

LC/C2179/4060

15th October 2013

Prospect GB Ltd
Unit 5
Meridian Business Park
Hansby Drive
Hunts Cross
Speke
L24 9LG

For the attention of Mr Johnson Mulik

Dear Johnson,

Re: Church Raik, Chipping

We write to report on the gas monitoring at the above site. Six ground gas monitoring visits were completed. The visits were undertaken between 11th March 2013 and 02nd July 2013.

The Geo-Environmental Assessment report (Ref: AJH/C2179/3577) issued in March 2013 identified a potential source of ground gas relating to a historic landfill that is located 110m south west of the site.

During the ground investigation works no made ground was encountered, topsoil was encountered at the surface of the site to a maximum depth of 0.30m. The natural ground generally comprised firm to stiff yellow brown sandy clay with gravel occurring locally.

Four ground gas monitoring wells were installed in WS02, WS04, WS06 and WS07 during the site investigation of 14th February 2013. These wells consisted of 35mm internal diameter pipe. Plain pipe was used from ground level to 1.0m bgl and sealed with a bentonite surround. Slotted pipe with a clean gravel surround was used from 1.0m down to the base of the wells at 3.0m bgl in WS02, WS06 and WS07 and to 3.8m bgl in WS04. The top of the pipe was sealed with a rubber bung with a gas valve and the installations covered with a lockable steel cover, concreted in place.

Ground gas concentrations were measured for both peak conditions (measurement of the accumulated gases on opening the valve) and steady state conditions (measurement of the stable concentrations after accumulated gases have been purged from the borehole). Groundwater levels, flow, atmospheric pressure, atmospheric oxygen and weather conditions were also recorded during each visit.

Results

Peak methane concentrations of 0.1%v/v were recorded in all of the wells on at least one of the monitoring visits. Steady state values were similar to the peak concentrations.



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The peak carbon dioxide concentrations ranged from 0.0%v/v to 0.7%v/v. Steady state values ranged from 0.0%v/v to 0.7%v/v, and were generally similar to the peak concentrations. CO₂ concentrations were generally low.

Peak oxygen concentrations ranged from 19.3%v/v to 20.9%v/v. Steady state concentrations ranged from 19.3%v/v to 21.0%v/v and were generally similar to peak.

A maximum positive flow of 0.1l/hr was recorded in WS04 on 24th April. Generally flows were not recorded across the site.

The atmospheric pressure ranged between 1003mb and 1014mb over the monitoring period.

Groundwater levels within the standpipes ranged from 0.30m and 1.00m bgl.

Full records of the ground gas monitoring results are enclosed together with a drawing showing the positions of the monitoring standpipes.

Discussion

Carbon dioxide has been recorded in all four of the standpipes at a peak concentration of 0.7%v/v and very low levels of methane were recorded with a peak concentration of 0.1%v/v.

No made ground has been encountered at the site and it is likely that the low concentrations of carbon dioxide and methane present are associated small amounts of organic material in the natural ground and possible made ground that may be present off site.

During the monitoring period the groundwater levels were relatively high and generally above the response zones of the installations. This can restrict the gas production due to gas being trapped and restricting the lateral migration towards the gas installation. The groundwater levels are indicative of the site and are unlikely to reduce.

Assessment

In order to assess the ground gas situation and the requirement for ground gas precautions, guidance was taken from CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' and the recent publication CL:AIRE Research Bulletin 17 'A Pragmatic Approach to Ground Gas Risk Assessment'.

The proposed residential end use dictates that the gas monitoring results are assessed in accordance with *Boyle and Witherington, 2006*.

The Boyle and Witherington method uses the concept of a Gas Screening Value (GSV), which is calculated using the maximum concentration of the ground gas and the flow rate. Typical concentration thresholds are worked out by a "Traffic Light System". The selected traffic light classification indicates the required protection measures.

| Traffic Light | Methane | | Carbon Dioxide | |
|---------------|--------------------------------------|---------------------------------|--------------------------------------|---------------------------------|
| | Typical maximum concentration (%v/v) | Gas Screening Value (GSV) (l/h) | Typical maximum concentration (%v/v) | Gas screening value (GSV) (l/h) |
| Green | <1 | <0.16 | <5 | <0.78 |
| Amber 1 | <5 | <0.63 | <10 | <1.56 |
| Amber 2 | <20 | <1.56 | <30 | <3.13 |
| Red | >20 | >1.56 | >30 | >3.13 |

The GSV for carbon dioxide has been calculated using the maximum carbon dioxide concentration, i.e. 0.7%v/v and the maximum recorded flow rate, 0.1l/hr. This results in a GSV for carbon dioxide of 0.0007l/hr which is consistent with a Green traffic light.

