

25th January 2024

Mr. P. Sinclair
Technical Director
Westchurch Homes
Kennedy House
31 Stamford Street
Altrincham
WA14 1ES



APP/T4210/W/22/3308871

Technical Note 003: Mitigation measures for shallow ground water

There is a planning condition (18) that relates to the drainage investigations and preliminary engineering works to investigation ground water flows feeding Starmont reservoir and the upper fishing lodge. The condition requires that if shallow groundwater is encountered then suitable mitigation measures for groundwater are proposed.

For ease of reference condition (18) is below: -

Condition (18)

18) Prior to the commencement of development, a scheme of intrusive site drainage investigations and preliminary engineering works to investigate ground water flows feeding Starmont reservoir and springs in the vicinity of the proposed swale, including the timing of such works, shall be submitted to and approved in writing by the local planning authority. A report of the findings of such investigations shall be submitted to the local planning authority.

Any such report should include where appropriate any additional drainage works that are necessary to safeguard the functionality of the swale and the water quality and ground water flows into the adjacent existing waterbodies. Including detailed design that demonstrates that the proposed works will safeguard the structural integrity of Starmont reservoir and the quantity and quality of the water feeding the reservoir.

Any such additional works shall be approved in writing by the local planning authority and shall thereafter be implemented prior to the completion of the drainage works to which they relate. The additional works shall be implemented in full in accordance with the approved details prior to the pitches hereby approved being brought into use and shall thereafter be retained and managed and maintained in accordance with the Management and Maintenance Scheme required by condition no. 6 above.

Following discussions with the local authority, a question of how the fishing pond system is fed arose. This should not be confused with Starmont reservoir, which is understood (anecdotally) to be fed by a deep borehole into the primary aquifer. It is important that existing connectivity from the site to the upper fishing pond is maintained and that there is no adverse impact on the Starmont reservoir, structurally or the quantity and quality of water.



Reference of spring lines has historically been mentioned by third parties at the northern boundary of the upper fishing pond. From a review of the existing ground investigation / solid and drift geology (superficial is predominantly glacial clay and rock head is much deeper than the spring line) we do not believe that these are springs as such, but a concentration of surface water runoff from a combination of field drainage and topography of the catchment and can be considered to be shallow ground water perched on the cohesive strata and not connected to the deeper primary aquifer feeding Starmont reservoir.

To confirm this is the case we proposed the following additional groundwater monitoring works to confirm the source and nature of the water feeding the ponds.

1. 1 x 30m open hole rotary, installed with 50mm water monitoring well with geo wrap, gravel filter, Bentonite seal(s), tracked dumper etc, CA permit application, drillers records.
2. 6 x 5m additional window sampler wells
3. 3no. ground water monitoring rounds – ideally inclusive of an over-winter period as this will likely be when the surface strata will most likely be saturated.

These monitoring points were installed in November 2023.

Appended to this letter is a plan showing the exploratory hole plan (ref. 20WCH01-EXP001-A) which identifies the proposed location of a rotary borehole (BH101) to a depth of ~30m and 6no. window sample locations (WS04-WS09) ~3-5m deep.

The locations were chosen to specifically target the groundwater concerns raised and to enhance our current understanding of the hydrogeology.

The window sample and bore hole logs are appended to this letter report as are the water level monitoring results from 16th November 2023 to 4th January 2024. Four groundwater monitoring visits were undertaken in this period and gathered data from both the new window samples (WS04-WS09) and borehole (BH101) and also the original window samples (WS01-WS03) to gather as much information as possible.

The water levels varied between visits, however it is clear that surface water runoff or shallow perched groundwater is present at, or near to surface in numerous locations; WS01, WS03, WS06, WS07, WS08 and WS09. Figure 1 overleaf shows these locations highlighted for quick reference.

The deep borehole ref. BH101 undertaken to a depth of ~30 metres encountered groundwater within the primary aquifer within the bedrock, the depth of groundwater varied from 12.5m to 9.16m below the surface over the 4no. visits. This corresponds to what was anticipated with there being a deep aquifer in the bedrock and some shallow perched groundwater / surface water runoff on the cohesive ground near surface. The depth of the deep aquifer means that the development proposals have no impact on the hydrology of the deep aquifer.

