



GROUNDTECH
CONSULTING

Job title: Whitworth Road, Rochdale

Report type: Permanent Ground Gas Risk
Assessment

Prepared for: Cornerstone Place

Date: August 2022

Document Control Form	
PROJECT	WHITWORTH ROAD, ROCHDALE
REPORT NAME	PERMANENT GROUND GAS RISK ASSESSMENT
REPORT REFERENCE	GRO-22083-3813
STATUS	FINAL
ISSUE DATE	15 AUGUST 2022
REVISION	
CLIENT	CORNERSTONE PLACE
CLIENT CONTACT	DAVID BALL
For and Behalf of Groundtech Consulting	
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Introduction

We are pleased to present our findings following the completion of the gas monitoring programme undertaken at the above site for the proposed residential development.

Preliminary Risk Assessment Information

A Phase 1 Geo-Environmental Desk Study was carried out by PG Consulting, referenced *PGC 388* and dated 9th February 2022.

Historical mapping indicates that residential properties were located across all three sites from 1858. By 1982 these are all been demolished and replaced with a children's play area, garages and car parking. These are still present to this day.

The Groundsure report has identified 5 No. active or recent landfills and 4 No. historic landfill within 500m of the site. The closest being 178m to the east.

Made Ground and the historic uses in the area associated with historical groundworks represent a potential source of hazardous ground gases. Carbon dioxide and methane are associated with asphyxiation and explosive risks. Installation of monitoring wells during intrusive ground investigation is recommended to assess for the presence of ground gases and facilitate further risk assessment.

Ground Model

Made Ground

Made Ground was recorded at the site to depths of between 0.8m and 2.5m bgl.

The surfacing across each of the three plots comprised tarmac (WS02, WS05, TP06), paving slabs and reworked dark brown clayey sandy gravelly topsoil including brick to a maximum depth of 0.46m bgl.

Two main Made Ground populations were encountered during the investigation and are described below:

- *Firm dark brown mottled grey sandy gravelly clay including sandstone and brick at depths between 0.1m and 2.5m bgl in all exploratory hole locations.*
- *Light grey gravelly sand was observed locally within TP06 at a depth of 0.1m to 0.35m bgl.*

The Made Ground was not bottomed out in TP04 and TP05 (Block B) due to the presence of the relic substructure comprising a historic basement. Additionally, it was not fully penetrated in WS05 (Block C) where a refusal was obtained at 2.35m bgl in the Made Ground clay.

Natural Ground

One main natural stratification was encountered during the investigation and comprised firm, firm to stiff and stiff medium to high strength brown mottled grey variably gravelly sandy silty Clay at depths between 0.8m and 4.4m bgl within all exploratory hole locations except for TP04, TP05 and WS05 where the Made Ground was not fully penetrated.

Soft Clay was locally encountered in WS01 at 3.0m bgl.

Bedrock

Bedrock consisting of extremely weak yellow orange residually weathered Sandstone was observed during the Ground Investigation from depths of between 2.1m and 4.4m bgl. The bedrock was not encountered in the trial pits.

Groundwater

Groundwater strikes were encountered during the Ground Investigation at depths of between 2.0m and 3.2m bgl within the natural Clay.

The exploratory hole positions are shown on the Exploratory Hole Location Plan *GRO-22083-P02*, and the exploratory logs are appended.

Gas Monitoring

During the Ground Investigation works, monitoring standpipes were installed in the following holes and a summary of the installations is provided in the table below.

Location	Depth (m bgl)	Response Zone (m bgl)	Targeted Strata	Reason
WS01	4.0	1.0 – 4.0	Made Ground/ Natural Clay	Ground Gas
WS03	3.0	1.0 – 3.0	Made Ground/ Natural Clay	Ground Gas
WS04	3.0	1.0 – 3.0	Made Ground/ Natural Clay	Ground Gas
WS05	2.0	1.0 – 2.0	Made Ground	Ground Gas
WS01	4.0	1.0 – 4.0	Made Ground/ Natural Clay	Ground Gas

The standpipes consisted of polyvinyl chloride (pvc) pipe - a bentonite seal was placed around the plain pipe and a clean gravel pack was placed around the slotted pipe.

