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Mr John Jones
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ALLAWUNA LANDFILL, YORK – LANDFILL GAS ASSESSMENT

Dear John

1.0 INTRODUCTION

SITA Australia (SITA) commissioned Golder Associates Pty Ltd (Golder) to undertake a landfill gas (LFG) assessment to support the Works Approval Application (WAA) for the proposed Allawuna Farm Landfill, York, Western Australia (herein referred to as the "site"). This assessment is an update of the work carried out previously for the original cell footprint.

The proposed landfill is located south of the Great Southern Highway, approximately 20 km west of the town of York.

The objective of this assessment is to estimate the potential volumes of landfill gas to be generated from the proposed landfill taking into consideration the proposed changes to overall landfill capacity and filling sequence.

2.0 REGULATORY GUIDANCE

The Victorian Environment Protection Authority (Vic EPA) has issued the Best Practice Environmental Measures (BPEM) for siting, design, operation and rehabilitation of landfills and is considered to be the industry best practice with regards to the management of LFG and therefore has been adopted for the purpose of achieving LFG management objectives.

The Vic BPEM details a hierarchy of control measures for LFG management with the preferred option being combined heat and power generation. We understand that SITA will be capturing LFG from Allawuna landfill and as such would meet the requirements of the management hierarchy.

3.0 MODEL METHODOLOGY AND INPUT PARAMETERS

GasSim V2.5 (GasSim) was used to model the potential landfill gas generation. GasSim is a commercially available (and independently verified) landfill gas resource assessment and risk assessment model, developed by Golder for the Environment Agency in the UK, which models gas generation and recovery.

GasSim requires input data for waste tonnages, waste breakdown and the composition of individual waste streams to model the gas generation capability of the waste. Data parameters used in GasSim may be modified by the user. Defaults are provided for most parameters to enable models to be compiled without site-specific data for each parameter. The use of site-specific data changes the assessment from a default to an assessment tailored to the site.

For the purposes of this assessment, the model input data have been based on site-specific data where available. Where site specific data is not available, assumptions have been made and published data, including GasSim default data, have been used.

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3.1 Modelling and Uncertainty

GasSim uses statistical distributions or Probability Density Functions (PDFs) to characterise most of the input parameters. Each time a modelling iteration is carried out, one value from the defined input distributions is selected by computer code. Each result is stored, such that after repeating the same calculation many times, an output distribution for the gas production is obtained.

The distribution output is given in terms of percentiles (%iles). These %iles specify the probability with which a certain value (e.g. gas production rate) will not be exceeded. For instance, if the 95%ile of a gas production rate distribution is shown as 1000 m³/hour, there is a 95% chance that the actual production rate will be below or equal to 1000 m³/hour (based on the assumptions of the model). It follows that there is also a 5% chance that the actual production rate will be above this amount.

For the purposes of this assessment of model outputs, results at the 50th%ile and 90th%ile have been considered.

3.2 Predicted Annual Waste Input Rates

The estimated rate of waste placement at the landfill is approximately 250 000 tonnes of waste per annum. At a total waste capacity of approximately 5.1 million tonnes (excluding daily cover material) this results in a proposed operational life of the landfill of approximately 22 years.

A uniform distribution with a ± 25 000 tonne range has been applied to all waste input tonnages to account for some possible change in future waste acceptance. A uniform distribution allows a minimum or maximum value for a parameter to be specified where there is an equal chance of all the values in the range being the actual value.

The modelled waste density was accounted for by a uniform distribution of 0.8 t/m^3 to 1.2 t/m^3. The modelled waste densities were selected as there is likely to be variance in the density of waste accepted at the site.

Table 1: Predicted Waste Volumes

Landfill Cell	Estimated Tonnages	Filling to Commence
CELL 1	478 244	Year 1
CELL 2	762 647	Year 3
CELL 3	644 243	Year 6
CELL 4	1 074 944	Year 9
CELL 5	753 793	Year 14
CELL 6	1 370 391	Year 17
TOTAL	**5 084 262**	

3.3 Waste Breakdown

GasSim requires that the waste streams and the composition of individual waste streams be defined. The waste composition used in the assessment (refer to Table 2) was based on the default waste mix types provided in the National Greenhouse and Energy Reporting (Measurement) Determination 2008, as amended, taking into account amendments up to National Greenhouse and Energy Reporting (Measurement) Determination 2013 (herein referred to as 'the Measurement Determination') for municipal solid waste (MSW) and commercial and industrial (C&I) waste.

