

Remediation Strategy

For a site at

Ferrous – Phoenix II

Undertaken for

Capital & Centric (Nineteen) Ltd

Report Title:	Ferrous – Phoenix II Remediation Strategy
Report Reference:	9861G-WML-XX-ZZ-RP-G-0003A
Client:	Capital & Centric (Nineteen) Ltd
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Revision Status / History

Rev	Date	Issue / Purpose/ Comment	Prepared	Checked	Authorised
-	25/11/2022	Original Issue	TPB	SCS	SCS
A	09/06/2025	Updated Gas Risk Assessment	-	-	SCS

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1.0 INTRODUCTION

Appointment

- 1.1 WML Consulting has been commissioned by Capital & Centric (Nineteen) Ltd to produce a Remediation Strategy for a site located off Chapeltown Street in Manchester.

Proposed Development

- 1.2 The project involves construction of a new multi-storey residential apartment building. It is assumed that the new building will not have a basement but will have plant at roof level and will include very localised external soft landscaping. It is also anticipated that a substation and kiosk are to be located within the north-eastern apex of the site.
- 1.3 The current proposed development plan is presented within Appendix 01.

Background

- 1.4 WML were initially commissioned by Capital & Centric (Nineteen) Ltd to undertake a Phase 1 Desk Study and Phase 2 Investigation and Assessment. These culminated in the following reports.
- Phase 1 Desk Study and Preliminary Geoenvironmental Assessment Report, Reference 9861G-WML-XX-ZZ-RP-G-0001, dated October 2021.
 - Phase 2 Geo-environmental Investigation and Assessment, 9861G-WML-XX-ZZ-RP-G-0002, dated November 2022.
- 1.5 It is understood that the reports have been presented to the Local Authority in support of the relevant Planning Application.
- 1.6 The findings of the Phase 1 and Phase 2 reports are summarised in the following sections.

2.0 SITE LOCATION AND DESCRIPTION

Site Location

- 2.1 The site comprises land off Chapeltown Street, Manchester. It is centred on approximate Ordnance Survey National Grid Reference 385219E, 398060N with an indicative postcode of M1 2BJ.
- 2.2 The site is bounded to the North by Chapeltown Street with residential properties beyond; to the north-east by an area of hardstanding and electricity sub-station; to the south by a Metrolink Line with Longacre Street beyond and to the west by existing 10-storey Phoenix residential development.

Site Description

- 2.3 The site comprises an area of maintained grass landscaping.
- 2.4 A CCTV service box is located close to the southwestern part of the site and a row of lamp-posts are located on the northern site boundary.
- 2.5 The southern and south-eastern site boundaries are formed by a Metrolink line which is located in a cutting in the north-eastern part, formed by a brick retaining wall with a line of electricity cables extending along its route, close to the site boundary.
- 2.6 Manholes located in the north-western and southern corners of the site together with a rodding-eye close to the south-western site boundary, indicate the presence of a sewer, although its extent is unknown at this time.
- 2.7 The north-eastern boundary of the site is demarcated by a billboard and is otherwise surrounded by timber knee-rail fencing restricting vehicular access from the north. The southern and south-eastern boundaries access is restricted due to the tramline.
- 2.8 The site slopes very gently west/south-west from approximately 47.40m Above Ordnance Datum (AOD) in the north-eastern corner to around 46.10m AOD at the western corner of the site.
- 2.9 The surrounding area is generally level with the exception of the south-eastern site boundary where the neighbouring Metrolink line extends into a cutting accommodated by a brick retaining wall. The tramline elevation is roughly 46.35m AOD to the south-west of the site, reducing to around 43.20m AOD immediately before it extends beneath the road bridge.

Summary of Salient Environmental Considerations

- 2.10 British Geological Survey (BGS) plans indicate the site to be underlain by Devensian Glacial Till comprising mainly clay but possibly with interbedded sand and gravel horizons. The drift deposits are underlain by the Triassic Chester Pebble Beds Formation indicated to comprise sandstone.
- 2.11 In consideration of the indicated geology, risks to the development from subsidence relating to shallow, unrecorded abandoned mine workings are considered low and can be discounted.
- 2.12 No radon protection measures are necessary for new properties as described in publication BR211 by the Building Research Establishment.
- 2.13 The bedrock underlying the site is classified as a 'Principal Aquifer'. The superficial strata is classified as a Secondary (Undifferentiated) Aquifer'.
- 2.14 There are no source protection zones within 500m of the site and no active groundwater abstraction licences are listed within the 1km of the site boundary. One surface water feature is located within 250m of the site, the Ashton Canal 47m north-west.

- 2.15 There are no active landfills located within 500m of the site or historic landfills located within 250m of the site.

