

Kiama Municipal Council

Preliminary Landfill Gas Risk Assessment
Former Gerroa Landfill

Report E2W-025 L001 *v1*

12 January 2021

Prepared by:

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Ref: E2W-025 L001-v1
12 January 2021

Paul Czulowski
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Manning Street
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Re: Preliminary Landfill Gas Risk Assessment – Former Gerroa Landfill

1 Introduction

Earth2Water Pty Ltd (E2W) was engaged by Kiama Municipal Council (Council) to undertake a preliminary Landfill Gas Risk Assessment (LGRA) at the former Gerroa Landfill (site, Figure 1). Landfill gas testing was undertaken on 4 January 2021 at the site by E2W (Dino Parisotto, *CEnvP site contamination specialist*) and in consultation with Council (Greg Hardy).

E2W understand that the purpose of the LGRA was to comply with a notice (17 December 2020) from the NSW EPA regarding the closed Gerroa Landfill Site. E2W understand that Council is to submit a Landfill Gas Risk Assessment to the NSW EPA as outlined below;

"*By 5pm on Friday 5 March 2021 Council must submit a landfill gas risk assessment prepared by an appropriately qualified and experienced person to determine the potential gas risk associated with the former landfill operations. The report must include, but not necessarily be limited to:*

- *An assessment of the suitability of groundwater monitoring wells located near the perimeter of the premises for sub-surface gas monitoring. In particular, provide details on the location of screens in the wells in relation to the groundwater table.* Refer to Table 4.
- *Undertake sub-surface gas monitoring in existing groundwater monitoring wells located near the premises boundary that are deemed suitable for sub-surface groundwater monitoring. Monitoring must consider Section 5.3 of the Environmental Guidelines: Solid Waste Guidelines (EPA, 2016) (the Guidelines).* Refer to Tables 1,2 & 3.
- *Assess and interpret the sub-surface gas monitoring results.*
- *Identify any potential risks to surrounding sensitives receptors.* Refer to Figure 3.

Once submitted, the EPA will review the report and determine whether ongoing sub-surface gas monitoring is required. The Notice also requires Council to undertake quarterly surface gas monitoring until further notice from the NSW EPA".

E2W (*Dino Parisotto, CEnvP site contamination specialist*) is an appropriately qualified and experienced scientist. E2W has been involved with the Gerroa landfill assessment and closure plans, CQA of the rehabilitation works, upgrading the well network and completing the annual EPL since 2006. E2W has undertaken over 50 environmental assessments for rural and urban landfills, including workshops and landfill (15) review work for the NSW EPA.

This LGRA report by E2W provides a summary of landfill gas testing on 4 January 2021[1] and our preliminary assessment regarding gas risks and recommendations.

[1] *Landfill gas testing included monitoring of existing wells (15), air monitoring over the landfill mound and soil probe spikes around the perimeter of the landfill.*

2 Scope of Work & Background Information

E2W conducted the following scope of work to comply with the notice served by NSWEPA;

1) Landfill Perimeter Soil Spikes

- Using a soil spike (15mm diameter steel rod of 250mm length) and hammer to approximately 0.2m depth. The soil spikes (37) were placed approximately 10m from the landfill footprint and perimeter access road (where present) and mostly into sandy soils.
- Using a calibrated gas meter (Geotech GA2000) to measure the landfill gases (methane, H_2S, CO_2) to assess potential risk to human health and the environment.

2) Monitoring of existing Groundwater Wells (15)

- Using a gas meter (Geotech GA2000) to measure landfill gases (methane, H2S, CO2) inside the PVC casing of the well. All wells (15) situated around the perimeter of the landfill mound were measured for landfill gases by removing the cap and inserting the gasmeter tubing inside the well.
    - Review of monitoring well construction records and tabulating the well screen configuration and assessing average water levels (MAHD) to determine if suitable for monitoring of landfill gases (i.e. if water levels are above top of well screen).

3) Ambient Air Monitoring over the Landfill Mound

- Using a gas meter (Geotech GA2000) to measure landfill gases (methane, CO_2) over the landfill mound at approx. 0.4m above ground level (ambient air). Several traverses were made with continuous measurements (60 measurements) whilst walking over accessible parts of the mound (i.e. thick grasses & bushes).

All work at the site was undertaken on 4 January 2021 by E2W (Dino Parisotto, *CEnvP site contamination specialist*) and in consultation with Council (Greg Hardy). Groundwater levels at (11) selected wells (MW-1, MW-1S, MW-1D, MW-3, MW-5, MW-6, MW-6s/6D, MW-12, MW-13, MW-14) were measured by E2W (Dino Parisotto) on 8 January 2021 to assess the saturation of the well screens[2].

The work was undertaken during dry and warm conditions after several weeks of wet weather.

All landfill soil gas results were recorded by E2W together with any relevant observations[3]. All sub-surface methane gas monitoring results were reported below <0.1% (volume/volume) on 4 January 2021, without needing notification to NSWEPA.

The preliminary risk assessment for the Gerroa site is based on the *Solid Waste Guidelines (EPA, 2016) and NEPM (2013) using* the exposure pathway and receptor linkages with issue identification, hazard assessment, exposure assessment and risk characterisation.

[2] *Most of the wells at the site have top of screen intervals below the water table which limit the assessment of gases in the unsaturated zone.*
[3] *The monitoring well (MW-5) was repaired by installing a 0.7m long PVC pipe & joiner.*

2.1 Background Information

The Gerroa landfill is located approximately 1.5 km southwest of the Gerroa Road bridge crossing of Crooked River and near the northern end of Seven Mile Beach. Blue Angle Creek is located around 80 m to the northwest of Crooked River Road (Figures 1 to 3).

The GWDD is located within the Seven Mile Soil Landscape as defined by Hazelton (1992). Coastal Plain Quaternary marine sands and Quaternary alluvium underlie the site. Previous site investigations, as discussed in the URS report (2002), identified light brown fine-grained dune sands to a depth of 4 to 6 m below grade. The sands vary in thickness (between dune ridges and swales) and are largely contained above the groundwater table.

