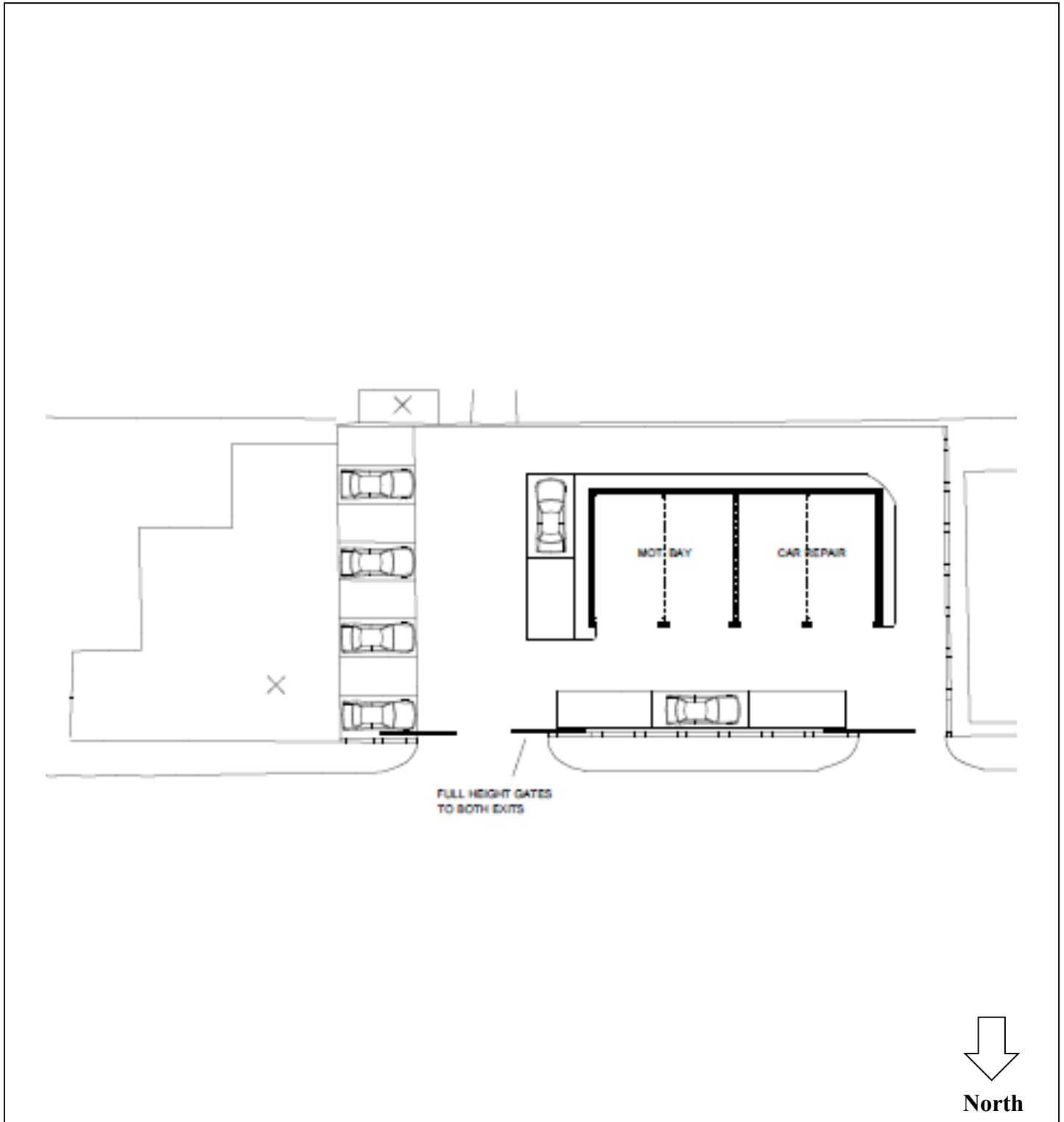
**Client. Mr. P. Akhtar**

**Project No. C0140**

**Date 11/10/2017**

Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn  
Phase 2 Site Investigation Report

**Appendix A – Proposed Site Layout**



**Chevin Geoviro Associates LTD**

**Tel: 01943 470363**

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**Geo-environmental Consultancy  
Ground Technologies & Investigation & Remediation**

