



LANDFILL GAS RISK ASSESSMENT

January 2020
173263/LGRA

Report for:
Tetron Finningley LLP
Hadzor Court
Hadzor
Droitwich
WR9 7DR

INTRODUCTION

Report Context

AA Environmental Limited (AAe) has been commissioned by Tetron Finningley LLP to produce a Landfill Gas Risk Assessment in support of a variation application from waste to installation permit at Finningley Quarry restoration. The proposed installation involves an inert landfill with asbestos in the proposed eastern cell only.

The aim of the assessment is to support the application for a bespoke installation permit and to assess the potential risk to sensitive receptors associated with landfill gas. The site, ground gas monitoring boreholes and the historic non-hazardous Biffa landfill waste deposit is presented in Monitoring Plan drawing ref. 173263/D/007. The relevant boreholes around the eastern cell and to the risk assessment are BH1001, BH1002, BH1003 and BH2001.

The proposed waste types are inert with asbestos waste. Consequently, a quantitative gas risk assessment (e.g. using the EA's approved GasSim software) is not considered appropriate and has not been used. However, the assessment has been written with reference to the following:

- Environment Agency, Landfill Technical Guidance 03 (LFTGN03);
- Perimeter soil gas emissions criteria and associated management Industry Guidance; and
- Position Statement: Industry code of practice on perimeter soil gas.

Conceptual Site Model – Landfill Gas

Sources

The main potential source for this gas risk assessment is the permanent deposit of waste within the cell. However, all waste types to be accepted will be inert with some asbestos material, which will therefore not give rise to notable levels of landfill gas. The permitted waste types are outlined in the Operational Working Plan.

Landfill gas is produced by the biological degradation of organic components. No organic matter will be present due to the nature of the wastes and it is therefore considered that the waste materials deposited at the site will not give rise to significant volumes of landfill gas. The potential for the generation of landfill gas is therefore considered to be very low.

Furthermore, the site will have strict waste acceptance procedures in place to ensure that only wastes consistent with Schedule 2 of the Operational Working Plan will be accepted at site (173263/OP).

Pathways

Technical Guidance LFTGN03 outlines the key potential pathways:

- Direct release to the atmosphere;
- Sub-surface migration through the ground or along service ducts / pipes;
- Indirect release to atmosphere e.g. from sub-surface landfill gas migration; and
- Direct release of combustion products to atmosphere e.g. from flares / engines.

The primary pathway for landfill gas within the site would be vertically to atmosphere through the waste column or sub-surface migration through the ground laterally through the side slopes to the underlying sandstone strata.



The waste will be deposited within an engineered geological barrier with a permeability of $< 1 \times 10^{-7}$ m/s and will be capped over with a capping layer, of minimum thickness 2 m and a further 0.5 m of restoration soils. This will cut off any potential pathway to a receptor.

Receptors

The surrounding land use is principally rural, and the main off-site receptors are considered to be a property circa 72 m south of the site and agricultural land. The receptors include:

- Residential dwellings;
- Recreational motor cross use;
- Vegetation on and off site;
- Habitats; and
- Public Rights of Way.

The potential receptors are outlined in Table 1 below:

Table 1. Potential receptor locations

Receptor	Operational Area	Minimum distance from proposed permit boundary (approx.) (m)
Domestic Dwellings		
Bancroft Farm	South	72 m
Priority Habitat		
Deciduous Woodland	East	< 10 m
Public Right of Way		
Crow Wood	East / North	< 50 m
Sensitive Land Uses		
Waste deposit (Biffa Landfill EPR/VP3497FN/S002)	West	< 10 m
Agricultural land (Bancroft Farm)	South	10 m
Recreational land (Motor Cross)	North / north east	< 10 m
Critical infrastructure (Doncaster Airport)	West	500 m
Groundwater		
Groundwater Source Protection Zone 3 – Total Catchment	Within	On site
Surface water		
Austerfield Drain	East	380 m



Current Monitoring

Three existing perimeter landfill gas monitoring boreholes (BH1001, BH1002 and BH1003) have been monitored at least 15 times from June 2018 to November 2019. An additional borehole BH2001 was installed to the south of the southern face of the proposed landfill in February 2019 and has been monitored 10 times since February 2019. All locations of the boreholes are presented on drawing 173263/D/007. Background concentrations of methane, carbon dioxide and oxygen were recorded using a portable gas analyser together with the differential pressure (millibars) in each borehole. Table 2 outlines the maximum methane (CH₄) and carbon dioxide (CO₂) concentration for each month.

