Witcham Meadlands Landfill Site

784-B070447

Landfill Gas Risk Assessment

Environmental Permit Variation Application

Mick George Limited

September 2025

Document prepared on behalf of Tetra Tech Limited

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1.0 Introduction

1.1 Report Context

1.1.1 Mick George Limited (Mick George) has commissioned Tetra Tech to undertake a Landfill Gas Risk Assessment for the Witcham Meadlands Landfill Site.

1.1.2 The Witcham Meadlands Landfill site is currently regulated under a bespoke Environmental Permit (EPR/LP3996ND) to allow the importation of non-hazardous waste and stable non-reactive hazardous wastes including gypsum and asbestos within an engineered cell (Phase 9). The Environmental Permit also allowed for the importation of inert waste within separate areas to the engineered cell (Phases 1-8).

1.1.3 Mick George are now seeking to vary the Environmental Permit to apply the following changes-

- Change the annual throughput to the following:-

Table 1: Proposed Changes to Throughput

Category	Current Limit Tonnes/Year	Proposed Limit Tonnes/Year
Non-hazardous / inert waste (Phase 9 only)	50,000	200,000
Stable Non-Reactive Hazardous Waste (Phase 9 only)	200,000 including a maximum of 20,000 tonnes of gypsum waste	200,000 including a maximum of 30,000 tonnes of gypsum waste
Asbestos waste and construction material containing asbestos (Phase 9 only)		
Gypsum waste (Phase 9 only)		
Inert Waste	50,000	0

- Update the location of the leachate monitoring points as they are not where the original permit application said they would be. This has also been raised by the local area officer in a Compliance Assessment Report (CAR Form) and Mick George have been advised to vary the environmental permit to ensure that the correct locations are referenced. As shown on Drawing Number MGL/B070447/LOC/01.
- Extend Phase 9 southwards as shown on Drawing Numbers MGL/B070447/LOC/01 and MGL/B070447/LOC/02.
- Amend the sulphate compliance levels that are currently set in Table S3.3 of the environmental permit.
- Allow the importation of Air Pollution Control (APC) wastes into the SNRHW cell.

Table 2: Proposed Waste Codes for APC Waste

EWC Code	Description
10 01 16*	Fly ash from co-incineration containing hazardous substances
10 01 18*	Wastes from gas cleaning containing dangerous substances
10 01 04*	Oil fly ash and boiler dust
10 01 13*	Fly ash from emulsified hydrocarbons used as fuel
19 01 07*	Solid wastes from gas treatment
19 01 15*	Boiler dust containing hazardous substances
19 01 17*	Pyrolysis wastes containing hazardous substances

- Add the following waste codes to the environmental permit:-

Table 3: Additional Waste Codes

EWC Code	Description
19 13 04	Sludges from soil remediation other than those mentioned in 19 13 03
19 12 11*	Other wastes (including mixtures of materials) from mechanical treatment of waste containing hazardous substances[1]
19 13 03*	Sludges from soil remediation containing hazardous substances)[1]
12 01 16*	Waste blasting material containing hazardous substances
17 02 04*	Glass, plastic and wood containing or contaminated with hazardous substances
17 04 09*	Metal waste contaminated with hazardous substances
15 01 11*	Metallic packaging containing a hazardous solid porous matrix (for example asbestos), including empty pressure containers

**Wastes codes for the asbestos list*

1.1.4 The objective of a Landfill Gas Risk Assessment is to provide an assessment of the potential landfill gas generation arising from the increased throughput, the enlarge Phase 9 area and the additional waste codes (including APCr) to allowed in Phase 9 in the SNRHW cell area and the effectiveness of the proposed landfill engineering at the site including both the liner and capping.

1.1.5 The source of the landfill gas (LFG), potential pathways through the geosphere and atmosphere by which landfill gas can migrate and the potential receptors are identified.

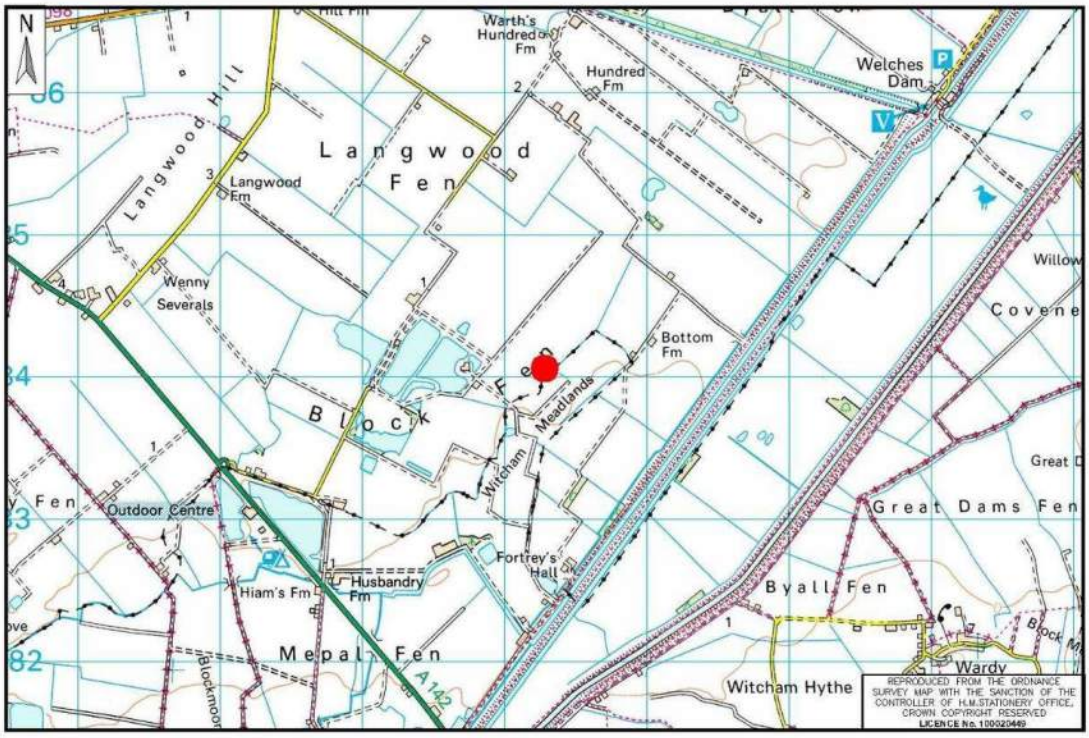
1.1.6 A conceptual model has been prepared and is presented as Drawing Number MGL/B070447/LOC/03 for the extended Phase 9 and SNRHW cell and has been simulated using the Environment Agency approved GasSim software to assess the potential risk that the landfill poses to the environment. The GasSim model provides a gas generation profile which can be used to support the proposal to accept additional waste types to the site and to advise on its future management.

2.0 Conceptual Landfill Gas Model

2.1 Site Setting

2.1.1 Mepal Landfill Site (formerly South Witcham Quarry) is located approximately 5km to the south east of Chatteris, Cambridgeshire. The site is located within the Block Fen area of Mepal as shown on Figure 1 below.

Figure 1: Site Location



2.1.2 The source, pathway, receptor approach has been used to derive a conceptual model showing the existing and proposed engineering arrangements. The conceptual model is shown in Drawing Number MGL/B070447/LOC/03.

2.1.3 The main potential source of landfill gas is the extended Phase 9 SNRHW cell area. The majority of the waste which is being accepted to the site is inert and will therefore not produce measurable quantities of landfill gas.

2.1.4 A vertical pathway is the most likely route for gas to escape through the capped and uncapped surface of the extended Phase 9 SNRHW cell area to atmosphere. The presence of an engineered clay landfill liner will limit the lateral migration of landfill gas through the surrounding geology and this would therefore be deemed a minor pathway.

2.1.5 The receptors are residential dwellings and farms around the site and the site buildings themselves. There are no residential dwellings within 500m of the SNRHW cell boundary. The nearest occupied receptor is currently Langwood Fen Farm which is located 670m to the north west of the extended Phase 9 SNRHW cell boundary. The next closest dwelling is Cooper's Farm located 1,055m to the north east of the SNRHW cell. This dwelling is currently unoccupied but is included within the risk assessment due to the potential for the property to be occupied in the future.

2.1.6 The extension of the Phase 9 area to the south does not change the distance from the nearest residential dwellings as they are both to the north of the current Phase 9 area and the extension will be south of the current Phase 9 area. The linkages between source and receptor can be seen in Drawing Number MGL/B070447/REC/01A.

2.1.7 For the purpose of this Landfill Gas Risk Assessment, an enlarged single landfill cell has been assessed, which is permitted to accept SNRHW encompassing the extension to the south.

2.1.8 The original SNRHW cell only commenced in March 2016. The landfill basal and side lining comprises 1m of engineered clay which will have a minimum permeability of $1x10^{-9}$ m/s. The cell has not yet been capped but the proposed cap will comprise 0.5m of engineered clay which will have a maximum permeability of $1x10^{-9}$ m/s. The clay cap will be overlain by 1m depth of restoration soils. The southern extension to the Phase 9 area will have exactly the same engineering profile as above as detailed in the latest approved CQA plan for Phase 9.

2.1.9 There are no proposals to actively manage or extract landfill gas from the Phase 9 SNRHW cell area.

2.2 Source

Landfill Gas – Composition

2.2.1 Gas is produced by the biological degradation of organic components. Microbial processes degrade organic matter in the absence of oxygen and produce methane and carbon dioxide. The generation of gas will be dependent on many factors that influence the optimum conditions for microbial activity, namely moisture content, pH and temperature. Other factors include waste type, density and particle size. Microbial activity would be at its optimum when the pH is between 6.5 and 8.5, the temperature ranges between 35 - 45°C and there is a high (but not saturated) moisture content.

Landfill Gas – Characteristics

2.2.2 Gas containing methane can form flammable mixtures in air. The concentration of carbon dioxide and oxygen will influence the probability of ignition. Both methane and carbon dioxide are known to have asphyxiation properties, under depleted oxygen conditions. The risk of asphyxiation increases within confined spaces and also when oxygen levels are depleted.

2.2.3 Carbon dioxide is classed as a highly toxic chemical. The short term exposure limit (STEL) is based upon a 10 minute reference period. At concentrations of 3% volume for volume (v/v) in air, shortness of breath and headaches will occur, these symptoms become severe at 5 to 6% v/v.

2.2.4 At levels of 10 to 11% v/v, headaches, visual distortion, tremors and rapid loss of consciousness occur. Concentrations of 22% v/v or more are likely to be fatal. Oxygen depletion accompanying elevated CO2 concentrations will make the effects more severe.

2.2.5 Other trace elements, such as hydrogen sulphide (H2S) may also be toxic and can potentially have significant health effects at relatively low concentrations (i.e. >20 parts per million).

2.3 Pathways

2.3.1 The primary pathway for any landfill gas produced within the cell is vertical migration into the atmosphere through the uncapped waste. Lateral migration may also occur into the surrounding geological strata and also into the adjacent asbestos cell through the clay liner, although this pathway is likely to be less preferable due to the presence of the low permeability clay liner. Furthermore, the extended Phase 9 SNRHW area will solidify as it dries which will also limit the vertical and lateral migration of landfill gas.

2.3.2 Once the extended Phase 9 SNRHW cell is capped, it is likely that migration of landfill gas will reduce significantly. The preferred pathway will continue to be vertically into the atmosphere with the minor pathway comprising lateral migration through the 1m thick clay liner and geological strata, although concentrations of emissions will be reduced.

2.4 Climate

2.4.1 Regionally the East of England is characterised by low rainfall compared with the rest of the United Kingdom. Within the Fens annual rainfall averages 600mm per annum, the majority of which is derived from the summer thunderstorms.

2.4.2 The local Catchment Abstraction Management Strategy (CAMS) Report produced by the Environment Agency (March 2006) for the ‘Old Bedford’ including ‘Middle Level

Catchment' identifies the average (1965-2002) rainfall for the area to be 520mm per annum, which compare to the long-term UK average (1971-2000) of 1125mm. Scott Doherty Associates (2002) reports the average annual rainfall for the local hydraulic catchment to be 538mm.

2.4.3 Site specific information on rainfall and potential evapo-transpiration is available from the Met Office in the form of MORECS data. The long term average (1961-1990) annual rainfall is reported to be 580.4mm whilst the long term average (1961-1990) annual potential evaporation is recorded to be 488.7 mm per annum for bare soil and 611.4 mm per annum for grass. This data indicates that the effective rainfall to the operational areas of the site will be approximately 92mm per year.

2.4.4 However, the solidification of the SNRHW will further limit the infiltration of rainfall to the waste mass. The effective rainfall figure of 92mm/yr is therefore likely to represent the absolute worst case scenario.

2.4.5 The wind rose data for the site shows that prevailing wind direction is the south west approximately 12% of the time. The highest wind speeds are most frequently from the south west.

2.5 Regional Geology

2.5.1 Based on the British Geological Survey (BGS) 1:50,000 Sheet 173 Ely (Bedrock and Superficial Deposits) published in 1980, the regional geology comprises Jurassic deposits overlain in places by Pleistocene and Recent superficial deposits. The solid geology regionally consists of the Jurassic Ampthill Clay/West Walton Formation and the Kimmeridge Clay, dipping gently to the south east.

