Ground Gas Addendum Report
South Heywood
Phase 6

Reference:13-417-R4-1
Date: March 2021

GROUND GAS ADDENDUM REPORT

Phase 6 – South Heywood Development Area
Land off Hareshill Road
Heywood
OL10 2TD

Prepared for:
Russell Homes

Report Ref: 13-417-R4-1
Date Issued: March 2021

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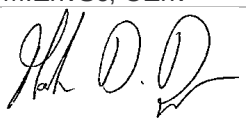
SIGNATURE			
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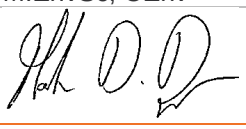
SIGNATURE			

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1. INTRODUCTION

1.1. BACKGROUND

E3P has previously completed a ground investigation on the site located off Hareshill Road in Heywood. The findings of the ground investigation are presented within the E3P report entitled Phase II, Geo-environmental Site Assessment (report ref: 13-417-R1-1, September 2019).

During the investigation E3P installed ground gas monitoring wells, which were to be monitored over a period of six months after installation. The data collected from the gas monitoring wells are summarised in this report and this comprises the completed ground gas assessment.

1.2. PROPOSED DEVELOPMENT

E3P understands that Russell Homes have been granted Outline Planning Consent for a strategic mixeduse development that will comprise a 2.2km link road, residential housing and commercial / industrial land use.

Russell Homes intend to develop the phase 6 development area which is located in the central eastern sector of the wider development for a residential end use comprising a series of low rise dwellings with associated private garden and landscaped areas, public open space, estate roads and infrastructure. The majority of the proposed development will be to the south of Hareshill Road, with a few dwellings to the east and one to the west of the existing residential property and gardens located to the north of Hareshill Road.

A snapshot of the proposed development layout is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.3. OBJECTIVES

The objectives of the ground gas addendum report are to provide a detailed assessment of ground gas risk based on all available data from the E3P ground investigation works.

1.4. LIMITATIONS

The limitations of this report are presented in Appendix I.

1.5. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.

2. INVESTIGATION RATIONALE

The Initial Conceptual Site Model has identified that the underlying Made Ground may represent a potential source of ground gas generation. Ground conditions are discussed in more detail in Section 3. Based on the identification of these sources, E3P has determined that the site represents a low to moderate ground gas source generation potential.

Within the context of the proposed residential end use and ground gas generation potential, the gas assessment requires that nine visits are required over six months, with at least two sets of readings at low or falling atmospheric pressure as set out within CIRIA 665 Tables 5.5a and 5.5b.

The spacing requirements for monitoring wells are detailed within CIRIA 665 Table 4.2, which indicates that for low gas hazard sites (Made Ground with limited degradable material, organic clay of limited thickness) and a high sensitivity development, nominal well spacing should be between 25 m and 50 m.

TABLE 2.1 GROUND GAS MONITORING LOCATION RATIONALE

LOCATION	GROUND GAS SOURCE	DEPTH OF MONITORING WELL (m)
WS101	Natural Strata (CLAY)	0.50–3.00
WS102	Natural Strata (CLAY & SAND)	0.50–4.00
WS103	Natural Strata (CLAY & SAND)	0.50–3.00
WS104	Natural Strata (CLAY & SAND)	0.50–4.00
WS105	Natural Strata (CLAY & SAND)	0.50–3.00
WS106	Natural Strata (CLAY & SAND)	0.50–4.00

2.1. MONITORING METHODOLOGY

Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) were measured using an infra-red gas analyser (GFM435) calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 60 seconds at each location, at which point the maximum concentration of CH_4 and CO_2, together with the lowest concentration of O_2 were recorded. The results of the ground gas monitoring are presented in Table 2.2.