Table 2. Peak methane and carbon dioxide (%v/v) gas monitoring concentrations

Month	BH1001		BH1002		BH1003		BH2001			
	CH ₄	CO ₂	CH ₄	CO ₂	CH ₄	CO ₂	CH ₄	CO ₂		
June 2018	1.20	6.70	0.00	0.40	0.00	1.10	Borehole not installed.			
July 2018	2.80	15.70	0.00	1.00	0.00	2.70				
August 2018	2.40	17.10	0.00	0.80	0.00	2.20				
September 2018	0.30	11.30	0.00	0.50	0.00	1.70				
November 2018	0.20	3.30	0.00	0.10	0.00	0.00				
January 2019 (02-03/01/2019)	1.00	11.50	0.00	2.00	0.00	2.50				
January 2019 (16-17/01/2019)	0.10	0.10	n/t	n/t	0.00	3.00				
February 2019	0.10	0.10	n/t	n/t	0.00	1.00			0.00	0.30
March 2019	0.00	3.30	0.00	0.10	0.00	0.10			0.00	0.10
April 2019	1.10	17.90	0.00	0.90	0.00	2.00			0.00	3.60
May 2019	0.00	7.30	0.00	0.90	0.00	1.70	0.00	3.60		
June 2019	0.30	14.50	0.00	1.60	0.00	1.70	0.00	0.60		
July 2019	1.10	20.30	0.00	1.00	0.10	1.80	0.10	1.10		
August 2019	0.30	15.70	0.00	1.00	0.00	1.50	0.00	0.80		
September 2019	0.60	17.10	0.10	0.50	0.00	2.30	0.10	1.50		
October 2019	0.50	16.60	0.00	0.90	0.00	2.00	0.00	3.90		
November 2019	1.30	20.00	0.00	0.90	0.00	2.40	0.00	3.50		
Distance from Biffa waste deposit (m)	10 m		165 m		30 m		130 m			

Results from the monitoring show that methane concentrations were generally 0 % v/v in BH1002, BH1003 and BH2001 with maximum methane concentrations recorded at 0.10 % v/v. Borehole BH1001's methane concentrations ranged from 0.0 to 2.8 % v/v. The difference in the methane concentrations between BH1001 and the other boreholes is likely to be attributable to its proximity to the Biffa waste deposit compared to the other perimeter boreholes. The average CO₂ concentrations in BH1002, BH1003 and BH2001 ranged from 0.10 to 3.90 % v/v which are considered to be representative of background ground gas conditions. BH1001 CO₂ concentrations ranged from 0.07 to 20.3 % v/v which are likely to be elevated due to the proximity to the adjacent waste deposit.

Environmental Assessment Levels (EALs)

EA Guidance LFTGN03 presents trigger levels for off site gas monitoring boreholes, which are 1% for methane and 1.5% for carbon dioxide by volume. The baseline concentrations of methane have not exceeded the benchmark in three of the four boreholes, but there are exceedances in BH1001. The baseline levels of carbon dioxide have exceeded the threshold 2 times in BH1002, 9 times in BH1003 and 4 times in BH2001. There are much higher exceedances in BH1001. Therefore, it would not be appropriate to include an EAL of 1.5 CO₂ %v/v at the site, as it is highly unlikely that the background levels would meet this. BH1002, BH1003 and BH2001 are considered representative of natural background levels and the action thresholds for each borehole has been derived using Industry Guidance: perimeter soil gas emissions criteria. The data set for CO₂ in boreholes BH1002, BH1003 and BH2001 is normally distributed with no outliers present. Table 3 below present the proposed site specific carbon dioxide and methane EALs for boreholes BH1002, BH1003 and BH2001.