Council has owned and operated the GWDD since the 1960's. It was previously licensed as a Solid Waste Class 1 Landfill, operating under the EPL No. 5959. The site also functioned as a night soil depot for liquid pump out sullage. Land filling operations at the GWDD were discontinued in October 2003. The facility covers an area of approximately 3.2 hectares.

From July 2004 to February 2005, the landfill was rehabilitated to eliminate, or at least minimise the potential for landfill leachate generation. The waste mound was reshaped, capped with a 0.5 m thick clay barrier and 0.3 m thick combined drainage/re-vegetation layer. The former night soil trench was also remediated in August 2004 (i.e. approximately 300 tonnes of bio-solid sludge were excavated and placed underneath the clay cap).

In February 2005, an irrigation system was installed to assist with the re-vegetation of the landfill mound using a combination of native and annual grasses. A groundwater holding dam (30 x 30 m) was also constructed next to the two existing evaporation ponds to contain and supply water for the irrigation system. A spear point was installed on the north-west corner of the landfill mound to allow groundwater (and landfill leachate) to fill the holding dam as well as supply water for the irrigation system.

The sludge pond (southern lined dam) at Gerroa Landfill has not been used since Council ceased undertaking the septic clean-outs. Waste Processing Solutions Pty Ltd was engaged by KMC in September 2009 to de-water the sludge in the lined pond, and subsequently taken to a Soilco Pty Ltd owned site. Removal of the pond liner (HDPE) was undertaken in October 2011 by Council and disposed to Shellharbour landfill (note: spillage of residual sludge may have occurred during removal of the liner).

Up until November 2008, Ecowise Pty Ltd/ALS performed the quarterly surface and groundwater monitoring at the landfill site (Wells include: MW-1S, MW-1D, MW-3, MW-4, MW-5, MW-6S, MW-6D, MW-7S, MW-7D, MW-9, MW-10, MW-11 & recently MW-12,13,14).

E2W and Council undertook the monitoring in November 2008, and subsequently Council and/or ALS performing the quarterly monitoring rounds. Water samples are sent to ALS for laboratory analyses. No assessment of landfill gas has been conducted since the closure of the landfill due its remote location, geology (dune sands) and low gas generation rates (LMS, 2003).

The access to the landfill is currently secured, with site entrance gates locked and maintained by Council.

3 Investigation Results & Preliminary Risk Assessment

The results of the landfill gas testing are presented in Figures 1,2, 3 and Tables 1,2,3 & 4. The recent groundwater monitoring results are summarised in Figure 4 (Ammonia @ 2019 to 2020) and Graph 1 (water levels @2001 to 2020). The calibration certificate for the gasmeter (GA5000) is provided in Appendix A.

- The landfill gas in the subsurface around the landfill footprint reported no detection of methane (i.e. all 0 % v/v). The soil spikes (0.2m depth) at 37 locations is considered to provide an adequate assessment of risk from landfill gas potentially migrating from the landfill mound.
- The landfill gas in ambient air over the landfill mound (~60 readings) reported no exceedance of landfill gas thresholds for methane (i.e. all 0 % v/v). The landfill gases over the landfill mound in ambient air were not expected as the clay barrier and evapo-transpiration layer are in sound condition.
- The landfill gas in headspace within the existing wells (15) surrounding the landfill mound reported no exceedance of landfill gas thresholds for methane (all 0 % v/v). Slightly elevated CO_2 (%) was noted at three well locations (MW-1s, MW-6s, MW-7s) but are below the 1.5% threshold recommended by the Guidelines (2016). Due to the low elevation and shallow water table, many of the wells are not suitable for assessing landfill gases as well screens are within the saturated zone (Table 4).

E2W preliminary risk assessment is based on the development and assessment of the source-exposure pathway-receptor linkages. The landfill site and surrounding areas are highlighted in Figure 3. The site is surrounded by a National Park and has no sensitive receptors within 250 m.

As per NEPM (2013, B4), the stepwise process for assessing risks from the landfill is based on the following:

- **Issue Identification:** The former landfill has caused impact to the local groundwater. The landfill leachate may cause risks to human and environment health due to the elevated nutrients and potential landfill gases associated with the plume. The plume has migrated offsite into the National Park and towards Blue Angle Creek and 7 Mile Beach. No sensitive receptors are located within 250 m of the site.
- **Hazard Assessment:** Landfill leachate has impacted the local groundwater which is migrating from the landfill towards 7 Mile Beach and Blue Angle Creek (Figure 4). The leachate is likely to be associated with landfill gases such as methane, H_2S and CO_2. Methane can be explosive in confined spaces such as sewer manholes or within buried services (i.e. no services are present at the landfill site). The risk from migration of landfill gases may be influenced by weather patterns such as prolonged hot and dry periods which favour subsurface gas emissions. The landfill gas hazard is assessed to be very low based on the monitoring results of 4 January 2021.
- **Exposure Assessment:** The preliminary assessment (4-1-2021) indicates a low potential for gas risk to onsite/offsite commercial workers, the general public or nearby farmers (Tables 1 to 3, no methane detected in ambient air, soil spikes or monitoring wells). Given the age of the landfill, sandy soils, surrounding national park, and shallow water table at the site the potential for horizontal migration of gases is interpreted to be localised and limited.
- **Risk Characterisation:** Low risks are indicated by the low gas testing results on 4 January 2021 and remote site location. Risk to human health is interpreted as very low/negligible as the site is locked, vacant and not used by the general public. The risk should be re-assessed during different climatic conditions such as during periods of hot dry weather which favour

gas emissions from the plume. E2W consider that gas testing of existing wells and numerous soil spikes (0.2m depth at ~30 locations) around the landfill perimeter provides adequate site coverage and assessment of risks to park users. Landfill Management Services Pty Ltd (LMS) undertook a landfill gas study in September 2003. The results of this study concluded that the Gerroa Landfill is a low producer of landfill gas. It is likely that this is due to the waste being old and located within and above a permeable foundation material. The report by LMS concluded that there is limited migration of landfill gas. The report also stated that a gas control system and flare are not currently recommended due to the low levels of gas being generated from the site, making sustained combustion difficult.