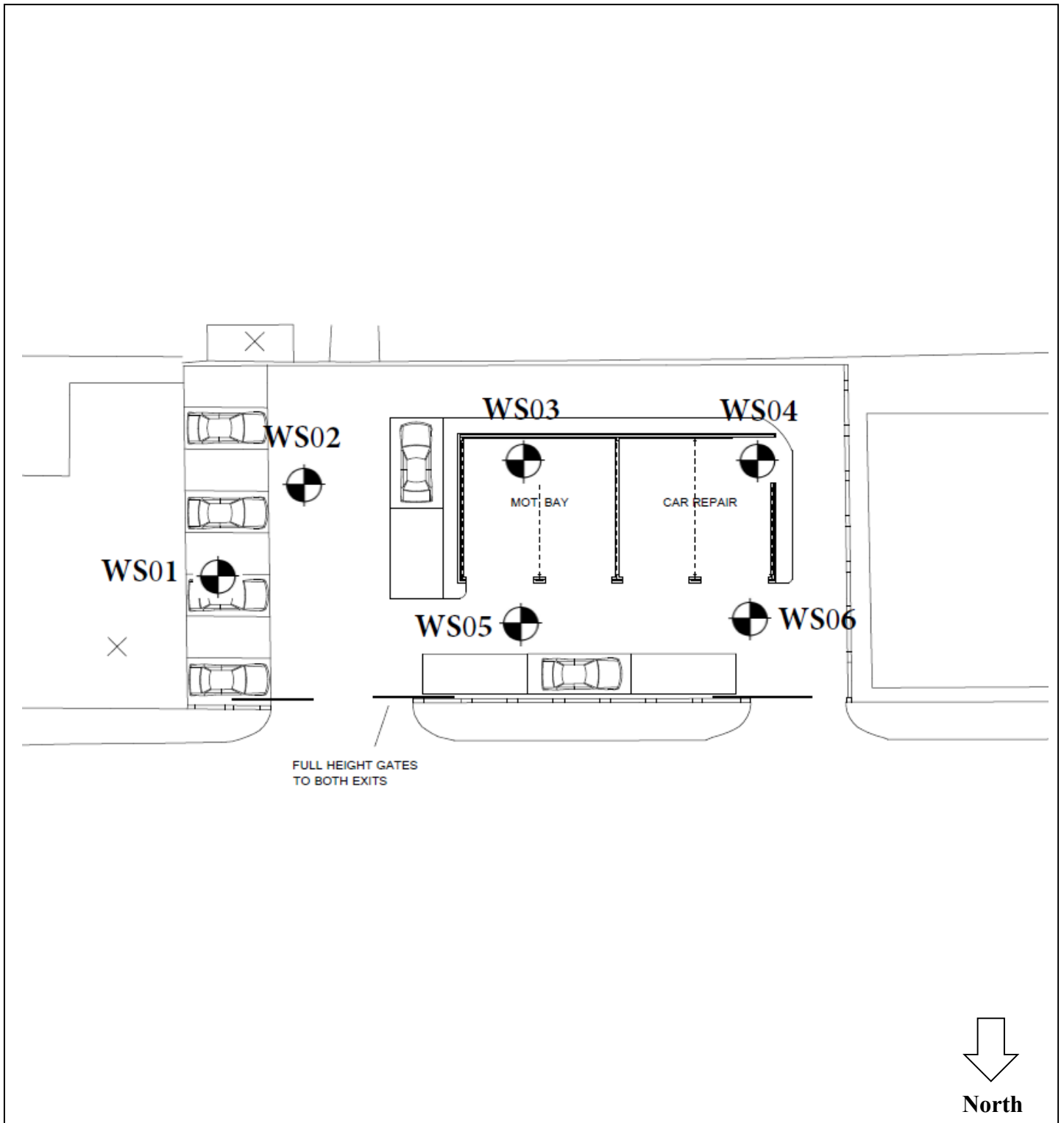
**Project :**  
**Land Adjacent to The Lion Hotel, Wensley Road,  
Blackburn**

**Client. Mr. P. Akhtar**

<b>Project No. C0140</b>	<b>Date 11/10/2017</b>
--------------------------	------------------------

Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn  
Phase 2 Site Investigation Report