TABLE 2.2 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	DATE	CH_4 INITIAL (%V/V)	CH_4 STEADY (%V/V)	CH_4 GSV (l/hr)	CO_2 INITIAL (%V/V)	CO_2 STEADY (%V/V)	CO_2 GSV (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	31/5/19	0.1	0.1	0.0001	4.2	4.2	0.0042	17.1	1005	Falling	0.10	0.50–3.00	2.42	1.31
	13/6/19	0.1	0.1	0.0001	3.9	3.9	0.0051	17.3	1004	Falling	0.13		2.41	1.29
	11/7/19	0.1	0.1	0.0001	1.7	1.7	0.0017	19.6	994	Steady	0.10		2.40	0.93
	2/8/19	0.1	0.1	0.0001	2.1	2.1	0.0027	19.4	1002	Steady	0.13		2.40	0.99
	30/8/19	0.1	0.1	0.0003	2.4	2.4	0.0062	19.1	1006	Falling	0.26		2.40	1.02
	26/9/19	0.1	0.1	0.0005	2.6	2.6	0.0135	18.7	1010	Rising	0.52		2.40	0.84
	14/10/19	0.1	0.1	0.0027	3.6	3.6	0.0972	18.9	987	Falling	2.70		2.20	0.56
	4/11/19	0.1	0.1	0.0034	**5.7**	**5.7**	0.1955	18.7	966	Rising	3.43		2.15	GL
	19/11/19	0.1	0.1	0.0028	**5.1**	**5.1**	0.1428	18.9	972	Falling	2.80		2.19	GL
WS102	31/5/19	0.1	0.1	0.0001	1.8	1.8	0.0018	18.9	1005	Falling	0.10	0.50–4.00	2.00	1.60
	13/6/19	0.1	0.1	0.0003	1.5	1.5	0.0039	19.1	1004	Falling	0.26		2.00	1.58
	11/7/19	Monitoring Well Damaged												
	2/8/19													
	30/8/19													
	26/9/19													
	4/11/19													
	4/11/19													
	19/11/19													

WELL	DATE	CH_4 INITIAL (%V/V)	CH_4 STEADY (%V/V)	CH_4 GSV (l/hr)	CO_2 INITIAL (%V/V)	CO_2 STEADY (%V/V)	CO_2 GSV (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS103	31/5/19	0.1	0.1	-0.0013	3.6	3.6	-0.0479	17.1	1005	Falling	-1.33	0.50–3.00	1.75	1.26
	13/6/19	0.1	0.1	-0.0005	3.1	3.1	-0.0152	17.6	1004	Falling	-0.49		1.75	1.30
	11/7/19	0.1	0.1	0.0014	3.0	3.0	0.0432	18.6	994	Steady	1.44		1.98	1.40
	2/8/19	0.1	0.1	0.0013	2.8	2.8	0.0353	19.1	1002	Steady	1.26		1.90	1.42
	30/8/19	0.1	0.1	0.0011	3.0	3.0	0.0336	19.3	1006	Falling	1.12		1.91	1.46
	26/9/19	0.1	0.1	0.0009	2.6	2.6	0.0234	19.1	1010	Rising	0.9		1.84	1.34
	14/10/19	0.1	0.1	0.0005	**5.8**	**5.8**	0.0302	12.8	987	Falling	0.52		1.60	0.34
	4/11/19	0.1	0.1	0.0014	**7.2**	**7.2**	0.1037	11.8	966	Rising	1.44		1.56	0.29
	19/11/19	0.1	0.1	0.0010	**6.9**	**6.9**	0.0662	11.9	972	Falling	0.96		1.57	0.27
WS104	31/5/19	0.1	0.1	0.0009	1.3	1.3	0.0114	19.3	1005	Falling	0.88	0.50–4.00	2.56	2.09
	13/6/19	0.1	0.1	0.0005	1.4	1.4	0.0073	19.2	1004	Falling	0.52		2.55	2.10
	11/7/19	0.1	0.1	0.0011	1.6	1.6	0.0179	19.8	994	Steady	1.12		2.60	2.15
	2/8/19	0.1	0.1	0.0017	1.2	1.2	0.0209	19.7	1002	Steady	1.74		2.59	2.20
	30/8/19	0.1	0.1	0.0013	1.1	1.1	0.0147	19.8	1006	Falling	1.34		2.30	2.21
	26/9/19	0.1	0.1	0.0009	1.2	1.2	0.0106	19.9	1010	Rising	0.88		2.32	2.30
	14/10/19	0.1	0.1	0.0029	2.1	2.1	0.0609	17.9	987	Falling	2.9		2.49	0.71
	4/11/19	0.1	0.1	0.0037	2.7	2.7	0.0991	17.4	966	Rising	3.67		2.45	0.62
	19/11/19	0.1	0.1	0.0029	2.4	2.4	0.0706	17.8	972	Falling	2.94		2.46	0.54