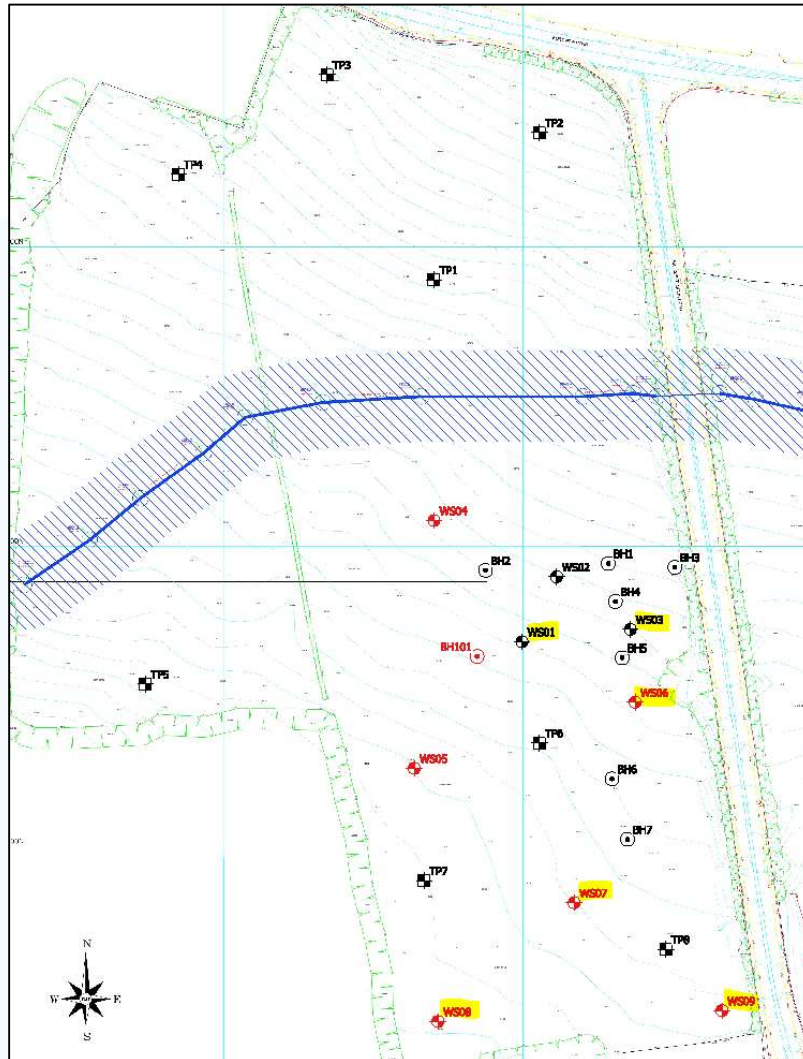


Figure 1 – Exploratory hole locations with shallow groundwater locations highlighted

Whilst it is the intention that the proposed design levels of the pitches are such that the construction depths are not anticipated to encounter for a large proportion of the development, there is potential perched water impact to pitch 1 and the car park. It is proposed that mitigation measures in the form of a french drain type method of groundwater interception and diversion around the proposals to prevent the construction from disrupting the current flow to the upper fishing pond and to ensure any existing groundwater flow continues to the current destination. The depth of a french drain would be approximately 750mm deep (below existing ground level). The proposed levels in the location of the interception drain remain the same as the existing levels.

There is a plan appended to this letter ref.: HYD633-WCH-BET-XX-ZZ-C-DR-1002-A that shows the proposed interception drain which is the mitigation measure proposed to address the shallow groundwater.

I would recommend that a suitable outfall structure should be discussed and agreed with the council drainage engineer rather than allowing the uncontrolled spill of water into the upper fishing pond as occurs at present.

There is no adverse impact on the hydrology of the Starmont reservoir or the upper fishing lodge. The shallow groundwater potentially impacting on the car park and pitch 1 location will be intercepted by the proposed interception drain on the eastern boundary which will maintain continuity of flow to the upper fishing lodge mimicking the existing situation.

Yours sincerely,

Richard Nicholas BEng (Hons) MSc MBA GMICE MCIWEM

Director

BETTS HYDRO LIMITED

Enc.

Window sample logs – WS01-WS03 (May 2021)

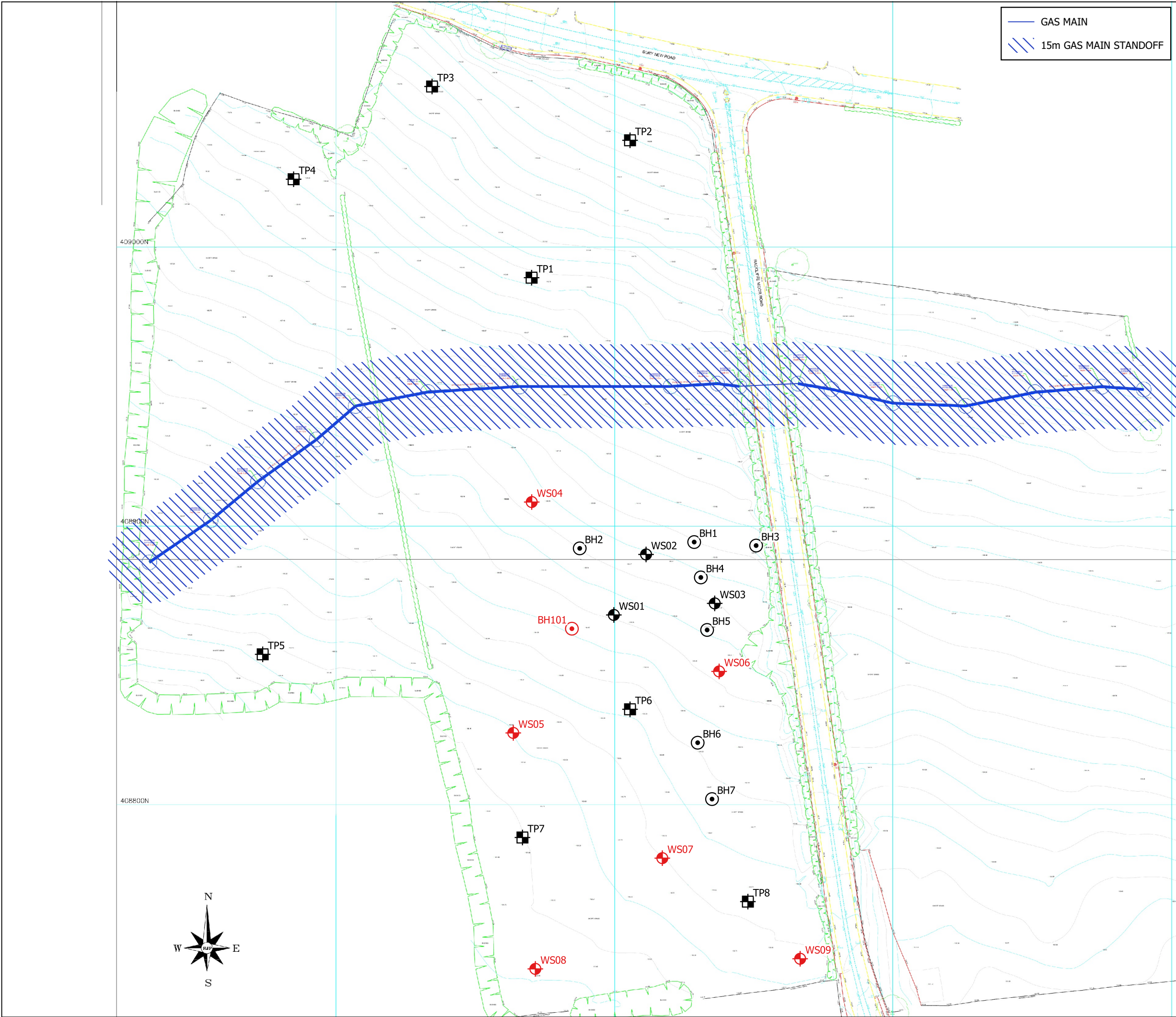
Window sample logs – WS04-WS09 (November 2023)