**Appendix A – Exploratory Hole Location Plan**



<p><b>Chevin Geoviro Associates LTD</b></p> <p>Tel: 01943 470363</p> <p>E-mail info@chevin-ltd.co.uk</p> <p>Geo-environmental Consultancy Ground Technologies &amp; Investigation &amp; Remediation</p>	<p><b>Project :</b> Land Adjacent to The Lion Hotel, Wensley Road, Blackburn</p>	
	<p><b>Client. Mr. P. Akhtar</b></p>	
	<p><b>Project No. C0140</b></p>	<p><b>Date 11/10/2017</b></p>

Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn  
Phase 2 Site Investigation Report

**Appendix B – Engineering Logs**

# Borehole Log

Borehole No.

**WS01**

Sheet 1 of 1

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type  
WS

Location: Blackburn

Level:

Scale  
1:25

Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By  
DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.35	ES				Dark brown slightly sandy clayey MADE GROUND. Gravel sized fragments of angular brick, coal and tarmac, rare cobbles of sandstone.	1	
		0.90	D		1.40				
		1.20		N=7 (1,0/0,2,2,3)				Firm light brown mottled grey sandy gravelly CLAY, gravel is medium subangular coarse sandstone.	2
		2.00		N=16 (2,2/2,3,6,5)	1.90				
		2.50	D					Firm light grey mottled brown very sandy slightly gravelly CLAY. Gravel is subrounded medium to coarse, coarse grained weak sandstone.	3
		3.00		N=43 (9,11/11,12,11,9)	3.00				
		3.40		N=50 (24 for 80mm/50 for 120mm)	3.60			Stiff dark grey sandy slightly gravelly CLAY. Gravel is subrounded fine, coarse grained sandstone.	4
							End of borehole at 3.60 m	5	

Remarks

# Borehole Log

Borehole No.

**WS02**

Sheet 1 of 1

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type WS

Location: Blackburn

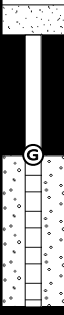
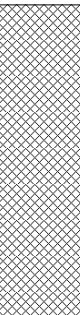

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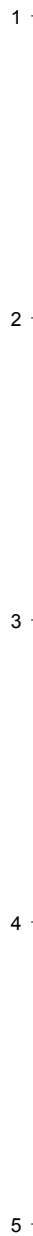
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Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.35	ES				Dark brown sandy clayey MADE GROUND. Gravel sized fragments of angular brick, concrete, sandstone, coal and plastic.	
		1.20		N=0 (30,20/0 for 0mm)	1.10 1.20		MADE GROUND of coarse grained sandstone COBBLES. (Old road surface) End of borehole at 1.20 m	



Remarks  
Refusal on old millstone grit road cobble.





# Borehole Log

Borehole No.

**WS03**

Sheet 1 of 1

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type  
WS

Location: Blackburn

Level:

Scale  
1:25

Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By  
DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES				Dark brown sandy clayey MADE GROUND. Gravel sized fragments of medium to coarse brick, weak coarse sandstone, concrete.	
		0.50	ES					
		0.80	D					
		1.00	ES					
		1.20		N=16 (1,2/5,4,4,3)	1.60			
					1.90		Firm dark brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium sandstone.	
		2.00		N=8 (1,0/1,2,2,3)			Firm light brown mottled grey sandy CLAY.	
		3.00		N=11 (2,2/3,3,2,3)				
		3.50	D		3.80			
		4.00		N=50 (9,13/14,14,16,6)	4.45			
							Stiff dark brown mottled grey slightly sandy gravelly CLAY with rare cobbles of sandstone.	
							End of borehole at 4.45 m	

Remarks  
Refusal on weak, coarse grained sandstone cobble.



# Borehole Log

Borehole No.

**WS04**

Sheet 1 of 1

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type  
WS

Location: Blackburn

Level:

Scale  
1:25

Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By  
DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.35	ES				Dark brown sandy clayey MADE GROUND. Gravel sized fragments of medium angular brick, concrete, plastic and cloth.	
		0.90	D					
		1.20		N=9 (1,2/3,2,2,2)				
		2.00		N=11 (2,2/3,3,3,2)				
					2.50		Firm brown sandy slightly gravelly CLAY. Gravel is subrounded medium, coarse grained weak sandstone.	
					3.00			
	▼				3.30		Very loose grey slightly clayey gravelly SAND. Gravel is subrounded to rounded coarse grained weak sandstone.	
		4.50	D					
		4.70		N=0 (45 for 66mm/0 for 0mm)	4.70 4.80		Stiff grey gravelly CLAY. Gravel is subangular medium to coarse sandstone. End of borehole at 4.80 m	

Remarks

# Borehole Log

Borehole No.