2.6 Local Geological Settings

2.6.1 Locally, the youngest solid stratum is the Upper Jurassic Ampthill Clay Formation. The Fenland area is covered by extensive superficial deposits that include unconsolidated peats, clays, silts, sands and gravels. The most extensive superficial deposits local to the site are the Pleistocene First and Second River Terrace Deposits which have been removed from the site as a result of the extraction works.

2.6.2 The River Terrace Deposits are thickest along the north western boundary of the wider Mepal Landfill Site and range from between 6.3m to 4.1m. The deposits are generally thinner to the south east where the deposits are typically less than 2m in thickness.

2.7 Receptors

2.7.1 Receptors which can be potentially affected by landfill gas include the following:-

- Residential dwellings;
- Vegetation on site;
- Commercial properties; and
- Site offices/buildings.

2.7.2 The only receptor which is located within 500m of the SNRHW cell boundary is the on-site office and buildings. The other closest residential dwellings to the SNRHW cell boundary are:-

- Langwood Fen Farm – 670m to the north west;
- Cooper's Farm (currently unoccupied) – 1,055m to the north east;
- Fortrey's Hall – 1,060m to the south;
- Common Farm – 1,355m to the south west; and
- Langwood Farm East – 1,600m to the north-north east.

2.7.3 There are a number of isolated commercial properties to the south and south west of the SNRHW cell but none are situated within 1km of the cell boundary. The closest is an unknown commercial development located 1,155m to the south-south west.

2.8 Current Monitoring

2.8.1 Gas monitoring has been undertaken at a number of perimeter boreholes at the landfill area since 2005. The location of these boreholes is shown on Drawing Number MGL/B070447/LOC/01.

2.8.2 Monitoring will continue at boreholes; GAS1, GAS2, GAS3, GAS4, GAS5, GAS6, and GAS7. With respect to the extended Phase 9 SNRHW cell, the closest gas monitoring boreholes are boreholes GW2/GAS2 to the south east, boreholes GW11/GAS6 and GW12/GAS7 located adjacent to the north western cell boundary and borehole GW1/GAS1 located to the west and south west of the cell.

2.8.3 The monitoring data for the site provides established background concentrations of methane (CH4) and carbon dioxide (CO2). Following an assessment of the landfill gas monitoring results site specific Environmental Assessment Limits (EALs) have been set for

the permitted area which vary from 1.8 to 2.1 %v/v for methane and 7.5 to 17.9 %v/v for carbon dioxide.

3.0 Landfill Gas Risk Assessment

3.1 The Nature of the Landfill Gas Risk Assessment

3.1.1 A quantitative gas risk assessment has been carried out based on the source, pathway, receptor concept and using computer modelling software. Only one cell has been modelled as this single cell is the subject of the Environmental Permit Variation.

3.1.2 A single engineering solution is proposed for this cell in terms of the low permeability clay liner and cap and therefore only one scenario has been modelled to represent the existing and future on-site arrangements. In the unlikely event that a different capping solution is proposed once the cell is filled, that isn't directly equivalent to the current design, further modelling would be required to assess the likely impact on gas management.

3.2 The Proposed Assessment Scenario

3.2.1 One model has been produced to cover the single extended Phase 9 SNRHW cell. In summary the model includes an assessment of the SNRHW cell which will be landfilled with a range of non-biodegradable wastes including industrial sludges (which will solidify as they dry) and ash. The extended Phase 9 SNRHW cell will include a 1m clay basal and side liner. On completion of filling the site will be capped with 0.5m single clay cap which will be overlain with 1m of restoration soils.

3.2.2 Landfilling is likely to be undertaken over a 3 year period, and for the purpose of the model landfilling is taken to commence in June 2025 and be completed by December 2028. The model has been run for 150 years with gas production reaching concentrations of less than 2m^3/hr approximately 26 years after tipping operations have ceased.

3.3 Accidents and their Consequences

3.3.1 The most likely accidents or failure scenarios are considered to be as follows:-

- Loss of waste containment (e.g. failure of landfill engineering);
- Landfill fire;
- Failure of waste acceptance procedures; and
- Failure of leachate collection system and resultant effect on landfill gas management.

3.3.2 A qualitative risk assessment of the above accident and failure scenarios is shown in Table 3 below. The risk assessment is based on the methodology set out in Environment Agency guidance document (LFTGN03) '*Guidance on The Management Of Landfill Gas.*'

Table 3: Qualitative Risk Assessment for Accidents and Failure Scenarios

Scenario	Likelihood	Severity	Score	Magnitude of Effect
Loss of waste containment	Very unlikely (2)	Minor (1)	2	Insignificant
Landfill fire	Very unlikely (2)	Significant (3)	6	Insignificant
Failure of waste acceptance procedures	Unlikely (3)	Significant (3)	9	Acceptable
Failure of leachate collection system	Somewhat unlikely (4)	Minor (1)	4	Insignificant

3.4 Justification for Modelling Approach and Software

3.4.1 The Environment Agency's approved software for modelling landfill gas risk is GasSim with version 2.05 used for this risk assessment.

3.5 Model Parameterisation

3.5.1 Site specific data has been used for the input parameters where possible but when data is not available, assumptions have been used which are discussed in Section 3.7. Justifications for the values used are contained within the GasSim model.

3.6 Model Validation

3.6.1 The models have been constructed to reflect, as closely as possible, the actual conditions at the Witcham Meadlands Landfill Site.

3.7 Assumptions

3.7.1 Whilst the engineering details for the cell are well understood, details relating to the waste inputs are limited and therefore assumptions have had to be made with regard to the relative proportions of the permitted waste types which will be landfilled over the life of the site. The assumptions made within the GasSim model are set out below:-

- Mepal Landfill Site's extended Phase 9 SNRHW cell has been modelled. For the purpose of this gas risk assessment, no other landfill cells have been included within the model;
- The extended Phase 9 SNRHW cell boundary and layout arrangements are based on information provided by MGL and are shown on Drawing Numbers MGL/B070447/LOC/01, MGL/B070447/LOC/02.

- Landfilling commenced in March 2016 and will be completed in December 2028;
- After landfilling has taken place the cells remain with zero waste inputs for each of the years up to capping;
- Uncapped infiltration has been set at 92mm/yr with capped infiltration at 58mm/yr (which represents 10% of the actual rainfall in the local area). However as noted above, the waste will solidify as it dries and this figure is likely to represent a worst case scenario;
- Although the annual rainfall in the East Anglia region is low when compared with the rest of the UK, the waste liquid saturation has been set as average wetness to represent a worst case scenario. However as noted above, the waste will solidify as it dries and this figure is likely to represent a worst case scenario;
- Leachate head has been set with a uniform distribution between 0.5m and 1.0m as stated within the HRA;
- Assumptions have therefore been made regarding the waste types and input rates (within the limits of the GasSim model parameters). It is assumed that 400,000 tonnes per annum (tpa) of waste will be accepted at the site, with this being broken down into the following:-
    - 30,000 tpa (or 7.5% of the total 400,000 tpa) will comprise gypsum waste;
    - 200,000 tpa (or 50% of the total 400,000 tpa) will comprise non-biodegradable waste; and
    - 170,000 tpa (or 42.5% of the total 400,000 tpa) will comprise ash.
- In order to represent the gypsum waste inputs to the cell, this waste has been classified as ash to take account of its non-putrescible nature. However, the trace gas inventory data has been amended for hydrogen sulphide (H_2S) due to the high potential for gypsum waste to produce quantities of H_2S. For the purpose of this risk assessment, the concentration of H_2S within the cell is taken to be between (uniform distribution) 100mg/m^3 and 580mg/m^3.
- A 1m clay basal and side liner with a maximum permeability of 1x10^{-9} m/s is being constructed;
- A 0.5m depth clay cap will be constructed with a maximum permeability of 1x10^{-9} m/s. The clay cap will be overlain by 1m of restoration soils;

- In terms of timescales, it is assumed that a temporary cap will be installed in December 2027 and a permanent cap being installed in Summer 2028 when landfilling is complete; and
- It is also assumed that no active landfill gas management (flare or engine) will be in place.

4.0 Results

4.1 Landfill Gas Emissions

4.1.1 Gas generation curves for bulk landfill gas, carbon dioxide and methane can be found in Appendix 1 and are reported here. The maximum predicted gas generation rates at any time during the lifecycle of the landfill are shown in Table 4 below:-

Table 4: Summary of Maximum Predicted Gas Production Rates

Model Reference	Bulk LFG (m^3/hr) with year recorded	Carbon Dioxide (m^3/hr) with year recorded	Methane (m^3/hr) with year recorded
Model 1	41 (2030)	20.6 (2030)	20.6 (2030)

4.1.2 The total gas generation rate for bulk landfill gases is very low, with the highest rate of 41m^3/hr being recorded for the year 2030. The highest values for bulk landfill gases are calculated for the period prior to the cap being placed on the landfill cells. As soon as the cell is capped, the generation rate of bulk landfill gases rapidly reduces.

4.1.3 It is likely that a proportion of the gypsum based waste will biodegrade to produce quantities of hydrogen sulphide. The maximum gas generation rate of hydrogen sulphide predicted is 9.9 g/hr (note the very low generation rate) which is forecast to arise in 2030 following the completion of landfilling.

4.2 Surface Emissions

4.2.1 Surface emissions for bulk landfill gas, methane and carbon dioxide are presented in Appendix 2.

4.2.2 The highest bulk landfill gas surface emission of 41 m^3/hr is calculated for the period prior to any capping being in place (2030). However, when capping has been completed the values decrease rapidly. The rate of bulk landfill gas surface emissions predicted from the cell are very low and fall to below 1m^3/hr (total bulk landfill gas) by 2057.

4.2.3 The highest gas generation rate of hydrogen sulphide surface emissions is predicted to be 9.9 g/hr. Once the cell is capped in 2028, the gas generation rates fall rapidly and by 2038 are below 1g/hr. The likely solidification of waste will further limit the movement of landfill gas through the waste mass and clay cap.

4.3 Lateral Emissions

4.3.1 Lateral emissions have been modelled and are presented in Appendix 3. The results show that whilst the cell remains uncapped there are no measurable lateral emissions produced. Once the site is capped in 2028, there is a small spike in gas generation rates (total bulk landfill gas, carbon dioxide and methane). However, the rates predicted are negligible with the total gas generation rate of bulk landfill gas of 1.4 m^3/hr recorded in 2030.

4.3.2 The extremely low rates of lateral emissions are attributed to the presence of the low permeability clay landfill liner and the largely non-biodegradable nature of the waste. The gypsum based waste will generate hydrogen sulphide with a maximum predicted lateral emission generation rate of 0.31 g/hr in 2030 following capping. This is not considered to be a significant concentration. The likely solidification of the waste will further limit the lateral migration of landfill gas through the waste mass and landfill liner.

4.4 Sub Surface Migration

4.4.1 The lateral migration module of GasSim has been used to determine potential migration through the ground subsurface, however, it is extremely limiting. The geology section is broad in nature and the model allows only one type of geology to be selected when in reality the geological setting for the site is more complex. However, the results have been modelled for 2030 which is the year when lateral emissions peak.

4.4.2 Migration has been assessed from the extended Phase 9 SNRHW cell for bulk landfill gas, carbon dioxide and methane, the results of which are shown in Appendix 4. The results show that the maximum concentration of bulk landfill gas in December 2030 is 1.85 x 10^5 mg/m^3 (i.e. 185,000 mg/m^3) at the cell boundary. The concentrations of landfill gas fall to 0mg/m^3 at a distance of 16 metres. As the closest receptor (Langwood Fen Farm) is located approximately 670m from the site boundary, it is considered that the site would not pose a risk in terms of bulk landfill gas migration.

4.5 Global Atmospheric Impact

4.5.1 In summary the maximum predicted Total Global Warming Potential is as follows: (units are tonnes of carbon dioxide):-

Table 5: Global Atmospheric Impact

Model	Maximum Global Warming Potential	Total Global Warming Potential (Sum of all years)	Ozone Depletion Total (Sum of all years)
Model 1	369, 2028	6.13 x 10^3	0.00

4.5.2 It can be seen that the optimum period for the generation of gases from the Mepal Landfill extended Phase 9 SNRHW cell with global warming potential is in 2028, which is prior to the landfill cell capping being completed. The results at the 50th percentile also show that in 2028, 49.2 tonnes of methane (surface), 351 tonnes of carbon dioxide (surface) and 0.042 tonnes of hydrogen sulphide would be released from the cell. By 2030, this has reduced to 39 tonnes of methane, 278 tonnes of carbon dioxide and 0.019 tonnes of hydrogen sulphide.

4.5.3 However, this does not take into account the likely solidification of the SNRHW which will limit the infiltration of rainwater to the waste and also minimise the movement of landfill gas within the waste mass. These factors will limit the production of landfill gas and the emissions of gas from the cell. These results are therefore considered to represent the worst case scenario.

4.5.3 Although the concentrations of landfill gas generated within the extended Phase 9 SNRHW cell are relatively low, the effect of capping the cell can be clearly seen in terms of reducing the potential global atmospheric impact and controlling greenhouse gas emissions.

4.6 Tier 1 Screening

4.6.1 Tier 1 screening has been carried out for years 2016 when landfilling commenced, 2028 when landfilling has been completed and the site is being capped, 2036 approximately 8 years after the site has been capped and the sum of all years.