- **Risk Management:** Monitoring of the existing wells and landfill perimeter for landfill gas is recommended for at least 1 year as part of the quarterly monitoring at the site. Installation of permanent gas wells may be proposed if the quarterly gas monitoring results exceed the EPA (2016) guidelines for methane (1% v/v). Council and E2W are currently investigating an EPA request at the site due to rising ammonia trends at several deep wells (e.g. MW-1D, MW-3, MW-4, MW-5, MW-6D, MW-7D). The site is currently vacant, locked and maintained by Council.

4 Recommendations

Based on the information review and landfill gas testing on 4 January 2021, the risks to human health and the environment from the migration of landfill gases is interpreted as low.

E2W recommend that landfill gas testing is incorporated as part of the quarterly monitoring at the site for at least 1 year. The landfill gas results should be reviewed after 1 year of data gathering to re-assess any changes or adjustments to the ongoing monitoring program.

Based on the remote location of the Gerroa landfill, absence of sensitive receptors, sandy soils, and gas testing results the installation of permanent gas monitoring wells are not considered necessary.

Yours Sincerely;

Earth2Water Pty Ltd

Dino Parisotto (Director)
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CEnvP- Certified Practitioner, Site Contamination Specialist
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Attached

Figure 1	Landfill Gas Results at Monitoring Wells (4 Jan 2021)
Figure 2	Landfill Gas Investigation (4 Jan 2021)
Figure 3	Risk Assessment for Landfill Gas (4 Jan 2021)
Figure 4	Summary of Ammonia Results (2019 to 2020)
Graph 1	Gerroa Landfill: Depth to Groundwater (2001 to 2020)
Table 1	Landfill Mound Ambient Air Results
Table 2	Landfill Perimeter & Subsurface Gas Results
Table 3	Groundwater Wells & Gas Results
Table 4	Summary of Well Screen Configuration
Appendix A	Calibration Certification (Gas meter GA5000)
Appendix B	Limitations

Figures

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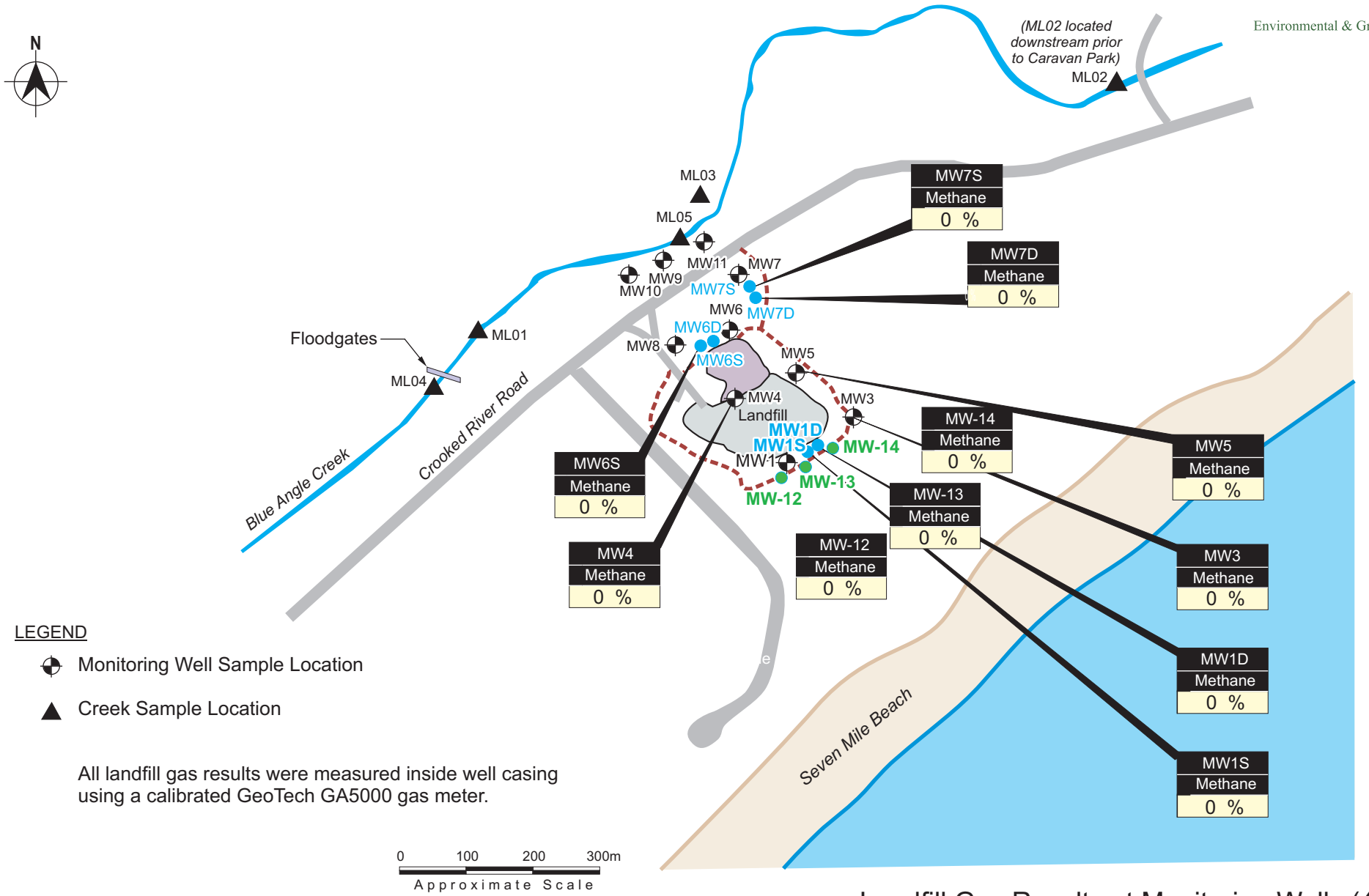