**WS05**

Sheet 1 of 1

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type  
WS

Location: Blackburn

Level:

Scale  
1:25

Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By  
DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.35	ES				Dark brown slightly sandy clayey MADE GROUND. Gravel sized fragments of angular brick and sandstone, cobbles of sandstone.	
		1.20		N=6 (1,2/0,2,2,2)				
		2.00		N=9 (3,2/2,2,2,3)	2.00		Firm orange mottled brown sandy CLAY with rare fine gravel of sandstone.	
		3.00		N=10 (2,3/3,2,2,3)	3.00		Very loose brown very sandy GRAVEL. Gravel is angular to subrounded fine to coarse, sandstone.	
		4.00		N=50 (9,10/12,13,14,11)	3.60		Stiff grey gravelly CLAY. Gravel is subrounded fine to coarse, sandstone.	
		4.50		0 (50 for 0mm/0 for 0mm)	4.50		End of borehole at 4.50 m	

Remarks

# Borehole Log

Borehole No.

**WS06**

Sheet 1 of 2

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type  
WS

Location: Blackburn

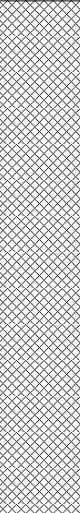
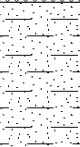
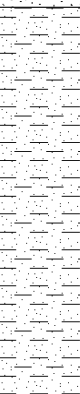
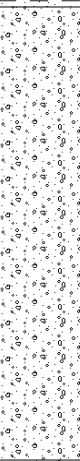
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Scale  
1:25

Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By  
DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.35	ES				Dark brown to grey sandy clayey MADE GROUND. Gravel sized fragments of angular brick, concrete and rare coal.	1	
		1.20		N=15 (4,5/6,3,3,3)	1.70		Very loose orange to brown clayey SAND with rare medium gravel of sandstone.	2	
		2.00		N=8 (1,1/2,2,2,2)	2.20		Firm grey mottled brown sandy gravelly fibrous CLAY. Gravel of subrounded to subangular medium to coarse sandstone.	3	
		3.00		N=11 (2,2/3,2,3,3)	3.50		Very loose grey sandy GRAVEL. Gravel is subrounded medium to coarse sandstone with occasional cobbles of sandstone.	4	
		4.00		N=43 (7,9/10,10,11,12)			End of borehole at 4.50 m		
		5.00		N=40 (6,8/12,11,9,8)			Continued on next sheet	5	

Remarks  
Refusal on weak, coarse grained sandstone cobble.

# Borehole Log

Borehole No.

**WS06**

Sheet 2 of 2

Project Name: Land Adjacent to Lion Hotel, 29 Wensley Road

Project No. C0140

Co-ords: -

Hole Type  
WS

Location: Blackburn

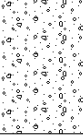
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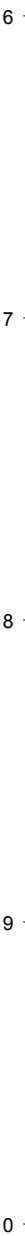
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Client: Mr. P. Akhtar

Dates: 20/10/2017 -

Logged By  
DW

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					5.45			



Remarks  
Refusal on weak, coarse grained sandstone cobble.



Land Adjacent to Lion Hotel, 29 Wensley Road, Blackburn  
Phase 2 Site Investigation Report

**Appendix C – Contamination Laboratory Test Results**



CONCEPT LIFE SCIENCES  
DELIVERING SCIENCE

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# Concept Life Sciences

## Certificate of Analysis

Hadfield House  
Hadfield Street  
Cornbrook  
Manchester  
M16 9FE  
Tel : 0161 874 2400  
Fax : 0161 874 2468