4.6.2 The Tier 1 screening assessment has followed Environment Agency Guidance (2002) which includes a set of lookup tables which have been integrated into GasSim 2. The screening exercise compares the emissions for a suite of gasses against a series of long-term and short-term thresholds ranking the results as insignificant or not-insignificant with those classed as not insignificant potentially requiring detailed modelling.

4.6.3 Emissions are deemed insignificant if:-

- The predicted concentration (PC) is less than 1 per cent of the environmental benchmark (long-term); and
- The PC is less than 10 per cent of the environmental benchmark (short-term).

4.6.4 For the years 2016, 2028, 2036 and the sum of all years, the screening indicates that all short-term and long term emissions are insignificant and that no detailed modelling is required.

4.7 Landfill Gas Completion Criteria

4.7.1 The concentrations of landfill gas produced within the site are predicted to be low with a maximum concentration of 41 m^3/hr at the peak year of 2030. This is due to the high proportion of non-degradable waste which is predicted to be accepted at the site. Once the site is capped, the concentrations reduce rapidly to insignificant levels.

4.7.2 There are no proposals to install active gas management at the site and the results of the landfill gas modelling confirm that concentrations are likely to be insufficient to sustain any small capacity flare or engine.

5.0 Conclusion

5.0.1 Landfilling within the extended Phase 9 SNRHW cell at Mepal Landfill Site commenced in March 2016. For the purposes of this model, it is predicted that landfilling will continue for approximately 12 years until the end of 2028. Although temporary capping will be placed on the waste during the landfilling operations, a permanent low permeability clay cap will be installed once landfilling is complete (i.e. during 2028).

5.0.2 The waste inputs to the site will be largely inert or non-degradable in nature. For the purposes of this GasSim model, it has been assumed that the waste comprises 'non-degradable' and' incinerator ash'. However, the waste inputs include a proportion of gypsum based waste and in order to represent this in GasSim the hydrogen sulphide concentrations have been adjusted. The waste will solidify on drying and this will limit both the infiltration of rainwater to the waste mass and minimise the movement of landfill gas within the waste. The results of the gas modelling can therefore be considered to represent the absolute worst case scenario.

5.0.3 The results of the modelling show that the engineered clay liner and cap will effectively control lateral and surface emissions of landfill gas. The model also demonstrates that the low concentrations of landfill gas will not migrate laterally from the site in sufficient concentrations or over sufficient distances to pose a risk to sensitive receptors.

5.0.4 There are no proposals to actively manage landfill gas from the extended Phase 9 SNRHW cell. The model demonstrates that active landfill gas management is not required to control landfill gas emissions from the cell and that local receptors are not at risk from landfill gas migration.

5.0.5 Landfill gas is monitored routinely at the site. The existing monitoring regime will continue and the trigger levels detailed within the Environmental Monitoring Plan will be applied to ensure that local receptors are not at risk.

Drawings

MGL/B070447/PER/01A – Permit Boundary Plan

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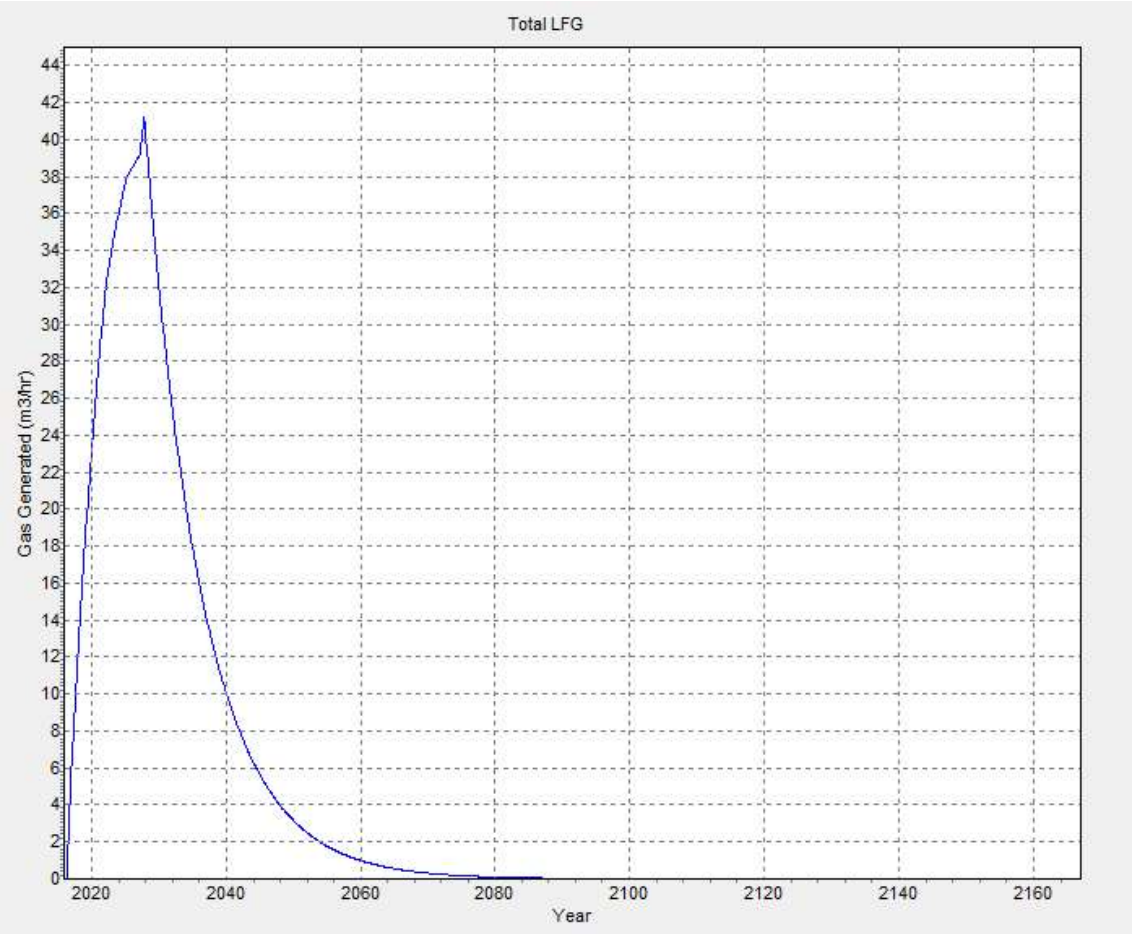
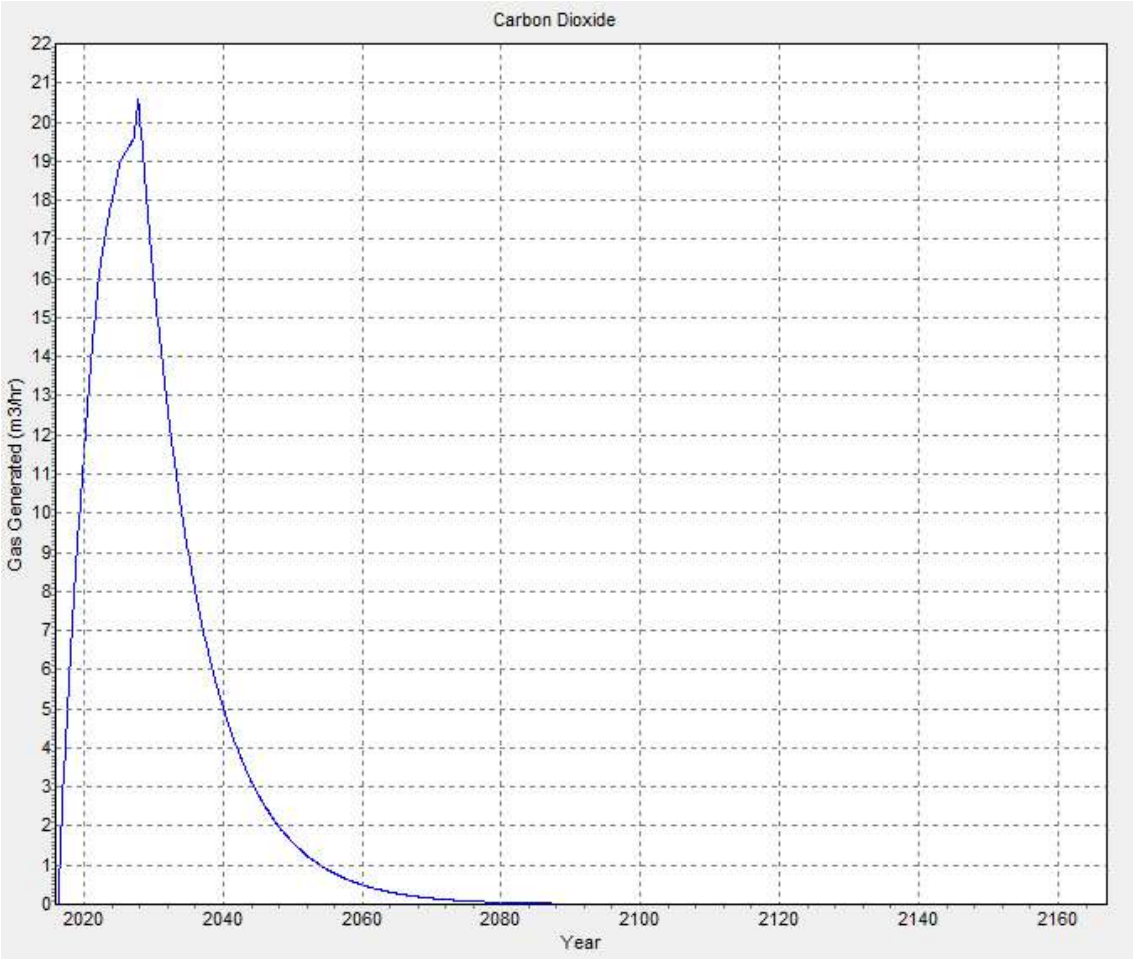
Appendices

Appendix A – Gas Generation Graphs

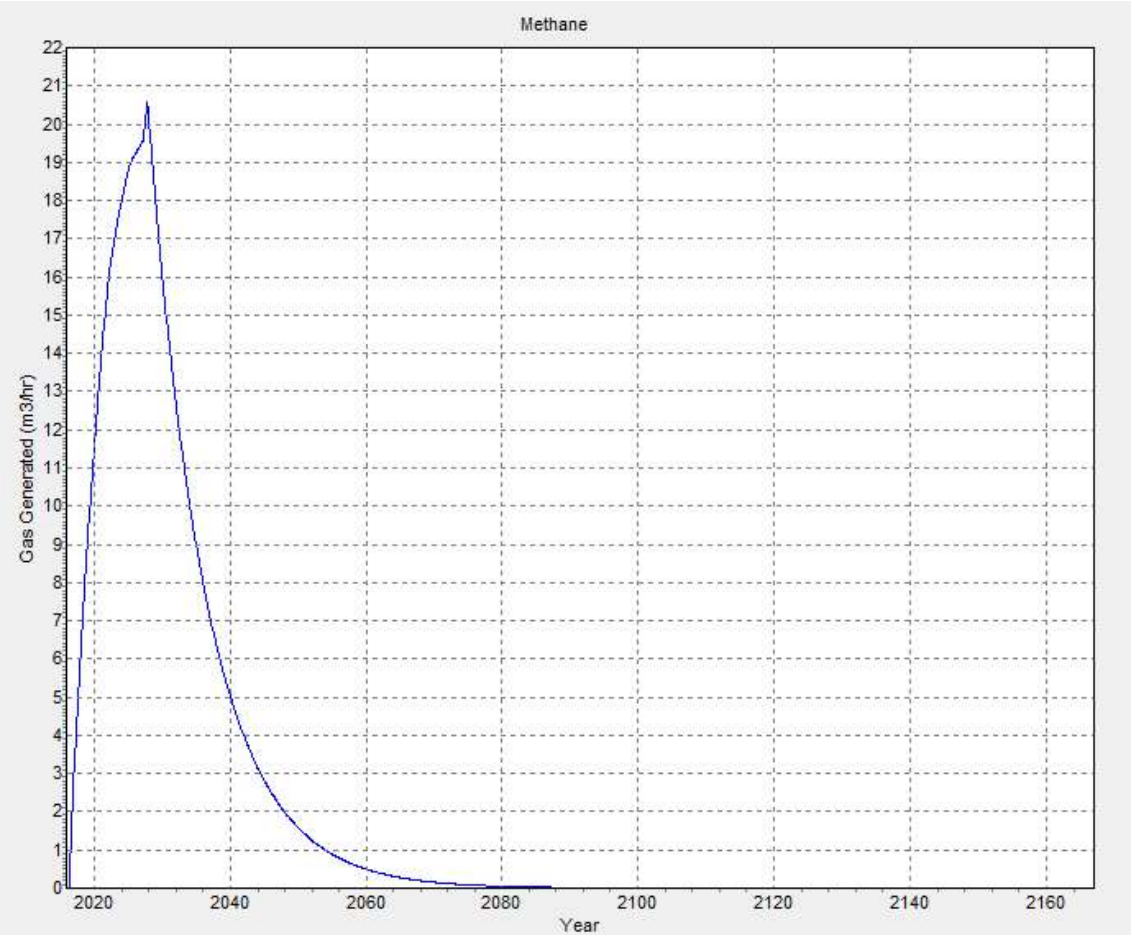
Model 1: Total Bulk Landfill Gas Produced (m^3/hr)