Source: *Base Plan, URS Australia Pty Ltd*

Landfill Gas Results at Monitoring Wells (4 Jan 2021)

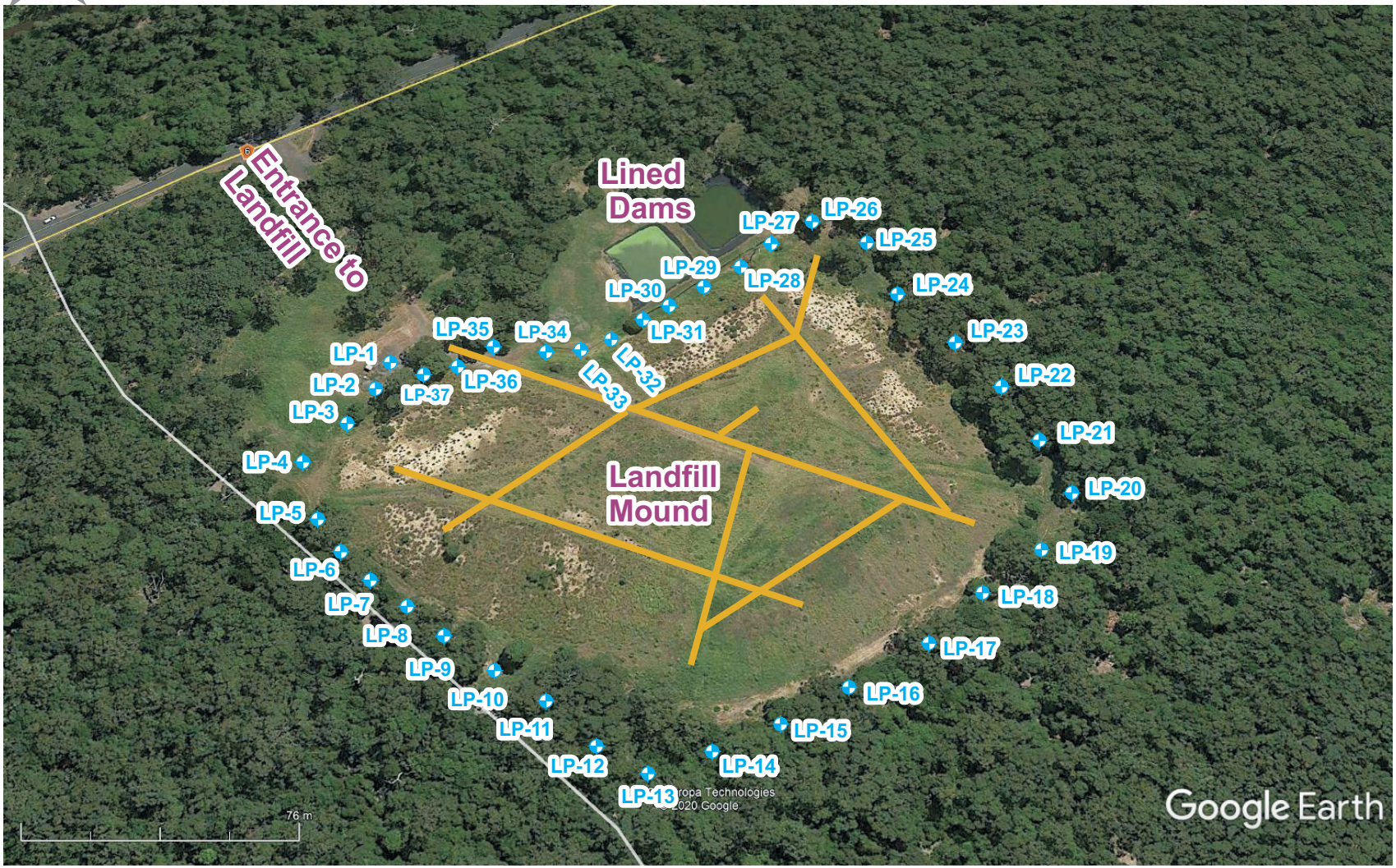
GERROA LANDFILL - GAS TESTING INVESTIGATION

Date: *4 Jan 2021*

Reference: *E2W_025_58.cdr*

Figure 1

N



0 40 m

Approx Scale (metres)

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LEGEND

LP-19 Earth2Water GasTest Location Subsurface Spike @ 0.2m depth on landfill perimeter.

Earth2Water Gas Monitoring Traverse for Ambient Air @ 0.4m high over landfill mound at accessible areas.

E2W (D.Parisotto) conducted the Gas testing on 4 Jan 2021 using a calibrated gasmeter; GA5000 GeoTech

All methane measurements = 0 % (air & subsurface)

Gerroa Landfill- Landfill Gas Investigation (4 January 2021)

