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property › environment › safety ›

Ground Level
5 Burwood Road
Hawthorn VIC 3122
(03) 9508 0100

27 March 2026

Kellie Scholes

Muswellbrook Shire Council

Campbell's Corner, 60-82 Bridge Street
Muswellbrook, NSW, 2333

Dear Kellie

Landfill Gas Risk Assessment at Muswellbrook Waste Management Facility, 252 Coal Road Muswellbrook NSW

Prensa Pty Ltd (Prensa) was engaged by Muswellbrook Shire Council (Council) to undertake a Landfill Gas Risk Assessment (LFGRA) (the Assessment) within a portion of 252 Coal Road, Muswellbrook NSW (the Site). The location of the Site has been illustrated in **Figure 1** within **Attachment B** of this report.

1 Background

The Site is currently the Muswellbrook Waste & Recycling Facility. Council is proposing to develop a community recycling centre on the southern side of the current landfill cell.

Uncertainty exists as to the potential risk from landfill gas on the proposed development. Enrisks (2025) completed a qualitative Landfill Gas Risk Assessment in relation to the proposed development, which included a review of landfill gas sampling data from wells across the wider landfill site, but no bores were located within the proposed development footprint (ref: *Landfill Gas Risk Assessment: Muswellbrook Community Infrastructure Depot and Waste Management Facility* (Enrisks 2025))

The risk assessment concluded that there was a moderate level of risk associated with impact by ground gases on the proposed building, and recommended the installation of a gas mitigation system as part of the development, either a passive sub slab ventilation system or membrane. It is understood that the planning panel (consent authority) for the proposed works requested that an intrusive ground gas assessment be undertaken in the footprint of the building

As such, Council requested Prensa to undertake a LFGRA to assess the potential risks relating to the presence of ground gas, specifically methane, in the subsurface in the area where the building is proposed to be developed.

2 Objectives

The objectives of the LFGRA are to:

- Identify whether a potential risk associated with LFG exists at the Site which may pose a risk to future users of the Site based on the proposed development; and
- Provide recommendations for further landfill gas (LFG) assessment (i.e. monitoring or LFG management (where required).

3 Scope of Works

Prensa undertook the following scope of works:

- A desktop a review of environmental setting and Enrisks (2025) report;
- A LFGRA including:
    - Supervision of the installation four LFG monitoring bores to a maximum depth of 6.0 m below ground level (m BGL) within the proposed building footprint at the Site;
    - Completion of three monitoring events of the LFG bores approximately following installation, one and two weeks after the bore installation;
    - Compare LFG monitoring results against relevant national and state-based guidelines for risk to human health (based on the proposed development) and the Modified Wilson and Card Gas Screening Value (GSV) characteristic situations described in CIRIA C665; and
- Preparation of this LFGRA report.

4 Desktop Review

As part of this LFGRA, Prensa undertook a detailed review of the Site to provide information pertaining to the landfill, the proposed development works and the Site's history.

4.1 Site Setting Review

Information from the Enrisks 2025 has been reviewed and summarised in **Table 1** below.

Table 1: Desktop Review Summary

Aspect	Details
Current Site Use	The waste facility comprises a weighbridge and staff amenities buildings, a sawtooth transfer station for waste and recycling drop offs, landfill and hardstand recycling area and Community Recycling Centre for household problem wastes.
Site History *(from Enrisks 2025)*	The WRF was previously part of Muswellbrook Common. In 1990 the extraction of 200,000 tonnes of coal was approved. At that time the WRF had been extensively reshaped as a consequence of mining activities in the area. The western portion had been covered with overburden and the foundations of a coal crushing and processing plant was located in the northern portion. The extraction of coal from an open cut pit occurred between 1990 and 1993. Following extraction of coal, the site was transformed into a landfill which has been operational since 1993. The landfill receives domestic, commercial and industrial waste and recycling materials from the Muswellbrook community, local mine site and Upper Hunter Region.
Topography	Surface elevation was likely between 243 m AHD on the easter boundary and 205 m AHD on the western boundary.

Table 1: Desktop Review Summary	
Aspect	**Details**
Geology	The site is underlain by the Rowan Formation of the Greta Coal Measures, characterised by coal seams, sandstone and siltstone rock types. Subsurface investigations identified the following subsurface types: • Fill described as: sandy gravel, silty sandy gravel, silty sand and gravelly clay; • Extremely weathered siltstone and sandy siltstone; and • Moderately weathered to highly weathered rock as siltstone.
Surface Water Receptors	No surface water bodies were noted to be present on-site. The closest off-site surface water receptor to the Site was considered to be an unnamed creek located approximately 300 m west of the Site at its nearest point.
Groundwater Depth	Anticipated to be encountered beyond 15 m BGL The landfill cell is listed as laying approximately 15 m above groundwater elevation. Given this and the low permeability of the surrounding rock the risk of leachate impacts on the underlying groundwater is considered 'low'.
Landfill Design *(from Enrisks 2025)*	Prior to the commencement of the landfilling operations the base of the void was lined with a 1 m thick layer of clay material. The walls of the void have been progressively lined with a 2 m thick layer of clay material as the level of waste rose. Leachate generated in the landfill percolates down through the landfill to the top of the landfill liner. The leachate then flows to the lowest point in the base of the landfill where a gravel sump and extraction riser has been installed. Material placed in the landfill is compacted and covered in accordance with the Licence for the site. The landfill is developing in 3 stages, with each stage being intermediately capped. Each stage will be final capped upon reaching its design levels. Once landfilling is complete in each stage, rehabilitation may be progressed sequentially
Proposed Development	The proposed development involves the construction of a new building on the site, to be used as the Community Recycling Centre. The development comprises a number of outdoor/open parking areas, barbeque (BBQ) areas and bays, and a new building located in the southern central part of the site (refer to Appendix A for relevant plans). The building is located approximately 30 m to the south of the edge of the landfill (refer to Figure 3). The new building includes: • A lower ground floor that comprises a store and parking/storage for lawnmowers and tractors; and • An upper ground floor that comprises administration, internal storage and workshop, kitchen and amenities.

4.2 Summary of EnRisks Assessment

Enrisks undertook a review of the site setting, potential for exposure based on the building design, and previous methane surface monitoring data. In summary:

- The lateral migration of methane from the landfill cell to the proposed building development was considered to be the primary risk mechanism of concern in relation to the proposed building;
- Review of 12 historical surface monitoring events for methane at the waste facility, sampled between 2018 – 2024, indicated surface methane levels were usually low and less the NSW EPA (2020) threshold of 0.05%, however elevated concentrations of methane were reported (up to 24.6%) in two monitoring events;

- Enrisks noted that gas production at the landfill is expected to increase and occur over a significant period of time (at least 30 years).

Based on the review, Enrisks conducted a Level 1 risk assessment in accordance with NSW EPA 2020.

Enrisks considered there to be '*Medium*' consequence level associated with the potential presence of methane in the building to be constructed, and it was considered '*Likely*' that the methane gas would migrate from the landfill to the area of the proposed development. As such, the proposed development at the Site was considered to pose an overall Level 1 risk assessment classification of '*Moderate*'.

		Consequence			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

Based on the findings of the Level 1 risk assessment, a gas mitigation system was recommended to be installed. These recommendations are restated in **Section 8** of this report. The Enrisks 2025 assessment is provided as an **Attachment F** to this report.

5 Landfill Gas Monitoring

5.1 Installation of Landfill Gas Bores

Four LFG bores, denoted LFGB01-4, were established on 20-21 February 2026 by licensed drillers (Epoca) using a hand auger and drill rig equipped with a compressed air hammer. The LFG bores were generally established near the northern boundary of the proposed building to target the closest point to the landfill, and were considered appropriate to evaluate the current presence and significance of LFG concentrations in the vicinity of the proposed building. The locations of the LFG bores are shown on **Figure 2** within **Attachment B** of this report.

A summary of the LFG monitoring bore construction details is provided in **Table 2** below.

Table 2: LFG Monitoring Bore Construction Details						
Bore ID.	Location	Date Installed	Total Depth (m)	Casing Depth (m BGL)	Screen Depth (m)	Lithology Screened
LFGB01	North-west portion of proposed development	20/02/2026	6.0	0.0 – 6.0	1.0 – 6.0	Natural: Siltstone
LFGB02	Centre -west portion of proposed development	20/02/2026	6.0	0.0 – 6.0	1.0 – 6.0	Natural: Siltstone
LFGB03	North – east portion of proposed development	21/02/2026	6.0	0.0 – 6.0	1.0 – 6.0	Natural: Siltstone
LFGB04	Centre of proposed development	21/02/2026	6.0	0.0 – 6.0	1.0 – 6.0	Natural: Siltstone

LFG monitoring bores were installed using Class 18 polyvinyl chloride (PVC) casing and screen with 3.0 mm machine-slotted PVC casing, with a 50 mm diameter. Sand was used as the filter pack and extended to 0.2 m above the screen. A 0.6 m bentonite seal was installed above the sand filter pack with grout used to the surface of the bores. The LFG bores were installed as monuments were fitted with a gas valve cap. Where fill soil was observed which had the potential to influence gas results, this material was appropriately sealed from the screen via bentonite or grout.

5.2 Field Observations During Installation

During the installation of the LFG bores, Prensa undertook a visual inspection of the soil/rock profile. Fill soil comprising a light brown gravelly clay we observed from surface to a maximum depth of 0.7 m BGL was encountered at the monitoring bore locations. Natural soil comprised a light grey clayey silt, overlying a grey siltstone rock which was encountered from depths between 1.6 m-4.6 m BGL until termination of the bores at 6.0 m BGL. During the bore installation, evidence of landfill waste and/or anaerobic odours was not observed by Prensa field personnel.

5.3 Gas Bore Monitoring

Three landfill gas monitoring events were undertaken as part of the LFG assessment using a calibrated portable Category 1 LFG analyser (GA5000).

Prensa monitored data published by the Bureau of Meteorology prior to attending site to forecast the LFG monitoring conditions (gas exchange potential), including weather conditions for Scone Airport (nearest weather station to Site with relevant monitoring information).