**Report Number:** 692215-1

**Date of Report:** 08-Nov-2017

**Customer:** Chevin Geoenviron Associates Ltd.  
Tarn House  
77 High Street  
Yeadon  
West Yorkshire  
LS19 7SP

**Customer Contact:** Mr Christiaan Wilkinson

**Customer Job Reference:** C0140

**Customer Purchase Order:** 0067683

**Customer Site Reference:** Wensley Road Blackburn

**Date Job Received at Concept:** 23-Oct-2017

**Date Analysis Started:** 27-Oct-2017

**Date Analysis Completed:** 08-Nov-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

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

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



Report checked  
and authorised by :  
Miajan Miah  
Customer Service Advisor

Issued by :  
Miajan Miah  
Customer Service Advisor

<b>Concept Reference:</b> 692215								
<b>Project Site:</b> Wensley Road Blackburn								
<b>Customer Reference:</b> C0140								
<b>Soil</b> Analysed as Soil								
<b>MCERTS Preparation</b>								
<b>Concept Reference</b>					692215 002	692215 004	692215 007	692215 008
<b>Customer Sample Reference</b>					WS02 ES01	WS03 ES02	WS05 ES01	WS06 ES01
<b>Depth</b>					0.35	0.50	0.35	0.35
<b>Date Sampled</b>					20-OCT-2017	20-OCT-2017	20-OCT-2017	20-OCT-2017
<b>Matrix Class</b>					Sandy Soil	Sandy Soil	Sandy Soil	Sandy Soil
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>				
Moisture @105C	T162	AR	0.1	%	14	17	14	17
Retained on 10mm sieve	T2	M40	0.1	%	<0.1	<0.1	<0.1	<0.1

<b>Concept Reference:</b> 692215								
<b>Project Site:</b> Wensley Road Blackburn								
<b>Customer Reference:</b> C0140								
<b>Soil</b> Analysed as Soil								
<b>Chevin Geoviro Standard Suite</b>								
<b>Concept Reference</b>					692215 002	692215 004	692215 007	692215 008
<b>Customer Sample Reference</b>					WS02 ES01	WS03 ES02	WS05 ES01	WS06 ES01
<b>Depth</b>					0.35	0.50	0.35	0.35
<b>Date Sampled</b>					20-OCT-2017	20-OCT-2017	20-OCT-2017	20-OCT-2017
<b>Matrix Class</b>					Sandy Soil	Sandy Soil	Sandy Soil	Sandy Soil
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>				
Arsenic	T6	M40	2	mg/kg	27	12	23	7
Cadmium	T6	M40	1	mg/kg	1	<1	3	<1
Chromium	T6	M40	1	mg/kg	37	22	33	27
Copper	T6	M40	1	mg/kg	110	64	170	32
Lead	T6	M40	1	mg/kg	270	310	700	87
Mercury	T6	M40	1	mg/kg	<1	<1	<1	<1
Nickel	T6	M40	1	mg/kg	37	18	50	24
Selenium	T6	M40	3	mg/kg	<3	<3	<3	<3
Zinc	T6	M40	1	mg/kg	320	220	660	110
pH	T7	AR			8.0	8.1	8.0	7.6
Cyanide(Total)	T546	AR	1	mg/kg	1	<1	<1	<1
TPH (C10-C35)	T8	M105	1	mg/kg	(13) 450	(13) 24	(13) 150	(13) 14
Soil Organic Matter	T287	A40	0.1	%	9.3	4.3	10	2.1
Asbestos ID	T27	AR			N.D.	N.D.	N.D.	N.D.

<b>Concept Reference:</b> 692215								
<b>Project Site:</b> Wensley Road Blackburn								
<b>Customer Reference:</b> C0140								
<b>Soil</b> Analysed as Soil								
<b>Miscellaneous</b>								
<b>Concept Reference</b>					692215 003	692215 004		
<b>Customer Sample Reference</b>					WS03 ES01	WS03 ES02		
<b>Depth</b>					0.20	0.50		
<b>Date Sampled</b>					20-OCT-2017	20-OCT-2017		
<b>Matrix Class</b>						Sandy Soil		
<b>Determinand</b>	<b>Method</b>	<b>Test Sample</b>	<b>LOD</b>	<b>Units</b>				
pH	T7	AR			8.0	8.1		
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	<0.01	<0.01		



Concept Reference: 692215  
 Project Site: Wensley Road Blackburn  
 Customer Reference: C0140