WELL	DATE	CH_4 INITIAL (%V/V)	CH_4 STEADY (%V/V)	CH_4 GSV (l/hr)	CO_2 INITIAL (%V/V)	CO_2 STEADY (%V/V)	CO_2 GSV (l/hr)	O_2 (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS105	31/5/19	0.1	0.1	0.0001	1.0	1.0	0.0010	19.5	1005	Falling	0.1	0.50–3.00	1.95	1.83
	13/6/19	0.1	0.1	0.0001	0.8	0.8	0.0010	19.6	1004	Falling	0.13		1.95	1.80
	11/7/19	0.1	0.1	0.0001	0.7	0.7	0.0007	19.7	994	Steady	0.1		1.95	1.74
	2/8/19	0.1	0.1	0.0001	0.9	0.9	0.0009	19.6	1002	Steady	0.1		1.95	1.76
	30/8/19	0.1	0.1	0.0001	0.8	0.8	0.0010	19.8	1006	Falling	0.13		1.95	1.80
	26/9/19	0.1	0.1	0.0003	0.6	0.6	0.0016	19.8	1010	Rising	0.26		1.94	1.69
	14/10/19	Monitoring Well Damaged												
	4/11/19													
	19/11/19													
WS106	31/5/19	0.1	0.1	0.0001	1.2	1.2	0.0016	19.4	1005	Falling	0.13	0.50–4.00	2.27	1.23
	13/6/19	0.1	0.1	0.0003	1.1	1.1	0.0029	19.5	1004	Falling	0.26		2.26	1.21
	11/7/19	0.1	0.1	0.0001	1.0	1.0	0.001	20.1	994	Steady	0.1		2.26	0.95
	2/8/19	0.1	0.1	0.0005	0.9	0.9	0.0047	20.2	1002	Steady	0.52		2.25	0.99
	30/8/19	0.1	0.1	0.0003	1.3	1.3	0.0034	19.7	1006	Falling	0.26		2.26	1.07
	26/9/19	0.1	0.1	0.0001	0.9	0.9	0.0012	20.1	1010	Rising	0.13		2.25	0.89
	14/10/19	0.1	0.1	0.0019	0.7	0.7	0.0136	19.9	987	Falling	1.94		2.15	0.49
	4/11/19	0.1	0.1	0.0026	0.5	0.5	0.0128	20.2	966	Rising	2.55		2.10	0.33
	19/11/19	0.1	0.1	0.0017	0.8	0.8	0.0138	19.9	972	Falling	1.73		2.14	0.41

NOTES

NHBC Traffic Light System		Typical Max CH4 Concentration	GSV CH4	Typical Max CO2 Concentration	GSV CO2
	Amber 1	1	0.16-0.63	5	0.78-1.56
	Amber 2	5	0.63-1.56	10	1.56-3.13
	Red	20	1.56+	30	3.13+

Values in **BOLD** exceed Amber 1 Thresholds
Values in BLUE denote water above monitoring well

3. GROUND GAS RISK ASSESSMENT

3.1. GROUND GAS RISK ASSESSMENT METHODOLOGY

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 – *Assessing risks posed by hazardous ground gases to buildings* (2007). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