Date: *4 Jan 2021*

Reference: *E2W_025_01.cdr*

Kiama Council - Gerroa Landfill Gas Assessment

Figure 2

Source: *Google EarthPro; 7Jan 2021*

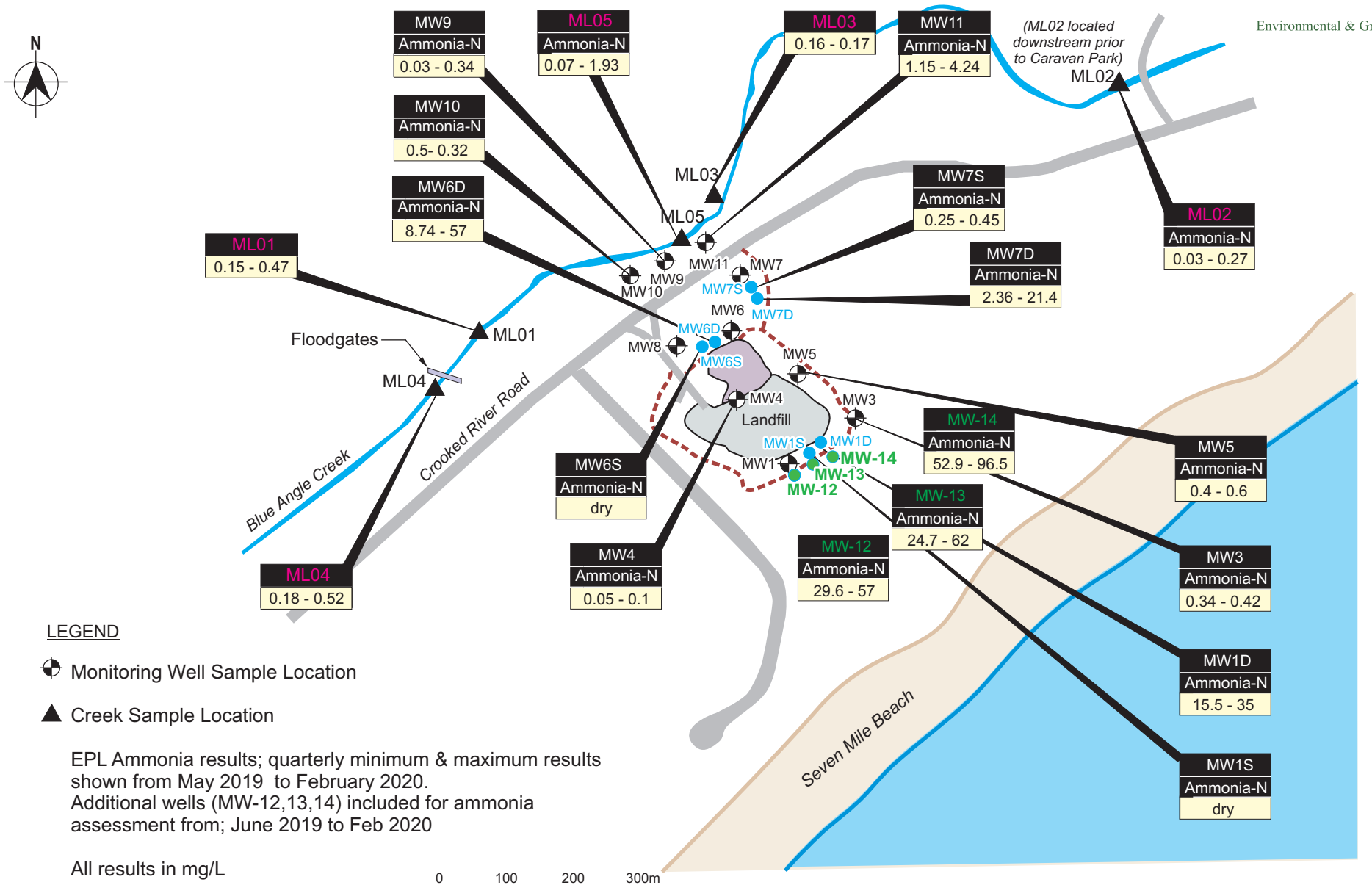
Gerroa Landfill- Risk Assessment for Landfill Gas (4 Jan 2021)

GERROA LANDFILL - GAS TESTING INVESTIGATION

Date: *4 Jan 2021*

Reference: *E2W_025_58.cdr*

Figure 3



Source: *Base Plan, URS Australia Pty Ltd*

SUMMARY OF AMMONIA RESULTS (mg/L); 2019 to 2020

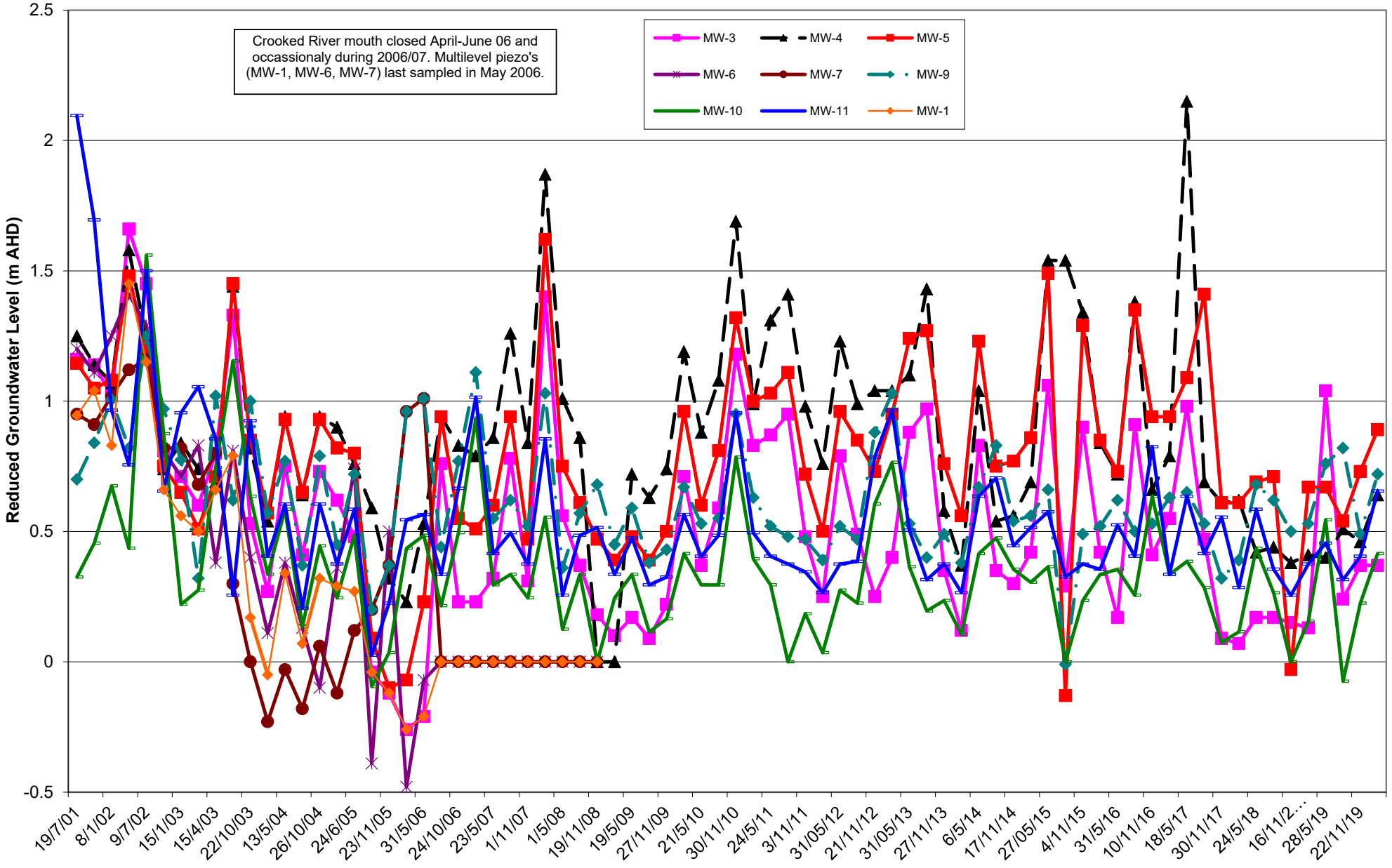
GERROA ANNUAL MONITORING REPORT (2019-2020)