It was assumed that the site would accept approximately 50% MSW waste and 50% C&I waste. A triangular distribution of 45, 50, 55 has been applied to all waste streams, this assumes the minimum percentage of MSW or C&I Waste is 45% the maximum is 55% with 50% being the most likely value.

Table 2: Estimated Waste Composition#

GasSim Classification	NGER Waste Stream included in Classification	MSW	C&I	Applied Degradation Rate
Other Putrescible	Food	35.0%	21.5%	Rapid 100%
Newspaper	Paper and Cardboard	13.0%	15.5%	Slow 100%
Garden Waste	Garden and Park	16.5%	4.0%	Rapid 100%
Wood	Wood and Wood Waste	1.0%	12.5%	Slow 75% Moderate 25%
Textiles	Textiles	1.5%	4.0%	Slow 100%
Sludge	Sludge	0.0%	1.5%	Moderate 100%
Disposable Nappies	Nappies	4.0%	0.0%	Moderate 100%
Other misc. combustibles	Rubber	1.0%	3.5%	Moderate 100%
Non-degradable	Inert Waste (including concrete, metal, plastic and glass)	28.0%	37.5%	Slow 100%

#Based on the Waste Composition of the Measurement Determination, actual waste accepted at the site may vary from those modelled.

3.4 Cap and Liner Details

For a landfill gas resource assessment, details regarding the cap and liner details are not crucial as they only determine the partitioning between lateral and surface emissions. Therefore, cap and liner details have not been included in the model.

3.5 Waste Moisture Content and Degradation Rate

GasSim has four default settings to calculate waste moisture content within the landfill, which in turn decides the waste degradation rates. The four default settings are:

- **Dry** – Less than 30% (v/v) moisture.
- **Average** – Greater than 30% (v/v) and less than 60% (v/v) Moisture.
- **Wet** – Greater than 60% (v/v) moisture and less than 80% (v/v) moisture.
- **Saturated** – Greater than 80% (v/v) moisture.

We have assumed a range between '*dry*' and '*average*' waste moisture content for the site. Selection of the range is a reflection of the k- values provided in the NGER Measurement Determination.

The waste degradation rates (k values) associated with the waste moisture content range are as follows:

- **Slow** – Uniform 0.013, 0.046.
- **Moderate** – Uniform 0.046, 0.076.
- **Rapid** – Single 0.076.

The k-values associated with Western Australia in the Measurement Determination range from 0.02 to 0.06. Therefore the range used to model the Site is slightly greater than the Measurement Determination and should therefore be considered as a conservative estimate.

4.0 MODEL RESULTS

The predicted LFG generation curve for the site based on 'Total Bulk Landfill Gas Produced' is shown in Figure 1.

In each case, the GasSim output at the 50th and 90th %iles are shown and the results summarised as presented in Table 3.

Table 3: GasSim Model Results

	Year	Model Gas Generated (50^{th} %ile) (m^3/hr)	Model Gas Generated (90^{th} %ile) (m^3/hr)
Total Bulk Landfill Gas Produced	2020 (Completion of Year 1)	32	36
	2041 (maximum gas production)	1548	1661