The calculated GSV for methane is 0.0001l/hr which is also consistent with a Green traffic light.

Recommendations

On the basis of the monitoring undertaken and the above assessment the site lies within the Green traffic light classification and therefore no specific gas precautions are required within the proposed dwellings.

However in accordance with BRE: BR211 Radon (2007) the site lies in an area where full radon precautions are required. This comprises a radon-proof barrier across the ground floor supplemented by provision for subfloor depressurisation or ventilation (either a radon sump or a ventilated subfloor void).

Bodies providing building control warranties are frequently asking for confirmation that the installed membrane is suitable for the gas detected. In our experience manufacturers will not warrant DPM manufactured from recycled plastics as being gas resistant. Where ground gases are of concern the manufacturer will recommend and warrant specific products.

Therefore we recommend that the installed membrane should be rated by the manufacturer as resistant to Radon.

The gas membrane should be installed by a competent contractor in accordance with the manufacturers' recommendations, this will include minimum laps, sealing any cavity and top-hat seals on the service entries.

If the installation of a membrane is a planning requirement the Local Authority is likely to require validation of the placement of protective measures. We recommend the requirements of the validation should be discussed with the Local Authority prior to installation.

If you have any queries please do not hesitate to contact the undersigned.

Yours sincerely

On behalf of Brownfield Solutions Limited



Lucy Crawford

Graduate Project Engineer

Enc Gas Monitoring Results
Borehole Location Plan

Church Raike, Chipping

Prospect GB Ltd

C2179

Ground Gas Monitoring Results

11/03/2013

| Location | State (Peak/Steady) | Percentage Concentrations | | | | Parts per Million | | m bgl | litres/hour | Sheen (Y/N) | Notes |
|----------|------------------------|-----------------------------|---|-------------------------------|-----|--|----------------------------|----------------|-------------|----------------|-------|
| | | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Water Level | Flow | | |
| WS02 | Peak | 20.9 | 0.4 | 0.1 | 2.0 | ND | ND | 0.78 | ND | N | |
| | Steady | 21.0 | 0.1 | 0.1 | 2.0 | ND | ND | | | | |
| WS04 | Peak | 20.9 | 0.1 | ND | ND | ND | ND | 0.68 | ND | N | |
| | Steady | 21.0 | ND | ND | ND | ND | ND | | | | |
| WS06 | Peak | 20.3 | 0.6 | ND | ND | ND | ND | 0.37 | ND | N | |
| | Steady | 20.7 | 0.1 | ND | ND | ND | ND | | | | |
| WS07 | Peak | 20.0 | 0.3 | 0.1 | 2.0 | ND | ND | 0.50 | ND | N | |
| | Steady | 20.3 | ND | ND | ND | ND | ND | | | | |

| Ambient | Percentage Concentrations | | | | Parts per Million | | mb | Monitored by | Equipment | Weather |
|---------|---------------------------|---|-------------------------------|-----|--|----------------------------|-----------------|-----------------|-----------|---------|
| | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Atm Pressure | | | |
| Start | 20.2 | ND | ND | ND | ND | ND | 1010 | LC | GA2000 | SNOWING |
| Finish | 21.0 | ND | ND | ND | ND | ND | 1010 | | | |