Date: *5 March 2020*

Reference: *E2W_025_58.cdr*

Figure 4

Graph-01: Gerroa Landfill: Depth to Groundwater; 2001 to 2020



Tables

Earth2Water Pty Ltd - Landfill Mound Ambient Air Results (Table 1)

Project number: E2W-025 Gerroa Landfill
Client: Kiama Council
Location: Landfill Mound - Air 0.4m high
Gasmeter SN/model GA5000 GeoTech
AES Pty Ltd: Equipment Hire calibration certificates obtained

Date & time: 4-Jan-21
Weather: Warm & humid, no breeze
Estimated ambient temperature (°C): 28 deg C

Location ID	Methane (v/v %)	C02 (%)	Location ID	Methane (ppm)	C02 (%)	Comments
SG-01	0%	0%	SG-30	0%	0%	No landfill Gases
SG-02	0%	0%	SG-31	0%	0%	No landfill Gases
SG-03	0%	0%	SG-32	0%	0%	No landfill Gases
SG-04	0%	0%	SG-33	0%	0%	No landfill Gases
SG-05	0%	0%	SG-34	0%	0%	No landfill Gases
SG-06	0%	0%	SG-35	0%	0%	No landfill Gases
SG-07	0%	0%	SG-36	0%	0%	No landfill Gases
SG-08	0%	0%	SG-37	0%	0%	No landfill Gases
SG-09	0%	0%	SG-38	0%	0%	No landfill Gases
SG-10	0%	0%	SG-39	0%	0%	No landfill Gases
SG-11	0%	0%	SG-40	0%	0%	No landfill Gases
SG-12	0%	0%	SG-41	0%	0%	No landfill Gases
SG-13	0%	0%	SG-42	0%	0%	No landfill Gases
SG-14	0%	0%	SG-43	0%	0%	No landfill Gases
SG-15	0%	0%	SG-44	0%	0%	No landfill Gases
SG-16	0%	0%	SG-45	0%	0%	No landfill Gases
SG-17	0%	0%	SG-46	0%	0%	No landfill Gases
SG-18	0%	0%	SG-47	0%	0%	No landfill Gases
SG-19	0%	0%	SG-48	0%	0%	No landfill Gases
SG-20	0%	0%	SG-49	0%	0%	No landfill Gases
SG-21	0%	0%	SG-50	0%	0%	No landfill Gases
SG-22	0%	0%	SG-51	0%	0%	No landfill Gases
SG-23	0%	0%	SG-52	0%	0%	No landfill Gases
SG-24	0%	0%	SG-53	0%	0%	No landfill Gases
SG-25	0%	0%	SG-54	0%	0%	No landfill Gases
SG-26	0%	0%	SG-55	0%	0%	No landfill Gases
SG-27	0%	0%	SG-56	0%	0%	No landfill Gases
SG-28	0%	0%	SG-57	0%	0%	No landfill Gases
SG-29	0%	0%	SG-58	0%	0%	No landfill Gases
SG-30	0%	0%	SG-59	0%	0%	No landfill Gases
SG-31	0%	0%	SG-60	0%	0%	No landfill Gases

Prepared By: Earth2Water
Checked By: DP

Earth2Water Pty Ltd - Landfill Perimeter & Subsurface Gas Results (Table 2)

Project number: E2W-025 Gerroa Landfill
Client: Kiama Council
Location: Landfill Perimeter; 0.2m bgl
Gasmeter SN/model GA5000 GeoTech
AES Pty Ltd: Equipment Hire calibration certificates obtained

Date & time: 4-Jan-21
Weather: Warm & humid, no breeze
Estimated ambient temperature (°C): 25 deg C