Site History

- 2.16 The earliest map dated 1848 indicates the site to comprise mixed residential terraced structures, together with back-to-back housing described as Whitaker's building and an Iron Foundry, later with a chimney. Chapel Street formed the north-western site boundary with Fair Street extending north to south-west in the extreme west of the site.
- 2.17 The site remained relatively unchanged until reconfiguration of the Dolphin Foundry (Iron) in 1932. By this time, the back-to-back houses had been cleared with the terrace structures remaining along Chapel Street.
- 2.18 By 1948, the remaining residential structures had been cleared with the Iron Foundry remaining in the south and western sections although modified in the central section.
- 2.19 By 1978, the Iron Foundry had been cleared and the central and western sections of the site redeveloped as a warehouse which extended southwards outside of the current site boundary. This remained until sometime in the 2010s when the site was cleared.
- 2.20 Between 2017 and 2020 the adjacent residential tower block and the tramline were constructed to the west and south respectively. Anecdotal information indicates that the western section of the site was used as a construction laydown area during the adjacent development before being landscaped into its 2021 configuration.
- 2.21 The area surrounding the site has historically comprised mixed residential and industrial development, including Phoenix (Brass, Iron & Machinery) Works immediately to the west and Chapel Street (Cotton) Mill and Victoria Iron Works both 10m north.
- 2.22 Many of the surrounding residential properties were cleared between 1932 and 1948 prior to industrial redevelopment, including an Engineering Works immediately north-east and a Box Factory immediately south-west on the site of the recently constructed Ferrous I building, with the Crusader Stationary Works to the north and south of Chapel Street further to the west.
- 2.23 More recently, the wider area has been cleared of industrial structures and redeveloped with multi-storey residential structures including those on the land immediately north and west of the site.

3.0 SUMMARY OF PHASE 2 INVESTIGATION

Ground Investigation

- 3.1 Ground Investigation works were undertaken by Groundtech Limited between the 12th and 23rd September 2022. This comprised 4no cable tool percussive boreholes (CP01 to CP04) advanced into bedrock by rotary core techniques to depths of between 24.00m and 28.50 metres below ground level (mbgl) and 6no windowless sample probeholes (WS01 to WS06) advanced to depths of between 1.45m and 2.45mbgl.

Ground Conditions

- 3.2 Ground conditions encountered during the intrusive investigation generally comprised made ground to depths of between 0.95m and 2.00mbgl. The made ground was underlain by cohesive Glacial Till to depths of between 9.50m and 11.00mbgl, interbedded with granular Glacial Deposits to between 11.00m and 15.50mbgl. The superficial deposits were in turn underlain by sandstone of the Chester Pebble Beds Formation to a maximum proven depth of 28.50mbgl.
- 3.3 Visual evidence of ash and clinker was noted within the made ground. Otherwise no visual and/or olfactory evidence of significant ground contamination was identified within the exploratory holes during the investigation.
- 3.4 Groundwater was not encountered during the formation of the exploratory holes. Initial groundwater monitoring recorded perched water levels in standpipes ranging between 0.86m and 1.98mbgl.

Chemical Analysis

Human Health

- 3.5 Chemical analysis indicate that the made ground beneath the site contains slightly elevated levels of certain contaminants recorded above their respective SL's for residential without homegrown produce. These relate to elevated concentrations of arsenic and PAH compounds recorded within 4no samples of made ground.
- 3.6 In addition, asbestos in the form of chrysotile fibres was recorded in a 1no sample of made ground. Although these appear to be localised and at low concentrations it cannot be wholly discounted that further made ground beneath the site could contain ACM and/or free fibres.

Controlled Waters

- 3.7 Taking into consideration the low sensitivity of the underlying superficial aquifer the concentrations recorded are not considered to represent a significant ongoing source of contamination.
- 3.8 Due to the low mobile contamination status of the site, the risk to the Principal Aquifer is considered low, even where a potential pathway could be provided by piled foundations for contaminants to migrate downwards towards it. However, it is anticipated that a piling risk assessment may need to be undertaken.
- 3.9 Notwithstanding the above, due to the past industrial nature of the site, it cannot be discounted that further unidentified ground contamination could be exposed during groundworks operations. In this respect, it is recommended that a 'watching brief' is undertaken with any suspected ground contamination encountered being segregated for further assessed by an environmental consultant.

4.0 UPDATED GROUND GAS RISK ASSESSMENT

- 4.1 Prior to the issue of the 2022 Phase 2 report and Remediation Strategy the ground gas had not been completed. Therefore, the preliminary remediation strategy concluded that the site classified as Characteristic Situation (CS) 1 – Very Low Gas Risk' with no specific gas protection measures required.
- 4.2 However, the Characteristic Situation was to be confirmed on completion of the monitoring programme and the following section provides an updated Ground Gas Risk Assessment.
- 4.3 A copy of the ground gas monitoring results are included within Appendix 02 and the relevant gas analyser calibration certificates are in Appendix 03.

Methodology

- 4.4 Current guidance for the assessment of risk associated with the presence of hazardous ground gases (principally methane and carbon dioxide) is provided in two key documents, namely:
- Code of practice for the Characterisation and remediation from Ground Gas in Affected Developments. British Standard Institution (BS 8485: 2015 & A1:2019); and
 - Assessing Risks posed by Hazardous Ground Gases to Buildings CIRIA (C665, 2007).
- 4.5 The assessment presented herein is primarily based on the BS8485 document.
- 4.6 Hazardous ground gas qualitative risk assessment is based on a conceptual model similar to that used for soil and groundwater contamination sources (i.e., source-pathway-receptor pollutant linkages). A semi-quantitative estimate of risk can be assessed based on knowledge of the conceptual model and a measure of hazardous gas concentration and gas flow at the site within monitoring standpipes.
- 4.7 Based on the measured flow rates and hazardous gas concentrations, individual "hazardous gas flow rates" (Qhg) can be derived for each monitoring point, from which the "site characteristic hazardous gas flow rate" (Qhgs), and then the "Characteristic Situation" (CS) can be determined.
- 4.8 BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation and the proposed development based on building type as outlined in Table 3.

Table 3 - Building Types

	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ Public, possible multiple	Commercial / Public	Commercial / Industrial
Control (Change of use)	None	Some but not all	Full	Full
Room Sizes	Small	Small/ medium	Small to Large	Large Industrial/ Retail Park

- 4.9 The proposed development therefore is indicated to comprise the construction of Type B buildings which include private or commercial structures with small to medium room sizes.