Key

ND Not Detected

N/A Not Available

Church Raike, Chipping

Prospect GB Ltd

C2179

Ground Gas Monitoring Results

26/03/2013

| Location | State (Peak/Steady) | Percentage Concentrations | | | | Parts per Million | | m bgl | litres/hour | Sheen (Y/N) | Notes |
|----------|------------------------|-----------------------------|---|-------------------------------|-----|--|----------------------------|----------------|-------------|----------------|---------|
| | | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Water Level | Flow | | |
| WS02 | Peak | 20.0 | 0.2 | ND | ND | ND | ND | 0.43 | ND | N | |
| | Steady | 20.4 | ND | ND | ND | ND | ND | | | | |
| WS04 | Peak | 20.5 | ND | ND | ND | ND | ND | 0.37 | ND | N | |
| | Steady | 20.5 | ND | ND | ND | ND | ND | | | | |
| WS06 | Peak | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N | FLOODED |
| | Steady | N/A | N/A | N/A | N/A | N/A | N/A | | | | |
| WS07 | Peak | 20.1 | 0.1 | ND | ND | ND | ND | 0.31 | ND | N | |
| | Steady | 20.4 | ND | ND | ND | ND | ND | | | | |

| Ambient | Percentage Concentrations | | | | Parts per Million | | mb | Monitored by | Equipment | Weather |
|---------|---------------------------|---|-------------------------------|-----|--|----------------------------|-----------------|-----------------|-----------|---------|
| | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Atm Pressure | | | |
| Start | 20.5 | ND | ND | ND | ND | ND | 1014 | LC | GA2000 | SNOWING |
| Finish | 20.5 | ND | ND | ND | ND | ND | 1014 | | | |

Key
 ND Not Detected
 N/A Not Available

Church Raike, Chipping

Prospect GB Ltd

C2179

Ground Gas Monitoring Results

15/04/2013

| Location | State (Peak/Steady) | Percentage Concentrations | | | | Parts per Million | | m bgl | litres/hour | Sheen (Y/N) | Notes |
|----------|------------------------|-----------------------------|---|-------------------------------|-----|--|----------------------------|----------------|-------------|----------------|---------|
| | | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Water Level | Flow | | |
| WS02 | Peak | 20.0 | 0.3 | 0.1 | 2.0 | ND | ND | 0.70 | ND | N | |
| | Steady | 20.0 | 0.3 | 0.1 | 2.0 | ND | ND | | | | |
| WS04 | Peak | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N | FLOODED |
| | Steady | N/A | N/A | N/A | N/A | N/A | N/A | | | | |
| WS06 | Peak | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N | FLOODED |
| | Steady | N/A | N/A | N/A | N/A | N/A | N/A | | | | |
| WS07 | Peak | 20.5 | ND | ND | ND | ND | ND | 0.30 | ND | N | |
| | Steady | 20.5 | ND | ND | ND | ND | ND | | | | |

| Ambient | Percentage Concentrations | | | | Parts per Million | | mb | Monitored by | Equipment | Weather |
|---------|---------------------------|---|-------------------------------|-----|--|----------------------------|-----------------|-----------------|-----------|---------|
| | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Atm Pressure | | | |
| Start | 20.5 | ND | ND | ND | ND | ND | 1003 | JB | GA2000 | Sunny |
| Finish | 20.5 | ND | ND | ND | ND | ND | 1003 | | | |

Key

ND Not Detected

N/A Not Available

Church Raike, Chipping

Prospect GB Ltd

C2179

Ground Gas Monitoring Results

24/04/2013

| Location | State (Peak/Steady) | Percentage Concentrations | | | | Parts per Million | | m bgl | litres/hour | Sheen (Y/N) | Notes |
|----------|------------------------|-----------------------------|---|-------------------------------|-----|--|----------------------------|----------------|-------------|----------------|-------|
| | | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Water Level | Flow | | |
| WS02 | Peak | 20.6 | 0.3 | ND | ND | ND | ND | 0.60 | ND | N | |
| | Steady | 20.6 | 0.3 | ND | ND | ND | ND | | | | |
| WS04 | Peak | 20.9 | 0.1 | 0.1 | 2.0 | N/A | N/A | 0.60 | 0.1 | N | |
| | Steady | 20.9 | 0.1 | 0.1 | 2.0 | N/A | N/A | | | | |
| WS06 | Peak | 20.8 | 0.3 | 0.1 | 2.0 | N/A | N/A | 0.30 | ND | N | |
| | Steady | 20.8 | 0.3 | 0.1 | 2.0 | N/A | N/A | | | | |
| WS07 | Peak | 20.6 | 0.1 | ND | ND | ND | ND | 0.40 | ND | N | |
| | Steady | 20.6 | 0.1 | ND | ND | ND | ND | | | | |

| Ambient | Percentage Concentrations | | | | Parts per Million | | mb | Monitored by | Equipment | Weather |
|---------|---------------------------|---|-------------------------------|-----|--|----------------------------|-----------------|-----------------|-----------|---------|
| | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Atm Pressure | | | |
| Start | 20.5 | ND | ND | ND | ND | ND | 1012 | JB | GA2000 | Cloudy |
| Finish | 20.5 | ND | ND | ND | ND | ND | 1012 | | | |