Location ID	Methane (v/v %)	H2S (ppm)	C02 (%)	Location ID	Methane (v/v %)	H2S (ppm)	C02 (%)
LP-01	0%	0 ppm	0.1	LP-21	0%	1 ppm	0.1
LP-02	0%	0 ppm	0.1	LP-22	0%	1 ppm	0.1
LP-03	0%	0 ppm	0.1	LP-23	0%	2 ppm	0.1
LP-04	0%	0 ppm	0.1	LP-24	0%	2 ppm	0.1
LP-05	0%	0 ppm	0.1	LP-25	0%	1 ppm	0.1
LP-06	0%	0 ppm	0.1	LP-26	0%	2 ppm	0.1
LP-07	0%	1 ppm	0.2	LP-27	0%	2 ppm	0.1
LP-08	0%	1 ppm	0.1	LP-28	0%	2 ppm	0.1
LP-09	0%	1 ppm	0.1	LP-29	0%	2 ppm	0.1
LP-10	0%	1 ppm	0.1	LP-30	0%	2 ppm	0.1
LP-11	0%	1 ppm	0.1	LP-31	0%	2 ppm	0.1
LP-12	0%	1 ppm	0.1	LP-32	0%	2 ppm	0.1
LP-13	0%	1 ppm	0.1	LP-33	0%	2 ppm	0.1
LP-14	0%	1 ppm	0.1	LP-34	0%	2 ppm	0.1
LP-15	0%	1 ppm	0.3	LP-35	0%	2 ppm	0.1
LP-16	0%	1 ppm	0.1	LP-36	0%	2 ppm	0.1
LP-17	0%	1 ppm	0.2	LP-37	0%	2 ppm	0.1
LP-18	0%	1 ppm	0.1				
LP-19	0%	1 ppm	0.1				
LP-20	0%	2 ppm	0.1				

Note: Subsurface gas measurments made by hammering steel rod into ground (~0.2m depth) & using GA5000 to measure gases inside borehole.

The soils around the landfill mound perimeter comprised mostly dune sands.

Prepared By: Earth2Water
Checked By: DP

Earth2Water Pty Ltd - Groundwater Wells & Gas Results (Table 3)

Project number: E2W-025 Gerroa Landfill
Client: Kiama Council
Location: Landfill Site; Existing Monitoring Wells
Gasmeter SN/model GA5000 GeoTech
AES Pty Ltd: Equipment Hire calibration certificates obtained

Date & time: 4-Jan-21
Weather: Warm & humid, no breeze
Estimated ambient temperature (°C): 25 deg C

Location ID	Methane (v/v %)	H2S (ppm)	C02 (%)	O2 (%)	Comments
MW-1s	0%	0 ppm	0.4	19.8	CO2 levels initially unstable.Measurement inside well
MW-1D	0%	0 ppm	0.2	19.9	Measurement taken inside 50 mm PVC well
MW-1	0%	0 ppm	0.1	20.1	Measurement taken inside 50 mm PVC well
MW-3	0%	1 ppm	0.1	19.8	Measurement taken inside 50 mm PVC well
MW-4	0%	1 ppm	0.3	19.7	Measurement taken inside 50 mm PVC well
MW-5	0%	1 ppm	0.1	19.9	PVC pipe/cap at ground level
MW-6	0%	1 ppm	0.2	19.8	Bundled piezo
MW-6s	0%	1 ppm	1.3	19.1	Measurement taken inside 50 mm PVC well
MW-6D	0%	1 ppm	0.1	19.9	Measurement taken inside 50 mm PVC well
MW-7S	0%	1 ppm	0.8	19.5	Measurement taken inside 50 mm PVC well
MW-7D	0%	1 ppm	0.1	19.9	Measurement taken inside 50 mm PVC well
MW-7	0%	1 ppm	0.1	19.9	Bundled piezo
MW-12	0%	0 ppm	0.1	20.4	Measurement taken inside 50 mm PVC well
MW-13	0%	0 ppm	0.1	20.2	Measurement taken inside 50 mm PVC well
MW-14	0%	0 ppm	0.1	19.9	Measurement taken inside 50 mm PVC well

Note: Water levels estimated at 0.2 to 1m AHD (wet period)

Prepared By: Earth2Water
Checked By: DP

Table 4: Gerroa Landfill, Summary of Well Screen Configuration

Monitoring Well ID	Well Screen Interval (m AHD)	Average SWLs (m AHD)	Suitable for Gas Testing	Groundwater Level (mTOC) 8 Jan 2021
MW-1S	Approx. 0 to -3	0 to 1	No, well screen saturated	SWL= 3.47m toc (approx 0.2 mAHD)
MW-1D	Approx. -4 to -7	0 to 1	No, well screen saturated	SWL= 3.44 m toc (approx 0.2 mAHD)
MW-3	0 to 1.5	0 to 1	No, well screen saturated	SWL= 3.83 m toc (approx 0.62 mAHD)
MW-4	0.79 to -0.71	0 to 1	Marginal	Located next to holding dam (locked compound)
MW-5	0.55 to -0.95	0 to 1	Marginal	SWL= 3.80 m toc (approx 0.95 mAHD)
MW-6	NA	0 to 1	No	Bundled Piezo SWL= 3.48 mtoc (approx 0.6 mAHD)
MW-6S	Approx 0 to -3	0 to 1	No, well screen saturated	SWL= 4.55 m toc (approx 0.6m AHD)
MW-6D	Approx -4 to -7	0 to 1	No, well screen saturated	SWL= 4.82 m toc (approx 0.6m AHD)
MW-7	NA	0 to 1	No	Bundled Piezo
MW-7S	Approx 0 to -3	0 to 1	No, well screen saturated	NA
MW-7D	Approx -4 to -7	0 to 1	No, well screen saturated	NA
MW-9	-0.53 to -1.53	0 to 1	No, well screen saturated	Outside of landfill site
MW-10	-0.525 to -1.525	0 to 1	No, well screen saturated	Outside of landfill site
MW-11	0.095 to -0.905	0 to 1	No, well screen saturated	Outside of landfill site
MW-12	approx; -4 to -7	0 to 1	No, well screen saturated	SWL= 3.15 mAHD (approx 0.2m AHD), deep well (10m)
MW-13	approx; -4 to -7	0 to 1	No, well screen saturated	SWL= 3.37 mAHD (approx 0.2m AHD), deep well (10m)
MW-14	approx; -4 to -7	0 to 1	No, well screen saturated	SWL= 2.98 mAHD (approx 0.2m AHD), deep well (10m)