Ground Gas Conceptual Model

- 4.10 The site is not in Radon Affected Area, defined by the UK Health Security Agency as less than 1% of properties are above the Action Level of exposure. Therefore, no radon protection measures are necessary for new structures as described in publication BR211 by the Building Research Establishment.

- 4.11 There are no active landfills located within 500m of the site or historic landfills located within 250m of the site.
- 4.12 The presence of ground gas resulting from shallow unrecorded mine workings is considered unlikely.
- 4.13 No appreciable thickness of made ground or other soil with significant organic content have been encountered beneath the site.
- 4.14 However, it has been considered prudent to undertake ground gas monitoring, primarily for methane and carbon dioxide, with associated flow rates on 6no occasions, the 6th October and 23rd November 2022.

Results and Recommendations

- 4.15 The results indicate concentrations of peak and steady state methane not exceeding 0.10% by volume in air (v/v) and peak and steady state carbon dioxide concentrations ranging between 0.30% and 3.60% v/v.
- 4.16 No detectable steady state ground gas flows were recorded during any of the monitoring visits.
- 4.17 The results give a maximum composite Q_{hg} value of 0.0036l/hr (carbon dioxide) and indicate the site to classify as Characteristic Situation (CS) 1 – Very Low Gas Risk' with no specific gas protection measures required.

5.0 REMEDIATION STRATEGY

Asbestos Control Measures

General

- 5.1 Although asbestos within shallow soils was not indicated to be widespread it cannot be discounted that further unidentified ground contamination could be exposed during groundworks operations.
- 5.2 Therefore, site operations will be under the full-time control of Site Manager who will ensure that all asbestos management personnel hold necessary certificates relating to asbestos awareness.
- 5.3 Site induction for site operatives and visitors will include a specific tool box talk relating to asbestos. This will cover basic identification of possible Asbestos Containing Material (ACM) and the procedure to be adopted if any such material is suspected.

Additional Suspected Asbestos

- 5.4 Although not anticipated, if it is suspected that asbestos contamination is more widespread across the site a specialist consultant in the identification of ACM should be present during any significant earth moving operations and the reduction of landscaped areas.
- 5.5 The asbestos specialist will be UKAS accredited and will set up perimeter background monitoring stations around the site boundary and at strategic locations within the site as considered necessary during the earthworks. In addition, personal monitoring equipment will be deployed around working areas for work location monitoring.
- 5.6 It is envisaged that air tests will be undertaken with asbestos fibre counting being undertaken in consultation with the asbestos specialist.
- 5.7 Furthermore, during periods of dry weather, the site surface will be dampened down to minimise the potential for airborne dust. Water sprays may also be employed at excavation locations to minimise the production of airborne dust. A detailed Method Statement for the control and management of dust on site will be contained within the main contractor's Environmental Management Plan.
- 5.8 The asbestos consultant will initially undertake a detailed walk-over of the site with selected samples of any suspected fibrous material so identified on the surface being sent to the laboratory for asbestos identification.
- 5.9 Where such materials are identified as ACM, similar fragments identified by further inspection will be located on plan and marked on site for subsequent removal by a licensed asbestos contractor. Where considered appropriate, further samples of such materials will be taken for laboratory identification.
- 5.10 The consultant will similarly identify any suspected ACM during the subsequent earthworks/groundworks. Where obvious fragments of ACM are identified, they will be hand-picked where practical and removal from site by the licensed asbestos contractor as soon as reasonably practical. Where such materials cannot be removed immediately, the ACM will be covered by impermeable membrane and clearly marked on site for subsequent removal.
- 5.11 Following the surface hand-picking exercise, samples of soil will be taken from the surface over the site and subjected to asbestos quantification analysis in the laboratory. Where the percentage of asbestos fibres are identified to be in excess of 0.1% by volume of the sample, further inspection of the soil in that area will be undertaken with removal of identified ACM where appropriate.
- 5.12 At the discretion of the asbestos consultant further samples may also be taken for quantification analysis at the laboratory.

- 5.13 The licensed asbestos contractor will arrange for the necessary disposal of hand-picked ACM to an appropriately licensed landfill facility. Records in the form of Duty of Care documentation will be kept by the site manager for presentation where required.

Capping Requirements for General Landscaping

- 5.14 As the level of contamination in the made ground renders it unsuitable for direct use beneath proposed landscaped areas, development will need to include the provision of a clean cover over the made ground to break the direct contact pollution linkage as set out below.
- 5.15 Therefore, new garden / landscaped areas will need to be capped with a nominal 600mm clean cover over the existing made ground to break the direct contact pollution linkage. The make-up of the 600mm cover would be expected to consist of:
- 150mm of clean imported Topsoil;
 - 450mm of clean imported sub-soil;

Unexpected Ground Contamination - Soils

- 5.16 Should any visual / olfactory evidence of contamination be encountered, the environmental consultant will advise of the most appropriate measures to deal with such contamination. This may include taking samples for chemical analysis and advising of appropriate routes for disposal to landfill.
- 5.17 Any unsuitable contaminated soil encountered during the site strip/enabling works will be segregated and stockpiled on impermeable sheeting and demarcated as contaminated soil for removal off-site.
- 5.18 Any contaminated soil will be stockpiled a sufficient distance from any other stockpiled clean soil such as arisings of natural soils, to prevent cross-contamination if immediate disposal to landfill is not possible.
- 5.19 A photographic record of any should be made available for inclusion within the validation report.
- 5.20 Removal dockets and receiving landfill information for any contaminated materials removed from the site will need to be retained for inclusion in the validation report.