In accordance with the gas monitoring proforma provided in CIRIA C665 2007, the following observations were noted prior to monitoring:

- Weather conditions, including rainfall, wind humidity and cloud cover;

- Ambient temperature and atmospheric pressure;
- Condition of the LFG bore; and
- Visible or olfactory evidence of gas migration.

Prior to monitoring, the LFG analyser was calibrated by running clean air through the system and zeroing the device. This was undertaken away from any source of soil gases and/or vapours (i.e. vehicles).

The tubing was then affixed to the gas tap and switched on. Prior to gas monitoring, the flow rate, relative pressure and barometric pressure at each bore was monitored.

Gas concentrations were measured for 4 to 6 minutes, with the peak value recorded. Field measured parameters included:

- Methane (%);
- Carbon dioxide (%);
- Oxygen (%);
- Hydrogen sulphide (ppm);
- Carbon monoxide (ppm);
- Flow rate (L/hr);
- Barometric pressure (hPa); and
- Relative pressure (Pa).

The calibration certificates for the landfill gas analyser are provided in **Attachment I** of this report.

5.4 Adopted Assessment Criteria and Action Levels

5.4.1 Qualitative Assessment of Risk

A semi-qualitative estimate of risk for the Site was ascertained through the application of the Wilson and Card methodology to calculate the Characteristic Situation, as detailed in CIRIA C665. The Wilson and Card methodology utilises both gas concentrations and borehole flow rates to define a Characteristic Situation for a site, based on the limiting borehole gas volume flow for methane and carbon dioxide. Gas screening value (GSV) is the designated term for describing the limiting borehole gas volume flow. The GSV is calculated using the following equation:

$$GSV\left(\frac{L}{hr}\right) = Maximum\ Flow\ Rate\ \left(\frac{L}{hr}\right) \times Maximum\ Gas\ Concentration\ (\%)$$

The GSV was determined for both methane and carbon dioxide using the above calculation, and the worst case value adopted. The lower measurement limit of the landfill gas analyser was used where no detectable flow rate was recorded.

The Characteristic Situation for the Site was determined from the GSV using the Wilson and Card methodology outlined in **Table 3**.

Table 3: Modified Wilson and Card Classification			
Characteristic Gas Situation	Risk Classification	Gas Screening Value Threshold (L/hr)	Additional Factors
1	Very Low Risk	<0.07	Typically, methane <1% v/v and/or carbon dioxide <5% v/v, otherwise consider increase to Situation 2.
2	Low Risk	<0.7	Borehole flow rate not to exceed 70 L/hr, otherwise consider increase to Situation 3.
3	Moderate Risk	<3.5	No additional factors.
4	Moderate to High Risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.
5	High Risk	<70	As per Situation 4 as a minimum.
6	Very High Risk	>70	As per Situation 4 as a minimum.

It should be noted that the higher the classification assigned to a site, the greater the risk posed by the presence of gas. Furthermore, the GSV is a guideline value and does not represent an absolute threshold.

6 Landfill Gas Monitoring Results

6.1 Weather and Site Conditions

During the LFG monitoring events, key observations pertaining to weather and site conditions were made which are summarised in **Table 4** below.

Table 4: Weather and Site Conditions			
Date	Temp (°C)	Humidity (%)	Noteworthy Observations
20/02/2026	21.5°C (min) - 34.3°C (max)	78% (9 AM) - 47% (3 PM)	Bores in sound condition
28/02/2026	19.8°C (min) - 29.6°C (max)	81% (9 AM) - 48% (3 PM)	Bores in sound condition
05/03/2026	17.3°C (min) - 36°C (max)	91% (9 AM) - 36% (3 PM)	Bores in sound condition

6.2 Atmospheric Pressure Readings

Site-specific atmospheric conditions were monitored during the sampling rounds with the landfill gas analyser GA5000. The calibration certificate for the landfill gas analyser is provided as **Attachment D** of this report. These results were compared with the atmospheric pressure reading reported by the Bureau of Meteorology (BOM), Viewbank, Station Number 086068. Further details regarding the atmospheric pressures measured during the sampling round are provided in **Table 5** below.

Table 5: Comparison of Field Measurements and BOM Atmospheric Pressure Readings				
Sampling Round		1	2	3
	Bore	20/02/2026	28/02/2026	05/03/2026
Field measured barometric pressure (mb) from GA5000	LFGB1	990	993	991
	LFGB2	991	992	990
	LFGB3	991	991	990
	LFGB4	991	992	991
Meteorological atmospheric pressure (hPa) from BOM website	9 am	1015.7	1016.6	1013.4
	3 pm	1011.8	1013.8	1009.4
Pressure Change		Decreasing	Decreasing	Decreasing

6.3 Monitoring Results

The data from the quick connect bore monitoring is provided within **Attachment E** of this report with a summary of the recorded concentrations detailed in **Table 6** below.

In addition, a summary of the measured gas concentrations, flow rates, Wilson and Card calculated GSVs are outline in **Table 6.**

Table 6: Summary of Landfill Gas in Bores						
Bore ID	Peak Gas Flow Rate (L/rh)	Methane (%) (max)	Carbon Dioxide (%) (max)	GSV (L/hr) Methane	GSV (L/hr) Carbon dioxide	Wilson and Card Calculations - Characteristic Situation
Round 1						
LFGB1	0.0	0.0	0.2	0.0	0.0	1 – Very low risk
LFGB2	0.0	0.0	0.0	0.0	0.0	1 – Very low risk
LFGB1	0.0	0.0	0.0	0.0	0.0	1 – Very low risk
LFGB2	0.0	0.0	0.0	0.0	0.0	1 – Very low risk
Round 2						
LFGB1	0.0	0.0	1.50	0.0	0.0	1 – Very low risk
LFGB2	0.1	0.0	3.40	0.0	0.0034	1 – Very low risk
LFGB3	0.3	0.0	1.80	0.0	0.0054	1 – Very low risk
LFGB4	0.4	0.0	0.10	0.0	0.0004	1 – Very low risk
Round 3						
LFGB1	0.2	0.0	6.80	0.0	0.0136	1 – Very low risk
LFGB2	0.1	0.0	6.20	0.0	0.0062	1 – Very low risk
LFGB3	0.0	0.0	5.40	0.0	0.0	1 – Very low risk
LFGB4	0.1	0.0	5.70	0.0	0.0057	1 – Very low risk

Given atmospheric pressure was likely to be falling during the monitoring event, Prensa considers that conditions would be conducive to elevated flow.

Based on the GSVs calculated for methane and CO_2, the characteristic situation was assessed to be **Very Low Risk**. Furthermore, methane concentrations were less than the levels outlined in Table 8.5 of CIRIA C665 (<1%).

Concentrations of CO_2, however, exceeded the levels outlined in Table 8.5 of CIRIA C665 (<5%). Further discussion regarding the CO_2 levels is provided in **Section 7**.

7 Discussion

Prensa reviewed the LFGRA undertaken by Enrisks (2025) which included a review of the site setting, potential for exposure based on the proposed building design, and previous methane surface monitoring data. In summary:

- The landfill began operation in 1993 and remains operations receiving putrescible and non putrescible wastes;
- The lateral migration of methane from the landfill cell to the proposed building development was considered to be the primary risk mechanism of concern in relation to the proposed building;
- Review of 12 historical surface monitoring events for methane at the waste facility, sampled between 2018 – 2024, indicated surface methane levels were usually low and less the NSW EPA (2020) threshold of 0.05%, however elevated concentrations of methane were reported (up to 24.6%) in two monitoring events;
- Enrisks noted that gas production at the landfill is expected to increase and occur over a significant period of time (at least 30 years).

Based on the review, Enrisks conducted a Level 1 risk assessment in accordance with NSW EPA 2020.

Enrisks considered there to be '*Medium*' consequence level associated with the potential presence of methane in the building to be constructed, and it was considered '*Likely*' that the methane gas would migrate from the landfill to the area of the proposed development. As such, the proposed development at the Site was considered to pose an overall Level 1 risk assessment classification of '*Moderate*'.

Prensa undertook three rounds of monitoring for of four landfill gas bores installed in the footprint of the proposed building, to evaluate the current risk of landfill gas migration from the adjacent landfill cells to the Site. Monitoring was conducted during times when atmospheric pressure was likely to be falling in conditions would be conducive to elevated flow.

In summary, methane was not detected during the assessment, and the maximum reported concentration of carbon dioxide was 6.8%. The calculated gas screening values across all monitoring rounds for methane and carbon dioxide were calculated to be ***Situation 1 – Very Low Risk.*** It is noted that the CO_2 concentration exceeded 5% v/v in all bores in the 3rd monitoring round.

Whilst the monitoring results generally indicated that there is currently a low risk of landfill gas migration to the Site, it is considered that the risk potential is likely to increase over time as the landfill ages, additional waste is deposited and more gas is produced or potential migration pathways are established. As such, the recommended mitigation methods for the building design are recommended as per Enrisks (2025) report.

8 Conclusion and Recommendations

This LFG Assessment included a desktop review of the Enrisks (2025) LFGRA, establishment of four LFG bores and three rounds of LFG monitoring. The key findings of the LFG Assessment included:

- The current potential for LFG migration to the proposed building footprint was considered to be very low, however this risk is likely to increase over time as the landfill ages, additional waste is added and more gas is produced or potential migration pathways are established.
- It is recommended that the design of the proposed building include the gas mitigation measures outlined in the Enrisks (2025) report.

Mitigation systems recommended for the proposed building that meet the required level of protection are as follows, as per Enrisks (2025):

- Reinforced concrete ground-bearing slab or waffle pod slab (protection value of 0.5) or reinforced concrete ground-bearing raft slab with limited service penetrations **AND** installation of a passive sub-slab ventilation system (protection value of 1.5 to 2.5 depending on the performance of the ventilation system). The passive sub-slab ventilation system would act as a break, venting any methane gas prior to methane reaching the building slab; **OR**
- Installation of a suitable gas-resistant membrane (protection value of 2). Such a membrane needs to be suitable for the management of methane gas and be installed by a specialist with documented quality control and testing that the membrane does not leak (including around service penetrations). The membrane would need to be placed beneath all slabs and walls of the lower ground level in direct contact with the ground. A gas membrane acts as a barrier to minimise the migration of gas into the building.