CIRIA C665 and NHBC Report No 10627-R01 provide assessments for carbon dioxide and methane based upon gas screening values (GSVs) utilising flow rates and concentrations. The site-based GSVs for steady state methane and carbon dioxide are based upon the following equation:

$$GSV = \frac{concentration\ (by\ vol)}{100} \times flowrate\ (1\ /\ hr)$$

The GSVs within CIRIA C665 are based upon all buildings other than standard residential houses. The NHBC GSVs are based upon standard residential houses with precast concrete floors (block and beam). The CIRIA 665 report author (Steve Wilson) since provided further clarification regarding which guidance should be adopted for residential houses that have suspended cast in-situ concrete floor slab: for the avoidance of doubt, it was confirmed that the GSVs within the CIRIA 665 guidance should be adopted.

The thresholds for GSVs based upon NHBC guidance are provided within Table 3.1.

TABLE 3.1 RESIDENTIAL THRESHOLDS FOR GAS SCREENING VALUES (GSV) IN ACCORDANCE WITH NHBC REPORT NO 10627-R01 – RESIDENTIAL END USE

NHBC – SUBFLOOR VOID				
CLASSIFICATION	**Methane[1]**		**Carbon Dioxide[1]**	
	TYPICAL MAXIMUM CONCENTRATION[3] (%V/V)	**GAS SCREENING VALUE [2,4] (l/hr)**	**TYPICAL MAXIMUM CONCENTRATION[3] (%V/V)**	**Gas Screening Value[2,4] (l/hr)**
Green	< 1	< 0.16	< 5	< 0.78
Amber 1	< 5	< 0.63	< 10	< 1.56
Amber 2	< 5	< 1.56	< 30	< 3.10
Red	> 20	> 1.56	> 30	> 3.10

Notes
1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worstcase temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated;
2. Gas Screening Value is the Borehole Gas Volume Flow Rate, in litres per hour, as defined in Wilson and Card (1999), which is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered;
3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so;
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.

3.1.1. SOURCES OF GROUND GAS

The Phase I report and subsequent ground investigation has identified the following potential sources of ground gas:

- Localised Made Ground deposits;
- Coal Measures.

3.1.2. GROUNDWATER

WS101, WS103 and WS106 were flooded towards the end of the monitoring period, therefore the results can be discounted.

Within the monitoring wells, groundwater levels were observed to fluctuate over the monitoring period, with levels generally increasing over the monitoring period. The greatest groundwater change occurred within WS104 where levels increased by 1.55 m over the monitoring period.

3.1.3. GAS FLOW

During the monitoring a positive flow was noted in all monitoring wells. The measure of positive flow is considered to be the result of groundwater fluctuations and flooding of the well causing compression – as opposed to gas generation – as the highest flows are recorded during periods of high groundwater levels.

Negative flows are indicative of back pressure from wind being greater than the active flow from the wells. Negative flows were recorded in WS103.

3.1.4. GAS CONCENTRATIONS

The maximum concentration of methane within all monitoring wells was 0.1 % v/v.

Carbon dioxide concentrations were recorded within all the monitoring wells at concentrations ranging from 0.5 % v/v to 7.2 % v/v (WS103). The maximum carbon dioxide levels were also associated with low oxygen concentrations.

3.1.5. GAS ASSESSMENT

In accordance with the methodology outlined with the CIRIA publication C665, E3P have utilised the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 3.2.