Unexpected Ground Contamination - Groundwater

- 5.21 If mobile contaminants, or localised groundwater suspected to be contaminated, were encountered during the redevelopment ground works', the following actions should be undertaken.
- 5.22 Works should cease and the suspect groundwater should be sampled and submitted for chemical analyses. The results of which would allow the most appropriate remedial action to be determined and undertaken.
- 5.23 A photographic record of any groundwater removal should be made available for inclusion within the validation report.
- 5.24 Removal dockets and disposal information for any contaminated materials removed from the site will need to be retained for inclusion in the Validation report.

Water Supply Pipes

- 5.25 The water utilities supplier will need to be consulted with regards the selection of suitable water supply pipe materials for the development. In light of the ground conditions encountered, the requirement for specific materials and measures to protect the water supply from ground contamination cannot be discounted at this stage.

Service Trenches

- 5.26 Although not anticipated, if significant volumes of asbestos are encountered during redevelopment consideration would need to be given to the provision of lining the service trenches.

Post-Development Considerations

- 5.27 Once completed the Validation report should be included within any documentation relating to future development groundworks as well as the subsequent Health and Safety file.
- 5.28 It should also be included in any post-development Operations and Maintenance documentation so that measures can be implemented, where considered necessary, to ensure that future construction and/or maintenance works are undertaken safely with due consideration of the potential presence of asbestos.

6.0 VALIDATION

Asbestos Control Measures

- 6.1 If / where required the validation that the asbestos control measures have been successfully implemented will be recorded in the Health and Safety File which will be held by the Client at their premises or other designated location.
- 6.2 Such documentation will primarily include:
- A record of the extent and results of all asbestos monitoring carried out to demonstrate that the concentration of asbestos in air have not exceeded the control limit of 0.1 fibres per cubic centimetre of air averaged over a continuous period of 4 hours.
 - A record of physical control measures which have been adopted to minimise the risk of the control limit being exceeded.
 - A record of ACM encountered and the measures adopted to deal with such materials.
 - A record of all ACM removed from site and details of the Duty of Care documentation identifying the licensed facility to which it has been disposed to.
 - A record of any incidents, accidents and emergencies.
 - Photographic evidence of material movement and remedial works such as hand-picking activities.

Unexpected Ground Contamination

- 6.3 It cannot be wholly discounted that unidentified contamination sources could be encountered during site enabling works. The removal of ground contamination would need to be witnessed by an environmental consultant who would take independent site records, including photographs to demonstrate appropriate compliance with the Remediation Strategy and subsequent Method Statements.
- 6.4 Removal of hotspots would also need to be validated by visual inspection to include photographs and measurements of the resulting excavations and / or sampling of suspected groundwater. Samples will be taken from the sides and, where practical, the bases of excavations for chemical analysis to demonstrate that remaining soils do not exceed the SAC.
- 6.5 Records of all material removed from site will be kept by the Site Manager to demonstrate compliance with Duty of Care regulations. This will include a record of volumes of waste taken from site and details of the landfill facility receiving the waste.
- 6.6 Where necessary, EA pre-notification requirements will be complied with for the removal and disposal of waste considered to be Hazardous, backed up where necessary by Waste Acceptance Criteria (WAC) testing.

Imported Topsoil / Subsoil

- 6.7 The source of all imported materials will be clearly identified by reference to the site of origin. This will be accompanied by the results of appropriate chemical analysis from the supplier to certify material suitability. Certificates will be forwarded to the environmental consultant for inspection prior to any imported material being brought to site.
- 6.8 Imported Topsoil and sub-soil will be stockpiled separately from other materials and clearly marked on site.
- 6.9 The site manager will keep records of the volumes of all imported Topsoil and sub-soil delivered to site in the form of delivery slips. The records will be presented as confirmation that sufficient analysis has been undertaken on imported Topsoil/sub-soil.

- 6.10 Notwithstanding the above, material delivered to site will be subject to further chemical analysis to confirm suitability, with sampling of all imported soil undertaken at a ratio of 1no sample per 50m³ of soil, with a minimum of 3no samples per individual source.
- 6.11 The results of the analysis will be compared against Site Specific Assessment Criteria for 'Residential without home-grown produce' as presented in Appendix 04.
- 6.12 Should the results of such analysis exceed the relevant Site Specific Assessment Criteria the soil may require additional sampling in order to further assess its suitability for use at the site and may ultimately need be removed from site and replaced with material which meets the relevant criteria.

Clean Cover Thickness

- 6.13 Where a clean cover is to be incorporated over areas of remaining Made Ground, the thickness of sub-soil and Topsoil will be validated by hand dug trial pits with photographic records undertaken on a 10m square grid, and may also be required in discrete areas as spot checks.
- 6.14 The photographic record will confirm the required clean cover thickness by use of a levelling staff. Each photograph will also clearly show pit location within the development.

