GEOLOGICAL
GEOTECHNICAL
GEOENVIRONMENTAL
DATA ACQUISITION
CONSULTANCY



Rotary & Ground Gas Monitoring Site Investigation Report

LOCATION	19 Church Street, Rhos, Wrexham, LL14 2BN
ISSUE DATE	June 2025
FOR	A Richards c/o Glyn Roberts Associates
CLIENT REF.	-
OUR REF.	G25148a

Prepared by

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Table of Contents

1. Introduction 1

2. Scope of Rotary & Ground Gas Monitoring Investigation 2

2.1 Scope of Works 2

2.2 Sampling Rationale 2

3. Rotary & Ground Gas Monitoring Investigation Findings 2

3.1 Ground Conditions 2

3.2 Conclusions with Respect to Mining Risk 3

3.3 Ground Gas Monitoring 3

3.4 Hazardous Ground Gas 4

Appendix 1 – Site Plans and Exploratory Hole Logs

Appendix 2 – Site Photos

1. Introduction

In accordance with your instruction, Geoinvestigate Limited has carried out an intrusive site investigation at 19 Church Street, Rhos, Wrexham, LL14 2BN.

No Phase 1 Desk Study has previously been completed for the site, but preliminary research found:

- The site is currently concreted car parking to front and soft landscaped grass.
- The most likely potential source of hazardous gas risk to the site and proposed development comprises potential made ground within the site itself, deeper infilled ground within or close to the site, and potential shallow historical coal mining activity.
- BGS records show the site not to have any recorded superficial deposits.
- BGS recorded show the site to be underlain by the Pennine Lower Coal Measures of mudstone, siltstone, sandstone at the west of the site and sandstone to the east.

A Coal Mining Risk Assessment CMRA has been carried out by Geoinvestigate for the site (Ref: G23279, July 2023), which details past mine workings beneath the site within the Ruabon Yard (Soft 5 Quarters) at 81m depth with an extraction thickness of 100cm. The Coal Authority (CA) places the site within and area of probable, unrecorded, shallow mine workings (i.e., less than 30m depth).

Within the CMRA, Geoinvestigate's opinion was to agree with the CA stating that further shallower mine workings may be present, and intrusive investigations were recommended.

The CA report identifies five mine entries in the vicinity of the property. The nearest (329346-570) and (329346-278) lie 28m and 35m from the site. These are at sufficient distant, in our opinion, to not impact ground stability in the development area. However, their proximity raises further concern about shallow mine working at this locality.

This CMRA has indicated that conditions may exist at this site increasing mine gas risk namely the possible presence of shallow mine working beneath the site and the proximity of several mine entries.

It is proposed to construct a new residential development at the site with associated soft landscaping (including private gardens) and hardstanding parking. The boundary of the current study area and the proposed developmental layout are presented on the site plan included within Appendix 1 of this report.

The purpose of this intrusive investigation has been to establish the true nature of the ground conditions at the site with regard to the potential hazardous gas and unrecorded coal seam risks, and to investigate the potential for SuDS by testing the soil permeability.

Investigation of contamination and geotechnical risks were not within the scope of these investigation works, nor was consideration of slope stability or, sinkhole risk.

Information with regard to infiltration testing can be found in our Infiltration Testing Report G25148.

2. Scope of Rotary & Ground Gas Monitoring Investigation

2.1 Scope of Works

Given the above, the following investigation was carried out to assess the potential risks to the proposed development:

- Three (3) boreholes (ref. BH1 to BH3) were undertaken at the site to depths of between 3.10m and 3.40m below ground level (bgl) with logging and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were commenced using windowless sampling techniques with a Dando Terrier 2002 mini drilling rig.

- Two (2) rotary open hole boreholes (ref. RH1 & RH2) were undertaken to depths of 30.00mbgl, under licence (Permit 29939) from the Coal Authority, to probe for shallow mine workings. The boreholes were commenced using the Geoinvestigate Microdrill® system with water flush.

- The installation of three (3) ground gas monitoring wells in boreholes BH1, BH2 and BH3 with allowance for up to six (6) gas monitoring visits over a period of up to three (3) months (if appropriate), including readings below 1000mb and where possible following a sharp drop in atmospheric pressure.

- Provision of a factual and interpretative report including site plan, borehole logs, ground gas monitoring results and information on the coal mining situation at the site.

The borehole positions are shown on the plan provided in Appendix 1.

The excavations were logged at site by a geoenvironmental engineer and the ground conditions encountered are described on the borehole logs also provided in Appendix 1.