Borehole logs – BH1-BH7 (May 2021)

Borehole log – BH101 (November 2023)

Groundwater monitoring results

Interception Drain plan – ref.: HYD633-WCH-BET-XX-ZZ-C-DR-1002-A



GAS MAIN

15m GAS MAIN STANDOFF

NOTES

DO NOT SCALE

THIS SKETCH SHOWS THE INDICATIVE LOCATIONS OF EXPLORATORY HOLES UNDERTAKEN BY BETTS GEO IN 2023 AND EXPLORATORY HOLES PREVIOUSLY UNDERTAKEN BY BETTS GEO IN 2021 OVERLAIN THE TOPOGRAPHICAL SURVEY.

BETTS GEO - NOV 2023

WINDOW SAMPLE BOREHOLE

ROTARY BOREHOLE

BETTS GEO - 2021

ROTARY BOREHOLE

WINDOW SAMPLE BOREHOLE

TRIAL PIT

A	13/11/23	RD	2023 HOLES ADDED	MJF
REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS:

DRAFT

BETTS GEO

CONSULTING ENGINEERS

Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178enquiries@betts-associates.co.uk

W

Westchurch
Homes

PROJECT:

LAND AT RADCLIFFE MOOR ROAD

TITLE:

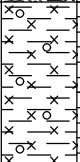
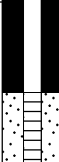
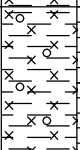
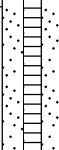
EXPLORATORY HOLE LOCATION PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
13/11/23	NTS	RD	MJF

PROJECT No:	DRAWING No:	REV:
20WCH011	EXP001	A

BOREHOLE LOG

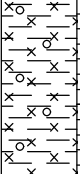
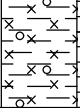
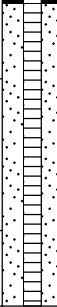
Project Land at Radcliffe Moor Road				BOREHOLE No WS1	
Job No 20WCH011	Date 18-05-21 18-05-21	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.30	ES1	N16			(0.40) 0.40	TOPSOIL: Brown sandy CLAY			
1.00 1.00	ES2				(1.10) 1.50	Firm greyish orange silty CLAY with occasional fine gravel of coal			
2.00	CBR1		N31			(1.00) 2.50	Firm to stiff greyish orange silty CLAY with occasional fine gravel of coal		
2.50					(0.50) 3.00	Stiff dark grey silty CLAY with occasional fine gravel			
3.00	N12								

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Wet from perched water at topsoil interface
All dimensions in metres Scale 1:50			Client Westchurch Homes			Method/ Plant Used Competitor Rig			Logged By		

BOREHOLE LOG

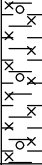
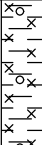
Project Land at Radcliffe Moor Road				BOREHOLE No WS2	
Job No 20WCH011	Date 18-05-21 18-05-21	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill	
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION			
0.30	ES1	N15				0.30	TOPSOIL: Brown sandy CLAY			
1.00							(1.20)	Firm greyish orange silty CLAY with occasional fine gravel of coal		
1.50	ES2						1.50	Stiff greyish orange silty CLAY with occasional fine gravel of coal		
2.00		N27					(1.00)			
2.50	CBR1						2.50	Stiff dark grey silty CLAY with occasional fine gravel		
3.00		N13					(0.50) 3.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Wet from perched water at topsoil interface
All dimensions in metres Scale 1:50			Client Westchurch Homes			Method/ Plant Used Competitor Rig			Logged By		

BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS3	
Job No 20WCH011	Date 18-05-21 18-05-21	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION		
0.30	ES1	N17				(0.40) 0.40	TOPSOIL: Brown sandy CLAY		
1.00 1.00	ES2					(1.10) 1.50	Firm greyish orange silty CLAY with occasional fine gravel of coal		
2.00	CBR1					(1.00) 2.50	Firm to stiff greyish orange silty CLAY with occasional fine gravel of coal		
2.50						(0.50) 3.00	Stiff dark grey silty CLAY with occasional fine gravel		
3.00									
</									

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Wet from perched water at topsoil interface
All dimensions in metres Scale 1:50			Client Westchurch Homes			Method/ Plant Used Competitor Rig			Logged By		

BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS04
Job No 20WCH011	Date 09-11-23 09-11-23	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet 1 of 1

[illegible]

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Drilled as rotary open hole with water flush due to no access across site for window sample rig. Descriptions are direct from drilling operatives.
All dimensions in metres Scale 1:50		Client Westchurch Homes				Method/ Plant Used Dando Tracked Rotary Rig					Logged By

GS3 UK BH 20WCH011 - LAND AT RADCLIFFE MOOR ROAD.GPJ GINT STD AGS3 1.GDT 4/1/24

BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS05	
Job No 20WCH011	Date 09-11-23 09-11-23	Ground Level (m)	Co-Ordinates ()	Sheet 1 of 1	
Contractor					

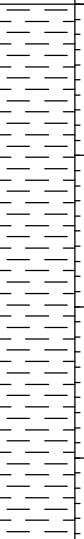
SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
					(2.60)	2.60	GRASS / TOPSOIL over yellow / brown CLAY / DRIFT.		
						2.90	Grey shaley CLAY / clayey MUDSTONE.		
					(2.10)	5.00	Grey MUDSTONE.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Drilled as rotary open hole with water flush due to no access across site for window sample rig. Descriptions are direct from drilling operatives.
All dimensions in metres Scale 1:50						Client Westchurch Homes		Method/ Plant Used Dando Tracked Rotary Rig		Logged By	