7.0 VALIDATION REPORT

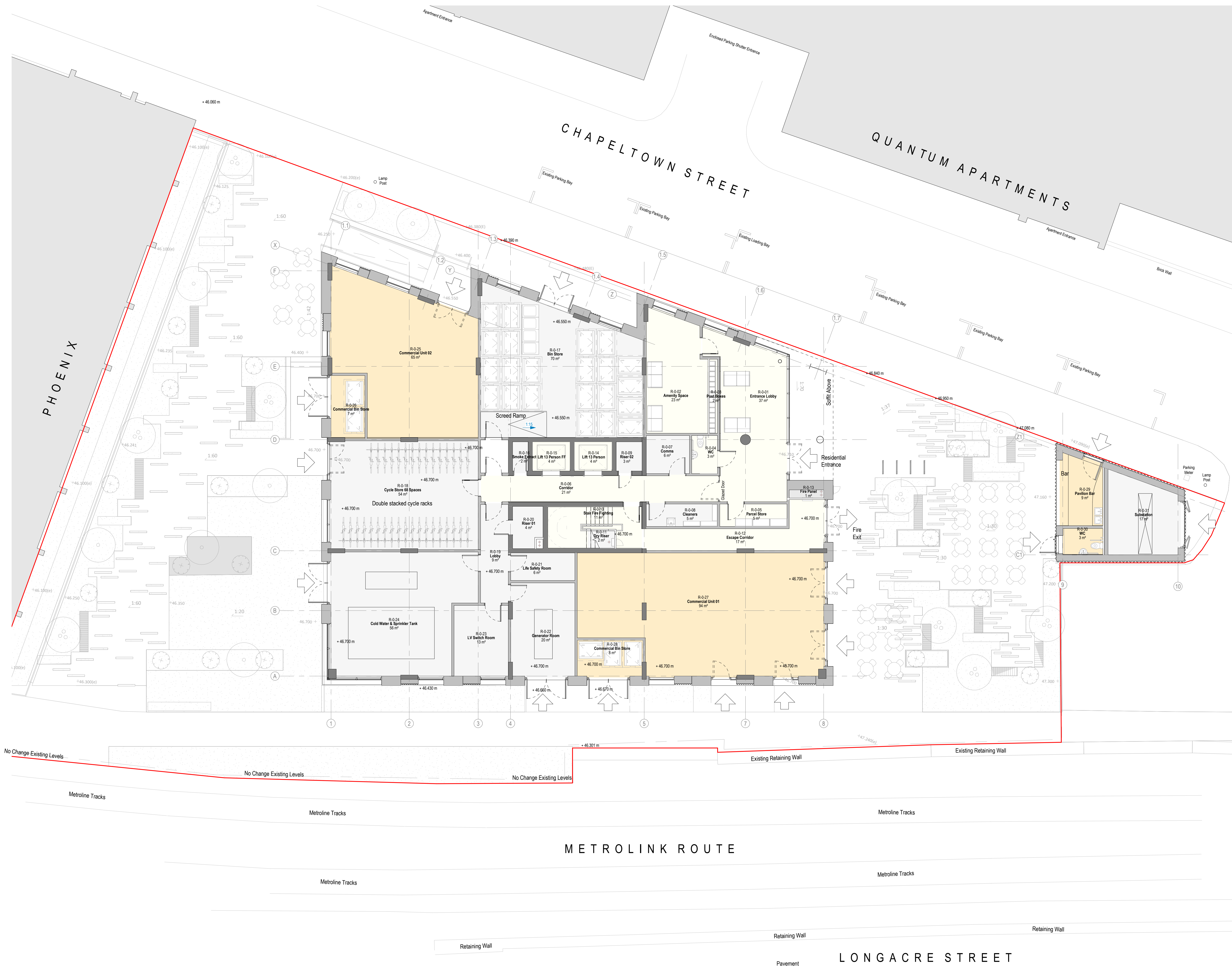
7.1 On completion of the Remediation Works to the site, a Validation Report will be produced by the geo-environmental engineer, which will be submitted to the Local Authority for approval.

7.2 Where applicable the Validation Report will include:

- Documentation in relation to asbestos control measures.
- Details of any unexpected ground contamination and the measures undertaken to deal with this, to include records of excavation, the results of chemical analysis resulting from the removal of contaminated soil and / or groundwater.
- Results of subsequent chemical analysis of imported Topsoil/sub-soil to confirm compliance with the Site Specific Assessment Criteria.
- Records of the volumes and suitability of all imported fill, Topsoil and sub-soil delivered to site in the form of delivery slips and certificates.
- Sample waste management records confirming compliance with Duty of Care regulations;
- Photographic evidence of suitable sub-soil/Topsoil cover in landscaped areas where underlain by Made Ground.
- Confirmation of potable water supply pipe materials.

APPENDIX 01

Drawings



BUILDING DESIGN PARTNERSHIP SHALL HAVE NO RESPONSIBILITY FOR ANY USE MADE OF THIS DOCUMENT OTHER THAN FOR THAT WHICH IT WAS PREPARED AND ISSUED.
ALL DIMENSIONS SHOULD BE CHECKED ON SITE.
DO NOT SCALE FROM THIS DRAWING
ANY DRAWING ERRORS OR DIVERGENCIES SHOULD BE BROUGHT TO THE ATTENTION OF BUILDING DESIGN PARTNERSHIP AT THE ADDRESS SHOWN BELOW.
DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE FOLLOWING BEFORE WORK COMMENCES:
• THE CDM DESIGN ISSUES REGISTER
• THE BDP RISK SERIES OF DRAWINGS
• THE PROJECT CDM RISK REGISTER

Notes

P08	Planning Issue	JSMB	01.11.21
P07	Planning Draft Issue	JSMB	25.10.21
REVISION	DESCRIPTION	DRAWN / CHECKED	DATE