9 References

- NSW Work Health and Safety Act 2011;
- NSW Work Health and Safety Regulation 2025;
- Contaminated Land Management Act 1997;
- Contaminated Land Management Amendment Act 2008;
- Protection of the Environment Operations (POEO) Act 1997;
- Protection of the Environment Operations (Waste) Regulation 2014;
- NSW, State Environmental Planning Policy (Resilience and Hazards), 2021;
- NSW Environmental Protection Agency (EPA), Consultants Reporting on Contaminated Land, 2020 (EPA 2020);
- National Environment Protection Council, National Environment Protection (Assessment of Site Contamination) Measure, 1999 (April 2013) (NEPM 2013);
- NSW EPA, Environmental Guidelines Solid Waste Landfills, Second Edition 2016; and
- NSW EPA, Assessment and management of hazardous ground gases, 2020 (NSW EPA 2020).
- enHealth, Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012a);
- UK Guidance on the management of landfill gas (UK Environment Agency 2004); and
- EPA Publication 788.3 (EPA Victoria 2015), Landfill BPEM Siting, design, operation and rehabilitation of landfill.

Should you have any questions regarding this report, please do not hesitate to contact the undersigned on (03) 9508 0100.

Yours sincerely,

Dane Fankhauser

Managing Consultant

Prensa Pty Ltd

Attachments

A – Statement of Limitations

B – Site Plan

C – Development Plans

D – Calibration Certificates

E – LFG Monitoring Logs

F – Enrisks LFGRA (2025)

Attachment A: Statement of Limitations

Statement of Limitations

This document has been prepared in response to specific instructions from Muswellbrook Shire Council to whom the report has been addressed. The work has been undertaken with the usual care and thoroughness of the consulting profession. The work is based on generally accepted standards, practices of the time the work was undertaken. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The report has been prepared for the use by Muswellbrook Shire Council and the use of this report by other parties may lead to misinterpretation of the issues contained in this report. To avoid misuse of this report, Prensa advise that the report should only be relied upon by Muswellbrook Shire Council and those parties expressly referred to in the introduction of the report. The report should not be separated or reproduced in part and Prensa should be retained to assist other professionals who may be affected by the issues addressed in this report to ensure the report is not misused in any way.

Prensa is not a professional quantity surveyor (QS) organisation. Any areas, volumes, tonnages or any other quantities noted in this report are indicative estimates only. The services of a professional QS organisation should be engaged if quantities are to be relied upon.

Sampling Risks

Prensa acknowledges that any scientifically designed sampling program cannot guarantee all sub-surface contamination will be detected. Sampling programs are designed based on known or suspected site conditions and the extent and nature of the sampling and analytical programs will be designed to achieve a level of confidence in the detection of known or suspected subsurface contamination. The sampling and analytical programs adopted will be those that maximises the probability of identifying contaminants. Muswellbrook Shire Council must therefore accept a level of risk associated with the possible failure to detect certain sub-surface contamination where the sampling and analytical program misses such contamination. Prensa will detail the nature and extent of the sampling and analytical program used in the investigation in the investigation report provided.

Environmental site assessments identify actual subsurface conditions only at those points where samples are taken and when they are taken. Soil contamination can be expected to be non-homogeneous across the stratified soils where present on site, and the concentrations of contaminants may vary significantly within areas where contamination has occurred. In addition, the migration of contaminants through groundwater and soils may follow preferential pathways, such as areas of higher permeability, which may not be intersected by sampling events. Subsurface conditions including contaminant concentrations can also change over time. For this reason, the results should be regarded as representative only.

Muswellbrook Shire Council recognises that sampling of subsurface conditions may result in some cross contamination. All care will be taken and the industry standards used to minimise the risk of such cross contamination occurring, however, Muswellbrook Shire Council recognises this risk and waives any claims against Prensa and agrees to defend, indemnify and hold Prensa harmless from any claims or liability for injury or loss which may arise as a result of alleged cross contamination caused by sampling.

Reliance on Information Provided by Others

Prensa notes that where information has been provided by other parties in order for the works to be undertaken, Prensa cannot guarantee the accuracy or completeness of this information. Muswellbrook Shire Council therefore waives any claim against the company and agrees to indemnify Prensa for any loss, claim or liability arising from inaccuracies or omissions in information provided to Prensa by third parties. No indications were found during our investigations that information contained in this report, as provided to Prensa, is false.

Recommendations for Further Study

The industry recognised methods used in undertaking the works may dictate a staged approach to specific investigations. The findings therefore of this report may represent preliminary findings in accordance with these industry recognised methodologies. In accordance with these methodologies, recommendations contained in this report may include a need for further investigation or analytical analysis. The decision to accept these recommendations and incur additional costs in doing so will be at the sole discretion of Muswellbrook Shire Council and Prensa recognises that Muswellbrook Shire Council will consider their specific needs and the business risks involved. Prensa does not accept any liability for losses incurred as a result of Muswellbrook Shire Council not accepting the recommendations made within this report.

Attachment B: Site Plan

prensa

FIGURE NAME - SITE LOCATION PLAN

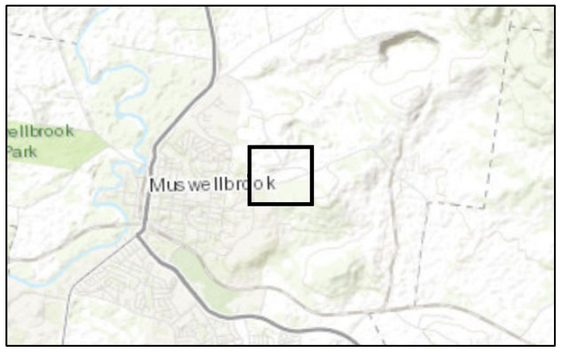
JOB NO - 149603S

PROJECT - MUSWELLBROOK WASTE FACILITY LFG

CLIENT / CLIENT NO - MUSWELLBROOK SHIRE COUNCIL / M0146

LEGEND

- Site Boundary - Proposed Recycling Building
- Muswellbrook Waste Facility



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SCALE 1:4,000 **M**

NOTES

1. PROJECTION: GDA2020 MGA ZONE 56

REFERENCES

1. AERIAL IMAGERY SOURCED FROM METROMAP.COM DATE OF CAPTURE 30 JAN 2024.
2. ROAD & CADASTRAL DATA SOURCED FROM NSW GOVERNMENT | COPYRIGHT © SPATIAL SERVICES 2026

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prensa

FIGURE NAME - SAMPLING LOCATION PLAN

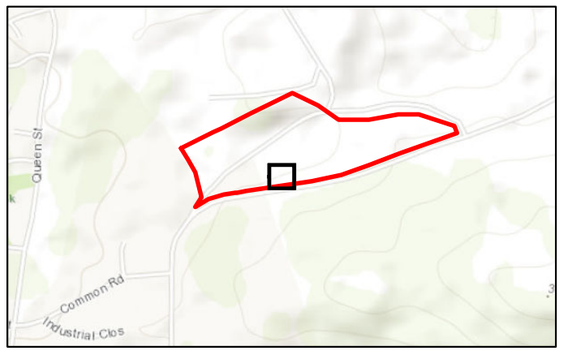
JOB NO - 149603S

PROJECT - MUSWELLBROOK WASTE FACILITY LFG

CLIENT / CLIENT NO - MUSWELLBROOK SHIRE COUNCIL / M0146

LEGEND

- Site Boundary - Proposed Depot Building
- Muswellbrook Waste Facility
- Landfill Gas Bore



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SCALE 1:300 M

NOTES
1. PROJECTION: GDA2020 MGA ZONE 56

REFERENCES
1. AERIAL IMAGERY SOURCED FROM METROMAP.COM DATE OF CAPTURE 30 DEC 2025
2. ROAD & CADASTRAL DATA SOURCED FROM NSW GOVERNMENT | COPYRIGHT © SPATIAL SERVICES 2026

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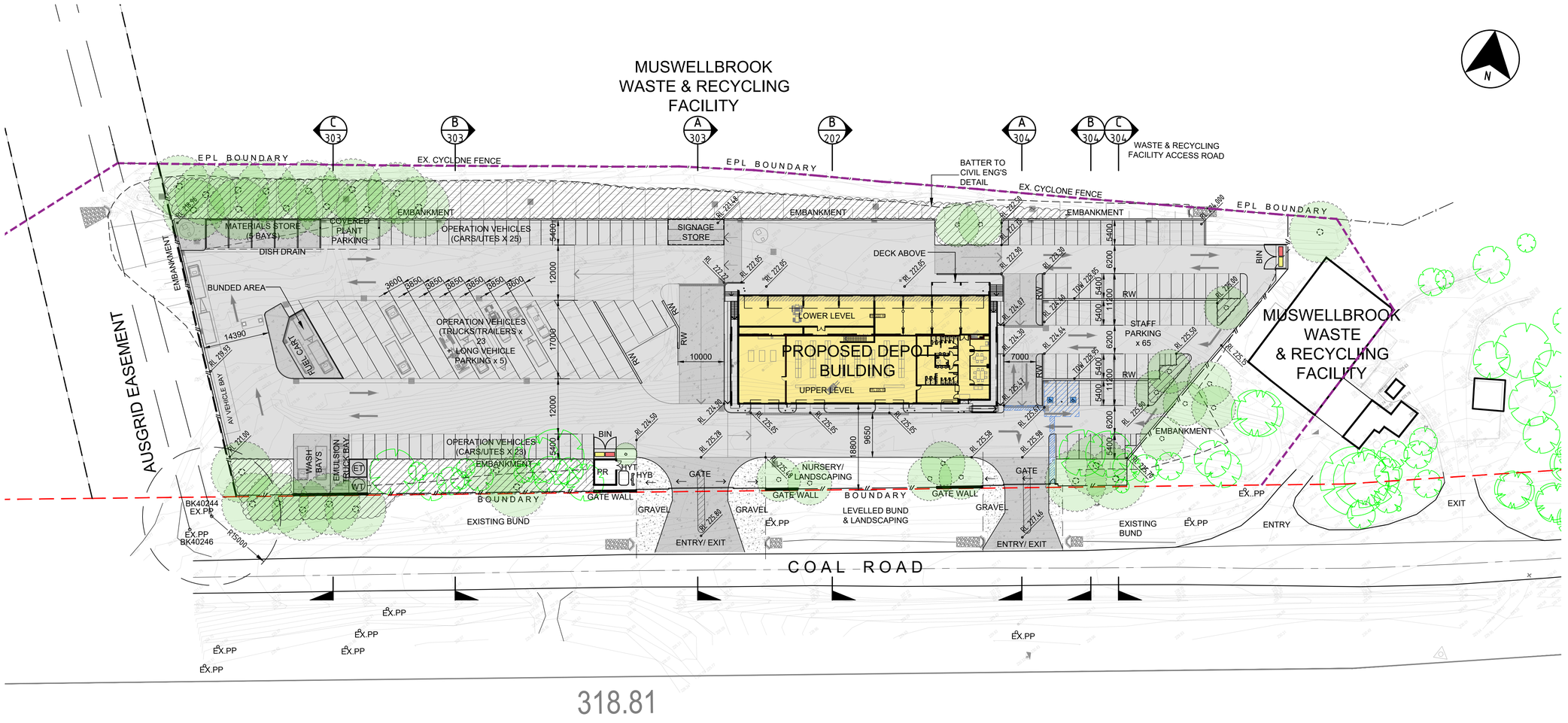
Attachment C: Development Plans