AGS3 UK BH 20WCH011 - LAND AT RADCLIFFE MOOR ROAD GPJ GINT STD AGS 3, 1 GDT 4/1/24

BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS06	
Job No 20WCH011	Date 13-11-23 13-11-23	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)	DESCRIPTION		
						(3.60) 			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Drilled as rotary open hole with water flush due to no access across site for window sample rig. Descriptions are direct from drilling operatives.
All dimensions in metres Scale 1:50			Client Westchurch Homes			Method/ Plant Used Dando Tracked Rotary Rig				Logged By	

AGS3 UK BH 20WCH011 - LAND AT RADCLIFFE MOOR ROAD GPJ GINT STD AGS 3 1 GDT 4/1/24

BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS07	
Job No 20WCH011	Date 13-11-23 13-11-23	Ground Level (m)	Co-Ordinates ()		
Contractor				Sheet 1 of 1	

SAMPLES & TESTS			STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION		
						(3.10)	GRASS / TOPSOIL over brown / grey CLAY.		
						3.10			
						(1.90)	Grey very clayey MUDSTONE.		
						5.00			

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Drilled as rotary open hole with water flush due to no access across site for window sample rig. Descriptions are direct from drilling operatives.
All dimensions in metres Scale 1:50			Client Westchurch Homes			Method/ Plant Used Dando Tracked Rotary Rig				Logged By	

AGS3 UK BH 20WCH011 - LAND AT RADCLIFFE MOOR ROAD GPJ GINT STD AGS 3, 1 GDT 4/1/24

BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS08
Job No 20WCH011	Date 13-11-23 13-11-23	Ground Level (m)	Co-Ordinates ()	
Contractor				Sheet 1 of 1

[illegible]

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Dia. mm	Water Dpt	From	To	Hours	From	To	
											Drilled as rotary open hole with water flush due to no access across site for window sample rig. Descriptions are direct from drilling operatives.
All dimensions in metres Scale 1:50		Client Westchurch Homes				Method/ Plant Used Dando Tracked Rotary Rig					Logged By

GS3 UK BH 20WCH011 - LAND AT RADCLIFFE MOOR ROAD.GPJ GINT STD AGS 3 1.GDT 4/1/24

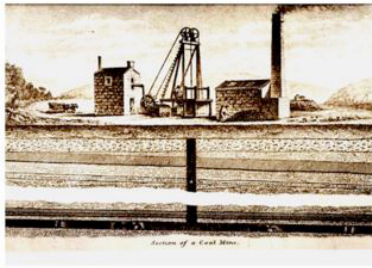
BOREHOLE LOG

Project Land at Radcliffe Moor Road				BOREHOLE No WS09	
Job No 20WCH011	Date 13-11-23 13-11-23	Ground Level (m)	Co-Ordinates ()	Sheet 1 of 1	
Contractor					

SAMPLES & TESTS			Water	STRATA			Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick- ness)		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
All dimensions in metres Scale 1:50			Client Westchurch Homes			Method/ Plant Used Dando Tracked Rotary Rig				Logged By	

AGS3 UK BH 20WCH011 - LAND AT RADCLIFFE MOOR ROAD GPJ GINT STD AGS 3, 1 GDT 4/1/24



Bh 1

REF 2032
Bh 1

SITE CLIENT
Radcliffe Moor Road, Breightmet
Betts Geo-environmental

TITLE
ORIGIN
printout direct from rig on site
drilled & logged by Neil Catlow

PRINTOUT SCALE
GL AOD
RIG
ORIENTATION
FLUSH
BIT

7 April 2021
1:200
Montabert Hydrofore
vertical
reservoir water supply
75mm T/C

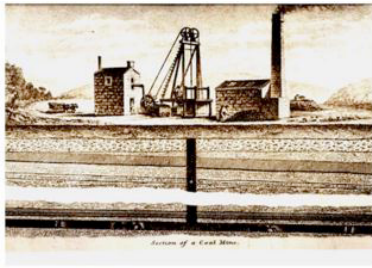
DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay	brown, silty, soft	not taken	ground level
0.5					
1.0					
1.5					
2.0	2.0	clay	grey with grey shale boulders, stiff occasional brown weathered layers		
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					
6.5					
7.0	7.2	sandstone	brown and orange, firm drilling layers of red sandstone		rockhead Cannel Rock
7.5					
8.0					
8.5					
9.0					
9.5					
10.0					
10.5					
11.0					
11.5					
12.0					
12.5					
13.0					
13.5					
14.0					
14.5					
15.0					
15.5					
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21.5					
22.0					
22.5					
23.0					
23.5					
24.0					
24.5					
25.0					
25.5					
26.0					
26.5					
27.0					
27.5					
28.0					
28.5					
29.0					
29.5					
30.0	30.0		bottom of hole		

drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

% O2	20.6
% CH4	0.0
% CO2	0.0
% LEL	0.0
ppm H2S	0.0
ppm CO	0.0

Nkc Geotech Ltd
25 Grosvenor Road
Wrexham
LL11 1BT
www.nkc.co.uk



Bh 2

REF 2032
Bh 2

SITE CLIENT
Radcliffe Moor Road, Breightmet
Betts Geo-environmental

TITLE
ORIGIN
printout direct from rig on site
drilled & logged by Neil Catlow

PRINTOUT SCALE
GL AOD
RIG
ORIENTATION
FLUSH
BIT

7 April 2021
1:200
Montabert Hydrofore
vertical
reservoir water supply
75mm T/C

DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0		brown, silty, soft	not taken	ground level
0.5					
1.0					
1.5					
2.0	2.0		grey with grey shale boulders, stiff		
2.5			occasional brown weathered layers		
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					
6.5					
7.0					
7.5					
8.0	8.2		orange, firm drilling		rockhead
8.5					
9.0					Cannel Rock
9.5					
10.0					
10.5					
11.0					
11.5					
12.0					
12.5					
13.0					
13.5					
14.0					
14.5					
15.0					
15.5					
16.0					
16.5					
17.0					
17.5					
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26.0					
26.5					
27.0					
27.5					
28.0					
28.5					
29.0					
29.5					
30.0	30.0		bottom of hole		