A similar approach is adopted for BH1001, although it is considered that this borehole is representative of conditions caused by the existing waste deposit. This will enable criteria to be derived which would potentially indicate a deterioration in conditions already caused by existing waste. With BH1001, it is to be anticipated that concentrations may increase once filling has taken place on the western side of the new landfill. Landfill gas from the existing Biffa waste deposit can currently disperse to the open quarry void of the proposed site. Once filling has been undertaken, this has the potential to reduce dispersion. Concentrations of landfill gas in BH1001 can be expected to rise initially, but reach an equilibrium once filling on the west is complete. At this point it will be appropriate to review the action levels for this borehole.

Table 3 Site Specific EALs for methane and carbon dioxide

Monitoring Location	Parameter	Monitoring frequency	Proposed Action Level (v/v%)
BH1002	Methane	Monthly during operational phase.	1.0
	Carbon dioxide		3.0
BH1003	Methane	Six monthly during closure phase.	1.0
	Carbon dioxide		4.0
BH2001	Methane		1.0
	Carbon dioxide		4.9
BH1001 (adjacent to existing waste)	Methane	3.3*	
	Carbon dioxide	24.3*	

* - to be review once filling on the west of the new site is complete

LANDFILL GAS RISK ASSESSMENT

LFTGN03 provides guidance on the level of risk assessment that is considered appropriate for different types of sites and states that Tier 1 Hazard Identification and Risk Screening should be sufficient to deal with inert waste site risks. The site is predicted to generate negligible quantities of landfill gas due to the nature of the waste types, and the containment of waste within a geological barrier. Furthermore, the Operator will implement a detailed waste acceptance procedure and EMS to ensure only permitted waste types are placed within the cell. Taking these factors into consideration, it is concluded that the overall risk is very low. A qualitative risk assessment is considered appropriate to determine the level of landfill gas risk at the site.

Accidents and their Consequences

EA guidance requires a number of accident and failure scenarios to be assessed to quantify the impact of given events. The reliability of landfill gas control measures and site engineering should be assessed and the main hazard that could lead to accidental emissions should be identified. Typical categories of accidents that may affect landfill gas control include, but not limited to:

- Loss of containment e.g. leakage, GSL failure, spillage;
- Loss of collection and/or treatment capability e.g. failure of pipework, control systems;
- Explosions and fires e.g. deep-seated landfill fire; and
- Failure of leachate extraction system and the effect on landfill gas extraction.

Qualitative Landfill Gas Risk Assessment

The potential hazards that exist from landfill gas are:

- Toxicity (acute and chronic);
- Ecotoxicity;
- Fire and explosion;
- Asphyxiation; and
- Odour.



The trace components of landfill gas pose an odour and toxicity risk whilst the bulk gases pose a risk of explosion and asphyxiation. CO₂ is also toxic and should be considered in the assessment of toxicity. Appendix A presents the qualitative gas risk assessment.

The results of the assessment indicate that the most significant accident/failure scenario is the acceptance of biodegradable waste into the landfill site which would arise from failure in the Operator’s waste acceptance procedures. Preventative actions include a briefing to all staff about the waste acceptance procedures and importance on adherence to the procedures. In the event non-compliant waste is delivered to site, there is a quarantine procedure and non-compliance procedure when a load is identified. It is unlikely that biodegradable waste will be deposited within the landfill site.

LANDFILL GAS MANAGEMENT PLAN

Control Measures

Negligible quantities of landfill gas are predicted to be generated and no active gas management is proposed at the site.

Landfill Gas Monitoring & Sampling Plan

Currently there are three dual landfill gas and groundwater monitoring boreholes (BH1002, BH1003 and BH2001), which have been installed on the eastern, south western and southern perimeter of the site respectively. BH1001 will continue to be monitored for internal information, however given its gas concentrations, it is not anticipated to form part of the action and compliance response at the site. BH1004, BH1007 and BH1011 will continue to be monitored for the wider site information.