CLIENT

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PROJECT TITLE	Ferrous
REF. OR NUMBER	P3001911
DRAWING TITLE	GA Plan - Level 00 Ground Floor
SCALE	@ A1 1 : 100
DATE FIRST ISSUED	21.04.21
DRAWING NO.	BDP-FRS-XX-00-DR-A-200211
REVISION	P08

APPENDIX 02

Ground Gas Monitoring Results

SITE NAME:		FERROUS PHASE II				ENGINEER:		Jack Perkins				
CLIENT:		WML CONSULTING				DATE:		06/10/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Rising	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.6	0.0	0.0	0.0	0.0	0.0					
Finish		20.6	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	3.6	2.4	7.4	10.6	0.0	0.0	0.0	0.0	0.0036	0.0000	1014	-	N	N/A	N/A	1.98
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.9	2.1	15.6	17.3	0.0	0.0	0.0	0.0	0.0029	0.0000	1013	-	N	N/A	N/A	0.86
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.7	1.6	10.1	15.0	0.0	0.0	0.0	0.0	0.0027	0.0000	1013	-	N	N/A	N/A	1.05
Notes:																						

SITE NAME:		FERROUS PHASE II				ENGINEER:		Jack Perkins				
CLIENT:		WML CONSULTING				DATE:		24/10/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Steady	Weather:	Raining			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.8	0.0	0.0	0.0	0.0	0.0					
Finish		20.8	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	3.4	2.8	7.9	9.7	0.0	0.0	0.0	0.0	0.0034	0.0000	1003	-	N	N/A	N/A	1.94
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.6	2.6	15.8	16.8	0.0	0.0	0.0	0.0	0.0026	0.0000	1003	-	N	N/A	N/A	0.86
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.5	2.4	10.4	14.3	0.0	0.0	0.0	0.0	0.0025	0.0000	1003	-	N	N/A	N/A	1.01

Notes:

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SITE NAME:		FERROUS PHASE II				ENGINEER:		Jack Perkins				
CLIENT:		WML CONSULTING				DATE:		31/10/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Falling	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.3	0.0	0.0	0.0	0.0	0.0					
Finish		20.3	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	3.1	3.0	7.8	9.2	0.0	0.0	0.0	0.0	0.0031	0.0000	996	-	N	N/A	N/A	1.91
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.4	2.2	15.8	16.1	0.0	0.0	0.0	0.0	0.0024	0.0000	996	-	N	N/A	N/A	0.89
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.2	2.2	11.4	13.4	0.0	0.0	0.0	0.0	0.0022	0.0000	996	-	N	N/A	N/A	1.08

Notes:

PERMANENT GROUND GAS MONITORING FORM



SITE NAME:		FERROUS PHASE II				ENGINEER:		William Sandiford Mitchell				
CLIENT:		WML CONSULTING				DATE:		09/11/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Steady	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.7	0.0	0.0	0.0	0.0	0.0					
Finish		20.7	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.01	0.0	0.0	0.0	0.5	0.3	16.5	19.5	0.0	0.0	0.0	0.0	0.0005	0.0000	995	-	N	N/A	N/A	1.39
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.1	1.8	17.5	17.9	0.0	0.0	0.0	0.0	0.0021	0.0000	995	-	N	N/A	N/A	0.95
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.4	2.1	11.3	11.7	0.0	0.0	0.0	0.0	0.0024	0.0000	997	-	N	N/A	N/A	0.93
Notes:																						

SITE NAME:		FERROUS PHASE II				ENGINEER:		Jack Perkins				
CLIENT:		WML CONSULTING				DATE:		15/11/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Falling	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.5	0.0	0.0	0.0	0.0	0.0					
Finish		20.5	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	3.4	2.8	8.5	9.9	0.0	0.0	0.0	0.0	0.0034	0.0000	980	-	N	N/A	N/A	1.82
WS03	0.0	0.0	0.00	0.0	0.0	0.0	2.3	2.0	16.7	17.2	0.0	0.0	0.0	0.0	0.0023	0.0000	980	-	N	N/A	N/A	0.81
WS06	0.0	0.0	0.00	0.0	0.0	0.0	2.5	2.1	12.7	13.2	0.0	0.0	0.0	0.0	0.0025	0.0000	980	-	N	N/A	N/A	0.92
Notes:																						

GROUNDTECH
CONSULTING

SITE NAME:		FERROUS PHASE II				ENGINEER:		William Sandiford Mitchell				
CLIENT:		WML CONSULTING				DATE:		23/11/2022				
JOB NO:		GRO-21454										
Pressure Trend:		Falling	Weather:	Overcast			Equipment:		GFM 436			
Ambient:		O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)					
Start		20.8	0.0	0.0	0.0	0.0	0.0					
Finish		20.8	0.0	0.0	0.0	0.0	0.0					

BH Ref.	Gas Flow Rate (l/hr)		Borehole Pressure (mb)	Methane (%v/v)			Carbon Dioxide (%v/v)		Oxygen (%v/v)		Hydrogen Sulphide (ppm)		Carbon Monoxide (ppm)		Q _{hg} CO ₂ (l/hr)	Q _{hg} CH ₄ (l/hr)	Atmos Press (mb)	PID (ppm)	Sheen (Y/N)	LNAPL (Y/N)	DNAPL (Y/N)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady								
WS02	0.0	0.0	0.00	0.0	0.0	0.0	1.3	0.9	17.6	18.7	0.0	0.0	0.0	0.0	0.0013	0.0000	991	-	N	N/A	N/A	1.36
WS03	0.0	0.0	0.00	0.0	0.0	0.0	1.7	1.5	18.5	18.7	0.0	0.0	0.0	0.0	0.0017	0.0000	991	-	N	N/A	N/A	0.92
WS06	0.0	0.0	0.00	0.0	0.0	0.0	3.6	3.3	13.7	14.2	0.0	0.0	0.0	0.0	0.0036	0.0000	990	-	N	N/A	N/A	0.97