Note; SWL = standing water level, based on average of previous EPL for the landfill (refer to Graph1)

Appendix A

Calibration & Service Report
Gas Monitor

Company:	Active Environmental Solutions Hire	**Manufacturer:**	Geotechnical Instruments Ltd	**Serial #:**	G505790
Contact:	Aleks Todorovic	**Instrument:**	Portable Gas Analyser	**Asset #:**	-
Address:	2 Merchant Avenue Thomastown Vic 3074	**Model:**	GA5000	**Part #:**	-
		Configuration:	CH4; CO2: O2; H2S; CO	**Sold:**	-
Phone:	03 9464 2300 | **Fax**: 03 9464 3421	**Wireless:**	-	**Last Cal:**	-
Email:	Hire@aesolutions.com.au	**Network ID:**	-	**Job #:**	-
		Unit ID:	-	**Cal Spec:**	Std

Item	Test	Pass/Fail	Comments
Battery	Li Ion	✓	
Charger	Charger, Power supply	✓	
Internal Flow Pod	Zeroed	✓	
Pump	Flow	✓	>600 mL/min
Filter	Filter, fitting, etc	✓	
Tubing	Set of 3 tubes	✓	
Display	Operation	✓	
PCB	Operation	✓	
Connectors	Condition	✓	
Firmware	Version	✓	1.14.12
Datalogger	Operation	✓	
Monitor Housing	Condition	✓	
Case	Condition/Type	✓	
Sensors			
Oxygen		✓	
CH4		✓	
CO2		✓	
H2S		✓	
CO		✓	
Toxic 3		-	
Toxic 4		-	
Toxic 5		-	

Engineer's Report- Calibration Certificate

Setup, service and calibration for hire

Sensor	Span Gas	Concentration	Traceability Lot #	CF	Reading
					Span
Oxygen	Nitrogen	99.99% N2 (0 % O2)	WO249622-15	1	0.0%
	Fresh air	20.9	Fresh Air	1	20.9%
CH4	Nitrogen	99.99% N2 (0% CH4)	WO249622-15	1	0.0%
	Methane	60%	2174-1-2	1	60.0%
CO2	Nitrogen	99.99% N2 (0% CO2)	WO249622-15	1	0.0%
	Carbon Dioxide	40%	2174-1-2	1	40.0%
CO	Nitrogen	99.99% N2 (0 PPM CO)	WO249622-15	1	0 PPM
	Carbon Monoxide	100 PPM	WO249309-28	1	100 PPM
H2S	Nitrogen	99.99% N2 (0 PPM H2S)	WO249622-15	1	0 PPM
	Hydrogen Sulfide	25 PPM	WO249309-28	1	25 PPM

Calibrated/Repaired by: Milenko Sisic

Date: 09/10/2020 Next due: 09/04/2021

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 21-May-2019

Certificate Number: G505790_2/23212

Issued by: QED Environmental Systems Ltd.

Customer: **Thermo Fisher Scientific Australia Pty L**
5 Caribbean Drive PO Box 9092 Scoresby
VIC 3179 AUSTRALIA

Description: Gas Analyser

Model: GA5000

Serial Number: G505790

UKAS Accredited results:

Results after adjustment :

Methane (CH_4)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	4.8	0.41
15.0	14.9	0.64
49.9	49.4	0.94

Carbon Dioxide (CO_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
5.0	4.9	0.43
15.0	14.9	0.70
50.1	50.3	1.1

Oxygen (O_2)		
Certified Gas (%)	**Instrument Reading (%)**	**Uncertainty (%)**
21.3	21.3	0.31

The inwards assessment was carried out 08-May-2019.
The maximum adjustment is larger than the inwards assessment uncertainty.
Inwards assessment data is available if requested.

All concentrations are molar.

CH_4, CO_2 readings recorded at : 33.5 °C ± 2.5 °C

O2 readings recorded at : 22.8 °C ± 2.5 °C

Barometric Pressure : 1009 mbar ± 4 mbar

Method of Test : The analyser is calibrated in a temperature controlled chamber using a series of reference gases, in compliance with procedure LP004.

Calibration Instance: 102 IGC Instance: 102

www.qedenv.com +44 (0) 333 800 0088 sales@qedenv.co.uk

QED Environmental Systems Ltd. Cyan Park - Unit 3, Jimmy Hill Way, Coventry, CV2 4QP, UNITED KINGDOM

Registered in England and Wales 1898734

CERTIFICATION OF CALIBRATION

4533

Date Of Calibration: 21-May-2019

Certificate Number: G505790_2/23212

Issued by: QED Environmental Systems Ltd.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Calibrations marked 'Non-UKAS Accredited results' on this certificate have been included for completeness.

Non-UKAS accredited results after adjustment:

Barometer (mbar)	
Reference	**Instrument Reading**
1009	1009

Additional Gas Cells		
Gas	**Certified Gas (ppm)**	**Instrument Reading (ppm)**
CO	507	516
H_2S	251	251

Internal Flow	
Applied (l/hr)	**Instrument Reading (l/hr)**
5.0	5.1
10.0	10.1

Date of Issue : 22-May-2019

Approved by Signatory

Graham Ingles

Laboratory Inspection

Calibration Instance: 102 IGC Instance: 102

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Appendix B

Limitations

Earth2Water Pty Ltd has prepared this report for the use of the client in accordance with the standard terms and conditions of the consulting profession. The methodology adopted and sources of information used by E2W are outlined in this report.

This preliminary risk assessment report was prepared during January 2021 and is based on the information reviewed at the time of preparation. This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the project budget limitations and timing. Our advice and interpretations are based upon previous works and E2W site testing, assessment of site information, and our previous experience with similar sites.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, E2W should be notified of any such findings and be provided with an opportunity to review recommendations within this report.