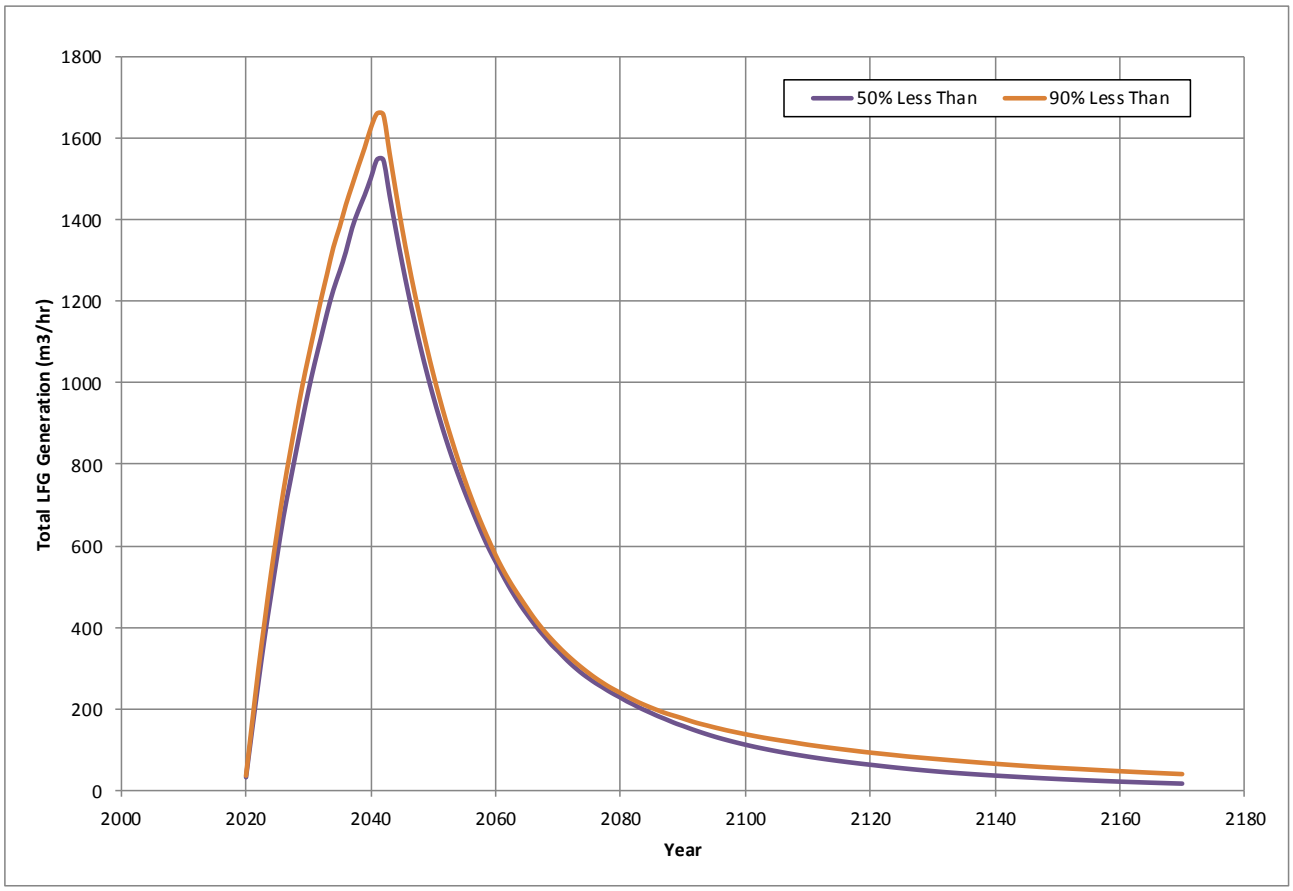


Figure 1: Total Bulk Landfill Gas Generation

5.0 CONCLUSIONS

The LFG generation modelled indicates significant volumes of LFG will be generated. Options for the management indicate that flaring would be the most likely option, while the installation of power infrastructure and power generation will be assessed as the landfill develops.

6.0 LIMITATIONS OF THE MODEL

SITA should understand that the GasSim model is a predictive tool and should not be relied upon for an exact landfill gas generation values. In practice, landfill gas generated by the site are likely to vary from those estimated by the model as site specific factors influence the rate of landfill gas generation. Refinement of the model is recommended as the landfill develops.

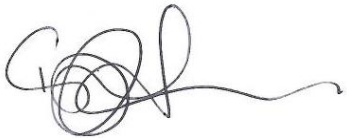
Your attention is drawn to the document “Limitations”, which is included as an attachment to this letter. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. We would be pleased to answer any questions the reader may have regarding these ‘Limitations’.

7.0 CLOSURE

If you have any question regarding this letter report then please do not hesitate to contact either of the undersigned on (03) 8862 3500.

GOLDER ASSOCIATES PTY LTD

David McFadden
Senior Environmental Engineer



Roger Parker
Principal

DI,DM/RP/hsl

Attachments: A – Limitations

https://aupws.golder.com/sites/147645033alluwunafarmpeerreview/correspondence out/147645033-010 lfg assessment/147645033-010-l-rev0.docx

ATTACHMENT A
Limitations

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