Key
 ND Not Detected
 N/A Not Available

Church Raike, Chipping

Prospect GB Ltd

C2179

Ground Gas Monitoring Results

07/06/2013

| Location | State (Peak/Steady) | Percentage Concentrations | | | | Parts per Million | | m bgl | litres/hour | Sheen (Y/N) | Notes |
|----------|------------------------|-----------------------------|---|-------------------------------|-----|--|----------------------------|----------------|-------------|----------------|-------------------|
| | | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Water Level | Flow | | |
| WS02 | Peak | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Unable to locate. |
| | Steady | N/A | N/A | N/A | N/A | N/A | N/A | | | | |
| WS04 | Peak | 20.3 | ND | ND | ND | ND | ND | 0.80 | ND | N | |
| | Steady | 20.3 | ND | ND | ND | ND | ND | | | | |
| WS06 | Peak | 19.3 | 0.7 | ND | ND | ND | ND | 0.65 | ND | N | |
| | Steady | 19.3 | 0.7 | ND | ND | ND | ND | | | | |
| WS07 | Peak | 20.1 | 0.2 | ND | ND | ND | ND | 1.00 | ND | N | |
| | Steady | 20.1 | 0.2 | ND | ND | ND | ND | | | | |

| Ambient | Percentage Concentrations | | | | Parts per Million | | mb | Monitored by | Equipment | Weather |
|---------|---------------------------|---|-------------------------------|-----|--|----------------------------|-----------------|-----------------|-----------|------------|
| | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Atm Pressure | | | |
| Start | 20.9 | ND | ND | ND | ND | ND | 1010 | JB | GA2000 | Sunny, dry |
| Finish | 20.9 | ND | ND | ND | ND | ND | 1010 | | | |