Six ground gas monitoring visits have been completed between 31st March and 6th July 2022. Monitoring of the weather conditions and predicted atmospheric pressures (Met Office Surface Pressure Charts) was carried out up to 72 hours in advance of proposed monitoring visits in order that a reasonable period of data was obtained to determine atmospheric trends, and also to target the 'worst case' scenario.

Permanent gas and flow rate monitoring was carried out using a GFM436 infrared gas monitor with integral electronic flow analyser. The measurements taken are listed below:

- Oxygen (O₂), carbon dioxide (CO₂) and methane (CH₄) as the percentage volume in air (%v/v).
- Hydrogen sulphide (H₂S) and carbon monoxide (CO) as the percentage volume in air (%v/v).
- Lower Explosive Limit (% LEL) of methane.
- Atmospheric and borehole pressure, including pressure trend.
- Flow measurements (l/hr).
- Weather and ground surface conditions.

Both peak and steady state conditions were monitored to understand the behaviour of the permanent ground gas, the steady state conditions were recorded by allowing the gas monitor to run for a minimum of 3 minutes.

Permanent gas and groundwater monitoring results are appended.

Gas Monitoring Results

During the monitoring period, no concentrations of methane (CH₄) have recorded within the standpipes. However, detectable levels of carbon dioxide (CO₂) were recorded up to a maximum level of 2.0% v/v together with associated depleted oxygen (O₂) concentrations (minimum 16.9% v/v).

No positive flow rates were recorded within any of the standpipes.

Groundwater levels were recorded within WS01 and WS05 ranging from 1.54m to 3.21m bgl during the monitoring period and were not above the response zone of the standpipes. This appears to be characteristic of the site as perched groundwater was encountered at depths of between 2.0m and 3.2m bgl in several of the exploratory holes advanced as part of the Ground Investigation.

The atmospheric pressure ranged between 991mb and 1007mb during the monitoring period and was carried out during periods of steady and falling barometric pressure.

Characterisation of the Gas Screening Value (GSV)

In accordance with CIRIA Report C665, November 2007 it is felt that an adequate risk assessment can be undertaken based on the following limiting factors:

- *The proposed development has been considered as **moderate sensitivity** based on the site being developed with residential apartments (Table 5.5 – Typical/Idealised frequency and period of monitoring, after Wilson et al, 2005).*
- *The risk associated with the generation potential of a source is considered as **very low**, (assessment based on the environmental setting) as well as observations noted during the fieldworks.*
- *No flow rates have been recorded (Table 8.5 – Modified Wilson & Card classification) For this site, two of the monitoring visits were targeted to correlate with a falling atmospheric pressure trend. As a comparison, monitoring has also been undertaken during steady and rising atmospheric pressure trend.*

Based upon the results recorded, in accordance with CIRIA Report C665, the risk to the site from ground gases has been assessed by converting the results to gas screening values (GSVs), calculated by multiplying the typical maximum gas concentrations with the recorded maximum positive flow rates. In addition, individual “hazardous gas flow rates” (Q_{hg}) have been derived for each monitoring point. As no levels of methane have been recorded a GSV for carbon dioxide only has been calculated.

$$GSV (l/hr) = \text{max borehole flow rate (l/hr)} \times \text{max gas concentration (\%)}$$

For this assessment, the maximum recorded concentration of carbon dioxide of 2.0% v/v has been used. As no positive gas flow rates have been recorded, the limit of detection of the gas analyser of 0.1 l/hr has been used to calculate the GSVs.

$$\text{Carbon Dioxide GSV} = 0.02 (2.0\%) \times 0.1 = 0.002 \text{ l/hr}$$

Assessment

Made Ground was encountered beneath the entire site to a maximum depth of 2.5m bgl and generally appeared to be inert.

No methane has been detected and a maximum concentration of carbon dioxide of 2.0% v/v has been recorded. The low concentrations of carbon dioxide are likely to be associated with the Made Ground deposits.