The proposed monitoring programme is detailed in Table 4.

Table 4. Proposed Monitoring Programme

Monitoring Location	Parameter	Monitoring Frequency
BH1002, BH1003 and BH2001	Methane, carbon dioxide, oxygen, meteorological data, atmospheric pressure, differential pressure and temperature	Monthly during operational phase. Six monthly during closure/aftercare phase.

Compliance Levels

Compliance (action) levels have been set for BH1002, BH1003 and BH2001 as presented in Table 3. The methane trigger level does not change from EA Guidance at 1.0 %v/v in any of the boreholes. Action levels for BH1001 will be used for internal reference only.

Industry Guidance suggests that it is appropriate to remove the compliance threshold for CO₂ based on naturally occurring levels of carbon dioxide above the compliance threshold. An action threshold for CO₂ for BH1002, BH1003 and BH2001 has been set in Table 3. For internal reference an initial threshold has also been derived for BH1001.

Action levels have been set at a level which enables the site management to take timely and appropriate action. An appropriate action plan is required in the event that Action levels are exceeded. In the event there is an exceedance, the action level response procedure is set out below:

- The Landfill Site Manager will be informed; and
- The Manager will assess the risk and may increase the frequency of landfill gas monitoring to determine whether there is an increasing trend in gas concentrations. The Manager may inform the EA if the trend is considered to be rising.






In Waste Gas Monitoring Boreholes



The in-waste gas boreholes are likely to be installed at the end of the restoration. In Waste Gas monitoring locations will be in accordance with drawing 173263/D/008. Post-landfilling, gas monitoring will be undertaken on a monthly basis for 2 years and data assessed. If there are low gas concentrations and flow, the frequency will be down-graded to quarterly in liaison with the EA. The boreholes will be measured for methane, carbon dioxide, oxygen, atmospheric pressure, differential pressure, temperature and weather condition.