Key

ND Not Detected

N/A Not Available

Church Raike, Chipping

Prospect GB Ltd

C2179

Ground Gas Monitoring Results

02/07/2013

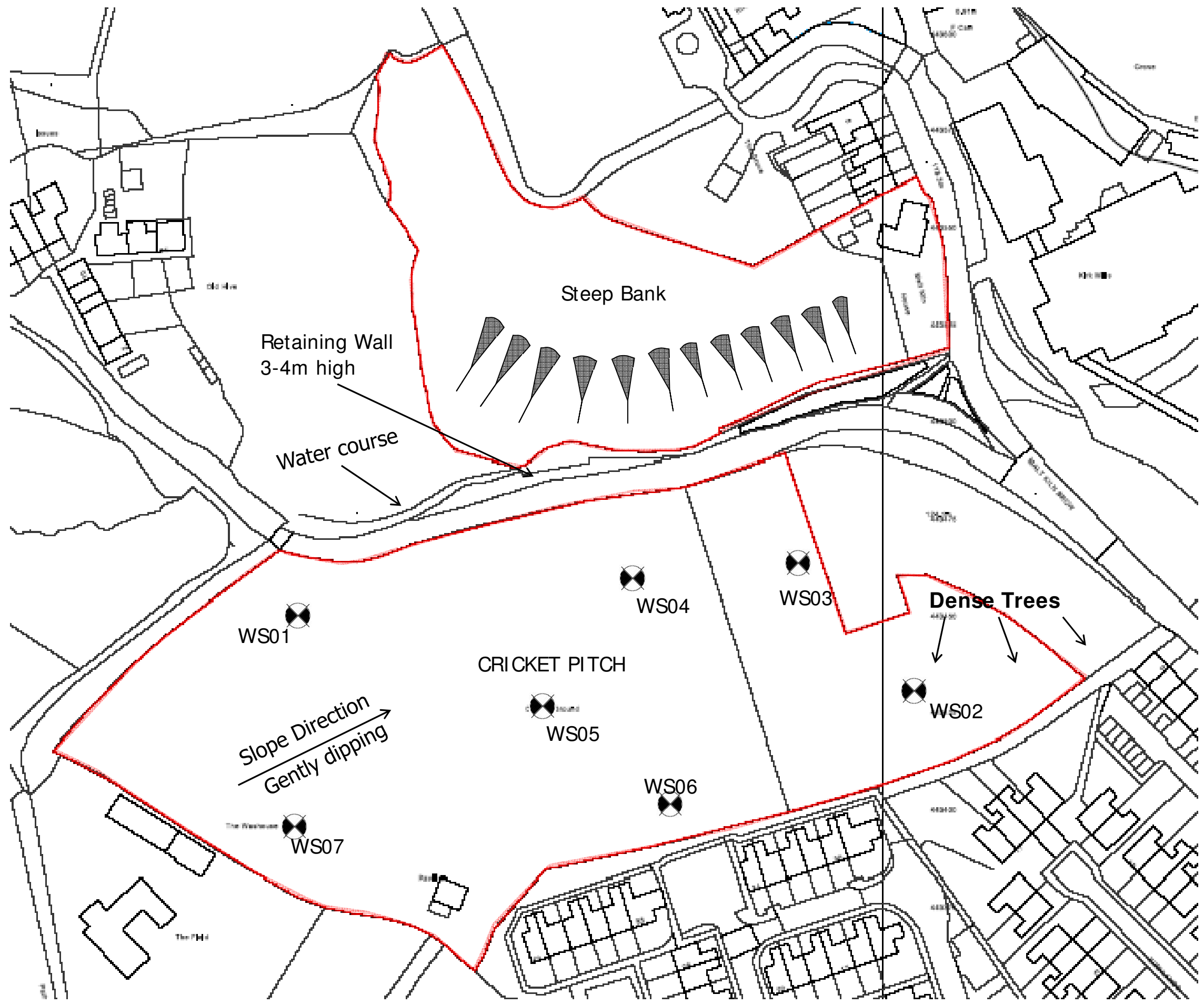
| Location | State (Peak/Steady) | Percentage Concentrations | | | | Parts per Million | | m bgl | litres/hour | Sheen (Y/N) | Notes |
|----------|------------------------|-----------------------------|---|-------------------------------|-----|--|----------------------------|----------------|-------------|----------------|-------|
| | | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Water Level | Flow | | |
| WS02 | Peak | 20.6 | 0.2 | ND | ND | ND | ND | 0.98 | ND | N | |
| | Steady | 20.6 | 0.1 | ND | ND | ND | ND | | | | |
| WS04 | Peak | 20.5 | 0.1 | ND | ND | ND | ND | 0.80 | ND | N | |
| | Steady | 20.6 | ND | ND | ND | ND | ND | | | | |
| WS06 | Peak | 19.5 | 0.6 | ND | ND | ND | ND | 0.65 | ND | N | |
| | Steady | 20.2 | 0.3 | ND | ND | ND | ND | | | | |
| WS07 | Peak | 20.3 | 0.1 | ND | ND | ND | ND | 1.00 | ND | N | |
| | Steady | 20.4 | 0.1 | ND | ND | ND | ND | | | | |

| Ambient | Percentage Concentrations | | | | Parts per Million | | mb | Monitored by | Equipment | Weather |
|---------|---------------------------|---|-------------------------------|-----|--|----------------------------|-----------------|-----------------|-----------|------------|
| | Oxygen (O ₂) | Carbon Dioxide (CO ₂) | Methane (CH ₄) | LEL | Hydrogen Sulphide (H ₂ S) | Carbon Monoxide (CO) | Atm Pressure | | | |
| Start | 20.7 | ND | ND | ND | ND | ND | 1009 | LC | GA2000 | Sunny, dry |
| Finish | 20.7 | ND | ND | ND | ND | ND | 1009 | | | |

Key

ND Not Detected

N/A Not Available



Key:



Window Sample Borehole

Brownfield Solutions Limited **BSL**

Prospect GB

Church Raike, Chipping

Proposed Exploratory Hole Plan

Drawing No. C2179/03

Date: 18 Feb 13

Scale: NTS

Drawn By: AJH

Checked By: JMJ