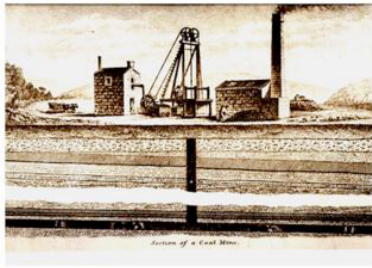
drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

% O2	20.6
% CH4	0.0
% CO2	0.0
% LEL	0.0
ppm H2S	0.0
ppm CO	0.0

Nkc Geotech Ltd
25 Grosvenor Road
Wrexham
LL11 1BT

www.nkc.co.uk



Bh 3

REF 2032
Bh 3

SITE
CLIENT

Radcliffe Moor Road, Breightmet
Betts Geo-environmental

PRINTOUT
SCALE

7 April 2021
1:200

TITLE

ORIGIN

printout direct from rig on site
drilled & logged by Neil Catlow

RIG

ORIENTATION

FLUSH

BIT

Montabert Hydrofore

vertical

reservoir water supply

75mm T/C

DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay	brown, silty, soft	not taken	ground level
0.5					
1.0					
1.5					
2.0	2.0	clay	grey with grey shale boulders, stiff occasional brown weathered layers		
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					
6.5					
7.0					
7.5					
8.0					
8.5	8.5	sandstone	orange, firm drilling		rockhead
9.0					
9.5					Cannel Rock
10.0					
10.5					
11.0					
11.5					
12.0					
12.5					
13.0					
13.5					
14.0					
14.5					
15.0					
15.5					
16.0					
16.5					
17.0					
17.5					
18.0					
18.5					
19.0					
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25.0					
25.5					
26.0					
26.5					
27.0					
27.5					
28.0					
28.5					
29.0					
29.5					
30.0	30.0		bottom of hole		

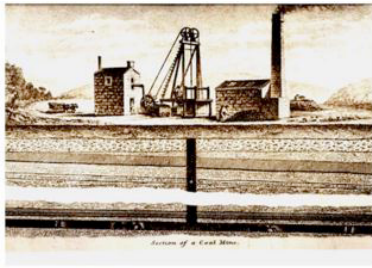


drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

% O2	20.6
% CH4	0.0
% CO2	0.0
% LEL	0.0
ppm H2S	0.0
ppm CO	0.0

Nkc Geotech Ltd
25 Grosvenor Road
Wrexham
LL11 1BT
www.nkc.co.uk



Bh 4

REF 2032
Bh 4

SITE CLIENT
Radcliffe Moor Road, Breightmet
Betts Geo-environmental

TITLE
ORIGIN
printout direct from rig on site
drilled & logged by Neil Catlow

PRINTOUT SCALE
GL AOD
RIG ORIENTATION
FLUSH
BIT

7 April 2021
1:200
Montabert Hydrofore
vertical
reservoir water supply
75mm T/C

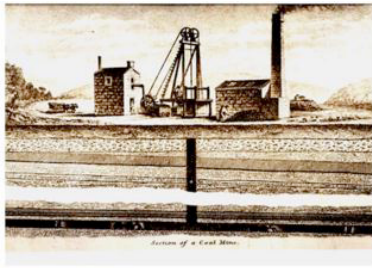
DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0		brown, silty, soft	not taken	ground level
0.5					
1.0					
1.5					
2.0	2.0		grey with grey shale boulders, stiff		
2.5			occasional brown weathered layers		
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					
6.5					
7.0	7.4		orange, firm drilling		rockhead
7.5					
8.0					Cannel Rock
8.5					
9.0					
9.5					
10.0					
10.5					
11.0					
11.5					
12.0			bottom of hole		
12.5					
13.0					
13.5					
14.0					
14.5					
15.0					
15.5					
16.0					
16.5					
17.0					
17.5					
18.0					
18.5					
19.0					
19.5					
20.0	20.0		bottom of hole		
20.5					
21.0					
21.5					
22.0					
22.5					
23.0					
23.5					
24.0					
24.5					
25.0					
25.5					
26.0					
26.5					
27.0					
27.5					
28.0					
28.5					
29.0					
29.5					
30.0					

drilled and logged by
Neil Catlow B.Sc FGS

IN HOLE GAS TESTING

% O2	20.6
% CH4	0.0
% CO2	0.0
% LEL	0.0
ppm H2S	0.0
ppm CO	0.0

Nkc Geotech Ltd
25 Grosvenor Road
Wrexham
LL11 1BT
www.nkc.co.uk



Bh 5

REF 2032
Bh 5

SITE CLIENT Radcliffe Moor Road, Breightmet
Betts Geo-environmental

TITLE

ORIGIN printout direct from rig on site
drilled & logged by Neil Catlow

PRINTOUT SCALE 7 April 2021
1:200

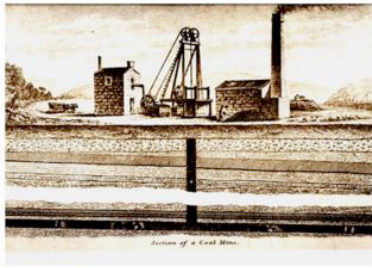
GL AOD

RIG ORIENTATION Montabert Hydrofore
vertical

FLUSH reservoir water supply

BIT 75mm T/C

DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay	brown, silty, soft	not taken	ground level
0.5					
1.0					
1.5					
2.0	2.0	clay	grey with grey shale boulders, stiff occasional brown weathered layers		
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					
6.5					
7.0					
7.5					
8.0	8.3	sandstone	orange, firm drilling		rockhead
8.5					Cannel Rock
9.0					
9.5					
10.0					
10.5					
11.0					
11.5	12.0		bottom of hole		
12.0					
12.5					
13.0					
13.5					
14.0					
14.5					
15.0					
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27.5					
28.0					
28.5					
29.0					
29.5					
30.0					