2.2 Sampling Rationale

The borehole positions were chosen to give an indication of the potential gas risk throughout the proposed foundation area of the new dwelling.

3. Rotary & Ground Gas Monitoring Investigation Findings

3.1 Ground Conditions

3.1.1 Windowless Sample Boreholes

The ground conditions were relatively uniform across the site and comprised topsoil underlain by made ground underlain by strata predominantly comprising highly weathered mudstone with sandstone gravel, and small inclusions of coal. Sandstone cobbles were noted at

The made ground comprised highly weathered mudstone with gravel constituents of brick and pot. This stratum was encountered to depths of between 0.40mbgl (BH2) and 1.20mbgl (BH3).

3.1.2 Rotary Open Hole Boreholes

The findings of the CMRA report necessitated that rotary open hole boreholes be sunk at the site as part of this investigation to explore for possible shallow coal workings. These were drilled using the Geoinvestigate custom-built and trademarked Microdrill system, a lightweight tracked drilling rig which uses water flush.

Two (2) holes were drilled to depths of 30.00mbgl (RH1 & RH2) and logs of the findings are presented in Appendix 1.

The rock descriptions are tentative and generally based on the contents of returned water flush, drilling progress (speed of advance) and water pressures observed during drilling; no cores were recovered from the boreholes to verify these though at several times during excavation the drill-string is withdrawn from the ground to inspect the composition of the build-up on the drill bit.

Gas monitoring was undertaken during and following drilling. No hazardous gas concentrations were detected. The boreholes were sealed rapidly on completion, following drilling.

The rotary boreholes encountered very similar conditions with rockhead at depths between 2.10mbgl and 2.30mbgl initially comprising yellowish/brown mudstone becoming grey from 5.10mbgl. This is underlain by grey siltstone from 6.70mbgl to 16.60mbgl. Below this a 1.30m (RH1) & 1.20m (RH2) thick horizon of very weak shaley, poor quality coal is present, underlain by grey mudstone which extends to 23.40mbgl which is further underlain by grey siltstone to termination at 30.00mbgl.

Full water flush was maintained throughout the 30.00m and no voids/worked ground was encountered.

3.2 Conclusions with Respect to Mining Risk

The Coal Mining Risk Assessment highlighted a moderate risk due to a possibly worked coal seam (Main Seam) which is inferred to be potentially between 3.00m and 10.00mbgl. Given the poor quality of the coal encountered, it is considered that this is unlikely to have been subject to any extraction and no voiding, indicative of mining evident.

Given that this deposit / poor quality seam is shown as being intact each of the boreholes, it is considered to be unworked beneath the site. In this case, even if the coal had been subject to working, based on the 10x seam thickness rule of thumb of competent rock cover above the seam, then the site would be deemed safe from any future collapse of these workings, given that there is at least >14m of unbroken rock cover has been confirmed.

Given the above findings, no mitigation in the form or foundation design or drilling and grouting is required at the site, with regard to the coal mining legacy at the site.

3.3 Ground Gas Monitoring

3.3.1 Gas Regime

Given the potential presence of potential shallow historical coal mine workings, and the potential for sources of ground gas deep infilled ground at nearby sites, a ground gas monitoring exercise has been

undertaken at the site to quantify the risk in this regard. Gas monitoring wells were installed in boreholes BH1, BH2 and BH3.

The results of two (2) initial gas monitoring visits at the site are presented in Table 3 below. A further set of up to four measurements are required to complete the gas risk assessment at the site. These will be provided in a separate addendum once completed.

Table 3: Summary of Gas Monitoring Data

Job Number	G25148
Client	G Roberts / A Richards
Site	19 Church Street, Rhos, LL14 2BN

	CH_4 (%)	CO_2 (%)	O_2 (%)
Mininum	0	0.1	15.2
Maximum	0	1.2	15.9

Borehole	Number of Visits	CH_4 (%)		CO_2 (%)		O_2 (%)		Flow Rate (l/hr)	H_2S (ppm)	CO (ppm)	Atmospheric Pressure (mb)
		Min.	Max.	Min.	Max.	Min.	Max.				
1	2	0	0	1	1.2	15.2	15.8	<0.1	0	0	989
2	2	0	0	0.5	0.9	15.6	15.9	<0.1	0	0	to
3	2	0	0	0.1	0.2	15.6	15.9	<0.1	0	0	1027

The gas monitoring visit carried out to date at atmospheric pressures of 973mb to 992mb returned:

- Consistently low levels of CO_2.
- Consistently negligible levels of CH_4.
- Near-normal oxygen levels.
- Consistently negligible H_2S and CO levels below detectable limits (<1ppm).
- Consistently negligible flow rates below detectable limits (<0.1 l/hr).

