

Attachment L.4– Landfill Gas

Organisation Name:*

Knockharley Landfill Limited

Application I.D.:*

LA004307

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1. Landfill Gas Management

Non-Stabilised Cells

During the initial phases of filling the non-stabilised landfill cells the gas is passively vented. Subsequently, and based on the levels of methane and gas flow rates, the passive vents are converted to active abstraction wells and connected to the gas engines. The design of the abstraction and utilisation system complies with the guidance in the EPA Manuals on Landfill Site Design and Landfill Operational Practices and operational experience and comprises:

- Horizontal gas extraction pipework in each cell.
- A network of vertical landfill gas extraction wells progressively installed on an approximately 50 metre grid, with addition wells installed based on the findings of fugitive gas surveys at the top of the capped areas.
- The vertical gas wells are sealed at surface with bentonite as required in order to minimise the ingress of oxygen and the potential for migration of landfill gas.)
- The connection of the extraction wells to a collection network that comprises a perimeter 355 mm ring main around the landfill that is connected to by 180 mm pipes laid across the landfill surface. The wells and ring main connection points are fitted with shut-off valves to enable flow restriction or isolation.
- The provision of 'knock out pots' that remove condensate from the collection network to avoid gas flow restrictions. The condensate is pumped to the leachate riser pipes.
- A landfill gas utilisation plant comprising gas engines and flares. There are four gas engines, two of which run continuously each with a capacity of 1,000 m³/hr, and two back-up engines, each 800 m³/hr. There are two enclosed duty flares (1,500 m³/hr and 1,500 m³/hr) and an enclosed back-up flare (2,500 m³/hr). The 2,500 m³ flare is connected to the booster station that provides the primary back up to the two duty engines. A fourth open flare (500 m³/hr) is provided, but only used for odour control measures as required.

Stabilised & Inert Cells

The stabilised and inert waste and SNRHW will not be sources of landfill gas generation and therefore an active abstraction and utilisation/flaring system is not required. As a precautionary measure passive vents will be installed in the cells.

IBA Weathering Area

During the early stages exothermic reactions may cause elevated temperatures and hydrogen gas is released. Peak gas production will occur within 3 to 4 months following receipt of IBA on-site and rapidly decline over the following 12 months. Horizontal gas collection pipes that connect to passive vents will be progressively installed in the cells.

2. Landfill Gas Monitoring

The monitoring and reporting requirements, which are specified in Schedules D and E and Condition 8 of the Licence, are presented in Table 1.1. The monitoring locations are presented in the Figure below.

Table 1.1 Monitoring & Reporting Requirements

MEDIA	MONITORING FREQUENCY				REPORTING FREQUENCY		
	Weekly	Monthly	Quarterly	Annually	Quarterly	Bi-Annually	Annually
(Offices)							
Methane (CH ₄)	Continuous					•	
Carbon Dioxide (CO ₂)	Continuous					•	
Oxygen (O ₂)	Continuous					•	
(Monitoring Boreholes)							
Methane (CH ₄)		•				•	
Oxygen (O ₂)		•				•	
Carbon Dioxide (CO ₂)		•				•	
Pressure/Temperature		•				•	
Flare (Enclosed)							
Inlet							
Methane (CH ₄)	Continuous						
Carbon Dioxide (CO ₂)	Continuous						
Oxygen (O ₂)	Continuous						
Total Sulphur				•			
Total Chlorine				•			
Total Fluorine				•			
Process Parameters							
Combustion Temperature	Continuous						
Outlet							
CO	Continuous				•		
NO _x				•	•		
SO ₂				•	•		
TOC				•	•		
Hydrochloric Acid				•	•		
Hydrogen Fluoride				•	•		
(Utilisation Plant)							
Inlet							
Methane (CH ₄)	•				•		
Carbon Dioxide (CO ₂)	•				•		
Oxygen (O ₂)	•				•		
Total Sulphur				•	•		
Total Chlorine				•	•		
Total Fluorine				•	•		
Process Parameters							
Combustion Temperature			•		•		
Outlet							
CO	Continuous				•		
NO _x				•	•		
SO ₂				•	•		
Particulates				•	•		
TA Luft Class I, II, III Organics				•	•		
Hydrochloric Acid				•	•		
Hydrogen Fluoride				•	•		

Monitoring of nineteen (19) perimeter wells has been ongoing since site operations began. In 2008 eleven (11) new wells were installed and were added to the monitoring program. In 2016 an additional six (6) wells were installed and these have been included in the monitoring programme, giving a total of 36 perimeter wells. The existing and proposed monitoring locations are presented in

Drawings LW 14-821-01-P-0050-001 and LW 14-821-01-P-0050-002 respectively in Vol 4 of the EIAR submitted with this application.