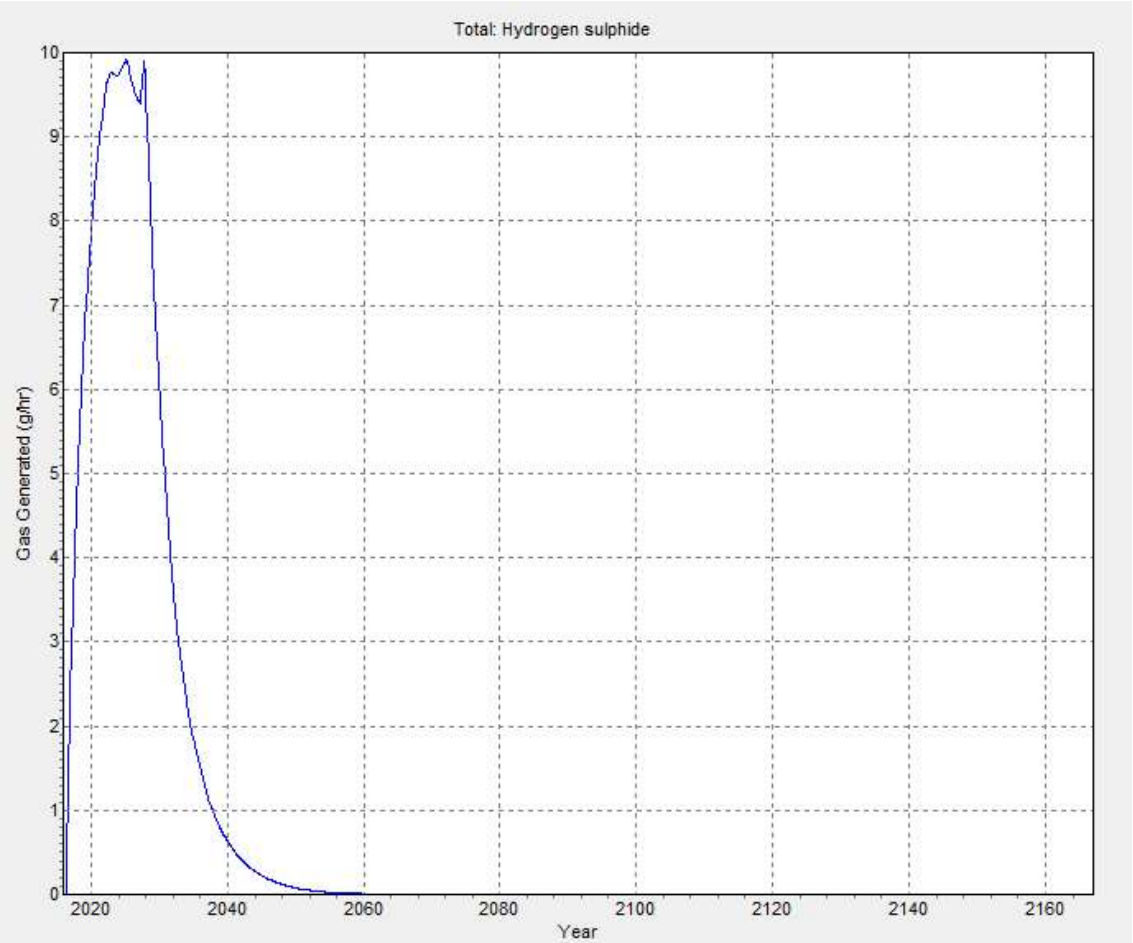
Model 1: Total Carbon Dioxide Produced (m^3/hr)



Model 1: Total Methane Produced (m^3/hr)

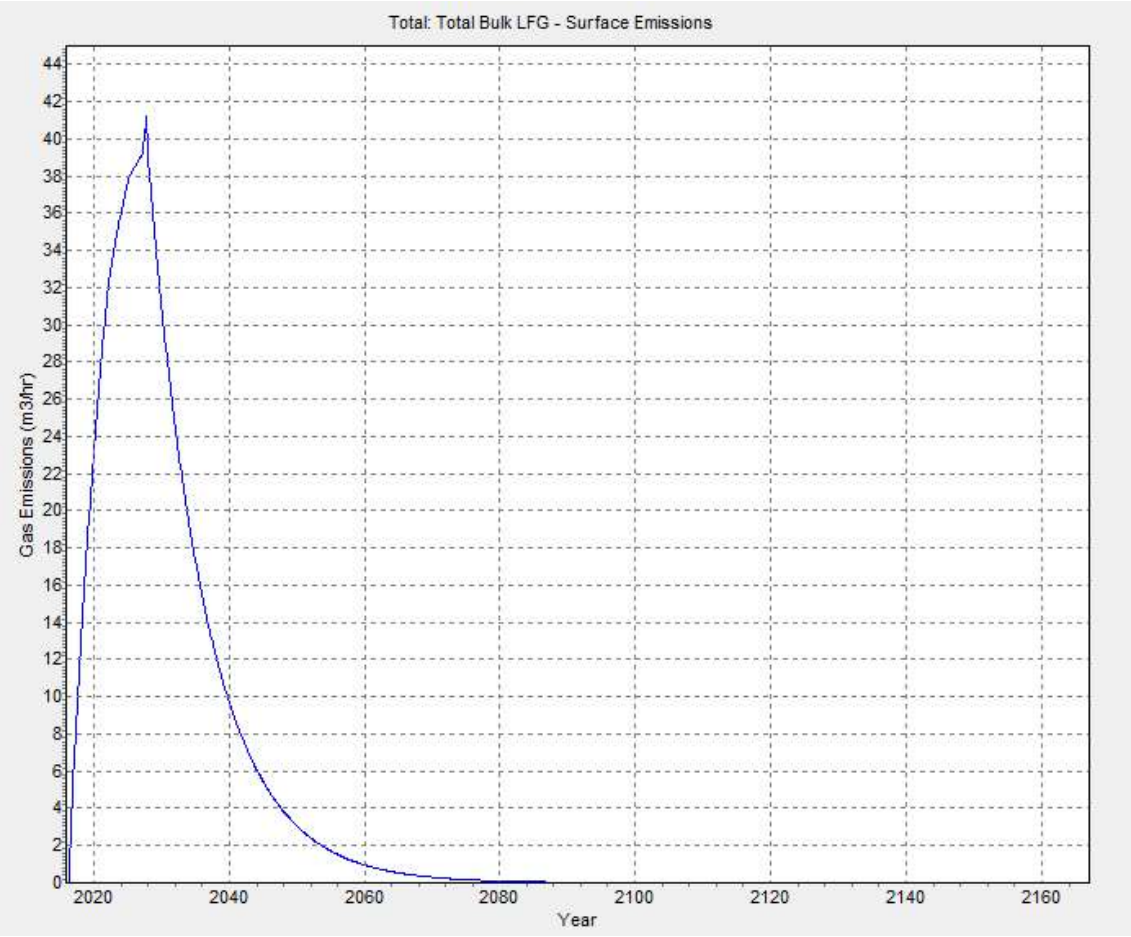


Model 1: Total Hydrogen Sulphide Produced (g/hr)

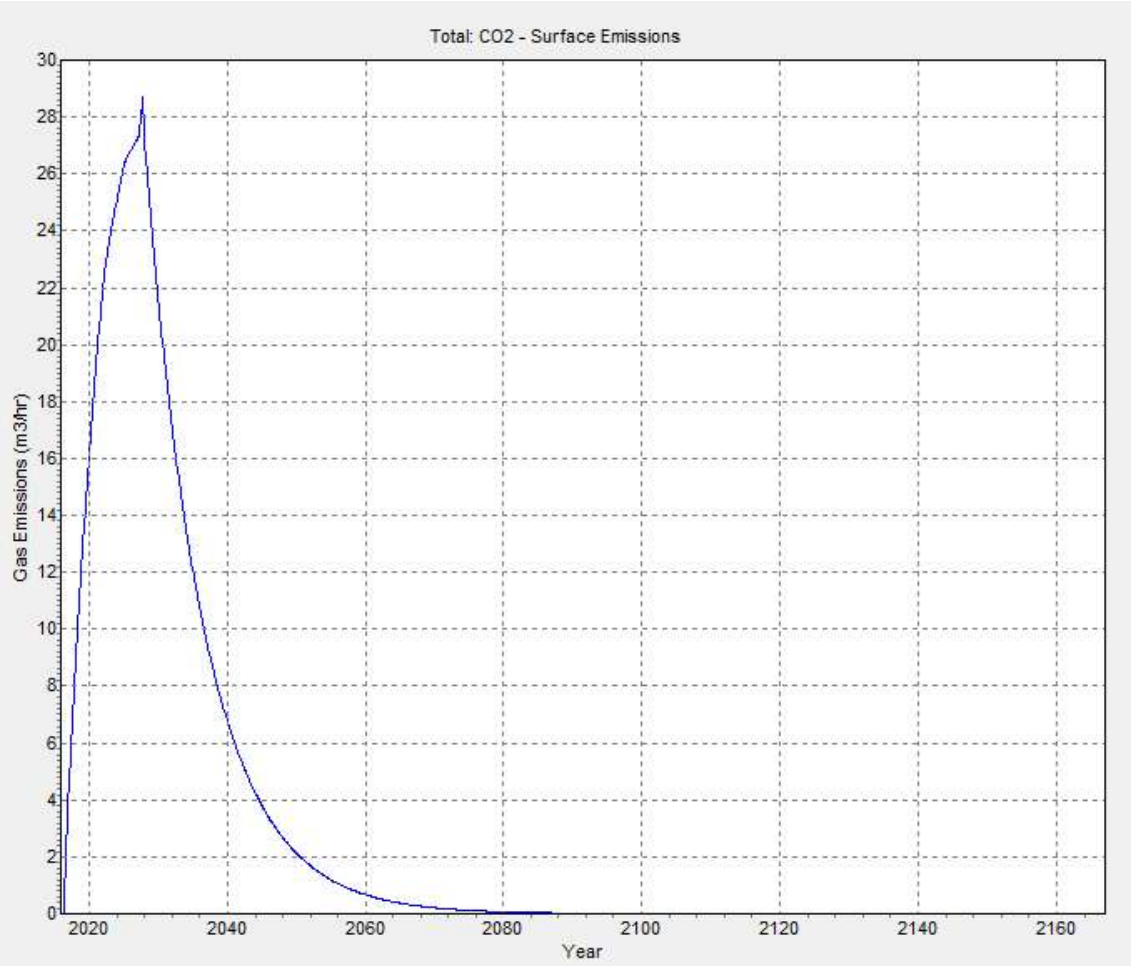


Appendix B – Surface Emissions Graphs

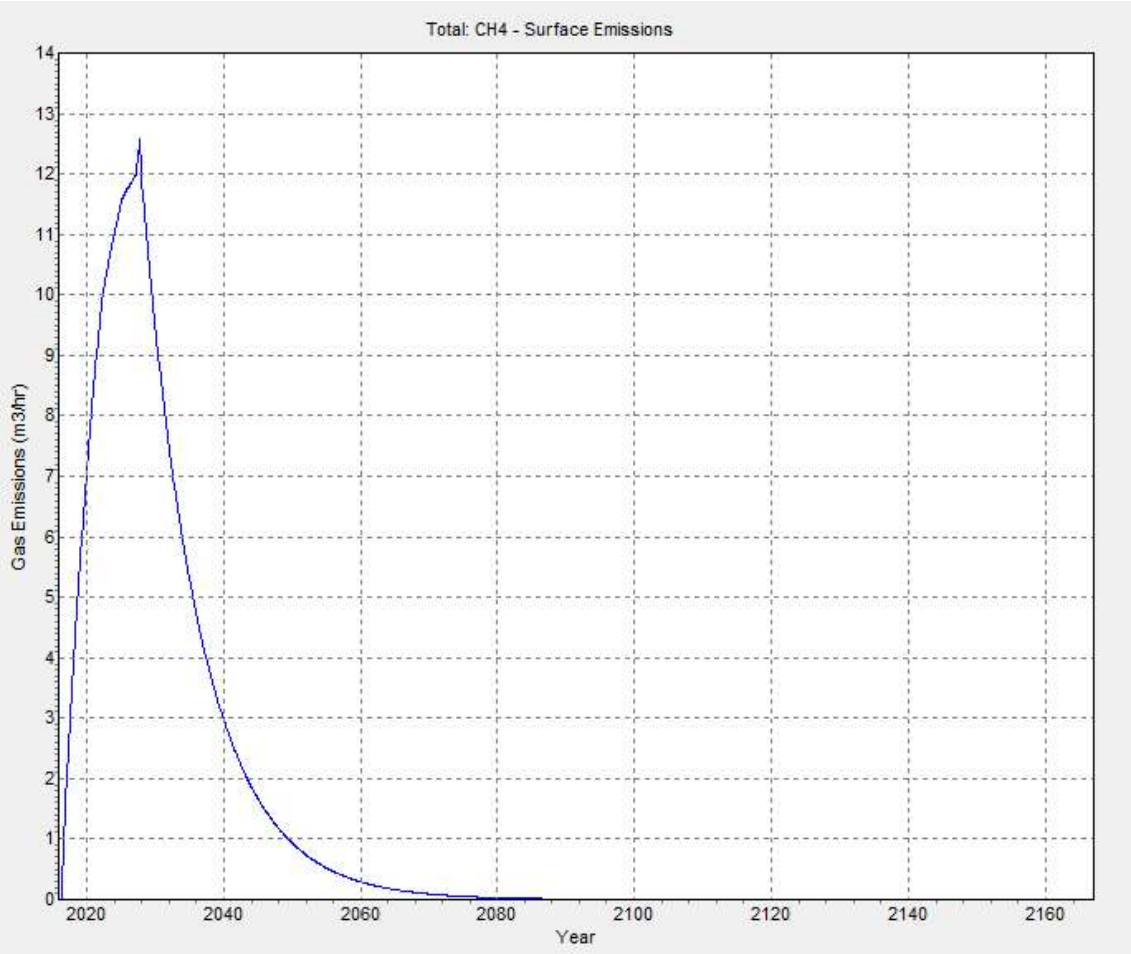
Model 1: Surface Emissions. Total Bulk Landfill Gas Produced (m^3/hr)