Bh 6

REF 2032
Bh 6

SITE
CLIENT

Radcliffe Moor Road, Breightmet
Betts Geo-environmental

PRINTOUT
SCALE

7 April 2021
1:200

TITLE

ORIGIN

printout direct from rig on site
drilled & logged by Neil Catlow

RIG

Montabert Hydrofore

ORIENTATION

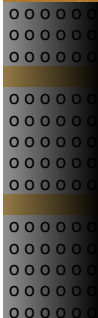
vertical

FLUSH

reservoir water supply

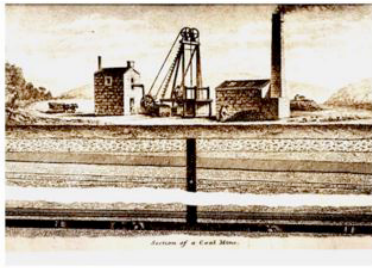
BIT

75mm T/C

	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION
0.0	0.0	clay		brown, silty, soft	not taken	ground level
0.5						
1.0						
1.5						
2.0						
2.5	2.0	clay		grey with grey shale boulders, stiff occasional brown weathered layers		
3.0						
3.5						
4.0						
4.5						
5.0						
5.5						
6.0						
6.5						
7.0						
7.5						
8.0						
8.5						
9.0						
9.5						
10.0	Cannel Rock					
10.5						
11.0						
11.5						
12.0	12.0			bottom of hole		
12.5						
13.0						
13.5						
14.0						
14.5						
15.0						
15.5						
16.0						
16.5						
17.0						
17.5						
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27.5						
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28.5						
29.0						
29.5						
30.0						



drilled and logged by
Neil Catlow B.Sc FGS



Bh 7

REF 2032
Bh 7

SITE
CLIENT

Radcliffe Moor Road, Breightmet
Betts Geo-environmental

PRINTOUT
SCALE

7 April 2021
1:200

TITLE

ORIGIN

printout direct from rig on site
drilled & logged by Neil Catlow

RIG

Montabert Hydrofore

ORIENTATION

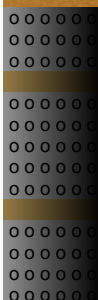
vertical

FLUSH

reservoir water supply

BIT

75mm T/C

	DEPTH	STRATA	GRAPHIC	DESCRIPTION	SPT N value	INTERPRETATION						
0.0	0.0	clay		brown, silty, soft	not taken	ground level						
0.5												
1.0												
1.5												
2.0												
2.5	2.0	clay		grey with grey shale boulders, stiff occasional brown weathered layers								
3.0												
3.5												
4.0												
4.5												
5.0												
5.5												
6.0												
6.5												
7.0												
7.5												
8.0												
8.5												
9.0							9.0	sandstone		orange, firm drilling		rockhead
9.5												
10.0	Cannel Rock											
10.5												
11.0												
11.5	12.0			bottom of hole								
12.0												
12.5												
13.0												
13.5												
14.0												
14.5												
15.0												
15.5												
16.0												
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drilled and logged by
Neil Catlow B.Sc FGS

ROTARY TEST DRILLING Marshes Farm, Coach Road, off Wigan Road, Hart Common, West Houghton, Bolton BL5 2BT Tel: 01942 - 810348 Fax: 01942 - 840543				Site Radcliffe Moor Road, Radcliffe				Job No. 25/23			
				Client Betts GEO				Borehole BH101			
				Date 08/11/23 - 09/11/23		O.D. Level		Page 1 of 1			

Day	Casing Depth	Strata Depth	Description of Strata	Leg- end	Inst.	Reduced Level	Flush Returns	Core Depths	TCR %	SCR %	RQD %
		G.L.	GRASS/TOPSOIL Over yellow/brown CLAYS, DRIFT (2.30)								
	3M	2.30	Clayey grey MUDSTONE/Very shaley CLAY (1.30)								
		3.60	Grey MUDSTONE (3.20)								
		6.80	Red SANDSTONE (3.30)								
		10.10	Brown SANDSTONE (1.90)								
		12.00	Red SANDSTONE & MUDSTONE, bands of red/brown MARL (4.50)				100%				
		16.50	Brown SANDSTONE & MUDSTONE, bands of red MARL (4.50)								
		21.00	As above with bands of very broken/ fissured SANDSTONE (5.50)				100%				
		26.50	Dark grey MUDSTONE (0.40)								
		26.90	Red MARL/SANDSTONE (0.10)								
		27.00	Dark grey MUDSTONE/Red MARL/MUDSTONE (3.00)								
		30.00	Base of Drillhole				100%				

Symbols

TCR - TOTAL ROCK RECOVERY

SCR - SOLID ROCK RECOVERY

RQD - ROCK QUALITY DESIGNATION

Drilling Methods

Water flush

Remarks

Set up water supply/pumping from angling club water

Very bad/slow moving

NOTE - Re-drilling from 21.0 - 30.0m bgl on 9/11/23 due to unstable rock/BH

100% Flush

Gas = normal throughout

Site: Radcliffe Moor Road
 Job Number: 20WCH011
 Date of Monitoring: 16/11/2023

Water Level Monitoring Round 1



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS01	-	-	-	-	-	-	-	-	-	-	-	0.15	2.82
WS02	-	-	-	-	-	-	-	-	-	-	-	0.42	2.81
WS03	-	-	-	-	-	-	-	-	-	-	-	0.08	2.90
WS04	-	-	-	-	-	-	-	-	-	-	-	0.71	4.82
WS05	-	-	-	-	-	-	-	-	-	-	-	0.35	4.86
WS06	-	-	-	-	-	-	-	-	-	-	-	0.15	4.82
WS07	-	-	-	-	-	-	-	-	-	-	-	0.14	4.83
WS08	-	-	-	-	-	-	-	-	-	-	-	0.17	4.85
WS09	-	-	-	-	-	-	-	-	-	-	-	0.11	4.81
BH101	-	-	-	-	-	-	-	-	-	-	-	12.51	29.44

Notes:

Monitoring order is left to right across the table

Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	GC
Weather:	Overcast, damp, cold, moderate breeze
Equipment Used:	GA5000
	Solinst Mini Interface Meter
Visible signs of damage/stress:	None
Other Comments/Observations:	None