TABLE 3.2 GAS RISK PROFILE AND LOCATION

LOCATION	MAX CH_4 (% v/v)	GSV (l/hr)	MAX CO_2 (% v/v)	GSV (l/hr)	CLASSIFICATION
WS101	0.1	0.0034	4.2	0.0972	Green/CS1
WS102	0.1	0.0003	1.8	0.0039	Green/CS1
WS103	0.1	0.0014	3.6	-0.0479	Green/CS1
WS104	0.1	0.0037	2.7	0.0991	Green/CS1
WS105	0.1	0.0003	1.0	0.0016	Green/CS1
WS106	0.1	0.0026	1.3	0.0138	Green/CS1

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

The marginally elevated carbon dioxide concentrations in WS101 and WS103 towards the end of the monitoring period coincide with flooding of the monitoring wells, therefore it is considered that the elevated readings are due to groundwater causing compression in the well and these can be discounted. When the monitoring wells were not flooded, no concentrations of carbon dioxide were recorded above the threshold of 5% v/v.

The GSV, even when considering the exaggerated carbon dioxide concentrations meets the threshold for Green. In addition, no significant ground gas source has been identified.

Therefore, it is considered that the site can be classified as CS1/Green and gas protection measures will not be required in the construction of new dwellings.

END OF REPORT

APPENDIX I
LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

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

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

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

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

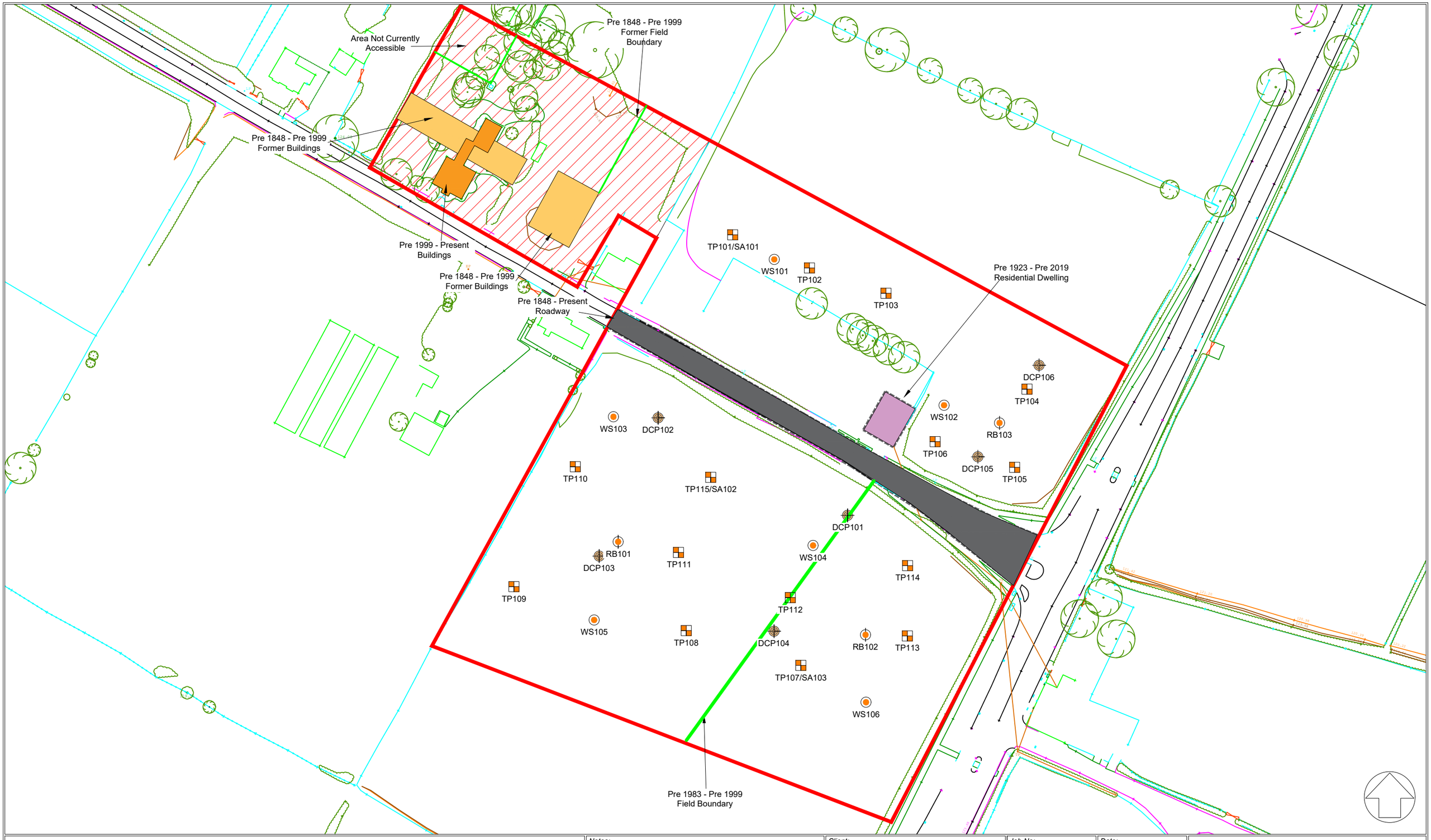
APPENDIX II
GLOSSARY

TERMS

ACM	Asbestos-containing material	**MMP**	Materials management plan
ADS	Acoustic design statement	**ND**	Not detected
AST	Above-ground storage tank	**NDP**	Nuclear density probe
BGS	British Geological Survey	**NMP**	Noise management plan
BSI	British Standards Institute	**NPSE**	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	**NR**	Not recorded
CA	Coal Authority	**PAH**	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	**PCB**	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	**PI**	Plasticity index
CIRIA	Construction Industry Research Association	**PID**	Photo ionisation detector
CLEA	Contaminated land exposure assessment	**POS**	Public open space
CML	Council of Mortgage Lenders	**PPE**	Personnel protective equipment