3.3.2 Radon Gas

The online map viewer at ukradon.org outlines the highest risk in a 1km grid square as 10% - 30% of properties affected which would require **Full Radon Protective Measures,** however, an address-specific report might offer more refined information and therefore potentially lower the inferred potential risk level. It is recommended that a radon report is ordered for the site, which may reduce the level of protection required at the site.

3.4 Hazardous Ground Gas

Ground gas monitoring is ongoing at the site with two of a potential six monitoring visits having been undertaken to date. The monitoring undertaken to date has returned no significantly elevated levels of hazardous gas and negligible gas flow rates (below detectable limits). Readings have been taken at low atmospheric pressure and in a period of high atmospheric pressure.

Based the data gathered to date, the site is expected to fall into Characteristic situation 1 (CS1) of the Modified Wilson and Card classification or “Green” of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665). If the continued monitoring returns comparable data, no ground gas protection (other than Radon Protection) will be required in the new building(s). No final decision should be made without further monitoring, however.

Note that these conclusions are provisional and that the gas monitoring exercise is not yet completed, with only two of a possible six sets of readings gathered to date. Final recommendations regarding gas protection will be issued in due course in a Gas Monitoring Addendum Report following completion of the gas monitoring exercise.

No hydrocarbon vapour protection is expected to be necessary for the new development.

END OF REPORT

The findings and contents of this (intrusive) Site Investigation Report pertain solely to the study area(s) outlined herein and are based solely on the findings of the excavations undertaken as part of the current exercise unless otherwise stated. The findings and/or recommendations of this report do not consider any ground conditions that may be present but have hitherto not been encountered and as such further investigation and/or a reconsideration of the findings of this report should be undertaken if such conditions are subsequently encountered or an alternative development plan or land use is subsequently proposed.

This report considers various environmental and/or geological risks posed to the site and/or proposed development and offers advice accordingly as guidance only. The findings of this report will remain valid provided no change of ground or groundwater conditions, either natural or anthropogenic, take place and no warrantee is offered or implied.

No copying of this report or any part of its contents is permitted without written permission of Geoinvestigate Ltd. nor should the report be made available to any third party without similar prior arrangement.

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APPENDIX 1

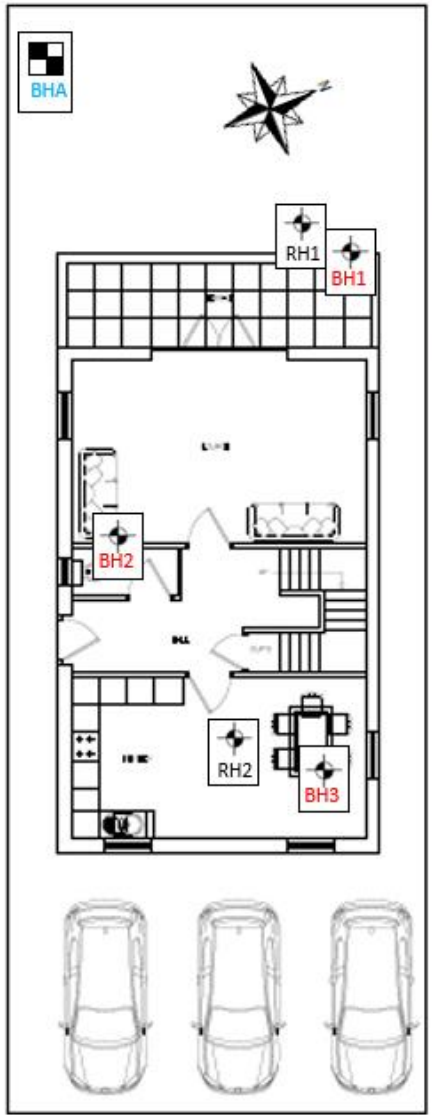
Site Plans

and

Exploratory Hole Logs

GEOINVESTIGATE Ltd.