SITE PLAN
SCALE 1:500

SITE AREA:

BUILDING AREA:	1285sqm
PARKING PAVEMENT AREA:	10645sqm
LANDSCAPE AREA:	3905sqm

BCA AREA/VOLUME CALCS

	FLOOR AREA	HEIGHT	VOLUME
UPPER LEVEL			
Workshop/Store	575m2	5.2m	2,990 m3
Admin/Amenities	700m2	2.7m	1,890 m3
LOWER LEVEL			
Garage/Store	460m2	2.7m	1,250 m3
TOTAL	1,735m2		6,130 m3

SITE LEGEND

BDY	BOUNDARY
EX.	EXISTING
ET	EMULSION TANK
GD	GRATED DRAIN
HYB	HYDRANT BOOSTER
HYT	HYDRANT BREAK TANK
KIP	KERB INLET PIT
LP	LIGHT POLE
PP	POWERPOLE
PR	PUMP ROOM
RL	REDUCED LEVEL
RW	RETAINING WALL
SHW	STORMWATER HEADWALL
SWP	STORMWATER PIT
WT	WATER TANK

BOUNDARY
EPL BOUNDARY
FENCE LINE
PROPOSED DEPOT BUILDING
PROPOSED ASPHALTIC CONCRETE CARPARK PAVEMENT
PROPOSED CONCRETE CARPARK PAVEMENT

EX.TREE TO BE RETAINED
PROPOSED TREE - REFER TO LANDSCAPE DWGS
PROPOSED LOW LEVEL PLANTING - REFER TO LANDSCAPE DWGS
RL 123.45 FINISHED LEVEL
SWP

QUALITY CHECK
Drawings Approval for:

Item	Drawn	Project Architect	Director	Date

AMENDMENTS

No.	Description	Drawn	Appd.	Date
1	CONCEPT DESIGN	GC		8.4.24
2	CONCEPT DESIGN	GC		15.4.24
3	DEVELOPED DESIGN	GC		24.4.24
4	DEVELOPED DESIGN	GC	HN	07.05.24
5	DEVELOPED DESIGN	GC		22.05.24
6	DEVELOPED DESIGN	AB		15.10.24
7	DA	AB		25.02.25

Director Approval:

LEGEND

NOTES
Verify all dimensions and levels on site and report any discrepancies prior to the commencement of work.

Drawings are to be read in conjunction with all contract documents.

Use figured dimensions only. Do not scale from drawings.

CCG Architects Pty. Ltd. cannot guarantee the accuracy of content and format for copies of drawings issued electronically.

The completion of the issue details checked and authorised section is confirmation of the status of the drawing. The drawing shall not be used for construction unless endorsed 'For Construction' and authorised for issue.

Nominated Architect: David Cook Registration No: 5086

CCG ARCHITECTS
NOMINATED ARCHITECTS: DAVID COOK (5086) HISHAM NOORI (5678)
ACN 157 777 065

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CONSULTANTS

CLIENT
muswellbrook shire council

PROJECT
PROPOSED COMMUNITY INFRASTRUCTURE DEPOT

252 COAL ROAD,
MUSWELLBROOK NSW 2333

DRAWING
SITE PLAN

PROJECT No.	DWG.No. DA 102
23-149	SCALE: 1:500

CCG Info: Plotted by Contractor Two on Tuesday, 25 February 2025
P:\23-149 MUSWELLBROOK SC, COMMUNITY INFRASTRUCTURE DEPOT\AUTOCAD\DA002_004 MSC DEPOT PROPOSED SITE PLAN.DWG

Attachment D: Calibration Certificates

Air-Met Scientific Pty Ltd
PO Box 133
Nunawading VIC 3131
Australia
Phone: 1800 000 744

CERTIFICATE OF CALIBRATION

This document certifies that the instrument detailed has been calibrated to the parameters listed below

Certificate Number: G505732-R-18-20260304
Calibration Date: 4/03/2026
Next Calibration Due: 4/06/2026

Customer: Air-Met Scientific (National Rental)
Address: 36 Punch Street , , ARTARMON , 2064
Equipment No: EP019976
Unit Under Test: GA5000 Landfill Gas Analyser
Serial No: G505732
Service Order No: CAL19789

Test Results

Item	Test	Pass	Comments

Reference Equipment:

Equipment ID	Description	Expiry Date	Reference Certificate Number
SY769	Hydrogen Sulphide (H2S) 25ppm, Carbon Monoxide (CO) 100ppm, Methane (CH4) 2.5%, Oxygen (O2) 18%, Nitogen (N2) Balance	17/09/2027	11829-9
SY696	Methane (CH4) 60%, Carbon Dioxide (CO2) Balance	28/02/2030	9205149649
SYFRESHAIR	Ambient Air	29/08/2028	SY N/A

Results:

Sensor	Units	Applied Value	Results		Pass/ Fail	Comments
			As Found	As Left		
CO2	%	40	41	40	Pass	
CH4	% LEL	60	63	60	Pass	
CO	ppm	100	101	100	Pass	
H2S	ppm	25	24.6	25	Pass	
O2	%	20.9	21	20.9	Pass	

Notes:

Air-Met Scientific Pty Ltd
PO Box 133
Nunawading VIC 3131
Australia
Phone: 1800 000 744

CERTIFICATE OF CALIBRATION

This document certifies that the instrument detailed has been calibrated to the parameters listed below

Certificate Number: G505732-S-2-20251016
Calibration Date: 15/10/2025
Next Calibration Due: 15/10/2026

Customer: Air-Met Scientific (National Rental)
Address: 65 Moray Street , , SOUTH MELBOURNE , 3205
Equipment No: EP019976
Unit Under Test: GA5000 Landfill Gas Analyser
Serial No: G505732
Service Order No: SVO003295

Reference Equipment:

Equipment ID	Description	Expiry Date	Reference Certificate Number
SA071	20.9% Oxygen, Nitrogen Balance	27/11/2029	220192
SA068	H2S 25ppm, CO 100ppm, Methane 50% LEL, O2 18%, N2 Balance	26/03/2026	220265
SA080	40% Vol Carbon Dioxide, Methane Balance	1/12/2026	BC625619

Results:

Sensor	Units	Applied Value	Results		Pass/ Fail	Comments
			As Found	As Left		
20.9% O2	%	20.9	20.9	20.9	Pass	
CH4	% vol	60	60	60	Pass	
CO2	% vol	40	40	40	Pass	
CO	ppm	100	100	100	Pass	
H2S	ppm	2	25	25	Pass	

Notes:

Calibrated By: GIOVANNI.PAMBUAN

Air-Met Scientific Pty Ltd
PO Box 133
Nunawading VIC 3131
Australia
Phone: 1800 000 744

CERTIFICATE OF CALIBRATION

This document certifies that the instrument detailed has been calibrated to the parameters listed below

Certificate Number: G504209-R-4-20260218
Calibration Date: 18/02/2026
Next Calibration Due: 18/05/2026

Customer: Air-Met Scientific (National Rental)
Address: 36 Punch Street , , ARTARMON , 2064
Equipment No: EP018405
Unit Under Test: GA5000 Measures CH4, CO2, O2 with H2S (0-200ppm) and CO (0-2,000PPM), with Internal Flow
Serial No: G504209
Service Order No: CAL18305

Test Results

Item	Test	Pass	Comments
Reference Equipment:			
Equipment ID	**Description**	**Expiry Date**	**Reference Certificate Number**
SY768	H2S 25 ppm, CO 100 ppm, Methane (50% LEL) 2.5%, O2 18%, N2 balance	17/09/2027	11829
SY665	CCS CH4 60% / CO2	2/01/2030	9205372526

Results:

Sensor	Units	Applied Value	Results		Pass/ Fail	Comments
			As Found	As Left		
CO2	%	40	39.9	40	Pass	
CH4	% LEL	60	60.1	60	Pass	
CO	ppm	100	104	100	Pass	
H2S	ppm	25	25.5	25	Pass	
O2	%	20.9	19	20.9	Pass	

Notes:

Calibrated By: RORY.MCGURK **Signed:** *RORY.MCGURK*

Certified System Quality ISO 9001 SAI GLOBAL

Attachment E: LFG Monitoring Logs

Landfill Gas Bore Monitoring Log

Project Details						Consultant & Equipment	
Job Name:	Muswellbrook Waste Facility LFG			**Job No:**	149603S	**Consultant:**	TJR
Client Name:	Muswellbrook Shire Council			**Client No:**	M0146	**Equipment:**	GA5000
Site Address:	252 Coal Road, Muswellbrook NSW 2333			**Date:**	20.02.2026	**Serial Number:**	G504209
Bore Status				**Weather Conditions:** Observations were drawn from Scone Airport AWS {station 061363} 26 kms from Site			
		Bore Damage:	NO	**Temperature:**	21.5°C (min) - 34.3°C (max)	**Ground Moisture:**	Dry (observed)
Time Start:	11:24	**Bore Secure:**	YES	**Humidity:**	78% (9 AM) - 47% (3 PM)	**Atmospheric Pressure:**	1015.7 (9 AM) - 1011.8 (3 PM)
Time Finish:	13:00	**LFG Cap:**	YES	**Rainfall:**	0 mm	**Clear/Overcast:**	Clear