CoC	Contaminants of concern	**ProPG**	Professional practice guidance
CSM	Conceptual site model	**QA**	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	**SGV**	Soil guideline value
DWS	Drinking water standard	**SPH**	Separate-phase hydrocarbon
EA	Environment Agency	**SPT**	Standard penetration test
EQS	Environmental quality standard	**SVOC**	Semi-volatile organic compound
FFL	Finished floor level	**TPH**	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	**UKWIR**	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	**UST**	Underground storage tank
HCV	Health criteria value	**VCC**	Vibro-concrete column
ICSM	Initial conceptual site model	**VOC**	Volatile organic compound
LEL	Lower explosive limit	**VRSC**	Vibro-replacement stone columns
LMRL	Lower method reporting limit	**VSC**	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	**WHO**	World Health Organisation
MCV	Moisture condition value	**WRAP**	Waste and Resources Action Programme

MIBK	Methyl isobutyl ketone	**WTE**	Water table elevation
m	Metres	**ppm**	Parts per million
km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	Kilonewtons per metre squared
ppb	Parts per billion	**µm**	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	**SSRT**	Site Specific Remediation Target
PSD	Particle Size Distribution	**DD**	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	**Mc**	Moisture Content
ρ	Bulk Density	**GPR**	Ground Penetrating Radar
NDP	Nuclear Density Probe	**FFL**	Finished Floor Level
LEL	Lower Explosive Limit	**UKWIR**	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	**LOD**	Limit of Detection

APPENDIX III
DRAWINGS



Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Soakaway Test Location
- Approximate Rotary Borehole Location
- Approximate Dynamic Cone Penetrometer Test Location
- Area Not Currently Accessible

Historical Features

- Roadway
- Former Buildings
- Former Field Boundaries
- Former Buildings
- Former Buildings

Notes:

Phase	Revision	Date	Issue	Drawn	Checked
P1	R3	23.03.2021	Revision	HM	MD
P1	R2	04.11.2019	Revision	HM	NS
P1	R1	16.07.2019	Revision	HM	NS
P1	-	10.07.2019	Draft	CB	NS

Client: Russell Homes

Job No: 13-417

Date: 23.03.2021

Drawing No: 004

Scale: NTS @ A3

Job Title: South Heywood - Phase 6

Drawing Title: Exploratory Hole Location Plan

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