The results of the most recent monitoring of the existing landfill gas flares and utilisation plant are in Table L.4(ii)

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Table L.4(ii) Landfill Gas Monitoring for existing landfill gas flares and utilisation plants – Emission/Monitoring point code A2-1/KH01

Parameter	Concentration (mg/Nm ³)	Frequency of Analysis	Method of Analysis
Inlet			
Methane (CH ₄) % v/v	39.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Carbon dioxide (CO ₂) %v/v	30.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Oxygen (O ₂) % v/v	2.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Electrochemical cell
Outlet			
Volumetric Flow Rate	2483 mg/m ³		
SO ₂	2543.51 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
NO _x	326.52 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
CO	1047.98 mg/m ³	Flare & Utilisation plant – Continuous	Flue gas analyser data-logger
Particulates	6.32 mg/m ³	Utilisation plant only - Annually	Isokinetic/gravimetric
Hydrochloric acid	8.04 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Hydrogen Fluoride	<0.34 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Other *	<17.51 mg/m ³	Utilisation plant only - TA Luft Class I, II, III organics - Annually	Adsorption/desorption /GC/ GCMS

Table L.4(ii) Landfill Gas Monitoring for existing landfill gas flares and utilisation plants – Emission/Monitoring point code A2-2/KH02

Parameter	Concentration (mg/Nm ³)	Frequency of Analysis	Method of Analysis
Inlet			
Methane (CH ₄) % v/v	39.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Carbon dioxide (CO ₂) %v/v	30.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Oxygen (O ₂) % v/v	2.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Electrochemical cell
Outlet			
Volumetric Flow Rate	2466 mg/m ³		
SO ₂	1353 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
NO _x	258 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
CO	1045 mg/m ³	Flare & Utilisation plant – Continuous	Flue gas analyser data-logger
Particulates	2.77 mg/m ³	Utilisation plant only - Annually	Isokinetic/gravimetric
Hydrochloric acid	<0.31 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Hydrogen Fluoride	<0.29 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Other *	<0.07 mg/m ³	Utilisation plant only - TA Luft Class I, II, III organics - Annually	Adsorption/desorption /GC/ GCMS

Table L.4(ii) Landfill Gas Monitoring for existing landfill gas flares and utilisation plants – Emission/Monitoring point code A2-3/KH03

Parameter	Concentration (mg/Nm ³)	Frequency of Analysis	Method of Analysis
Inlet			
Methane (CH ₄) % v/v	39.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Carbon dioxide (CO ₂) %v/v	30.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Oxygen (O ₂) % v/v	2.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Electrochemical cell
Outlet			
Volumetric Flow Rate	2606 mg/m ³		
SO ₂	1332 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
NO _x	229 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
CO	1038 mg/m ³	Flare & Utilisation plant – Continuous	Flue gas analyser data-logger
Particulates	1.38 mg/m ³	Utilisation plant only - Annually	Isokinetic/gravimetric
Hydrochloric acid	<0.32 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Hydrogen Fluoride	3.04 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Other *	<0.07 mg/m ³	Utilisation plant only - TA Luft Class I, II, III organics - Annually	Adsorption/desorption /GC/ GCMS

Table L.4(ii) Landfill Gas Monitoring for existing landfill gas flares and utilisation plants – Emission/Monitoring point code A2-4/KH04

Parameter	Concentration (mg/Nm ³)	Frequency of Analysis	Method of Analysis
Inlet			
Methane (CH ₄) % v/v	39.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Carbon dioxide (CO ₂) %v/v	30.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Oxygen (O ₂) % v/v	2.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Electrochemical cell
Outlet			
Volumetric Flow Rate	2606 mg/m ³		
SO ₂	1312 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
NO _x	221 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
CO	1033 mg/m ³	Flare & Utilisation plant – Continuous	Flue gas analyser data-logger
Particulates	2.3 mg/m ³	Utilisation plant only - Annually	Isokinetic/gravimetric
Hydrochloric acid	<0.31 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Hydrogen Fluoride	2.32 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Other *	<0.06 mg/m ³	Utilisation plant only - TA Luft Class I, II, III organics - Annually	Adsorption/desorption /GC/ GCMS

Table L.4(ii) Landfill Gas Monitoring for existing landfill gas flares and utilisation plants – Emission/Monitoring point code A2-5/F1

Parameter	Concentration (mg/Nm ³)	Frequency of Analysis	Method of Analysis
Inlet			
Methane (CH ₄) % v/v	39.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Carbon dioxide (CO ₂) %v/v	30.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Oxygen (O ₂) % v/v	2.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Electrochemical cell
Outlet			
Volumetric Flow Rate			
SO ₂	2240.5 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
NO _x	113.7 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
CO	3.03 mg/m ³	Flare & Utilisation plant – Continuous	Flue gas analyser data-logger
Particulates		Utilisation plant only - Annually	Isokinetic/gravimetric
Hydrochloric acid	6.15 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Hydrogen Fluoride	<0.46 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Other *	3.81 mg/m ³	Flare only - TOC - Annually	Flame ionisation

Table L.4(ii) Landfill Gas Monitoring for existing landfill gas flares and utilisation plants – Emission/Monitoring point code A2-6/F2

Parameter	Concentration (mg/Nm ³)	Frequency of Analysis	Method of Analysis
Inlet			
Methane (CH ₄) % v/v	30.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Carbon dioxide (CO ₂) %v/v	33.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Infrared analyser/flame ionisation detector
Oxygen (O ₂) % v/v	3.00 %v/v	Flare – Continuous Utilisation plant - Weekly	Electrochemical cell
Outlet			
Volumetric Flow Rate			
SO ₂	5926.32 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
NO _x	69.19 mg/m ³	Flare & Utilisation plant – Annually	Flue gas analyser
CO	2 mg/m ³	Flare & Utilisation plant – Continuous	Flue gas analyser data-logger
Particulates		Utilisation plant only - Annually	Isokinetic/gravimetric
Hydrochloric acid	<0.45 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Hydrogen Fluoride	<0.43 mg/m ³	Flare & Utilisation plant – Annually	Impinger/ion chromatography
Other *	4.03 mg/m ³	Flare only - TOC - Annually	Flame ionisation