Bore Readings

Parameter	Time	Peak Gas Flow	Relative Pressure	Barometric Pressure	Methane (CH_4)	Dioxide (CO_2)	Oxygen (O_2)	Hydrogen Sulphide (H_2S)	Carbon Monoxide (CO)	Comments
Unit	**Minutes**	**L/hour**	**mb**	**Pa/mb**	**%v/v**	**%v/v**	**%v/v**	**ppm**	**ppm**	
Location ID: LFGB01										
Bore Readings	1:00:00 PM	0.00	0.09	990.00	0.00	0.20	20.20	1.00	6.00	
Location ID: LFGB02										
Bore Readings	12:01:00 PM	0.00	-0.03	991.00	0.00	0.00	19.10	1.00	6.00	
Location ID: LFGB03										
Bore Readings	12:42:00 PM	0.0	0.0	991.0	0.0	0.0	20.0	1.0	5.0	
Location ID: LFGB04										
Bore Readings	12:17:00 PM	0.0	0.0	991.0	0.0	0.0	20.1	1.0	6.0	

Notes

Gas concentrations stabilised, peak reading reported

Landfill Gas Bore Monitoring Log

Project Details				Consultant & Equipment	
Job Name:	Muswellbrook Waste Facility LFG	**Job No:**	149603S	**Consultant:**	JXL
Client Name:	Muswellbrook Shire Council	**Client No:**	M0146	**Equipment:**	GA5000
Site Address:	252 Coal Road, Muswellbrook NSW 2333	**Date:**	28.02.2026	**Serial Number:**	G506045
Bore Status		**Weather Conditions:** Observations were drawn from Scone Airport AWS {station 061363} 26 kms from Site			
	Bore Damage: NO	**Temperature:** 19.8°C (min) - 29.6°C (max)		**Ground Moisture:**	Dry (observed)
Time Start: 8:31	**Bore Secure:** YES	**Humidity:**	81% (9 AM) - 48% (3 PM)	**Atmospheric Pressure:**	1016.6 (9 AM) - 1013.8 (3 PM)
Time Finish: 8:55	**LFG Cap:** YES	**Rainfall:**	0 mm	**Clear/Overcast:**	Overcast

Bore Readings

Parameter	Time	Peak Gas Flow	Relative Pressure	Barometric Pressure	Methane (CH_4)	Dioxide (CO_2)	Oxygen (O_2)	Hydrogen Sulphide (H_2S)	Carbon Monoxide (CO)	
Unit	**Minutes**	**L/hour**	**mb**	**Pa/mb**	**%v/v**	**%v/v**	**%v/v**	**ppm**	**ppm**	**Comments**
Location ID:	**LFGB01**									
Bore Readings	8:55:00 AM	0.00	-0.03	993.00	0.00	1.50	19.60	0.00	1.00	
Location ID:	**LFGB02**									
Bore Readings	8:36:00 AM	0.10	0.02	992.00	0.00	3.40	18.10	0.00	1.00	
Location ID:	**LFGB03**									
Bore Readings	8:31:00 AM	0.30	-0.02	991.00	0.00	1.80	19.60	0.00	1.00	
Location ID:	**LFGB04**									
Bore Readings	8:46:00 AM	0.40	-0.09	992.00	0.00	0.10	20.70	0.00	0.00	

Notes

Gas concentrations stabilised, peak reading reported

Landfill Gas Bore Monitoring Log

Project Details				Consultant & Equipment	
Job Name:	Muswellbrook Waste Facility LFG	**Job No:**	149603S	**Consultant:**	JXL
Client Name:	Muswellbrook Shire Council	**Client No:**	M0146	**Equipment:**	GA5000
Site Address:	252 Coal Road, Muswellbrook NSW 2333	**Date:**	5/03/2026	**Serial Number:**	G506045

Bore Status				Weather Conditions: Observations were drawn from Scone Airport AWS {station 061363} 26 kms from Site			
		Bore Damage:	NO	**Temperature:**	17.3°C (min) - 36°C (max)	**Ground Moisture:**	Dry (observed)
Time Start:	8:31	**Bore Secure:**	YES	**Humidity:**	91% (9 AM) - 36% (3 PM)	**Atmospheric Pressure:**	1013.4 (9 AM) - 1009.4 (3 PM)
Time Finish:	8:55	**LFG Cap:**	YES	**Rainfall:**	0.4	**Clear/Overcast:**	Clear

Bore Readings

Parameter / Unit	Time / Minutes	Peak Gas Flow / L/hour	Relative Pressure / mb	Barometric Pressure / Pa/mb	Methane (CH_4) / %v/v	Dioxide (CO_2) / %v/v	Oxygen (O_2) / %v/v	Hydrogen Sulphide (H_2S) / ppm	Carbon Monoxide (CO) / ppm	Comments
Location ID: LFGB01										
Bore Readings	7:50:00 AM	0.20	0.07	991.00	0.00	6.80	16.10	1.00	3.00	
Location ID: LFGB02										
Bore Readings	7:31:00 AM	0.10	0.05	990.00	0.00	6.20	16.30	1.00	3.00	
Location ID: LFGB03										
Bore Readings	7:23:00 AM	0.00	0.19	990.00	0.00	5.40	19.60	0.00	3.00	
Location ID: LFGB04										
Bore	7:40:00 AM	0.10	0.07	991.00	0.00	5.70	17.00	1.00	4.00	

Notes

Gas concentrations stabilised, peak reading reported

Attachment F: Enrisks LFGRA (2025)

Landfill Gas Risk Assessment: Muswellbrook Community Infrastructure Depot and Waste Management Facility

Prepared for: Muswellbrook Shire Council

24 January 2025

Document History and Status

Report Reference	M/25/LFGR01
Revision	B - Final
Date	24 January 2025
Previous Revisions	A – Draft issued on 23 January 2025

Limitations

Environmental Risk Sciences Pty Ltd has prepared this report for the use of Muswellbrook Shire Council in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

It is prepared in accordance with the scope of work and for the purpose outlined in the **Section 1** of this report.

The methodology adopted and sources of information used are outlined in this report. Environmental Risk Sciences has made no independent verification of this information beyond the agreed scope of works and assumes no responsibility for any inaccuracies or omissions. No indications were found that information contained in information provided for use in this assessment was false.

This report was prepared in January 2025 and is based on the information provided and reviewed at that time. Environmental Risk Sciences disclaims responsibility for any changes that may have occurred after this time.

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. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Table of Contents

Glossary of terms

ANZECC	Australia and New Zealand Environment and Conservation Council
AT	Averaging time
BCA	Building Code of Australia
bgl	Below ground level
CH_4	Methane
CO_2	Carbon dioxide
CSM	Conceptual site model
EPA	Environment Protection Authority
HHRA	Human Health Risk Assessment
LFG	Landfill gas
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW	New South Wales
NSW DECC	New South Wales Department of Environment and Climate Change
USEPA	United States Environmental Protection Agency
WHO	World Health Organization

Section 1. Introduction

1.1 Background

Environmental Risk Sciences Pty Ltd (enRiskS) has been engaged by Muswellbrook Shire Council to conduct a risk assessment in relation to the presence of ground gas, specifically methane that may be present beneath the proposed construction and operation of a community recycling centre at the Muswellbrook landfill located on Coal Road in Muswellbrook, NSW ("the site") (refer to **Figure 1**).

The proposed development relates to the construction of a new building on the southern side of the landfill. The new building includes:

- a lower ground floor that comprises a store and parking/storage for lawnmowers and tractors
- an upper ground floor that comprises administration, internal storage and workshop, kitchen and amenities.

Other areas of the proposed development include parking, barbeque (BBQ) and landscape areas.

The Muswellbrook landfill has commenced receiving waste with current operations in the eastern part of the larger landfill site. These operations are further from the proposed building. However, as landfill activities continue the waste fill will extend to the west and is expected to result in waste disposal adjacent to the northern side of the building.

Planning requirements for the construction of the proposed building include a risk screening assessment and hazard analysis. It is understood that a HAZOP assessment is not required, however an assessment of risks posed by the potential presence of hazardous ground gases from the landfill is required.

1.2 Objectives

The objectives of the risk assessment presented in this report are to:

- review the available methane data and undertake a screening level assessment of potential risks to the proposed building, assuming landfilling activities extend further west and close to the proposed building
- identify risk mitigation measures that need to be incorporated into the proposed building to ensure that methane hazards are managed/prevented for the life of the building.

The risk assessment has addressed risks from the potential presence of methane, relevant to the proposed development. The assessment has not addressed off-site risks in relation to the operation of the landfill, or any ecological risks.

Figure 1: Location of Muswellbrook landfill

1.3 Methodology

The methodology adopted for the conduct of this risk assessment will be in accordance with the relevant National protocols/ guidelines including:

- enHealth, Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth 2012a)
- enHealth, Australian Exposure Factor Guide (enHealth 2012b)
- NSW EPA guidance on the assessment of ground gases (NSW EPA 2020)
- UK Guidance on the management of landfill gas (UK Environment Agency 2004)
- EPA Publication 788.3 (EPA Victoria 2015), Landfill BPEM Siting, design, operation and rehabilitation of landfill.

In addition, protocols and guidelines developed by international agencies such as the United States Environmental Protection Authority (USEPA) and the World Health Organisation (WHO) have been used (and referenced) to provide supplementary guidance where required.

Following this guidance, the assessment has been undertaken to include the following:

- review of the available information with the aim of developing an appropriate conceptual site model (**Section 2**)
- further assessment of potential landfill gas risks, including Level 1 risk assessment (**Section 3**)
- mitigation measures recommended for the proposed development (**Section 4**)
- summary and conclusions of the assessment (**Section 5**).