In order to assess the ground gas regime beneath the site and the need to incorporate ground gas precautions, guidance was taken from CIRIA C665 ‘Assessing risks posed by hazardous ground gases to buildings’. Based on

the site being developed with apartments, the Wilson and Card method has been used to carry out the assessment.

When considering the results, in accordance with CIRIA C665 (Section A Development and Table 8.5 – Modified Wilson and Card Classification) it can be seen that the GSV values for methane and carbon dioxide correspond with CS1 criteria (GSV of less than 0.07 l/hr) and gas protection measures are not required.

Characteristic Situation 1

An extract of the table is presented below.

Modified Wilson and Card classification

	Characteristic situation (CIRIA R149)	Comparable classification in DETR et al (1999)	Risk classification	Gas screening value (GSV) (CH ₄ or CO ₂) (l/hr) ¹ Threshold	Additional factors	Typical source of generation
	1	A	Very low risk	<0.07	Typically methane <1 % and/or carbon dioxide <5 %. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
	2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
	3	C	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
	4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mineworking – susceptible to flooding, completed landfill (WMP 26B criteria)
	5	E	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
	6	F	Very high risk	>70		Recent landfill site

Table 8.5 – Modified Wilson and Card Classification

The proposed apartments are classified as a Building Type A in accordance with BS8485:2015 and the site falls in CS1 in accordance with Table 2 of the above guidance and as such, 0 points of protection are required for the proposed development and no gas protection measures are deemed necessary.

Radon Gas

The Phase 1 Geo-Environmental Desk Study was carried out by PG Consulting states that the site is not in a radon affected area, and no radon protection measures are required in new buildings constructed at the site.

Conclusions

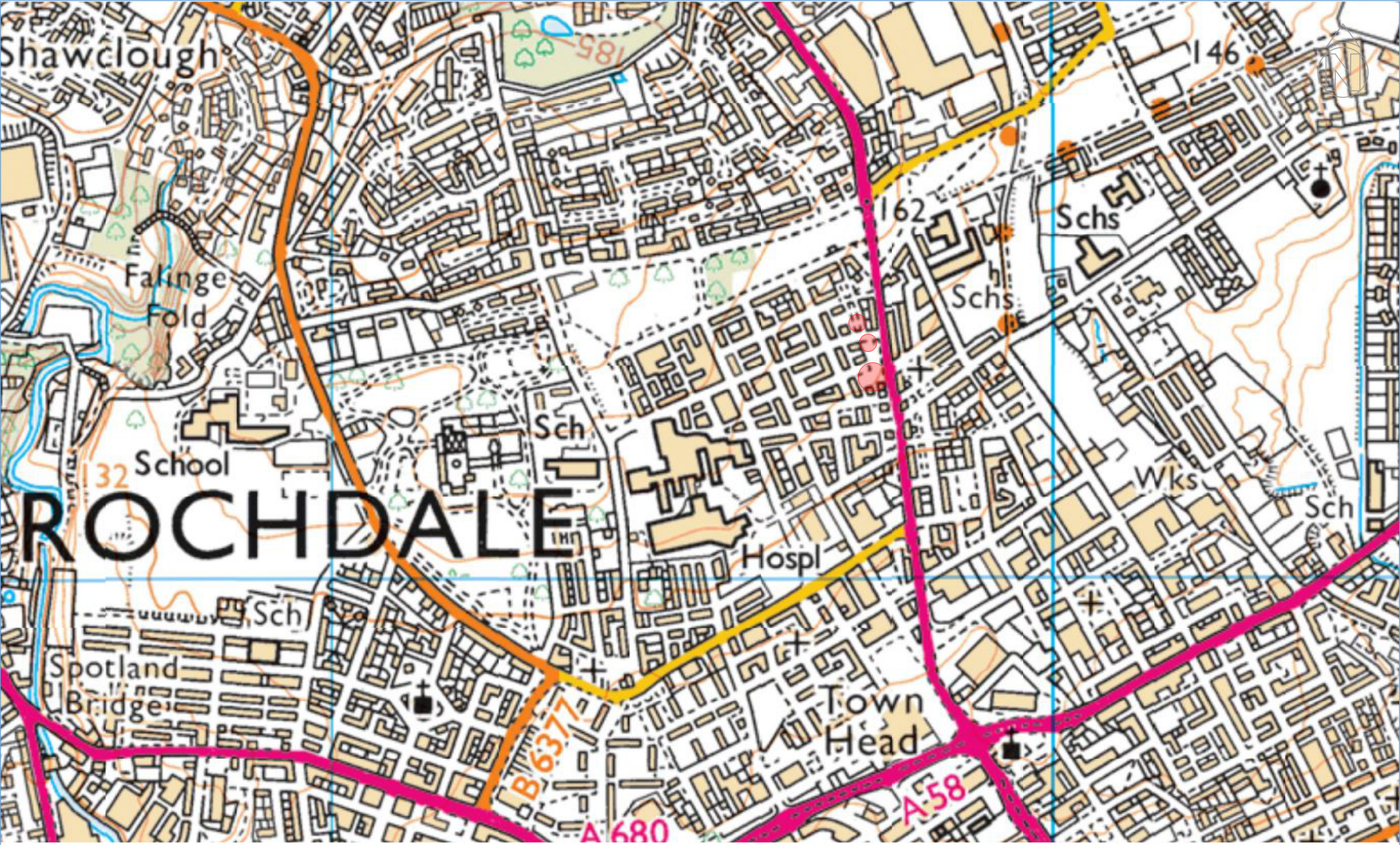
No gas protection measures are required within the proposed apartments at the site.