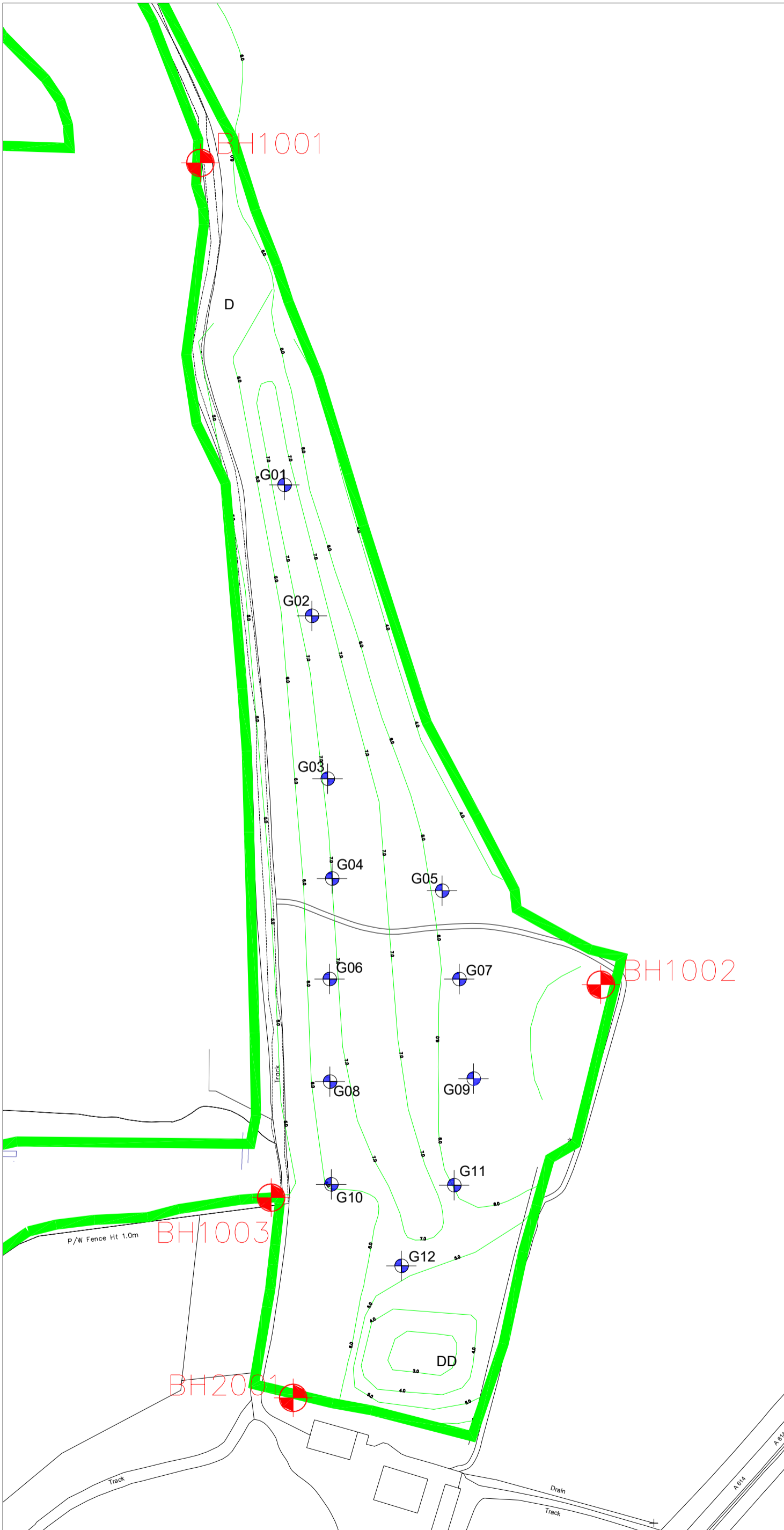
Drawings



- Key:**
-  Permit boundary
 -  Groundwater and perimeter ground gas monitoring location.
 -  Indicative downwind asbestos air monitoring location.
 -  Indicative upwind asbestos air monitoring location.
 -  Visual site boundary inspection location

- Notes:**
1. Asbestos air monitoring locations will be determined by the prevailing wind direction during site operations on the day.
 2. Asbestos air monitoring locations will be set up at the upwind and downwind location along the site boundary.
 3. Asbestos air monitoring will follow Environment Agency M17 guidance.
 4. Boreholes shown on drawing 173263/D/003 will be monitored for ground gas and groundwater on a monthly basis during in-filling.
 5. The whole permit boundary is shown in drawing 173263/D/003. The operation will only take place within the eastern cell.

Rev.	Details	Drawn	Date
		Chkd.	
Project			
173263 Finningley Quarry			
Title			
Monitoring Plan			
		AA Environmental Ltd Units 4-8 Cholswell Court Shippon Abingdon Oxon OX13 6HX T: (01235) 536042 F: (01235) 523849 info@aae-lp.com www.aae-lp.com	
Scale	Date	Feb '20	Drg. No.
1:2,500@A3	Drawn	JM	173263/D/007
	Chkd.	EB	Rev.



- Key:**
- Permit boundary
 - Proposed restoration contour
 - + Groundwater and perimeter ground gas monitoring location
 - + Proposed in-waste ground gas probe location

- Notes:**
1. Gas probes will be installed into the waste deposit after the landfilling has been completed.
 2. The borehole locations (shown in drawing 173263/D/003) and the gas probes will be monitored on a quarterly basis after landfilling has been completed.
 3. The whole permit boundary is shown in drawing 173263/D/003. The operation will only take place within the eastern cell.

Rev.	Details	Drawn	Date
		Chkd.	
Project 173263 Finningley Quarry			
Title Post-landfill Monitoring Plan			
		AA Environmental Ltd Units 4 to 8 Cholswell Court Shippon Abingdon Oxon. OX13 6HX T: (01235) 536042 F: (01235) 523849 info@aae-lp.com www.aae-lp.com	
Scale	Date	Drng. No.	Rev.
1:2,000@A3	Feb '20	173263/D/008	
	Drawn	Chkd.	
	JM	EB	