OUR REF: G25148	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE:20/05/2025	LOCATION: 19 Church Street, Rhos, LL14 2BN	





Key:

- BH1 — Borehole location with gas well
- BHA — Borehole for soakaway testing
- RH1 — Deep Rotary Probe Drilling

GEO INVESTIGATE

Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location: 19 Church Street, Rhos, LL14 2BN
Comments: Borehole for soakaway testing

BHA
Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

Depth (m)	Description of Strata	Thick -ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF AND TOPSOIL brown sandy, very gravelly clay. Gravel is fine brick and sandstone	200				Cv kN/m^2			0.25
0.60	MADE GROUND grey slightly clayey, gravelly, highly weathered mudstone. Gravel is fine to coarse pot	400							0.50
	Grey mottled orange highly weathered MUDSTONE. Recovered as gravel.								0.75
									1.00
									1.25
		1400							1.50
	Inclusion of coal at 1.60m								1.75
2.00	Inclusion of coal at 2.00m								2.00
	Borehole terminated at 2.00m for soakaway testing								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 2.00 mbgl
Borehole remained open and dry on completion

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BHA

GEO INVESTIGATE
Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location: 19 Church Street, Rhos, LL14 2BN
Comments:

BH 1
Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPTN Value (Depth)	Depth to Water	Depth (m)
0.20	TURF AND TOPSOIL brown, sandy, gravelly clay. Gravel is fine to coarse sandstone and pot	200				Cv kN/m^2			0.25
0.60	MADE GROUND grey, gravelly, highly weathered mudstone recovered as gravel. Gravel of coarse pot	400							0.50
1.00	Grey mottled orange highly weathered MUDSTONE recovered as gravel	400							0.75
1.80	Grey mottled black highly weathered MUDSTONE Coal inclusion at 1.50m	800							1.00 1.25 1.50 1.75
2.00	Grey mottled orange highly weathered MUDSTONE	200							2.00
3.40	Light brown and orange gravelly, highly weathered MUDSTONE. Gravel is coarse and cobbles of sandstone	1400							2.25 2.50 2.75 3.00 3.25 3.40
	Borehole terminated at 3.40m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.40 mbgl
Borehole remained open and dry on completion
Gas well installed to 3.40m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH 1

GEO INVESTIGATE
Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location:
Comments:

BH 2
Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPTN Value (Depth)	Depth to Water	Depth (m)
	TURF AND TOPSOIL brown sandy, gravelly clay. Gravel is fine to coarse brick, pot and sandstone	400				Cv kN/m^2			0.25
0.40									0.50
	Grey highly weathered MUDSTONE								0.75
	Coal inclusion at 0.80m	1400							1.00
									1.25
									1.50
1.80	Coal inclusion at 1.80m								1.75
	Orange slightly gravelly highly weathered MUDSTONE recovered as clay. Gravel is fine to coarse weathered mudstone	1200							2.00
									2.25
									2.50
									2.75
3.00									3.00
	Orange clayey highly weathered MUDSTONE recovered as gravel. Cobbles of sandstone noted	400							3.25
3.40									3.40
	Borehole terminated at 3.40m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.40 mbgl
Borehole remained open and dry on completion
Gas well installed to 3.40m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH 2

GEO INVESTIGATE
Borehole Log

Client Ref:
Our Ref: G25148
Date: 20/05/2025
Location:
Comments:

BH 3
Sheet No 1 of 1
Drilled by: CM/JP
Logged by: CM

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	TURF AND TOPSOIL brown sandy, gravelly, clay. Gravel is fine to coarse brick and mudstone	200				Cv kN/m²			0.25
1.20	MADE GROUND Grey mottled black, gravelly, highly weathered mudstone. Gravel is fine brick	1000							0.50 0.75 1.00
1.80	Orange mottled brown slightly gravelly, hightly weathered MUDSTONE recovered as clay. Gravel is fine to coarse coal and sandstone	600							1.25 1.50 1.75
3.10	Grey mottled orange highly weathered MUDSTONE Sandstone cobbles present	1300							2.00 2.25 2.50 2.75 3.00 3.10
	Borehole terminated at 3.10m due to refusal								

Remarks:
Casing to 1.00m
Dynamic windowless sampling by Terrier Rig to 3.10 mbgl
Borehole remained open and dry on completion
Gas well installed to 3.10m with gas bung and cover

Key:
Slotted Pipe
Plain Pipe
Bentonite
Gravel Filter

O Disturbed sample
Cv Shear vane
W Water sample
S Standard Penetration Test
C Cone Penetration Test

BH 3

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 1

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
2.10	TURF / brown DRIFT.	2,100			
6.40	Light yellowish brown MUDSTONE. >Becoming grey from 4.90m	4,300			2.50 5.00
16.50	Grey SILTSTONE.	10,100			7.50 10.00 12.50 15.00
17.80	Darl grey SHALEY COAL / COALEY SHALE. Very weak.	1,300			17.50
23.10	Grey MUDSTONE.	5,300			20.00 22.50
	Grey SILTSTONE. Rotary hole continued on page 2	6,900			25.00