Notes:

APPENDIX 03

Calibration Certificates

TEST DATE AND CONDITIONS			
Date	6.4.22		
Atmospheric Pressure	977	mB	
Ambient Temperature	20.4	°C	
EnviroNics Serial No.	5089		

GAS DATA LTD Unit 4 Fairfield Court Seven Stars Estate Coventry CV3 4LJ UK +44 (0)24 7630 3311	 GAS DATA LISTEN · ANALYSE · INFORM
--	--

GFM436-1 OUTWARD INSPECTION & QUALITY CHECK SHEET

INSTRUMENT DETAILS			
SO Number	Instrument Type	Instrument Serial Number + SW Version	Job Number(s)
330761	GFM 436	12982 G436-27/10	123131

Calibration Technician J. [Signature]

Date 6.4.22

Inspection Technician [Signature]

Date 7.4.22

	INSTRUMENT CHECKS	Pass (P), Fail (F) or not applicable (NA)	INSTRUMENT PACKING LIST	Tick if included
Function Tests	Dust Caps Fitted	P	Instrument	✓
	Keyboard Test (All Keys)	P	Leather Case	✓
	Backlight	P	Instrument Strap	✓
	Clock Set / Running	P	AC Battery Charger (UK)	✓
	Comms Test	P	AC Battery Charger (EURO)	✓
	Pump Flow Test (In & Out)	P	AC Battery Charger (US)	✓
	Overall Leak Test (30mB)	n/a	AC Battery Charger (AUS)	✓
	Battery Charge Test	P	Gas Sample Pipe - (new issue)	✓
	Service Date set to?	6.4.23	Flow Sample Pipe - (new issue)	✓
Channel Tests	Data Logging Enabled?	P	Hard Carry Case	✓
	Verify CH4/LEL/Hexane/PID	P	Spares Pot	✓
	Verify CO2	P	Allen Key	✓
	Verify O2	P	Temperature Probe	✓
	Verify H2S	P	Vane Anemometer	✓
	Verify CO	P	USB Cable	✓
	Verify LEL	P	USB Memory stick	✓
	Verify 1 st Option Gas	N/A	SM V5 Software	Ver 6.05
	Verify Atmospheric pressure	P	Internal Filter Pack	Qty
	Verify differential pressure	P	External Filter Pack	Qty
	Verify flow	P	Field Guide	✓
	Verify temperature probe input	P	Extra Items: Sample Tube	
	Verify vane anemometer input	P		
		P		
DataBase Checks	Jobcard(s) completed and signed	P	Comments:	
	Jobcard(s) booked off database	P		
	Calibration certificate completed	P		
	Complete & print QI record	n/a		
Label Checks	No. of Calibration label fitted	GDC 11406		
	MCERTS label displayed	N/A		
	Warranty label fitted	P		
H2S Range	H2S Range from Sales Order	5000	ppm	
	H2S Range from Cal Cert	5000	ppm	
	Over-range value correct?	P		

TEST DATE AND CONDITIONS			
Date		06/04/2022	
Atmospheric Pressure Ambient Temperature Envionics Serial No.		977	mB
		20.4	°C
		5089	

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311



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Fax 02476307711

Customer	Groundtech Consulting
Certificate Number	123131
Order Number	330761

Serial Number	12982
Software Version	G436-00.0027/0010

Recalibration DUE Date
06/04/23

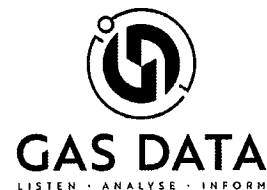
Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	450	Accept > 200 cc/min	Pump Flow @ -200mB	300	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	59.8	60	39.7	40	20.9	20.9
	Accept ±3.0		Accept ±3.0		Accept ±0.5	
	5.1	5	5.0	5	6.0	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N2	0.0	0	0.0	0	0.0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H2S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	1002	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

TEST DATE AND CONDITIONS	
Date	29/7/22
Atmospheric pressure	1004mb
Ambient Temp	24.2°C
Envionics Serial No.	2633

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Unit 4 Fairfield court
Seven Stars Estate
Coventry
CV3 4LJ, UK
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GFM436-1 FINAL INSPECTION & CALIBRATION CHECK CERTIFICATE

INSTRUMENT DETAILS	
Serial No	Customer
13516	Groundtech Consulting

INSTRUMENT CHECKS			
Keyboard	✓	Pump Flow	500cc/min
Display Contrast	✓	Pump Flow @ -200mB	350cc/min
Clock Set / Running	✓	S/W Version	G436.0029/0010
Labels Fitted	✓	Recalibration Date	29/7/23

GAS CHECKS							
Calibration Gas		Instrument Gas Channels Read					
Gas Type	Applied Conc.	CH4 (%)	tol. (% vol.)	CO2 (%)	tol. (% vol.)	O2 (%)	tol. (% vol.)
N2	100%	0.0	0.0	0.0	0.0	0.0	+/-0.1
CH4	5%	4.9	+/-0.3	0.0	0.0	0.0	+/-0.1
	60%	59.9	+/-3.0	0.0	0.0	0.0	+/-0.1
CO2	5%	0.0	0.0	4.9	+/-0.3	0.0	+/-0.1
	40%	0.0	0.0	39.8	+/-3.0	0.0	+/-0.1
O2	20.9%	0.0	0.0	0.0	+0.1	20.9	+/-0.5