No radon precautions are necessary.



It is recommended that confirmation of these findings is made with the Local Authority prior to any irrevocable action being taken.

PLANS



GROUNDTECH CONSULTING	CLIENT CORNERSTONE PLACE	DATE JUNE 2022				Status Preliminary Draft Issued For Comment Approved		Notes SITE LOCATION
	PROJECT TITLE WHITWORTH ROAD, ROCHDALE	SCALE NTS						
	PLAN TITLE PROJECT LOCATION PLAN	PLAN NUMBER GRO-22083-P01						
			Rev.	Details	Date			







EXPLORATORY HOLE LOGS



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Borehole Log

Borehole No.

WS01

Sheet 1 of 1

Project Name: WHITWORTH ROAD

Project No.
GRO-22083

Co-ords: -

Hole Type
WS

Location: ROCHDALE

Level:

Scale
1:25

Client: CORNERSTONE PLACE

Dates: 16/03/2022 -

Logged By
DR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.20			MADE GROUND: Dark brown clayey sandy gravelly topsoil. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including brick.	
		0.30	ES					MADE GROUND: Firm brown mottled grey sandy gravelly clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and brick.	
		1.00	ES						1
		1.20		N=22 (3,4/7,7,5,3)					
		1.50	ES						
		2.00	D		2.00			Firm dark brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone.	2
		2.00	ES	N=12 (2,4/3,3,3,3)					
		2.10							
		3.00	D					Becoming soft from 3.0m bgl.	3
		3.00		N=3 (0,0/0,1,1,1)					
		4.00	D					Becoming firm to stiff from 4.0m bgl.	4
		4.00		N=14 (2,2/3,3,4,4)					
					4.40 4.45			Extremely weak yellow orange SANDSTONE residually weathered recovered as sandy gravel. End of borehole at 4.45 m	5

Remarks

1. Location cleared for utilities. 2. Hand dug inspection pit to 1.2m bgl. 3. Groundwater encountered at 2.0m bgl. 4. Installation to 4.0m bgl, 1.0m plain 3.0m slotted.





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Borehole Log

Borehole No.

WS02

Sheet 1 of 1

Project Name: WHITWORTH ROAD

Project No.
GRO-22083

Co-ords: -

Hole Type
WS

Location: ROCHDALE

Level:

Scale
1:25

Client: CORNERSTONE PLACE

Dates: 16/03/2022 -

Logged By
DR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Tarmac.	
		0.50	ES					MADE GROUND: Firm brown mottled grey sandy gravelly clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and brick.	1
		1.00	ES						
		1.20		N=12 (3,3/3,3,3,3)					
		1.50	ES						
		2.00	ES					Firm medium strength dark brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone.	2
		2.00		N=16 (3,3/4,4,4,4)					
		2.40	ES		2.30				
		2.55 - 3.00	U						
		3.00		N=13 (1,2/3,3,3,4)	3.00			NO RETURN.	3
		4.00		N=50 (5,10/50 for 90mm)	4.00			Stiff dark brown sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone.	4
					4.10				
		4.30	D		4.30			Extremely weak yellow orange SANDSTONE residually weathered recovered as sandy gravel. End of borehole at 4.30 m	5

Remarks

1. Location cleared for utilities. 2. Hand dug inspection pit to 1.2m bgl. 3. Groundwater encountered at 3.0m bgl. 4. Borehole backfilled with arisings.





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Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: WHITWORTH ROAD

Project No.
GRO-22083

Co-ords: -

Hole Type
WS

Location: ROCHDALE

Level:

Scale
1:25

Client: CORNERSTONE PLACE

Dates: 16/03/2022 -

Logged By
DR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES	N=7 (0,0/0,1,2,4)	0.30			MADE GROUND: Dark brown clayey sandy gravelly topsoil. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including brick.	1
		0.40	ES					MADE GROUND: Firm brown mottled grey sandy gravelly clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and brick.	
		1.00	ES						
		1.20							
		1.55 - 2.00	U						
		2.00	D	N=22 (1,3/5,5,6,6)	2.00			Firm dark brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone.	2
		2.00	ES						
		2.00							
		3.00	D	N=50 (5,7/50 for 235mm)	3.00			Extremely weak yellow orange SANDSTONE residually weathered recovered as sandy gravel.	3
		3.00							
		3.30 - 3.45	D		3.35			End of borehole at 3.35 m	4
									5

Remarks

1. Location cleared for utilities. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Refusal on sandstone bedrock at 3.35m bgl. 5. Installation to 3.0m bgl, 1.0m plain 2.0m slotted.





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Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: WHITWORTH ROAD

Project No.
GRO-22083

Co-ords: -

Hole Type
WS

Location: ROCHDALE

Level:

Scale
1:25

Client: CORNERSTONE PLACE

Dates: 16/03/2022 -

Logged By
DR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.20			MADE GROUND: Dark brown clayey sandy gravelly topsoil. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including brick.	
		0.60	ES		0.50			MADE GROUND: Dark brown black fine to coarse sand and subangular to subrounded gravel of mixed lithologies including brick.	
		1.00	D					MADE GROUND: Firm brown mottled grey sandy gravelly clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and brick.	
		1.00	ES						
		1.20		N=15 (2,4/4,4,4,3)	1.30				
		1.55 - 2.00	U					Firm high strength dark brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone.	
		2.00	D						
		2.00		N=9 (2,2/2,2,2,3)					
		3.00	D						
		3.00		N=50 (1,2/50 for 235mm)	3.10				
		3.35	D		3.35			Extremely weak yellow orange SANDSTONE residually weathered recovered as sandy gravel.	
								End of borehole at 3.35 m	

Remarks

1. Location cleared for utilities. 2. Hand dug pit to 1.2m bgl. 3. No groundwater encountered. 4. Refusal on sandstone bedrock at 3.35m bgl. 5. Installation to 3.0m bgl, 1.0m plain 2.0m slotted.





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Borehole Log

Borehole No.

WS05

Sheet 1 of 1

Project Name: WHITWORTH ROAD

Project No.
GRO-22083

Co-ords: -

Hole Type
WS

Location: ROCHDALE

Level:

Scale
1:25

Client: CORNERSTONE PLACE

Dates: 16/03/2022 -

Logged By
DR

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.20			MADE GROUND: Tarmac.	
								MADE GROUND: Dark brown black fine to coarse sand and subangular to subrounded gravel of mixed lithologies including brick.	
								<i>Brick cobbles between 0.5m and 1.0m bgl.</i>	
		1.10 1.20	ES	N=3 (1,2/0,0,1,2)	1.00			MADE GROUND: Firm brown mottled grey sandy gravelly clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies including sandstone and brick.	1
		1.50	ES						
		2.00 2.00	D	N=50 (5,10/50 for 235mm)	2.35			End of borehole at 2.35 m	2
									3
									4
									5

Remarks

1. Location cleared for utilities. 2. Hand dug inspection pit to 1.2m bgl. 3. No groundwater encountered. 4. Refusal on sandstone bedrock at 2.35m bgl. 5. Installation to 2.0m bgl, 1.0m plain 1.0m slotted.