Remarks:

Casing to 3.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 1

Drilled by: AM
Logged by: AM

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 1

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
	Grey SILTSTONE.	6,900			27.50
30.00				Full Flush	30.00
	Rotary hole terminated at 30.00m				

Remarks:

Casing to 3.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 1

Drilled by: AM
Logged by: AM

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 2

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
2.30	TURF / brown DRIFT.	2,300			2.50
6.70	Light yellowish brown MUDSTONE. >Becoming grey from 5.10m	4,400			5.00
16.60	Grey SILTSTONE.	9,900			7.50 10.00 12.50 15.00
17.80	Dark grey SHALEY COAL / COALEY SHALE. Very weak.	1,200			17.50
23.40	Grey MUDSTONE.	5,600			20.00 22.50
	Grey SILTSTONE. Rotary hole continued on page 2	6,600			25.00

Remarks:

Casing to 2.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 2

Drilled by: AM
Logged by: AM

GEO INVESTIGATE

Rotary Borehole Log

Client Ref:
Our Ref: G25148
Date: 13/06/2025
Location: 19 Church Street, Rhos LL14 2BN
Comments:

RH 2

Sheet No 1 of 2

Depth (m)	Description of Strata	Thick -ness	Legend	Flush	Depth (m)
	Grey SILTSTONE.	6,600			27.50
30.00				Full Flush	30.00
	Rotary hole terminated at 30.00m				

Remarks:

Casing to 2.00m
Microdrill rotary open hole borehole to 30.00 m
No cores recovered from borehole
No gas detected from borehole on completion
Full flush maintained. No voids encountered.

RH 2

Drilled by: AM
Logged by: AM

Mining Remediation Authority

Permit to Enter or Disturb Mining Remediation Authority Interests

Permit 29939

Name and Address of Permit Holder:

Complete Soft Play Services
Unit B Coppi Industrial Estate
Rhos
LL14 1TJ

Site Location:

Land at 19 Church Street
Rhos
LL14 2BN

This certificate hereby grants the above named Permit Holder a Permit to carry out:-

Ground investigation by two boreholes to 30m to determine presence of shallow mine workings

within the Authority's interests at the identified site location above as shown on the Grant Permit Boundary (overleaf) for the period of **12 months** from the granted date shown below. *The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Permit Holder's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.*

Conditions:

- *Manned entry (i.e.) into mine entries/workings) is strictly prohibited.*
- *Water flush*
- *Gas Monitoring CO, CH_4, CO_2, O_2, H_2S at borehole and rig*
- *Operators undertaking the work must be in possession of this certificate and the Permit boundary plan at the time of works*
- *Appropriate borehole sealing without delay and to withstand site level changes*

Signed: [redacted] Granted Date: ***3rd June 2025***

For and on behalf of the Mining Remediation Authority

Nominated Representative: Amy McKenna, Permitting Manager;

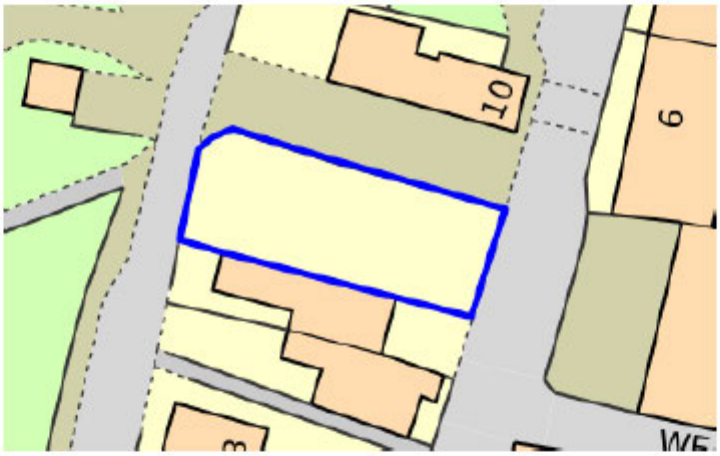
Mining Remediation Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG
Tel: 01623 637450; E-Mail: permissions@coal.gov.uk

Mining Remediation Authority

Granted Permit Boundary

Permit Ref: 29939

Permit Boundary:



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The Mining Remediation Authority is the trading name of the Coal Authority ('TCA') established pursuant to Section 1 of the Coal Industry Act 1994, of 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG. The Coal Authority remains the legal name of the Authority

APPENDIX 2

Site Photos








Oriental