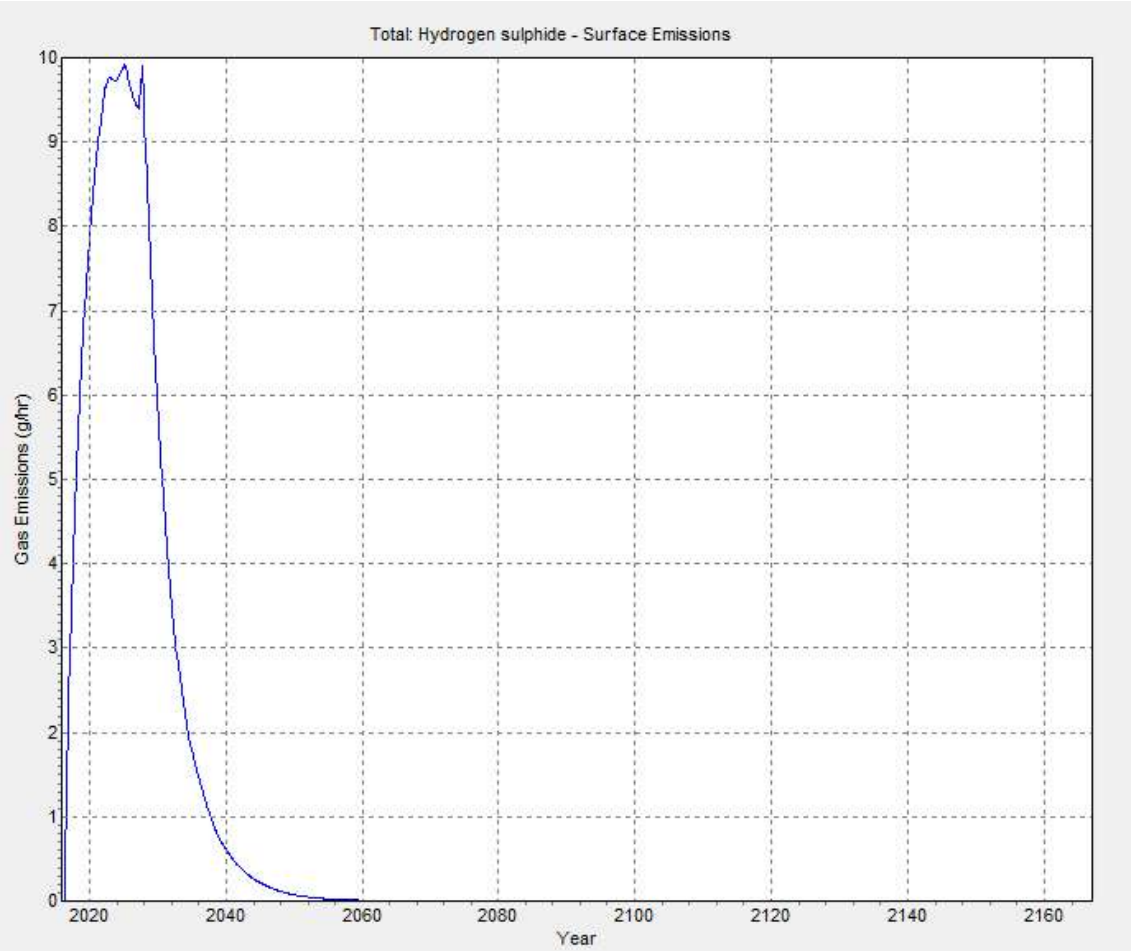
Model 1: Surface Emissions. Total Carbon Dioxide Produced (m^3/hr)



Model 1: Surface Emissions. Total Methane Produced (m^3/hr)

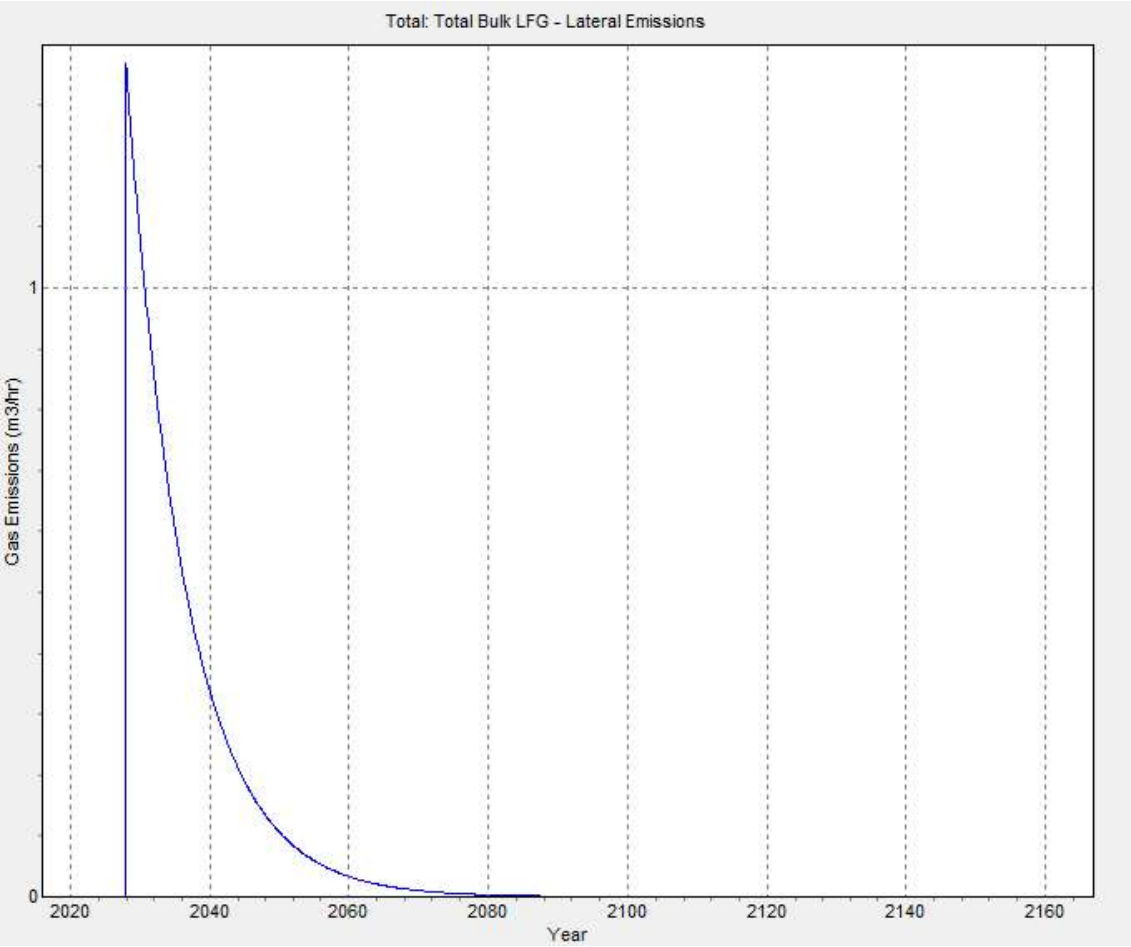


Model 1: Surface Emissions. Hydrogen Sulphide Produced (g/hr)