GROUND GAS MONITORING RESULTS

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Pressure Trend:	Falling	Weather:	Sunny			Equipment:	GFM 436
Ambient:	O ₂ (%v/v)	CH ₄ (%v/v)	CO ₂ (%v/v)	LEL	H ₂ S (ppm)	CO (ppm)	
Start	20.4	0.0	0.0	0.0	0.0	0.0	
Finish	20.4	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)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
WS01	0.0	0.0	0.00	0.0	0.0	0.0	0.5	0.2	19.6	20.0	0.0	0.0	0.0	0.0	0.0005	0.0000	994	-	N	NGW
WS03	0.0	0.0	0.00	0.0	0.0	0.0	0.7	0.0	19.6	20.0	0.0	0.0	0.0	0.0	0.0007	0.0000	994	-	N	NGW
WS04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	19.8	19.8	0.0	0.0	0.0	0.0	0.0000	0.0000	994	-	N	1.58
Notes: Unable to locate WS04.																				

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Pressure Trend:	Steady	Weather:	Sunny			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	0.0	0.0	0.0	0.0	0.0		
Finish	20	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)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
WS01	0.0	0.0	0.00	0.0	0.0	0.0	1.5	1.4	16.9	17.5	0.0	0.0	0.0	0.0	0.0015	0.0000	1000	-	N	NGW
WS03	0.0	0.0	0.00	0.0	0.0	0.0	0.7	0.3	19.2	19.7	0.0	0.0	0.0	0.0	0.0007	0.0000	1000	-	N	NGW
WS04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.2	0.0	19.4	19.8	0.0	0.0	0.0	0.0	0.0002	0.0000	1000	-	N	1.54
Notes: Unable to locate WS04.																				

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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	20.1	0.0	0.0	0.0	0.0	0.0	
Finish	20.1	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)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
WS01	0.0	0.0	0.00	0.0	0.0	0.0	1.5	0.8	17.5	18.7	0.0	0.0	0.0	0.0	0.0015	0.0000	1002	-	N	3.18
WS03	0.0	0.0	0.00	0.0	0.0	0.0	0.6	0.3	19.6	19.9	0.0	0.0	0.0	0.0	0.0006	0.0000	1002	-	N	NGW
WS04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.0	0.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0000	0.0000	1001	-	N	1.57
Notes: Unable to locate WS04.																				

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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	20.1	0.0	0.0	0.0	0.0	0.0	
Finish	20.1	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)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
WS01	0.0	0.0	0.00	0.0	0.0	0.0	1.4	1.3	17.7	17.9	0.0	0.0	0.0	0.0	0.0014	0.0000	991	-	N	3.16
WS03	0.0	0.0	0.00	0.0	0.0	0.0	0.7	0.5	19.2	19.5	0.0	0.0	0.0	0.0	0.0007	0.0000	991	-	N	NGW
WS04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	NA
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.6	0.5	18.9	19.1	0.0	0.0	0.0	0.0	0.0006	0.0000	991	-	N	1.55
Notes: Unable to locate WS04.																				

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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	20.8	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)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
WS01	0.0	0.0	0.00	0.0	0.0	0.0	2.0	0.9	18.1	19.6	0.0	0.0	0.0	0.0	0.0020	0.0000	1001	-	N	3.17
WS03	0.0	0.0	0.00	0.0	0.0	0.0	0.7	0.5	20.3	20.6	0.0	0.0	0.0	0.0	0.0007	0.0000	1001	-	N	NGW
WS04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A
WS05	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.3	19.6	19.8	0.0	0.0	0.0	0.0	0.0005	0.0000	1001	-	N	1.61
Notes:																				