Soil  
 PAH USEPA16

Analysed as Soil

Concept Reference	692215 002	692215 004	692215 007	692215 008				
Customer Sample Reference	WS02 ES01	WS03 ES02	WS05 ES01	WS06 ES01				
Depth	0.35	0.50	0.35	0.35				
Date Sampled	20-OCT-2017	20-OCT-2017	20-OCT-2017	20-OCT-2017				
Matrix Class	Sandy Soil	Sandy Soil	Sandy Soil	Sandy Soil				
Determinand	Method	Test Sample	LOD	Units				
Naphthalene	T207	M105	0.1	mg/kg	2.1	<0.1	<sup>(9)</sup> <1.0	<0.1
Acenaphthylene	T207	M105	0.1	mg/kg	<sup>(9)</sup> <1.0	<0.1	<sup>(9)</sup> <1.0	<0.1
Acenaphthene	T207	M105	0.1	mg/kg	5.7	0.2	<sup>(9)</sup> <1.0	<0.1
Fluorene	T207	M105	0.1	mg/kg	4.2	0.1	<sup>(9)</sup> <1.0	<0.1
Phenanthrene	T207	M105	0.1	mg/kg	31	1.9	6.4	0.2
Anthracene	T207	M105	0.1	mg/kg	7.1	0.4	1.1	<0.1
Fluoranthene	T207	M105	0.1	mg/kg	34	2.7	9.7	0.3
Pyrene	T207	M105	0.1	mg/kg	29	2.1	7.9	0.3
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	14	1.0	3.3	0.1
Chrysene	T207	M105	0.1	mg/kg	16	1.1	4.4	0.1
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	12	0.8	2.8	<0.1
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	11	0.7	3.8	<0.1
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	11	0.7	3.3	<0.1
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	4.8	0.4	2.1	<0.1
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	2.6	0.2	<sup>(9)</sup> <1.0	<0.1
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	4.7	0.5	2.3	<0.1
PAH(total)	T207	M105	0.1	mg/kg	190	13	47	1.2

## Index to symbols used in 692215-1

Value	Description
M40	Analysis conducted on sample assisted dried at no more than 40C. Results are reported on a dry weight basis.
M105	Analysis conducted on an "as received" aliquot. Results are reported on a dry weight basis where moisture content was determined by assisted drying of sample at 105C
A40	Assisted dried < 40C
AR	As Received
N.D.	Not Detected
9	LOD raised due to dilution of sample
13	Results have been blank corrected.
S	Analysis was subcontracted
M	Analysis is MCERTS accredited
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

## Notes

These samples have been analysed exceeding recommended holding times of 5 days for pH. It is possible therefore that the results provided may be compromised.  
 Asbestos was subcontracted to REC Asbestos.

## Method Index

Value	Description
T207	GC/MS (MCERTS)
T546	Colorimetry (CF)
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T6	ICP/OES
T7	Probe
T287	Calc TOC/0.58
T8	GC/FID
T162	Grav (1 Dec) (105 C)
T2	Grav
T27	PLM

## Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
(Water Soluble) SO <sub>4</sub> expressed as SO <sub>4</sub>	T242	AR	0.01	g/l	N	003-004
Moisture @105C	T162	AR	0.1	%	N	002,004,007-008
Retained on 10mm sieve	T2	M40	0.1	%	N	002,004,007-008
Arsenic	T6	M40	2	mg/kg	M	002,004,007-008
Cadmium	T6	M40	1	mg/kg	M	002,004,007-008
Chromium	T6	M40	1	mg/kg	M	002,004,007-008
Copper	T6	M40	1	mg/kg	M	002,004,007-008
Lead	T6	M40	1	mg/kg	M	002,004,007-008
Mercury	T6	M40	1	mg/kg	M	002,004,007-008
Nickel	T6	M40	1	mg/kg	M	002,004,007-008
Selenium	T6	M40	3	mg/kg	M	002,004,007-008
Zinc	T6	M40	1	mg/kg	M	002,004,007-008
pH	T7	AR			M	002-004,007-008
Cyanide(Total)	T546	AR	1	mg/kg	M	002,004,007-008
TPH (C10-C35)	T8	M105	1	mg/kg	M	002,004,007-008
Soil Organic Matter	T287	A40	0.1	%	N	002,004,007-008
Asbestos ID	T27	AR			SU	002,004,007-008
Naphthalene	T207	M105	0.1	mg/kg	M	002,004,007-008
Acenaphthylene	T207	M105	0.1	mg/kg	U	002,004,007-008
Acenaphthene	T207	M105	0.1	mg/kg	M	002,004,007-008
Fluorene	T207	M105	0.1	mg/kg	M	002,004,007-008
Phenanthrene	T207	M105	0.1	mg/kg	M	002,004,007-008
Anthracene	T207	M105	0.1	mg/kg	U	002,004,007-008
Fluoranthene	T207	M105	0.1	mg/kg	M	002,004,007-008
Pyrene	T207	M105	0.1	mg/kg	M	002,004,007-008
Benzo(a)Anthracene	T207	M105	0.1	mg/kg	M	002,004,007-008
Chrysene	T207	M105	0.1	mg/kg	M	002,004,007-008
Benzo(b)fluoranthene	T207	M105	0.1	mg/kg	M	002,004,007-008
Benzo(k)fluoranthene	T207	M105	0.1	mg/kg	M	002,004,007-008
Benzo(a)Pyrene	T207	M105	0.1	mg/kg	M	002,004,007-008
Indeno(123-cd)Pyrene	T207	M105	0.1	mg/kg	M	002,004,007-008
Dibenzo(ah)Anthracene	T207	M105	0.1	mg/kg	M	002,004,007-008
Benzo(ghi)Perylene	T207	M105	0.1	mg/kg	M	002,004,007-008
PAH(total)	T207	M105	0.1	mg/kg	U	002,004,007-008



## **Appendix D – Gas Monitoring Results**



Hole ID: WS01

Project Name: Wensley Road, Blackburn  
Project No. C0140

Ground Gas Monitoring Results

NOTES:

Measured Parameter	Units	Detection						
Monitoring round no.	N/ A	N/ A	1	2	3	4	5	6
Date	dd/ mm/ yyyy	N/ A	24/10/2017	31/10/2017	20/11/2017	29/11/2017		
Time of initial readings	hh: mm: ss	N/ A	12:04	11:11	09:30	12:40		
Water Level	m	0.01	0.82m	1.25m	0.9m	2m		
Atmospheric pressure	mb	1	1013	1008	1010	1001		
Relative pressure	mb	1	NR	NR	NR	NR		
Base depth of installation	m	0.01	2.95m	3m	2.9m	2.95m		
Time of 'Peak' readings	hh: mm: ss	N/ A	12:07	11:14	09:33	12:44		
CH4: (LEL) Peak	%	1	<1	<1	<1	<1		
CH4: Peak	%v / v	0.1	0	0	0.1	0.2		
CO2: Peak	%v / v	0.1	0.1	0.1	0.1	0.2		
O2: Minimum	%v / v	0.1	19.3	20	20.5	20.2		
CO: Peak	ppm	1	8	0	0	0		
H2S: Peak	ppm	1	0	0	1	1		
Time of Steady readings	hh: mm: ss	N/ A	12:10	11:20	09:35	12:48		
CH4: (LEL) Steady State	%	1	0	0	0.1	0.2		
CH4: Steady State	%v / v	0.1	0	0	0.1	0.2		
CO2: Steady State	%v / v	0.1	0.1	0.1	0.1	0.2		
O2: Steady State	%v / v	0.1	19.3	20	20.5	20.2		
CO: Steady State	ppm	1	8	0	0	0		
H2S: Steady State	ppm	1	0	0	1	1		
Gas Flow	l / hr	0.1	0.2	0.1	0.3	0.2		
Weather Conditions:			Overcast	Overcast	Heavy Rain	Overcast		
Equipment Type			GA5000	GA5000	GA5000	GA5000		
Equipment Serial Number			G504574	G504574	G504574	G504574		
Equipment Last Calibrated			18/10/2017	18/10/2017	18/10/2017	18/10/2017		
Monitored By			DW	DW	DW	DW		
Comments								
Form Number: 03-2017								



Hole ID: WS02

Project Name: Wensley Road, Blackburn  
Project No. C0140

Ground Gas Monitoring Results

NOTES:

Measured Parameter	Units	Detection						
Monitoring round no.	N/ A	N/ A	1	2	3	4	5	6
Date	dd/ mm/ yyyy	N/ A	24/10/2017	31/10/2017	20/11/2017	29/11/2017		
Time of initial readings	hh: mm: ss	N/ A	12:16	11:30	09:42	12:53		
Water Level	m	0.01	0.75m	0.85m	0.8m	0.8m		
Atmospheric pressure	mb	1	1013	1008	1010	1001		
Relative pressure	mb	1	NR	NR	NR	NR		
Base depth of installation	m	0.01	0.95m	0.95m	0.95m	0.95m		
Time of 'Peak' readings	hh: mm: ss	N/ A	12:18	11:33	09:44	12:59		
CH4: (LEL) Peak	%	1	<1	<1	<1	<1		
CH4: Peak	%v / v	0.1	0	0	0.1	0.2		
CO2: Peak	%v / v	0.1	0.1	0.1	0.3	0.2		
O2: Minimum	%v / v	0.1	18	19.9	19.8	20.7		
CO: Peak	ppm	1	30	1	0	0		
H2S: Peak	ppm	1	2	1	1	1		
Time of Steady readings	hh: mm: ss	N/ A	12:22	11:37	09:47	13:04		
CH4: (LEL) Steady State	%	1	0	0	0.1	0.2		
CH4: Steady State	%v / v	0.1	0	0	0.1	0.2		
CO2: Steady State	%v / v	0.1	0.1	0.1	0.3	0.2		
O2: Steady State	%v / v	0.1	18	19.9	19.8	20.7		
CO: Steady State	ppm	1	30	1	0	0		
H2S: Steady State	ppm	1	2	1	1	1		
Gas Flow	l / hr	0.1	0.1	0.2	0.4	0.1		
Weather Conditions:			Overcast	Overcast	Heavy Rain	Overcast		
Equipment Type			GA5000	GA5000	GA5000	GA5000		
Equipment Serial Number			G504574	G504574	G504574	G504574		
Equipment Last Calibrated			18/10/2017	18/10/2017	18/10/2017	18/10/2017		
Monitored By			DW	DW	DW	DW		
Comments								
Form Number: 03-2017								



Hole ID: WS04

Project Name: Wensley Road, Blackburn  
Project No. C0140

Ground Gas Monitoring Results

NOTES:

Measured Parameter	Units	Detection						
Monitoring round no.	N/ A	N/ A	1	2	3	4	5	6
Date	dd/ mm/ yyyy	N/ A	24/10/2017	31/10/2017	20/11/2017	29/11/2017		
Time of initial readings	hh: mm: ss	N/ A	12:28	11:42	09:51	13:09		
Water Level	m	0.01	1.9m	1.98m	1.95m	1.8m		
Atmospheric pressure	mb	1	1013	1008	1010	1001		
Relative pressure	mb	1	NR	NR	NR	NR		
Base depth of installation	m	0.01	3.75m	3.75m	3.70m	3.75m		
Time of 'Peak' readings	hh: mm: ss	N/ A	12:32	11:45	09:53	13:13		
CH4: (LEL) Peak	%	1	<1	<1	<1	<1		
CH4: Peak	%v / v	0.1	0	0	0	0.2		
CO2: Peak	%v / v	0.1	7.9	7.7	5.5	0.1		
O2: Minimum	%v / v	0.1	11.4	9	8.9	22		
CO: Peak	ppm	1	1	0	0	0		
H2S: Peak	ppm	1	2	1	1	1		
Time of Steady readings	hh: mm: ss	N/ A	12:36	11:50	09:56	13:17		
CH4: (LEL) Steady State	%	1	0	0	0	0.2		
CH4: Steady State	%v / v	0.1	0	0	0	0.2		
CO2: Steady State	%v / v	0.1	7.9	7.7	5.5	0.1		
O2: Steady State	%v / v	0.1	11.4	9	8.9	22		
CO: Steady State	ppm	1	1	0	0	0		
H2S: Steady State	ppm	1	2	1	1	1		
Gas Flow	l / hr	0.1	0.1	0.2	0.4	0.1		
Weather Conditions:			Overcast	Overcast	Heavy Rain	Overcast		
Equipment Type			GA5000	GA5000	GA5000	GA5000		
Equipment Serial Number			G504574	G504574	G504574	G504574		
Equipment Last Calibrated			18/10/2017	18/10/2017	18/10/2017	18/10/2017		
Monitored By			DW	DW	DW	DW		
Comments								
Form Number: 03-2017								