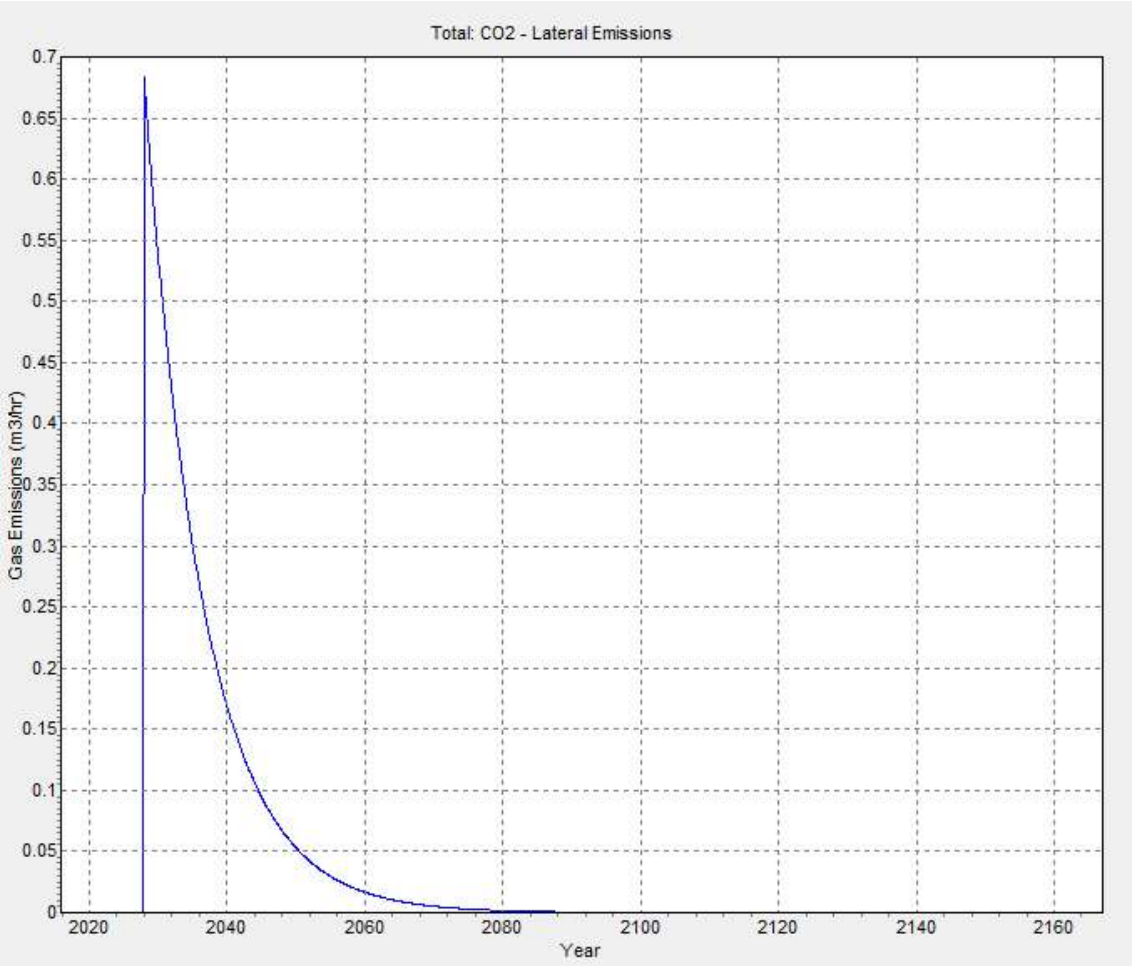


Appendix C – Lateral Emissions Graphs

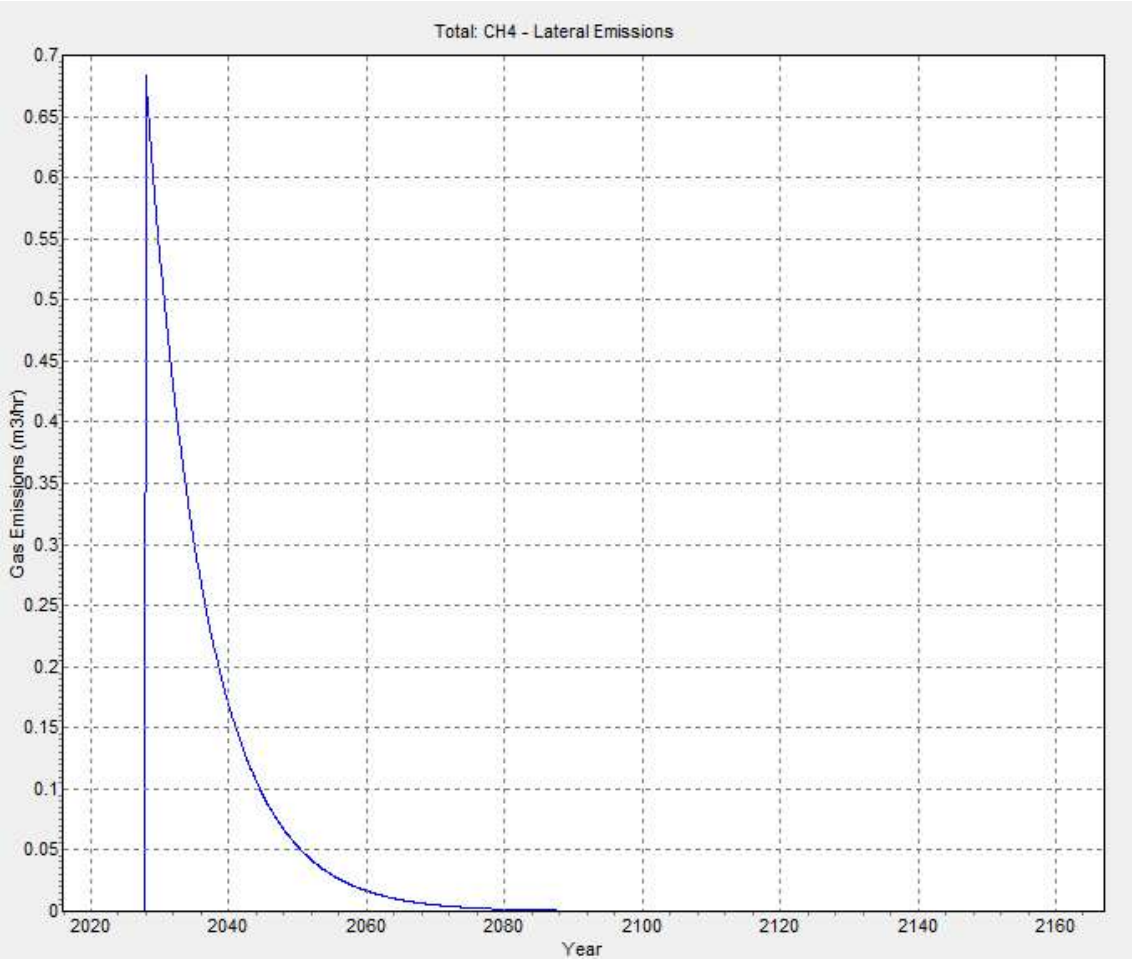
Model 1: Lateral Emissions. Total Bulk Landfill Gas Produced (m^3/hr)



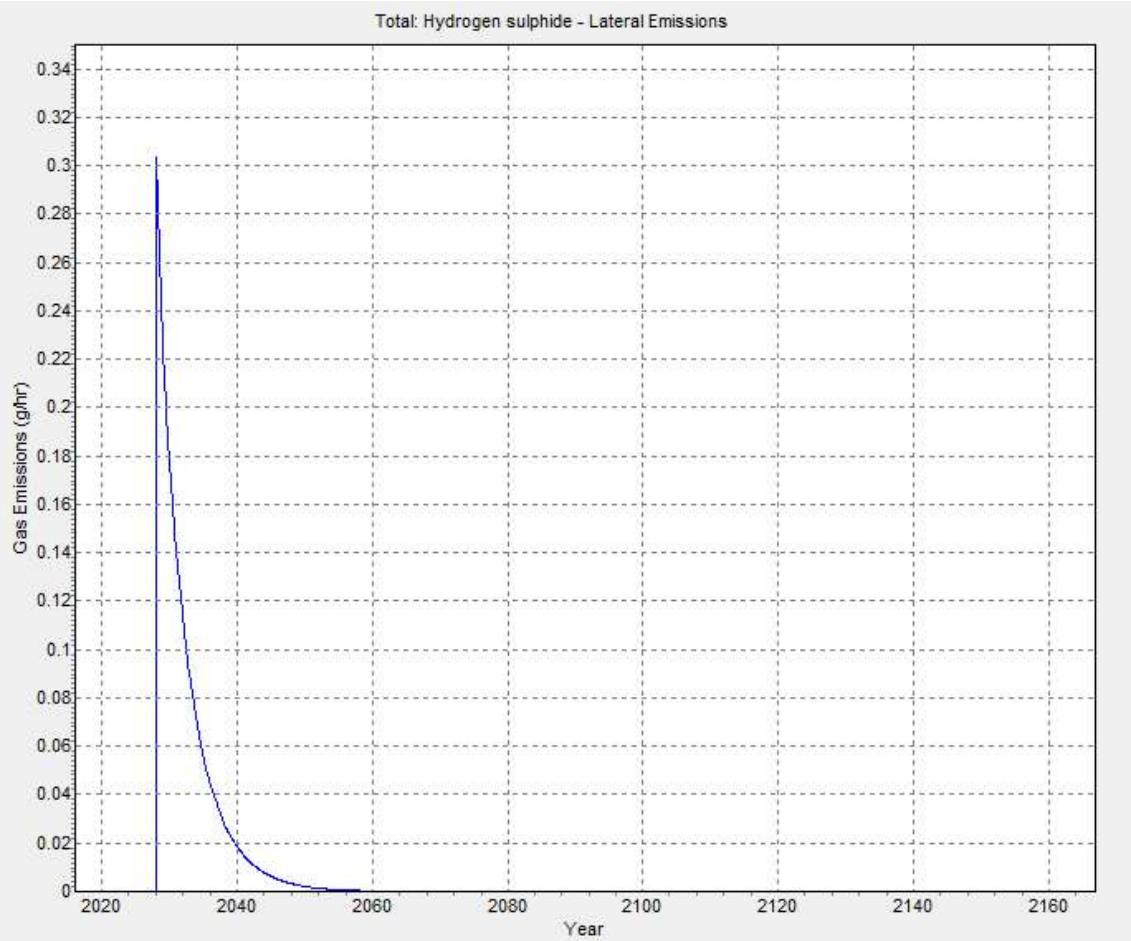
Model 1: Lateral Emissions. Total Carbon Dioxide Produced (m^3/hr)



Model 1: Lateral Emissions. Total Methane Produced (m^3/hr)

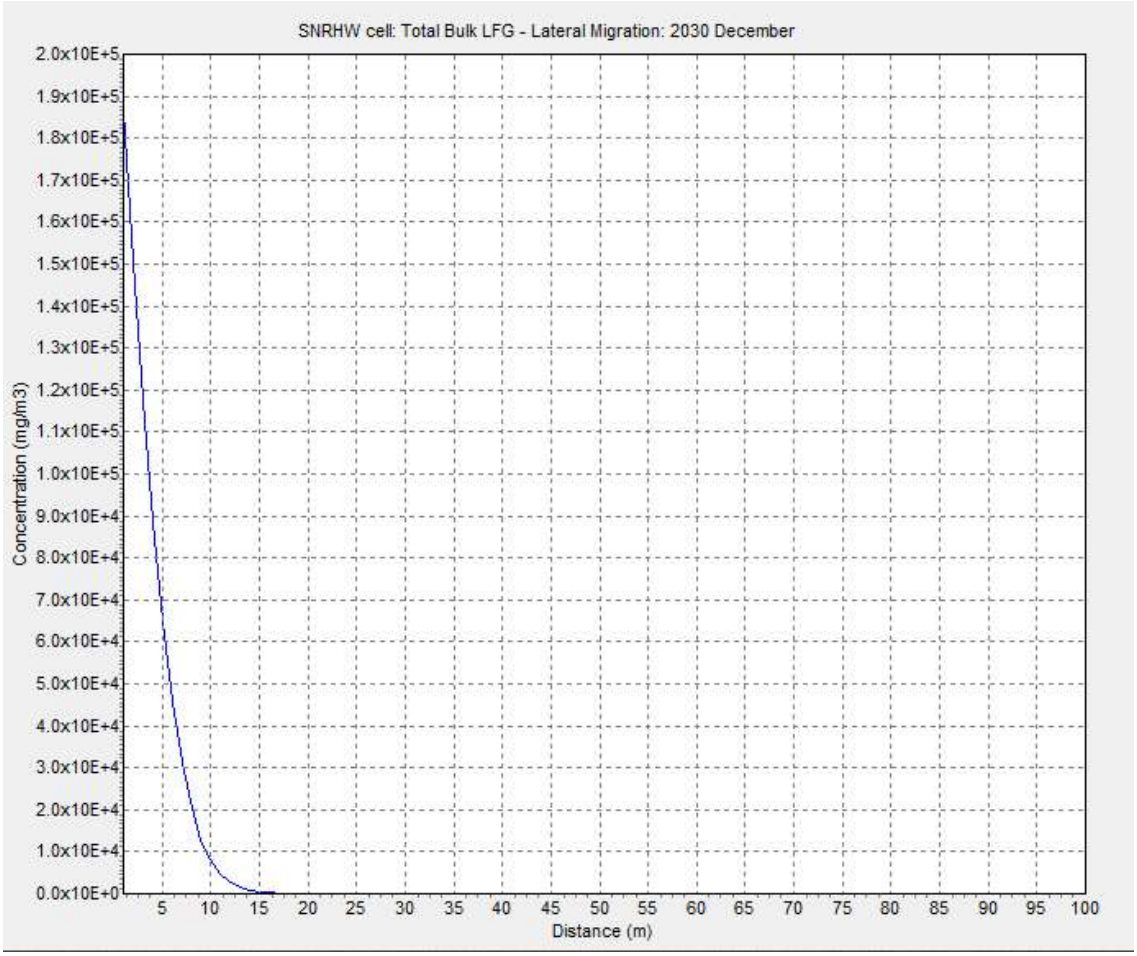


Model 1: Lateral Emissions. Hydrogen Sulphide Produced (g/hr)