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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	20.7	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)	Depth to Water (m bgl)
	Peak	Steady		Peak	Steady	LEL	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady						
WS01	0.0	0.0	0.00	0.0	0.0	0.0	1.7	1.7	18.7	18.7	0.0	0.0	0.0	0.0	0.0017	0.0000	1007	-	N	3.21
WS03	0.0	0.0	0.00	0.0	0.0	0.0	0.7	0.7	19.8	20.3	0.0	0.0	0.0	0.0	0.0007	0.0000	1007	-	N	NGW
WS04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	N/A
WS05	0.0	0.0	0.00	0.0	0.0	0.0	0.4	0.2	20.3	20.5	0.0	0.0	0.0	0.0	0.0004	0.0000	1007	-	N	1.56
Notes:																				



LIMITATIONS

Limitations

This report (Report) forms part of the Services and if applicable Additional Services undertaken by Groundtech Consulting Ltd pursuant to a written contract (Agreement) which contains detailed provisions including express limitations of the liability of Groundtech Consulting Ltd.

This Report was prepared using reasonable skill and care as stated in the Agreement for the purpose including intended end use stated by the Client (Purpose) and the liability of Groundtech Consulting Ltd in respect of the form and content of this Report is no greater than its liability under the Agreement. All records, measurements notes, or any other data (Data) obtained by or for the benefit of the Consultant were obtained at a specific point in time and it may not be assumed by the Client or any person relying on this Report that the Data will remain unaffected by the passage of time, the seasons, weather conditions, changes in the water table or the carrying out and completion of works at the Site.

Unless otherwise agreed this Report has been prepared exclusively for the use and reliance of the Client and may not be relied upon, by any other party except as provided for in the Agreement. A third party who relies on this Report, does so at their own and sole risk and Groundtech Consulting Ltd has no liability to such parties.

Groundtech Consulting Ltd that this Report is to be used for the Purpose. The Purpose was instrumental in determining the scope and of the Services provided. If the Purpose should change, the Client may not be able to rely on the Report without the separate agreement of Groundtech Consulting Ltd.

Since the Report was written, later changes in legislation, statutory requirements and industry best practices have not been considered and this should be allowed for. Ground conditions can also change (see below) and should be investigated if there is any significant delay in acting on the findings of this Report. The period of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the Report inaccurate or unreliable. The information and conclusions in this Report should not be relied upon in the future without written confirmation from Groundtech Consulting Ltd that it is safe to do so.

The observations and conclusions outlined in this Report are based exclusively on the services that were provided as set out in the agreement between the client and Groundtech Consulting Ltd.

Groundtech Consulting Ltd is not liable for the existence of any condition, the discovery of which would require additional investigation outside the agreed scope of works or core competency. The Report is based upon Groundtech Consulting Ltd's observations of existing physical conditions at the Site gained from site reconnaissance together with interpretation of information including documentation, obtained from third parties and from the Client on the history and usage of the Site. The findings and recommendations contained in this Report are based in part upon information provided by third parties, and Groundtech Consulting Ltd have relied upon such information assuming it to be correct.

Groundtech Consulting Ltd accepts no responsibility for errors or inaccuracies in third party information presented in this Report. Groundtech Consulting Ltd was not authorised to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services or Additional Services. Groundtech Consulting Ltd is not liable for any inaccurate information, misrepresentation of data or conclusions, which may inform the scope of investigation undertaken by Groundtech Consulting Ltd and forms the contract with the client.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions may also vary due to the ground's heterogeneous properties and because investigation exploratory locations only allow examination of the ground at discrete

locations. The potential exists for ground conditions to be encountered which are different to those considered in this Report, particularly between exploratory holes. The extent of the limited area depends on the soil and groundwater conditions, together with other constraints such as the position of any existing structures and underground utilities. If so stipulated in the Agreement, geo-environmental testing was carried out for a limited number of parameters based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

Any groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The groundwater level often has not had time to reach equilibrium and a monitoring period is required. Furthermore, groundwater levels are subject to seasonal variation or changes in local drainage conditions and groundwater levels may occur at other times of the year which are higher than were recorded during this investigation.

Any site drawings provided in this Report are preliminary and used to present the general relative locations of features on, and surrounding, the Site.