Site: Radcliffe Moor Road
 Job Number: 20WCH011
 Date of Monitoring: 21/11/2023

Water Level Monitoring Round 2



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS01	-	-	-	-	-	-	-	-	-	-	-	0.11	2.79
WS02	-	-	-	-	-	-	-	-	-	-	-	0.27	2.84
WS03	-	-	-	-	-	-	-	-	-	-	-	0.09	2.88
WS04	-	-	-	-	-	-	-	-	-	-	-	0.61	4.84
WS05	-	-	-	-	-	-	-	-	-	-	-	0.22	4.83
WS06	-	-	-	-	-	-	-	-	-	-	-	0.08	4.85
WS07	-	-	-	-	-	-	-	-	-	-	-	0.11	4.81
WS08	-	-	-	-	-	-	-	-	-	-	-	0.14	4.87
WS09	-	-	-	-	-	-	-	-	-	-	-	0.07	4.82
BH101	-	-	-	-	-	-	-	-	-	-	-	10.08	29.51

Notes:
 Monitoring order is left to right across the table
 Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	GC
Weather:	Partial cloud, damp, cold, slight breeze
Equipment Used:	GA5000
	Solinst Mini Interface Meter
Visible signs of damage/stress:	None
Other Comments/Observations:	None

Site: Radcliffe Moor Road
 Job Number: 20WCH011
 Date of Monitoring: 30/11/2023

Water Level Monitoring Round 3



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS01	-	-	-	-	-	-	-	-	-	-	-	0.09	2.83
WS02	-	-	-	-	-	-	-	-	-	-	-	0.16	2.81
WS03	-	-	-	-	-	-	-	-	-	-	-	0.07	3.91
WS04	-	-	-	-	-	-	-	-	-	-	-	0.43	4.79
WS05	-	-	-	-	-	-	-	-	-	-	-	0.26	4.88
WS06	-	-	-	-	-	-	-	-	-	-	-	0.11	4.81
WS07	-	-	-	-	-	-	-	-	-	-	-	0.13	4.85
WS08	-	-	-	-	-	-	-	-	-	-	-	0.12	4.92
WS09	-	-	-	-	-	-	-	-	-	-	-	0.09	4.84
BH101	-	-	-	-	-	-	-	-	-	-	-	9.16	29.41

Notes:
 Monitoring order is left to right across the table
 Monitoring should be for not less than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	GC
Weather:	Sunny, damp, cold, slight breeze
Equipment Used:	GA5000
	Solinst Mini Interface Meter
Visible signs of damage/stress:	None
Other Comments/Observations:	None