Section 2. Site description and conceptual site model

2.1 General

This section provides a summary of information relevant to the assessment of LFG at the site. This information has been summarised from the following reports:

- Northrop 2024, General arrangement plans for proposed building.
- Collins and Turner 2023, MSC Depot, Community Recycling Centre, Coal Road Muswellbrook Shire Council, Concept Design, June 2023.
- Qualtest 2022a, Proposed Community Infrastructure Depot – Geotechnical Assessment, Low 1 DP819014, No 252 Coal Road, Muswellbrook. Report dated 29 June 2022.
- Qualtest 2022b, Preliminary & Detailed Contamination Assessment, 252 Coal Road Muswellbrook. Report dated 12 July 2022.
- GHD 2017, Muswellbrook WRF Filling Plan, Stage 1 – Landfill Works and Typical Fill Detail.
- Muswellbrook Shire Council 2019, Environmental Management Plan, Muswellbrook Waste & Recycling Facility. Dated June 2019.
- Field sheets and laboratory reports relevant to gas monitoring and groundwater monitoring works completed on the landfill site on 31 May 2021, 31 August 2021, 23 December 2021, 22 February 2022, 30 August 2023, 15 May 2024.

2.2 Site location and history

The Muswellbrook Waste & Recycling Facility (WRF) is located on Lot 1 DP 819014, which is approximately 3 km to the east of Muswellbrook central business district (CBD). The facility comprises a weighbridge and staff amenities buildings, a sawtooth transfer station for waste and recycling drop offs, landfill and hardstand recycling area and Community Recycling Centre for household problem wastes. The landfill is owned and operated by Muswellbrook Shire Council and operates under Environment Protection Licence EPL 5980.

Table 1 provides a summary of the land uses surrounding the site.

Table 1: Land use for off-site areas

Direction from site	Land use and existing uses
North	Rural land comprising open space/bushland including former quarry/mine
East	Muswellbrook WRF with Coal Co Ltd further east comprising an open cut mine and rehabilitated land
South	Coal Road with rural land comprising open space/bushland with industrial premises located to the southwest
West	Rural land comprising open space and bushland, including Weeraman Fields with the urban areas of Muswellbrook located approximately 900 m to the west of the facility.

The WRF was previously part of Muswellbrook Common. In 1990 the extraction of 200,000 tonnes of coal was approved. At that time the WRF had been extensively reshapped as a consequence of mining activities in the area. The western portion had been covered with overburden and the foundations of a coal crushing and processing plant was located in the northern portion. The extraction of coal from an open cut pit occurred between 1990 and 1993. Following extraction of coal, the site was transformed into a landfill which has been operational since 1993 (Muswellbrook

Shire Council 2019). The landfill receives domestic, commercial and industrial waste and recycling materials from the Muswellbrook community, local mine site and Upper Hunter Region (Qualtest 2022b).

Figure 2 shows the current layout and location of infrastructure at the site.

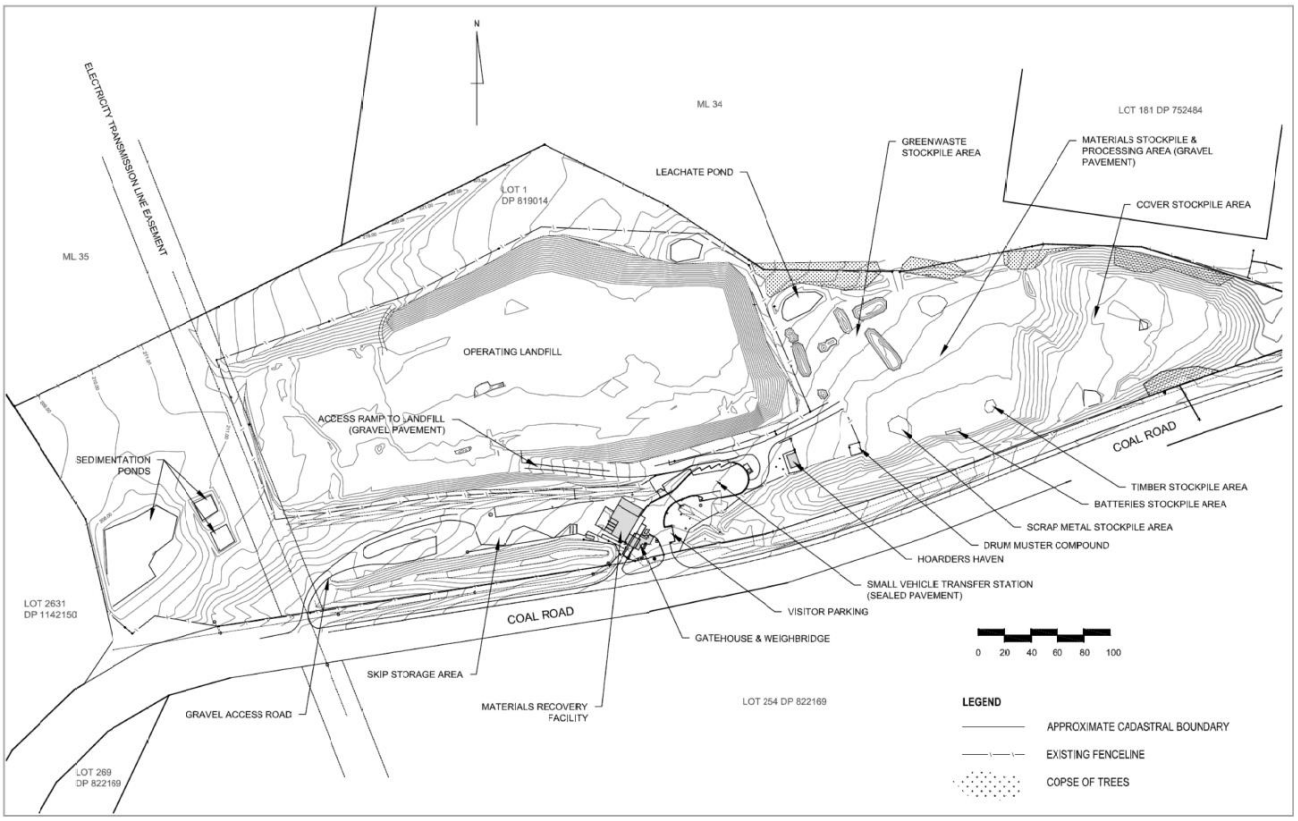


Figure 2: Current layout of the landfill (source: Muswellbrook Shire Council 2019)

2.3 Geology and hydrogeology

Qualatest (2022a) indicates that regionally the site is underlain by the Rowan Formation of the Greta Coal Measures, characterised by coal seams, sandstone and siltstone rock types.

Geotechnical investigations conducted on the site identified the presence of:

- fill-topsoil, described as sandy clay
- fill described as sandy gravel, silty sandy gravel, silty sand and gravelly clay
- topsoil and slopewash materials comprising gravelly silty sand
- residual soil comprising clay, silty clay and sandy gravel
- extremely weathered rock namely siltstone and sandy siltstone
- moderately weathered to highly weathered rock as siltstone.

Groundwater beneath the site is anticipated to be present in a semi-confined aquifer in residual soils and weathered rock at depths greater than 15m below ground surface (bgs). Groundwater flow direction is anticipated to follow the surface topography and flow west towards an unnamed creek located approximately 300 m west of the site and eventually discharging into the Hunter River located approximately 2.2 km west of the site (Qualtest 2022b).

Use of groundwater is not proposed as part of the development.

2.4 Landfill design and operation

The solid waste landfill is currently being operated within a void created by the extraction of coal prior to the development of the WRF.

Prior to the commencement of the landfilling operations the base of the void was lined with a 1 m thick layer of clay material. The walls of the void have been progressively lined with a 2 m thick layer of clay material as the level of waste rose (Muswellbrook Shire Council 2019).

Leachate generated in the landfill percolates down through the landfill to the top of the landfill liner. The leachate then flows to the lowest point in the base of the landfill where a gravel sump and extraction riser has been installed. A windmill was installed in 2012 to service the extraction riser with the leachate being pumped into an evaporation pond located within the landfill void (Muswellbrook Shire Council 2019).

Material placed in the landfill is compacted and covered in accordance with the Licence for the site. The landfill is developing in 3 stages, with each stage being intermediately capped. Each stage will be final capped upon reaching its design levels. Once landfilling is complete in each stage, rehabilitation may be progressed sequentially (Muswellbrook Shire Council 2019).

The capping comprises (Muswellbrook Shire Council 2019):

- 0.3 m gas drainage layer
- 0.5 m clay sealing layer
- 0.3 m drainage layer
- 1.0 m revegetation layer.

The base of the landfill cell lies approximately 15 m above the current groundwater elevation within siltstone and sandstone strata of generally low permeability. Given the separation distance and the occurrence of groundwater within fractured rock, the risk of leachate impact to groundwater beneath the site is considered to be low (Muswellbrook Shire Council 2019).

2.5 Proposed development

The proposed development involves the construction of a new building on the site, to be used as the Community Recycling Centre. The development comprises a number of outdoor/open parking areas, barbeque (BBQ) areas and bays, and a new building located in the southern central part of the site (refer to **Appendix A** for relevant plans). The building is located approximately 30 m to the south of the edge of the landfill (refer to **Figure 3**).

The building is proposed to be constructed with two levels to fit in with the existing topography at the location and comprises the following:

- Lower ground floor constructed on a slab with a store and spaces to store mowers and tractors. The rear of the area comprises a retaining wall (blockwork)
- Upper ground level comprising:
    - administration and kitchen areas above the lower ground floor with slab thickness ranging from 180 to 400 mm
    - internal store and workshop (including loading and unloading doors), as well as meeting rooms and amenities with:
        - a slab with thickness 150 mm for the workshop and store areas

- suspended slab with adjacent raft slab in the eastern portion of the area
  - deck on the northern side of the site.