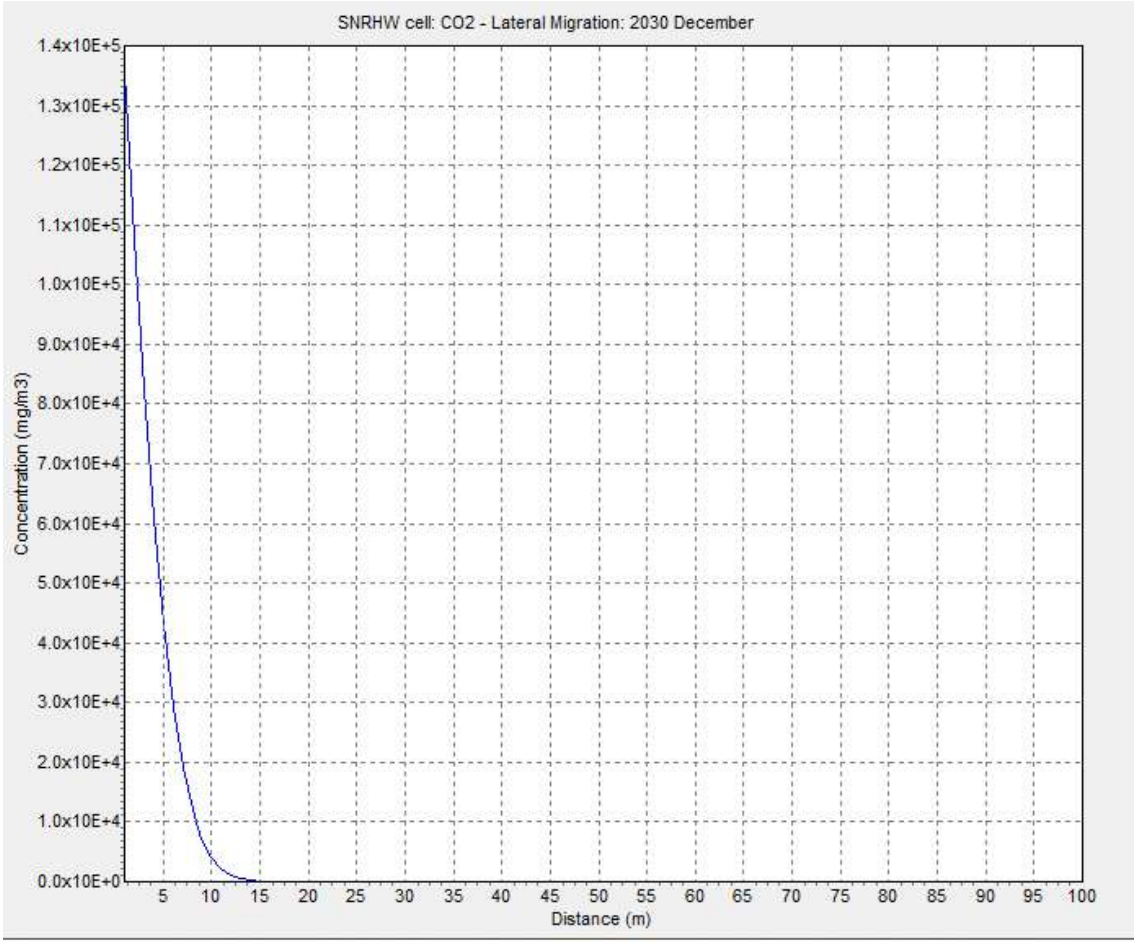


Appendix D – Lateral Migration Graphs

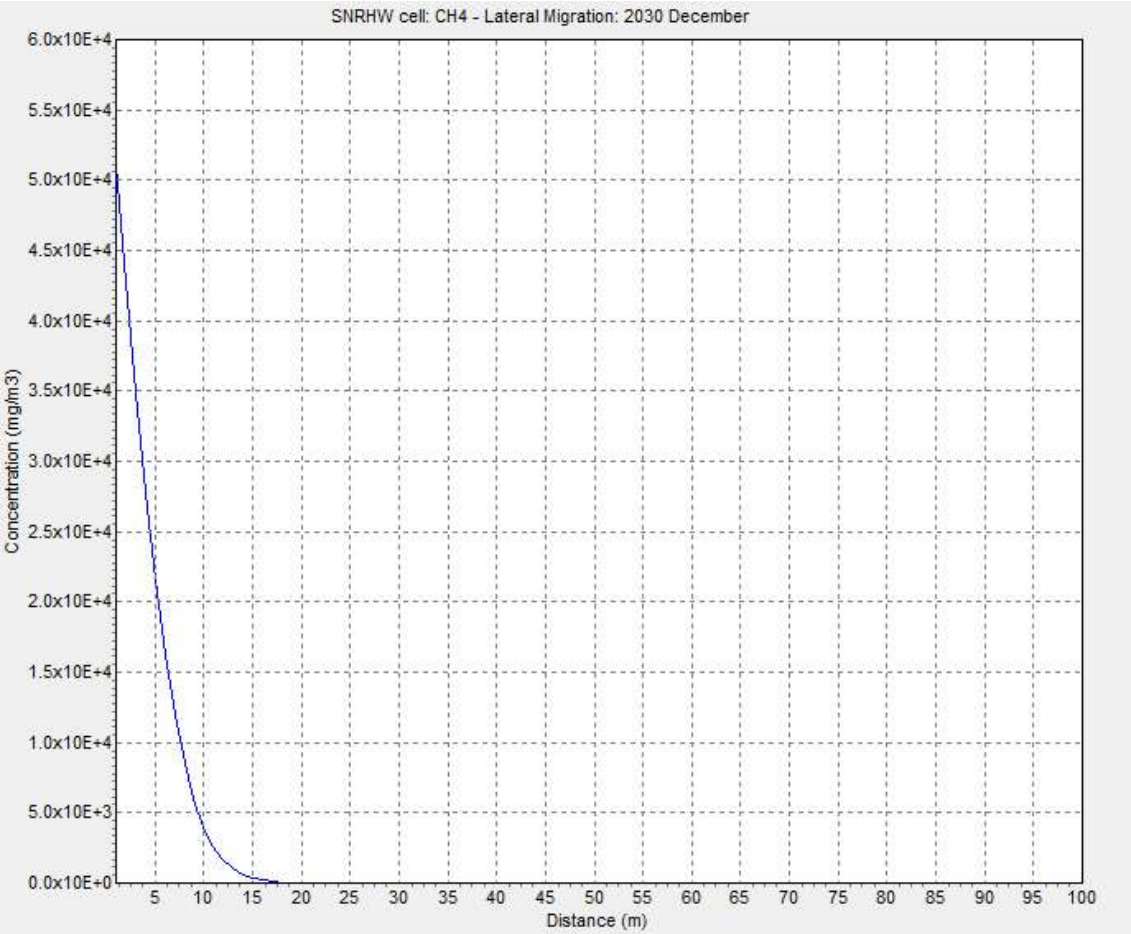
Model 1: Lateral Migration. Total Bulk Landfill Gas Produced (mg/m^3)



Model 1: Lateral Migration. Total Carbon Dioxide Produced (mg/m^3)



Model 1: Lateral Migration. Total Methane Produced (mg/m^3)



Appendix E – Tier 1 Screening Results

Year of Interest: All

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
Hydrogen sulphide - surface	2019	150	140	0
Hydrogen sulphide - surface	2020	150	140	0
Hydrogen sulphide - surface	2021	150	140	0
Hydrogen sulphide - surface	2022	150	140	0
Hydrogen sulphide - surface	2023	150	140	0
Hydrogen sulphide - surface	2024	150	140	0
Hydrogen sulphide - surface	2025	150	140	0
Hydrogen sulphide - surface	2026	150	140	0
Hydrogen sulphide - surface	2027	150	140	0
Hydrogen sulphide - surface	2028	150	140	0
Hydrogen sulphide - surface	2029	150	140	0

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Hydrogen sulphide - surface - 2019	15.8336(5m)	2.9688(710.33m)	Yes (at receptor)	No	0.326568(5m)	0.019792(710.33m)	Yes	No
Hydrogen sulphide - surface - 2020	18.3082(5m)	3.43279(710.33m)	Yes (at receptor)	No	0.377606(5m)	0.0228852(710.33m)	Yes	No
Hydrogen sulphide - surface - 2021	20.1285(5m)	3.77409(710.33m)	Yes (at receptor)	No	0.41515(5m)	0.0251606(710.33m)	Yes	No
Hydrogen sulphide - surface - 2022	21.4242(5m)	4.01704(710.33m)	Yes (at receptor)	No	0.441875(5m)	0.0267803(710.33m)	Yes	No
Hydrogen sulphide - surface - 2023	21.6592(5m)	4.06109(710.33m)	Yes (at receptor)	No	0.44672(5m)	0.027074(710.33m)	Yes	No
Hydrogen sulphide - surface - 2024	21.7774(5m)	4.08326(710.33m)	Yes (at receptor)	No	0.449159(5m)	0.0272217(710.33m)	Yes	No
Hydrogen sulphide - surface - 2025	21.926(5m)	4.11113(710.33m)	Yes (at receptor)	No	0.452224(5m)	0.0274075(710.33m)	Yes	No
Hydrogen sulphide - surface - 2026	21.1533(5m)	3.96624(710.33m)	Yes (at receptor)	No	0.436286(5m)	0.0264416(710.33m)	Yes	No
Hydrogen sulphide - surface - 2027	21.3182(5m)	3.99715(710.33m)	Yes (at receptor)	No	0.439687(5m)	0.0266477(710.33m)	Yes	No
Hydrogen sulphide - surface - 2028	19.1034(5m)	3.58188(710.33m)	Yes (at receptor)	No	0.394007(5m)	0.0238792(710.33m)	Yes	No
Hydrogen sulphide - surface - 2029	15.0397(5m)	2.81994(710.33m)	Yes (at receptor)	No	0.310194(5m)	0.0187996(710.33m)	Yes	No

Year of Interest: 2016

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
Carbon tetrachloride (tetrachloromethane) - surface	2016	3900	130	0
Chloroform (trichloromethane) - surface	2016	2970	99	0
Hydrogen sulphide - surface	2016	150	140	0

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Carbon tetrachloride (tetrachloromethane) - surface - 2016	9.01155e-007(5m)	1.68967e-007(710.33m)	Yes	No	1.85863e-008(5m)	1.12644e-009(710.33m)	Yes	No
Chloroform (trichloromethane) - surface - 2016	0.0169142(5m)	0.00317142(710.33m)	Yes	No	0.000348856(5m)	2.11428e-005(710.33m)	Yes	No
Hydrogen sulphide - surface - 2016	1.2762(5m)	0.239288(710.33m)	Yes	No	0.0263216(5m)	0.00159525(710.33m)	Yes	No

Year of Interest: 2028

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
Carbon tetrachloride (tetrachloromethane) - surface	2028	3900	130	0
Chloroform (trichloromethane) - surface	2028	2970	99	0
Hydrogen sulphide - surface	2028	150	140	0

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Carbon tetrachloride (tetrachloromethane) - surface - 2028	1.1207e-005(5m)	2.10131e-006(710.33m)	Yes	No	2.31145e-007(5m)	1.40088e-008(710.33m)	Yes	No
Chloroform (trichloromethane) - surface - 2028	0.192792(5m)	0.0361486(710.33m)	Yes	No	0.00397634(5m)	0.00024099(710.33m)	Yes	No
Hydrogen sulphide - surface - 2028	19.1034(5m)	3.58188(710.33m)	Yes (at receptor)	No	0.394007(5m)	0.0238792(710.33m)	Yes	No

Year of Interest: 2036

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
Carbon tetrachloride (tetrachloromethane) - surface	2036	3900	130	0
Chloroform (trichloromethane) - surface	2036	2970	99	0
Hydrogen sulphide - surface	2036	150	140	0

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Carbon tetrachloride (tetrachloromethane) - surface - 2036	1.42366e-006(5m)	2.66937e-007(710.33m)	Yes	No	2.9363e-008(5m)	1.77958e-009(710.33m)	Yes	No
Chloroform (trichloromethane) - surface - 2036	0.0174836(5m)	0.00327818(710.33m)	Yes	No	0.0003606(5m)	2.18545e-005(710.33m)	Yes	No
Hydrogen sulphide - surface - 2036	3.03157(5m)	0.56842(710.33m)	Yes	No	0.0625262(5m)	0.00378947(710.33m)	Yes	No

Appendix F – Print Of Gassim Model

ProjectDetails

Project Name	Mepal SNRHW Cell Gas Risk Assessment
Client	Mick George Limited
Model	c:\users\michael.jones2\desktop\mepal_model_d2.gss
Model Date	25/06/2025 08:21:02
Comments	
Start Year	2016
Operation Period	12
Simulation Period	150
Iterations	201

Confined Migration Pathway

Waste Composition

Year	Composition
2016	England 2000-2010 waste streams
Newspapers	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(48.5)
Hemi-Cellulose (%)	SINGLE(9.0)
Decomposition (%)	SINGLE(35.0)
Magazines	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(42.3)
Hemi-Cellulose (%)	SINGLE(9.4)
Decomposition (%)	SINGLE(46.0)
Other paper	
Domestic	SINGLE(19.8)
Civic Amenity	SINGLE(3.3)
Commercial	SINGLE(28.8)
Industrial	SINGLE(8.8)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(87.4)
Hemi-Cellulose (%)	SINGLE(8.4)
Decomposition (%)	SINGLE(98.0)
Liquid cartons	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Card packaging	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Other card	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Wood	
Domestic	SINGLE(3.0)
Civic Amenity	SINGLE(11.2)
Commercial	SINGLE(3.3)
Industrial	SINGLE(5.0)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(21.0)
Hemi-Cellulose (%)	SINGLE(11.0)
Decomposition (%)	SINGLE(75.0)
Textiles	
Domestic	SINGLE(3.3)
Civic Amenity	SINGLE(2.3)
Commercial	SINGLE(1.1)
Industrial	SINGLE(0.3)
Water (%)	SINGLE(25.0)
Cellulose (%)	SINGLE(20.0)
Hemi-Cellulose (%)	SINGLE(20.0)
Decomposition (%)	SINGLE(50.0)
Disposable nappies	
Domestic	SINGLE(3.3)
Civic Amenity	SINGLE(2.9)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Other misc. combustibles	
Domestic	SINGLE(0.3)
Civic Amenity	SINGLE(4.2)
Commercial	SINGLE(10.4)
Industrial	SINGLE(17.7)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Garden waste	
Domestic	SINGLE(16.0)
Civic Amenity	SINGLE(32.1)
Commercial	SINGLE(9.8)
Industrial	SINGLE(4.7)

Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(25.7)
Hemi-Cellulose (%)	SINGLE(13.0)
Decomposition (%)	SINGLE(62.0)
Other putrescible	
Domestic	SINGLE(25.6)
Civic Amenity	SINGLE(14.8)
Commercial	SINGLE(10.4)
Industrial	SINGLE(6.8)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(55.4)
Hemi-Cellulose (%)	SINGLE(7.2)
Decomposition (%)	SINGLE(76.0)
10mm fines	
Domestic	SINGLE(4.1)
Civic Amenity	SINGLE(1.2)
Commercial	SINGLE(1.9)
Industrial	SINGLE(0.5)
Water (%)	SINGLE(40.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Sewage sludge	
Sewage Sludge	SINGLE(100.0)
Water (%)	SINGLE(70.0)
Cellulose (%)	SINGLE(14.0)
Hemi-Cellulose (%)	SINGLE(14.0)
Decomposition (%)	SINGLE(75.0)
Composted organic material	
Composted Organic Material	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	UNIFORM(7.47, 9.59)
Hemi-Cellulose (%)	UNIFORM(7.47, 9.59)
Decomposition (%)	SINGLE(57.0)
Incinerator ash	
Commercial	SINGLE(0.2)
Industrial	SINGLE(25.5)
Incinerator Ash	SINGLE(100.0)
User Defined 1	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Hemi-Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Decomposition (%)	SINGLE(57.0)
Non degradable	
Domestic	SINGLE(24.6)
Civic Amenity	SINGLE(28.0)
Commercial	SINGLE(34.1)
Industrial	SINGLE(30.7)
Inert	SINGLE(100.0)
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Calcium Sulphate (%)	
Domestic	TRIANGULAR(0.2, 0.35, 2.3)
Civic Amenity	TRIANGULAR(0.2, 0.35, 2.3)
Composted Organic Material	TRIANGULAR(0.2, 0.35, 2.3)
Incinerator Ash	TRIANGULAR(0.2, 0.35, 2.3)
Residues from MRF	TRIANGULAR(0.2, 0.35, 2.3)
Recycling Schemes	TRIANGULAR(0.2, 0.35, 2.3)
Chemical Sludge	TRIANGULAR(0.2, 0.35, 2.3)
Industrial Liquid Waste	TRIANGULAR(0.2, 0.35, 2.3)
Iron (%)	
Domestic	TRIANGULAR(0.3, 4.8, 8.2)
Civic Amenity	TRIANGULAR(0.3, 4.8, 8.2)
Commercial	TRIANGULAR(0.3, 4.8, 8.2)
Industrial	TRIANGULAR(0.3, 4.8, 8.2)
Inert	TRIANGULAR(0.3, 4.8, 8.2)
Liquid Inert	TRIANGULAR(0.3, 4.8, 8.2)
Sewage Sludge	TRIANGULAR(0.3, 4.8, 8.2)
Composted Organic Material	TRIANGULAR(0.3, 4.8, 8.2)
Incinerator Ash	TRIANGULAR(0.3, 4.8, 8.2)
Residues from MRF	TRIANGULAR(0.3, 4.8, 8.2)
Recycling Schemes	TRIANGULAR(0.3, 4.8, 8.2)
Chemical Sludge	TRIANGULAR(0.3, 4.8, 8.2)
Industrial Liquid Waste	TRIANGULAR(0.3, 4.8, 8.2)
User Defined 1	TRIANGULAR(0.3, 4.8, 8.2)
User Defined 2	TRIANGULAR(0.3, 4.8, 8.2)
User Defined 3	TRIANGULAR(0.3, 4.8, 8.2)
2017	England 2000-2010 waste streams
2018	England 2000-2010 waste streams
2019	England 2000-2010 waste streams
2020	England 2000-2010 waste streams
2021	England 2000-2010 waste streams
2022	England 2000-2010 waste streams
2023	England 2000-2010 waste streams
2024	England 2000-2010 waste streams
2025	England 2000-2010 waste streams
2026	England 2000-2010 waste streams
2027	England 2000-2010 waste streams
Justification: [Changed]	Based on actual waste inputs and proposed inputs of gypsum waste