Site: Radcliffe Moor Road
 Job Number: 20WCH011
 Date of Monitoring: 04/01/2024

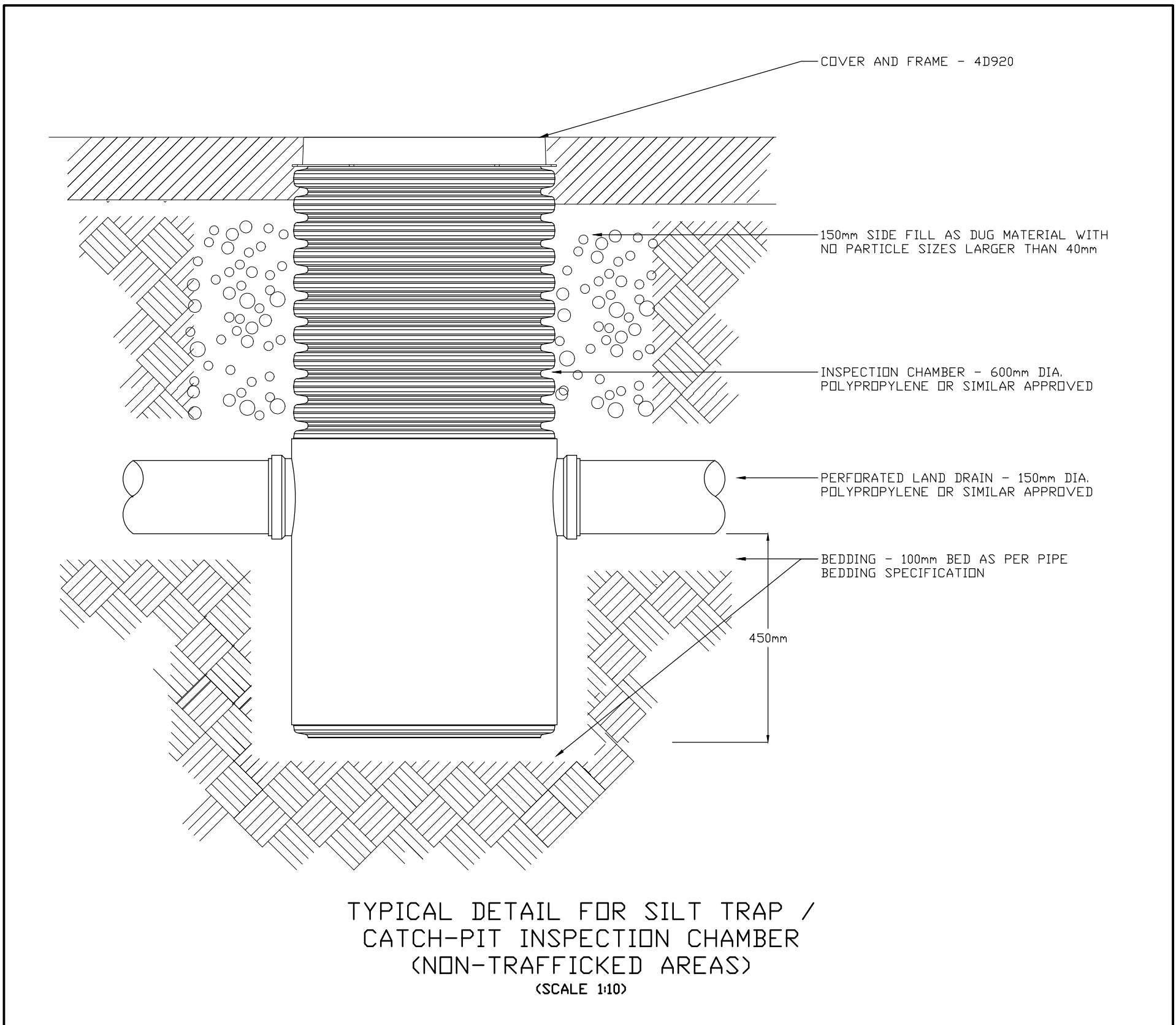
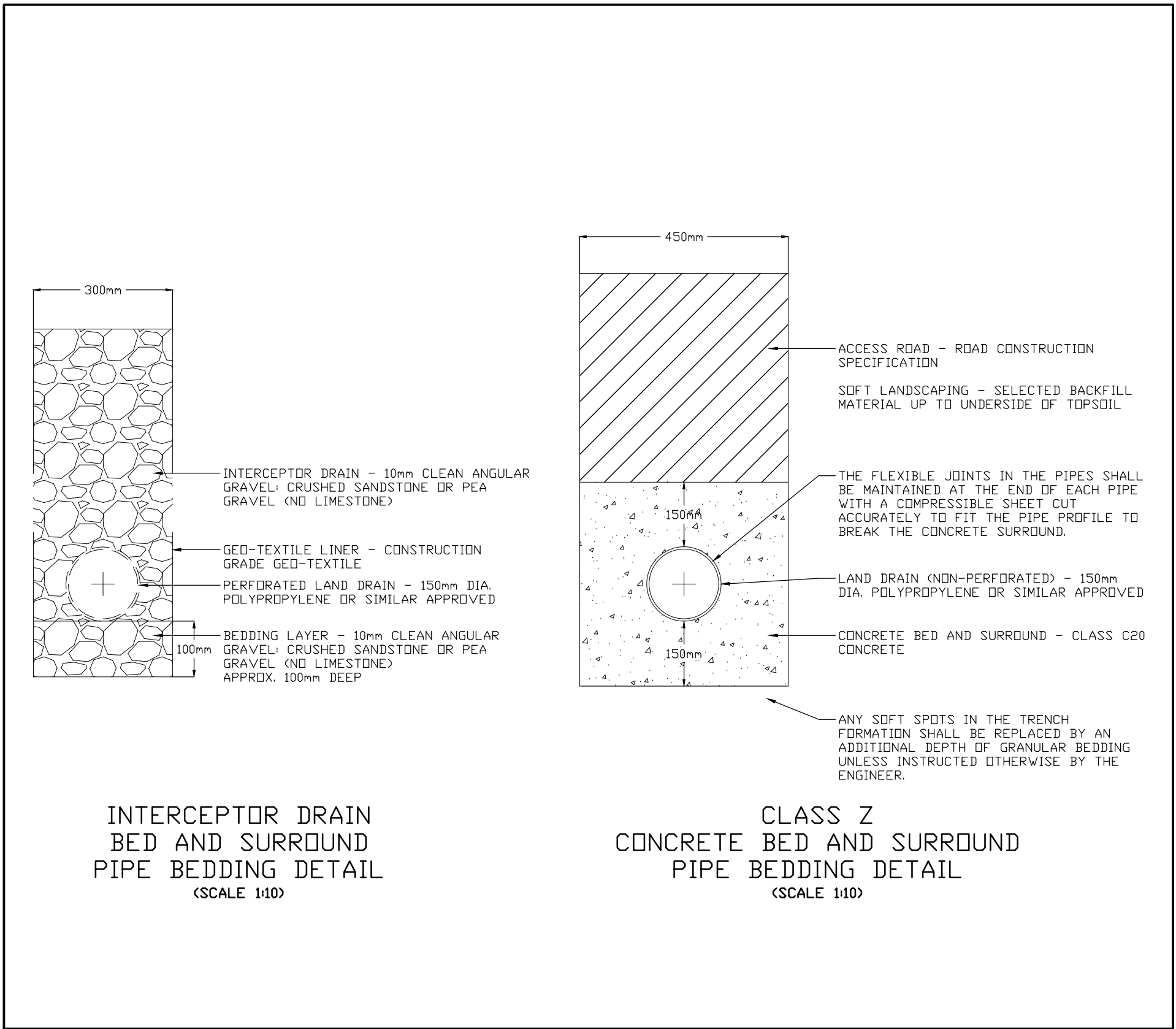
Water Level Monitoring Round 4



Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mB)	Methane CH ₄ (%v/v)		Carbon Dioxide CO ₂ (% v/v)		Oxygen (%v/v)		Other Gases			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H ₂ S	CO	(mbgl)	BH depth
WS01	-	-	-	-	-	-	-	-	-	-	-	0.00	2.79
WS02	-	-	-	-	-	-	-	-	-	-	-	0.27	2.72
WS03	-	-	-	-	-	-	-	-	-	-	-	0.00	2.84
WS04	-	-	-	-	-	-	-	-	-	-	-	0.58	4.73
WS05	-	-	-	-	-	-	-	-	-	-	-	0.22	4.79
WS06	-	-	-	-	-	-	-	-	-	-	-	0.00	4.71
WS07	-	-	-	-	-	-	-	-	-	-	-	0.06	4.80
WS08	-	-	-	-	-	-	-	-	-	-	-	0.09	4.77
WS09	-	-	-	-	-	-	-	-	-	-	-	0.00	4.75
BH101	-	-	-	-	-	-	-	-	-	-	-	11.86	29.24

Notes:
 Monitoring order is left to right across the table
 Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	GC
Weather:	Overcast, damp, cold, slight breeze
Equipment Used:	GA5000
	Solinst Mini Interface Meter
Visible signs of damage/stress:	None
Other Comments/Observations:	None



Mark	Date	Details	By
Revision history			
Drawing originator:			
Client:			
Project title:			
Drawing title:			
Scale:			
Drawing status:			
Job No:			
Do not scale this drawing			
Chapter 01244.201718			