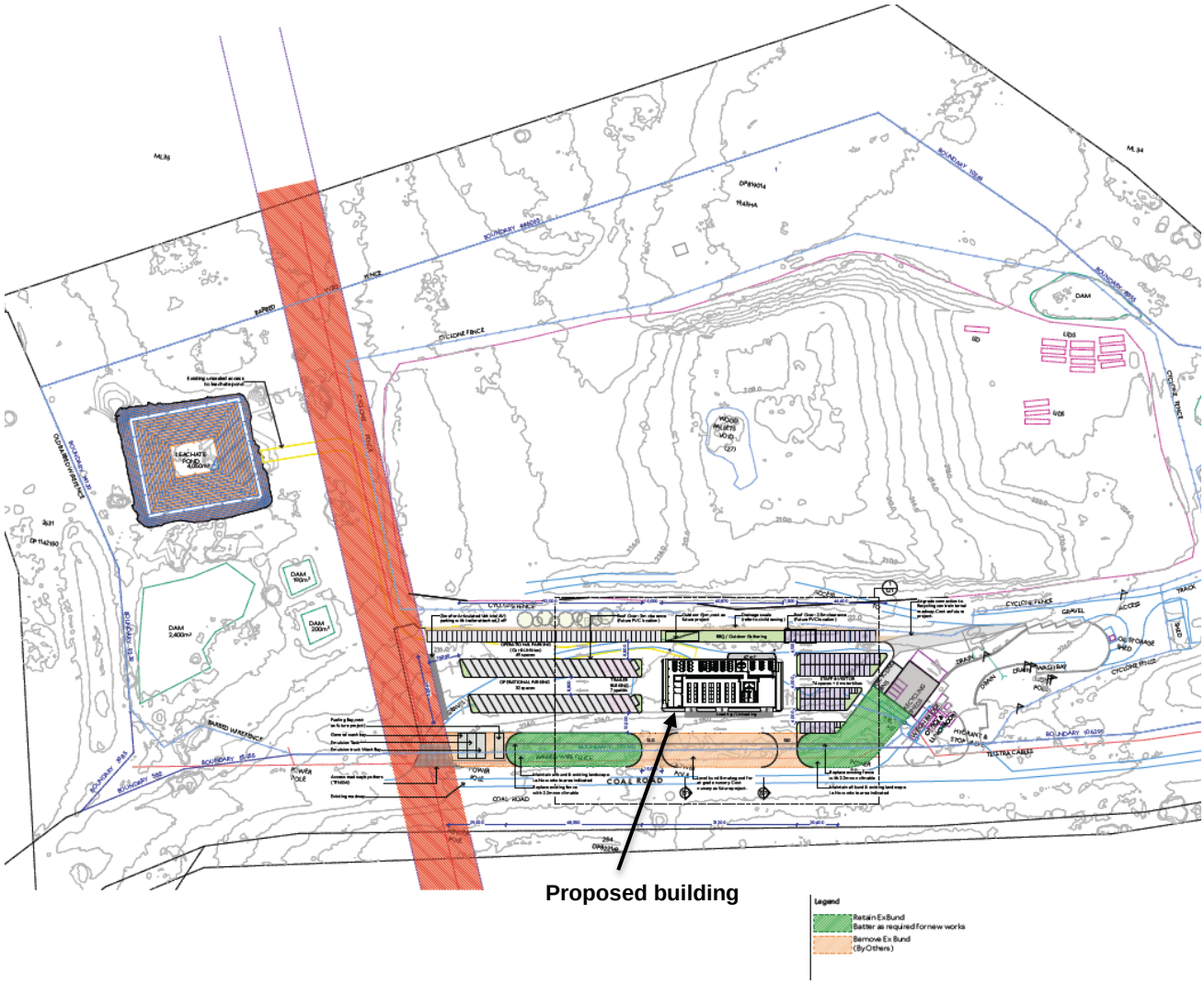


Figure 3: Proposed development (including location of proposed building)

2.6 Potential for exposure

The focus of this assessment relates to the presence of ground gas, specifically methane, in the subsurface in the area where the building is proposed to be constructed. Methane has the potential to pose an explosive and asphyxiant risk and has the potential to migrate into the building via gaps and cracks and service penetrations and accumulate in enclosed spaces such as the proposed building.

The building is not proposed to be constructed above land used or proposed to be used for filling/landfilling. The source of ground gas is expected to be the placement of fill on the site, noting the site is to be progressively filled over the life of the landfill. The lateral migration of methane from the landfill cells in the subsurface to the area of the building is the key mechanism of concern in relation to the proposed building.

Given the depth to groundwater beneath the landfill cells, groundwater is not considered to be a migration pathway for methane away from the landfill.

The presence of methane is of potential concern to future occupants of the building (workers and the general public).

The current design plans for the building on the site do not include any gas mitigation measures.

2.7 Review of methane data

The EPL does not include any requirement to monitor landfill gas, as subsurface gas or surface gas emissions.

Methane gas emissions from the landfill have been monitored since June 2004 (Muswellbrook Shire Council 2019). The sampling undertaken involves surface sampling of gas from four locations (refer to **Figure 4**):

- Old section
- Leachate well
- Elevated area
- Near MP2.

These locations are within the landfilling area on the WRF.

One sampling event, conducted on 31 May 2021 also included the collection of surface samples from four additional locations, adjacent to groundwater monitoring wells MP1, MP3, MP4 and MP6.

The samples were collected as grab samples using evacuated canisters with analysis for methane by ALS.

Low concentrations of methane have been reported at the sample locations. The EMP provides information on methane levels reported in 2018 and 2019, and data for monitoring conducted on 31 May 2021, 31 August 2021, 23 December 2021, 22 February 2022, 30 August 2023 and 15 May 2024 has also been provided for consideration in this assessment.

Table 1 presents a summary of the methane data for the period 2018 to 2024, as reported from the sampling locations on the landfill.

The NSW EPA (NSW EPA 2020) indicates that a threshold level for further investigation in relation to the presence of methane in surface emissions is 500 ppm v/v at any location. A methane level of 500 ppm v/v is equal to 330 mg/m^3 or 0.05%. Table 1 includes comparison of the reported methane levels against this guideline.

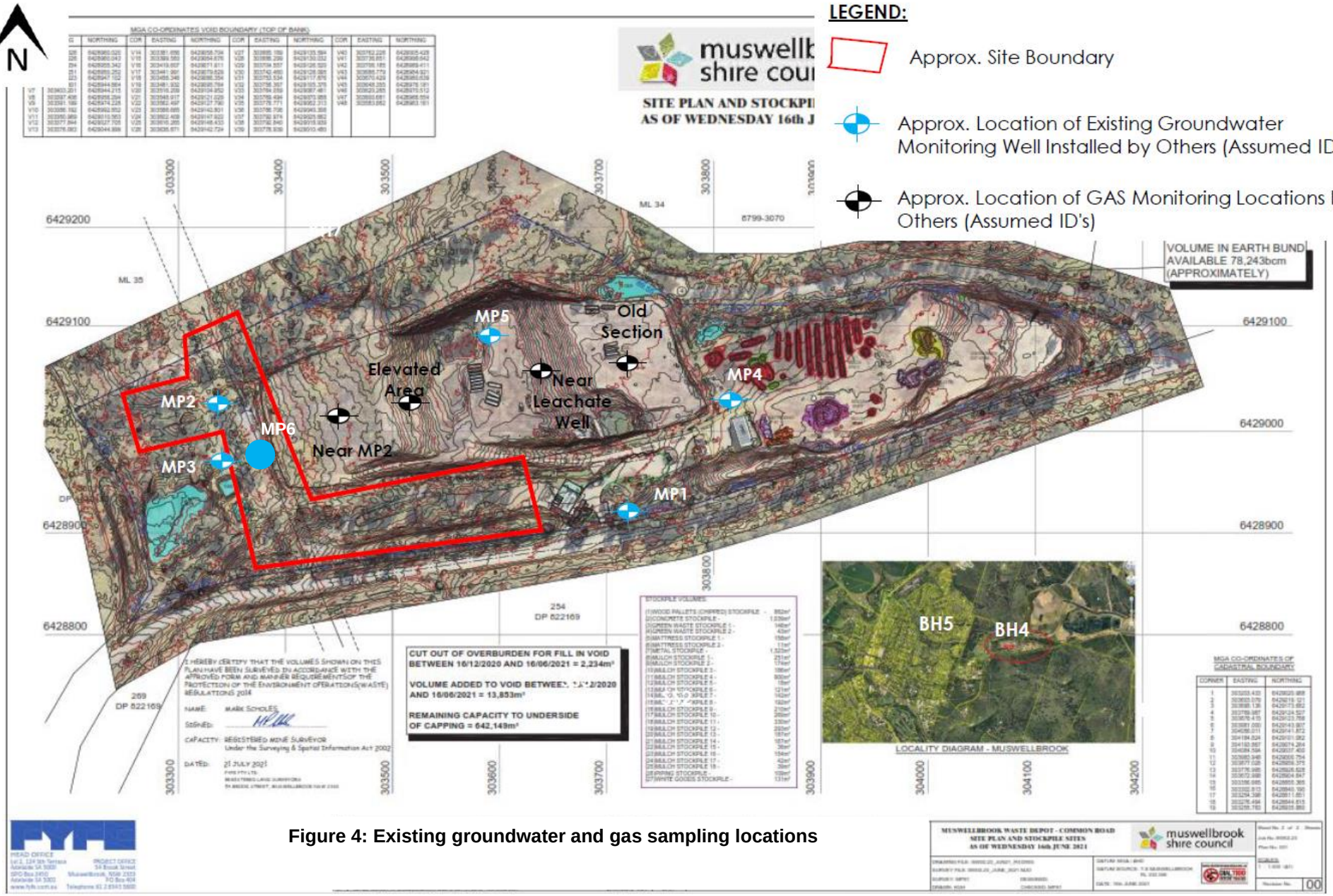


Figure 4: Existing groundwater and gas sampling locations

Client:	MUSWELLBROOK SHIRE COUNCIL	Drawing No:	
Project:	PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT	Project No:	NEW22P-0092-AA
Location:	252 COAL ROAD, MUSWELLBROOK	Scale:	N.T.S.
Title:	EXISTING GROUNDWATER AND GAS SAMPLE LOCATION PLAN (ASSUMED IDs)	Date:	2/06/2022

Qualtest LABORATORY (NSW) PTY LTD

Table 1: Summary and review of methane reported from surface monitoring on landfill