OPTIONAL GAS CHECKS								
Calibration Gas		Instrument Gas Channels Read						
Gas Type	Applied Conc.	Label	H2S	CO			Hexane	tol. (% vol.)
		Range	5000ppm	2000ppm			2.00%	
N2	100%		0	0			0.000	0.0
H2S	1500ppm		1510	0				+/- 5.0
CO	1000ppm		80	1002				+/- 5.0
Hexane	2.00%						1.895	+/- 10.0

PRESSURE CHECKS							
Calibration Pressure		Instrument Pressure Channels Read					
Pressure @	Applied Pressure	Atmospheric [Ap] (mB)	tol. (mB)				
All Ports	Current Atmospheric	1004	+/-2.0				
Ap Port (Internal)	+800mB(a)	802	+/-5.0				
	+1200mB(a)	1198	+/-5.0				

TEST DATE AND CONDITIONS	
Date	29/7/22
Atmospheric pressure	1004mb
Ambient Temp	24.2°C
Enviroics Serial No.	2633

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Seven Stars Estate	
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GFM436-1 FINAL INSPECTION & CALIBRATION CHECK CERTIFICATE

FLOW CHECKS					
Calibration Flow		Instrument Flow Channels Read			
Applied Flow (l/hour)	Applied Pressure (Pa)	Flow [Flow] (l/hour)	tol. (l/hour)	Differential Pressure [Dp] (Pa)	tol. (Pa)
-30.0	-420	-29.1	+/-3.0	-404	+/-50
-3.0	-19	-2.8	+/-1.0	-18	+/-6
0.0	0	0.0	0.0	0	0.0
+3.0	15	3.0	+/-0.5	14	+/-3
+30.0	345	29.5	+/-3.0	339	+/-50
+60.0	1076	59.1	+/-6.0	1053	+/-130
+90.0	2156	90.2	+/-9.0	2216	+/-250

TEMPERATURE CHECK		
Calibration Temperature	Instrument Temperature Channel Read	
Applied Equivalent Temperature (°C)	Temperature [Temp] (°C)	tol. (°C)
-10.0	-11.5	+/- 2.0
0.0	-0.5	+/- 1.0
30.0	30.0	+/- 1.0
60.0	60.0	+/- 1.0
100.0	99.5	+/- 1.0

Notes:

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015, BS EN ISO 14001:2015 and BS EN ISO 45001:2018 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated. The results displayed on the instrument at each stage are recorded above.

Gas Data Ltd is certified to: BS EN ISO 9001:2015
BS EN ISO 14001:2015
BS EN ISO 45001:2018

APPENDIX 04

Soil Assessment Criteria

Site Specific Assessment Criteria for Residential (without homegrown produce) assuming a 1% SOM for hydrocarbons

Contaminant	Assessment Criteria for Residential (without homegrown produce) (mg/kg)
Metals	
Arsenic	40
Boron	11,000
Cadmium	85
Chromium III	910
Chromium VI	6
Copper	7,100
Lead*	310
Mercury	1.2
Nickel	180
Selenium	430
Vanadium	1,200
Zinc	40,000
Non – Metals	
Phenol	440 ^{dir} (460)
Polyaromatic Hydrocarbons (PAH)	
Benzo[a]anthracene	11
Benzo[a]pyrene	3.2
Benzo[b]fluoranthene	3.9
Benzo[ghi]perylene	360
Benzo[k]fluoranthene	110
Chrysene	30
Dibenz[ah]anthracene	0.31
Fluoranthene	1,500
Indeno[123-cd]pyrene	45
Naphthalene	2.3
Pyrene	3,700

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* Where not included in the S4UL's criteria for a limited number of contaminants, namely lead, have been derived by DEFRA in their document entitled SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, April 2014.

Contaminant	Criteria (mg/kg)
Volatile Organic Compounds – (VOCs) 1% SOM	
Benzene	0.38
Ethylbenzene	83
Toluene	880 ^{vap} (869)
Xylene	79
1,2-Dichloroethane	0.0092
1,1,1-Trichloroethane	9.0
Tetrachloroethane	3.9
Tetrachloroethene (PCE)	0.18
Tetrachloromethane	0.026
Trichloroethene (TCE)	0.017
Trichloromethane	1.2
Vinyl Chloride	0.00077
Semi-Volatile Organic Compounds (SVOCs) 1% SOM	
1,2-Dichlorobenzene	24
1,4-Dichlorobenzene	61
1,2,4-Trichlorobenzene	2.6
Hexachlorobenzene	4.1(0.2) ^{vap}
Total Petroleum Hydrocarbons – TPH	
Aliphatic C5-6	42
Aliphatic C6-8	100
Aliphatic C8-10	27
Aliphatic C10-12	130(48) ^{vap}
Aliphatic C12-16	1,100(24) ^{sol}
Aliphatic C16-35	65,000(8.48) ^{sol}
Aliphatic C35 - 44	65,000(8.84) ^{sol}
Aromatic C5 – 7 (benzene)	370
Aromatic C7 – 8 (toluene)	860
Aromatic C8-10	47
Aromatic C10-12	250
Aromatic C12-16	1,800
Aromatic C16-21	1,900
Aromatic C21-35	1,900
Aromatic C35 - 44	1,900

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