Trace Gases

No Combustion Products Selected

SNRHW cell

Infiltration		SINGLE(92.0)
Justification:	[Changed]	Value taken from HRA

Waste Input

Year	AmountDepositied (t)
2016	SINGLE(1.25E+05)
2017	SINGLE(1.25E+05)
2018	SINGLE(1.25E+05)
2019	SINGLE(1.25E+05)
2020	SINGLE(1.25E+05)
2021	SINGLE(1.25E+05)
2022	SINGLE(1.00E+05)
2023	SINGLE(1.00E+05)
2024	SINGLE(1.00E+05)
2025	SINGLE(1.00E+05)
2026	SINGLE(1.00E+05)
2027	SINGLE(1.00E+05)
Justification: [Changed]	Based on actual and proposed waste inputs

Waste Breakdown

2016	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2017	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2018	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2019	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2020	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2021	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2022	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2023	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2024	
Inert	SINGLE(42.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(16.0)
2025	
Inert	SINGLE(50.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(7.5)
2026	
Inert	SINGLE(50.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(7.5)
2027	
Inert	SINGLE(50.0)
Incinerator Ash	SINGLE(42.0)
User Defined 1	SINGLE(7.5)
Justification: [Default]	Default Value

Trace Gases

Source Gases	Concentration [mg/m3]
1,1,1,2-Tetrafluorochloroethane	LOGTRIANGULAR(0.002, 0.2, 2.0)
1,1,1-Trichlorotrifluoroethane	LOGTRIANGULAR(0.005, 0.4, 8.0)
1,1-Dichlorotetrafluoroethane	LOGTRIANGULAR(0.05, 0.25, 6.4)
1,2-Dichlorotetrafluoroethane	LOGTRIANGULAR(0.01, 9.8, 300.0)
1-Chloro-1,1-difluoroethane	LOGTRIANGULAR(0.04, 0.57, 31.0)
2-Chloro-1,1,1-trifluoroethane	LOGUNIFORM(0.05, 1.5)
Carbon tetrachloride (tetrachloromethane	LOGUNIFORM(1.00E-30, 2.00E-02)
Chlorodifluoromethane	LOGTRIANGULAR(0.005, 0.1, 9900.0)
Chlorofluorocarbons (CFCs) (Total)	LOGTRIANGULAR(0.06, 102.3, 1230.0)
Chlorofluoromethane	LOGTRIANGULAR(0.008, 0.2, 110.0)
Chloroform (trichloromethane)	LOGTRIANGULAR(1.00E-03, 2.00E-01, 7.00E+01)
Chlorotrifluoromethane	LOGTRIANGULAR(0.1, 0.2, 49.0)
Dichlorodifluoromethane	LOGTRIANGULAR(0.01, 9.0, 790.0)
Dichlorofluoromethane	LOGTRIANGULAR(1.00E-03, 1.00E-02, 6.02E+02)
Freon 113	LOGTRIANGULAR(0.013, 4.8, 125.0)
Halons	SINGLE(0.0)

Hydrochlorofluorocarbons (HCFCs) (Total		LOGTRIANGULAR(0.02, 128.8, 916.2)
Hydrofluorocarbons (HFCs) (Total)		SINGLE(0.0)
Hydrogen sulphide		UNIFORM(100.0, 580.0)
Perfluorocarbons (PFCs) (Total)		SINGLE(0.0)
Trichlorofluoromethane		LOGTRIANGULAR(1.00E-03, 1.00E-02, 1.00E+03)
Trichlorotrifluoroethane		LOGTRIANGULAR(1.00E-03, 4.80E+00, 2.40E+01)
Justification:	[Default]	Default Value
VOC Halflife		NORMAL(4.11, 1.56)
Justification:	[Default]	Default Value

Waste Moisture Content

Degradation rate - Filling Phase		Average
Justification:	[Default]	Default Value
Degradation rate - after change		Average
Justification:	[Default]	Default Value
Waste Density		UNIFORM(0.8, 1.2)
Justification:	[Default]	Default Value
Leachate Head		UNIFORM(0.5, 2.0)
Justification:	[Changed]	Not Justified
Hydraulic Conductivity		LOGUNIFORM(1.00E-09, 1.00E-05)
Justification:	[Default]	Default Value

Engineered Controls

Cap		Single Clay
Cap Thickness		SINGLE(0.5)
Cap Hydraulic Conductivity		SINGLE(1.00E-09)
Justifications		
Cap	[Changed]	Value taken from Permit application documents
Cap Thickness	[Changed]	Value taken from Permit application documents
Cap Hydraulic Conductivity	[Changed]	Value taken from Permit application documents and CQA Plan
liner		Single Clay
Liner Thickness		SINGLE(1.0)
Liner Hydraulic Conductivity		SINGLE(1.00E-09)
Justifications		
Liner	[Changed]	Value taken from Permit applictaion documents
Liner Thickness	[Changed]	Value taken from Permit application documents
Liner Hydraulic Conductivit	[Changed]	Value taken from Permit application documents and CQA Plan
Justification:	[Changed]	Not Justified
Methane Oxidation %		TRIANGULAR(10.0, 25.0, 46.0)
Justification:	[Changed]	Not Justified
Soil Depth		SINGLE(1.0)
% Fissures		SINGLE(10.0)
Land Raise Depth		SINGLE(0.0)

Geosphere

Ground Surface (mAOD)	0
Water Table (mAOD)	-2.26
Geosphere Moisture Content	UNIFORM(10.0, 50.0)
Geosphere Porosity	UNIFORM(25.0, 40.0)

Site Characteristics

Proportion to CO2 [%]		SINGLE(50.0)
Justification:	[Default]	Default Value
Proportion to CH4 [%]		SINGLE(50.0)
Justification:	[Default]	Default Value

Cellulose Decay Rates

	Slow	Moderate	Fast
Dry	SINGLE(0.013)	SINGLE(0.046)	SINGLE(0.076)
Average	SINGLE(0.046)	SINGLE(0.076)	SINGLE(0.116)
Wet	SINGLE(0.076)	SINGLE(0.116)	SINGLE(0.694)
Saturated	SINGLE(0.013)	SINGLE(0.046)	SINGLE(0.076)
User Defined 1	SINGLE(0.046)	UNIFORM(0.046, 0.076)	UNIFORM(0.076, 0.116)
User Defined 2	UNIFORM(0.046, 0.076)	UNIFORM(0.076, 0.116)	UNIFORM(0.116, 0.694)

Justification: [Default] Default Value

Gas Plant

No Flares/Engines in use

Engine/Flare Order [Changed] Assumed based on results of this GRA.

Trace Gas Plant

1,1,1,2-Tetrafluorochloroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
1,1,1-Trichlorotrifluoroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
1,1-Dichlorotetrafluoroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
1,2-Dichlorotetrafluoroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
1-Chloro-1,1-difluoroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)

Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
2-Chloro-1,1,1-trifluoroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Carbon tetrachloride (tetrachloromethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chlorodifluoromethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chlorofluorocarbons (CFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chlorofluoromethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chloroform (trichloromethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chlorotrifluoromethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Dichlorodifluoromethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Dichlorofluoromethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Freon 113		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Halons		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hydrochlorofluorocarbons (HCFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hydrofluorocarbons (HFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hydrogen sulphide		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Nitrogen dioxide (NO2)		
Spark Ignition Engine:	combustion products	SINGLE(0.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	SINGLE(0.0)
Nitrogen monoxide (NO)		
Spark Ignition Engine:	combustion products	SINGLE(0.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	SINGLE(0.0)
Nitrogen oxides (NOx)		
Spark Ignition Engine:	combustion products	LOGUNIFORM(330.0, 2132.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	TRIANGULAR(43.0, 85.0, 149.0)
Perfluorocarbons (PFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)

Flare:	non-combustion products	SINGLE(99.0)
Trichlorofluoromethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Trichlorotrifluoroethane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Justification: [Changed]	Based on research of potential concentrations	

Global Impact

Bulk Gases

Global Warming Potential		
Carbon Dioxide [t]:	1	
Methane [t carbon dioxoide]:	21	
Hydrogen [t carbon dioxide]:	0	
Justification: [Default]	Default Value	
Ozone Depletion Potential		
Carbon Dioxide [t trichlorofluoromethane]:	0	
Methane [t trichlorofluoromethane]:	0	
Hydrogen [t trichlorofluoromethane]:	0	
Justification: [Default]	Default Value	

Trace Gases

Gas	Global Warming Potential	Ozone Depletion Potential
1,1,1,2-Tetrafluorochloroethane	609	0.02
1,1,1-Trichlorotrifluoroethane	6130	1
1,1-Dichlorotetrafluoroethane	10000	0.94
1,2-Dichlorotetrafluoroethane	0	0
1-Chloro-1,1-difluoroethane	2310	0.07
2-Chloro-1,1,1-trifluoroethane	0	0
Carbon tetrachloride (tetrachloromethane	1400	0.73
Chlorodifluoromethane	1810	0.05
Chlorofluorocarbons (CFCs) (Total)	0	0
Chlorofluoromethane	0	0
Chloroform (trichloromethane)	30	0
Chlorotrifluoromethane	14400	0
Dichlorodifluoromethane	10900	1
Dichlorofluoromethane	210	0
Freon 113	6130	1
Halons	0	0
Hydrochlorofluorocarbons (HCFCs) (Total	0	0
Hydrofluorocarbons (HFCs) (Total)	0	0
Hydrogen sulphide	0	0
Nitrogen dioxide (NO2)	0	0
Nitrogen monoxide (NO)	0	0
Nitrogen oxides (NOx)	0	0
Perfluorocarbons (PFCs) (Total)	0	0
Trichlorofluoromethane	4750	1
Trichlorotrifluoroethane	6130	1

Lateral Migration

Bulk Gases

Air Diffusion Coefficients		
CO2 Dispersivity	SINGLE(0.1613)	
CH4 Dispersivity	SINGLE(0.2192)	
H2 Dispersivity	#UNDEFINED?	
Justification: [Default]	Default Value	

Geosphere

Cell	SNRHW cell
Geosphere Moisture Content	UNIFORM(10.0, 50.0)
Geosphere Porosity	UNIFORM(25.0, 40.0)
Justification: [Changed]	Not Justified

Trace Gases

Gas	Air Diffusion Coefficient
1,1,1,2-Tetrafluorochloroethane	SINGLE(0.071)
1,1,1-Trichlorotrifluoroethane	#UNDEFINED?
1,1-Dichlorotetrafluoroethane	#UNDEFINED?
1,2-Dichlorotetrafluoroethane	#UNDEFINED?
1-Chloro-1,1-difluoroethane	#UNDEFINED?
2-Chloro-1,1,1-trifluoroethane	#UNDEFINED?
Carbon tetrachloride (tetrachloromethane	SINGLE(0.078)
Chlorodifluoromethane	#UNDEFINED?
Chlorofluorocarbons (CFCs) (Total)	SINGLE(0.0826)
Chlorofluoromethane	#UNDEFINED?
Chloroform (trichloromethane)	SINGLE(0.104)
Chlorotrifluoromethane	#UNDEFINED?
Dichlorodifluoromethane	#UNDEFINED?
Dichlorofluoromethane	#UNDEFINED?
Freon 113	#UNDEFINED?
Halons	SINGLE(0.0754)
Hydrochlorofluorocarbons (HCFCs) (Total	SINGLE(0.0967)
Hydrofluorocarbons (HFCs) (Total)	#UNDEFINED?
Hydrogen sulphide	SINGLE(0.1623)
Nitrogen dioxide (NO2)	SINGLE(0.2276)
Nitrogen monoxide (NO)	SINGLE(0.2276)
Nitrogen oxides (NOx)	SINGLE(0.2276)
Perfluorocarbons (PFCs) (Total)	SINGLE(0.071)
Trichlorofluoromethane	#UNDEFINED?

Trichlorotrifluoroethane		#UNDEFINED?
Justification:	[Default]	Default Value