Monitoring date	Methane concentration reported from each location							
	Old section		Leachate well		Elevated area		Near MP2	
	(mg/m^3)	%	(mg/m^3)	%	(mg/m^3)	%	(mg/m^3)	%
May 2018	1.24	0.00019	2.24	0.00034	2.74	0.00042	2.2	0.00033
August 2018	3.01	0.00046	1.2	0.00019	2.12	0.00032	0.9	0.00014
November 2018	2.21	0.00034	1.65	0.00025	1.79	0.00027	0.98	0.00015
February 2019	1.19	0.00018	2.77	0.00042	1.99	0.00030	1.32	0.00020
May 2019	2.01	0.00031	1.95	0.00030	3.16	0.00048	0.87	0.00013
31 May 2021	<4.95	<0.0008	<4.95	<0.0008	<4.95	<0.0008	<4.95	<0.0008
31 August 2021	<4.95	<0.0008	<4.95	<0.0008	<4.95	<0.0008	<4.95	<0.0008
23 November 2021	<4.95	<0.0008	NA	NA	<4.95	<0.0008	<4.95	<0.0008
22 February 2022	480	0.0734	11.1	0.0017	<4.95	<0.0008	<4.95	<0.0008
30 August 2023	<6.6	<0.001	<6.6	<0.001	10	0.0015	<6.6	<0.001
15 May 2024	<4.95	<0.0008	NA	NA	<4.95	<0.0008	<4.95	<0.0008
20 June 2024	NA	NA	4.99	0.0008	NA	NA	NA	NA

Monitoring date	MP1		MP3		MP4		MP6	
	(mg/m^3)	%	(mg/m^3)	%	(mg/m^3)	%	(mg/m^3)	%
31 May 2021	<4.95	<0.0008	161,000	24.6	141	0.0216	<4.95	<0.0008
NSW EPA (2020) threshold	**330**	**0.05**	**330**	**0.05**	**330**	**0.05**	**330**	**0.05**

Notes:

Shaded cells are methane concentrations that exceed the adopted NSW EPA (2020) threshold for methane in surface emissions.

Review of **Table 1** indicates the following:

- methane was reported at levels less than 0.05% all most monitoring events conducted at the four regular sampling locations (old section, leachate well, elevated area and near MP2). One exceedance was reported on 22 February 2022 at the old section location which is in the eastern portion of the landfill
- methane was sampled from four other locations on one occasion only, with data reported from locations near MP1, MP4 and MP6 also below 0.05%, noting the concentration of methane at MP4 of 141 mg/m^3 exceeded the NSW EPA guideline where the guideline is converted to mg/m^3 at standard temperature and pressure
- methane data from a location near MP3 located on the western side of the landfill was elevated at 24.6%. This methane level is significantly elevated above the NSW EPA threshold of 0.05%. Data from locations close to MP3, namely MP6 and MP2 were significantly lower suggesting the reading at MP3 was localised.

The available data supports that for most of the time methane levels on the surface of the landfill are low, however there are times when surface level of methane increase, with some locations potentially increasing to a level significantly higher than the NSW threshold. It is likely that the elevated readings occur during falling atmospheric pressure or at locations (potentially MP3) where there may be a preferential pathway for the migration of methane from the subsurface.

In relation to active landfills that accept municipal waste as putrescible and non-putrescible waste, NSW EPA (NSW EPA 2020) indicates that for these types of landfills methane levels in ground gas (i.e. subsurface) are expected to be in the range 20% to 65% as a result of microbial degradation of organic matter.

It is also noted that methane can also be present as a result of the presence of coal washery reject (potentially in the range 0 to 20%) and gas migration from coal seams (with methane levels in coal measures and coal seam gas reported between <1% to 95%). Given the extraction of coal from the site (former extraction) and adjacent areas the presence of methane derived from coal and former coal materials may also occur.

No data is available on subsurface levels of methane at or close to the landfill. In addition, no data is available on subsurface gas pressures or gas flows (as a result of gas being generated under pressure). NSW EPA (2020) indicates that for active and recently closed landfills can produce gas that is under significant pressure – typically 0.3 to 3 kPa. When a landfill is capped, lateral migration is likely to occur unless the pressure is controlled by gas extraction (for power generation or flared) or venting by other means. The WRF does not include any gas extraction from closed cells. The capping design includes a gas venting layer, which may limit the lateral migration of gases from the waste materials, however the gases may migrate laterally from the venting layer.

Gas production from a landfill is expected to occur over a significant period of time (at least 30 years), particularly following the creation of anaerobic conditions where waste is buried and capped.

Where an active gas source is present (such as a landfill), migration and intrusion of bulk ground gases into buildings is generally advective (pressure-driven). Ground gas intrusion pathways into buildings are highly dependent on building design and condition. For slab-on-ground construction, cracks, service penetrations and poorly filled construction joints provide the most likely pathways. Cavity wall vents may also allow ingress, particularly where convective currents occur due to a stack effect. Preferential pathways formed by piles, service ducts and trenches, lift shafts, sumps and drains are frequently present (NSW EPA 2020).

Further assessment of potential risks derived from methane, in relation to the proposed development, specifically the proposed building, is presented in **Section 3**.

Section 3. Further assessment: Landfill gas

3.1 General

Based on the review undertaken and presented in **Section 2**, the available data suggests that there is the potential for methane levels at or close to the landfill to be elevated, at times.

In relation to assessment of risk, NSW guidance provides for the conduct of a qualitative assessment (Level 1) or a quantitative assessment (Levels 2 and 3). Insufficient data is available to undertake a quantitative ground gas screening or detailed assessment, hence a qualitative assessment has been undertaken.

3.2 Level 1 risk assessment

A Level 1 assessment involves a qualitative assessment of potential risk based on a ranking of hazards/consequences and likelihood. The Level 1 assessment has been undertaken in accordance with NSW EPA guidance (2020).

For the proposed development, the likely sources of methane have been identified and the key pathway by which methane gas may migrate to and impact on the proposed building is via advection or pressure driven gas migration from the landfill, and potentially from coal measures/seams present in the area of the landfill.

The hazard of concern for this assessment is methane.

Consequences

In relation to assessing the potential consequences associated with the potential presence of methane in the area where the building is proposed to be constructed, the following has been considered:

- Methane hazards relate to the potential for explosive conditions to occur and the displacement of oxygen resulting in an asphyxiant risk. High levels of methane can decrease the level of oxygen in air which causes suffocation with symptoms of headache, dizziness, weakness, nausea, vomiting, loss of coordination and judgment, increased breathing rate and loss of consciousness. Workplace exposure protection (i.e. the use of a respirator) is required for methane levels above 1,000 ppm or 0.1%. Such conditions were reported during one sampling event (Table 1) with another sampling event reporting methane levels close to 0.1%.
- For the proposed building the lower ground level comprises a store room and storage of mowers and tractors. It is likely that these areas will have larger openings for doors that can fully open to allow for equipment to move in and out of the building. When left open the ventilation rate would be higher and may minimise the potential for methane to accumulate in this part of the building.
- The equipment in the lower ground level of the building includes those that would generate a spark, which has the potential to result in an explosion should methane accumulate in the area. These conditions may occur (for example) overnight when the building is closed, and if conditions are conducive to the movement of methane into the building. The explosive range for methane in air is 5% to 15% (NSW EPA 2020). Such conditions may occur noting that one reading of methane at the surface of the landfill was 24%.

- The upper ground level comprises a range of areas with larger bifold doors on the southern side for loading and unloading of materials. When these doors are open the ventilation rate into this part of the building would be higher and may assist in minimising the accumulation of methane.

Based on the above and the consequence categories defined by NSW EPA (2020) the consequences associated with the potential accumulation of methane in the proposed building is considered to be medium, based on the potential for explosive conditions that may result in major damage to structures and injury to people (where present), and the potential for asphyxiant conditions to occur.

The consequence categories and the category selected as relevant to this assessment are shown in **Table 2**.

Table 2: Classification of consequences – with selection relevant to the proposed building identified (source NSW EPA 2020)

Classification	Definition	Examples
Severe	Fatalities, including multiple fatalities Very serious injuries Catastrophic damage to buildings	Explosion causing building collapse
Medium	Long-term damage to human health Serious injuries Major damage to structures	Permanent injuries Structural damage requiring major repair or demolition and rebuild
Mild	More significant non-permanent injuries Significant damage to buildings, structures or services	Fractures, burns, gas inhalation or other injuries requiring medical treatment Severe cracking requiring closure of buildings and urgent repair
Minor	Minor non-permanent health effects Harm that may result in financial loss, business disruption or reputational damage Minor property damage	Minor cuts or bruises requiring first-aid treatment Cosmetic damage to buildings or pavement Damage to landscaping Minor damage to vehicles

Likelihood

The assessment of likelihood relates to the probability of an incident occurring that results in adverse consequences. For this site there is limited data available, however the following has been considered:

- the proposed building is located approximately 30 m from the southern boundary of the landfill
- the landfill has been operating since 1993, and remains an active landfill with cells continuing to receive waste that includes putrescible and non-putrescible materials that include a high organic content
- the landfill does not include ground gas extraction and there are no other design measures that would prevent all lateral migration of gases from the landfill
- methane would be expected to biodegrade in the subsurface where oxygen is present, however where significant pressure driven gas migration occurs, the reduction in methane levels from the landfill to the building is not known
- the available data suggests that there may be times where peak methane levels occur at the surface, and then assumed to occur in the subsurface.

Based on the above a likelihood for methane to migrate from the landfill to the proposed building is considered to be likely based on the definitions provided by the NSW EPA. The likelihood categories and the category selected as relevant to this assessment are shown in **Table 3**.

Table 3: Classification of likelihoods – with selection relevant to the proposed building identified (source NSW EPA 2020)

Classification	Definition
High likelihood	A credible linkage exists, and a trigger hazardous event is very likely to occur in the short term and is almost inevitable over the full timeframe of concern (typically the effective life of a building or development). The likelihood of the stated consequence is also high.
Likely	A credible linkage exists, and all necessary elements required for a trigger hazardous event to occur are present. Occurrence is not inevitable, but it is possible in the short term, and probable over the full timeframe of concern. The stated consequence is likely.
Low likelihood	A credible linkage exists and circumstances under which a trigger hazardous event could occur are possible. However, it is by no means certain that the event will occur within the timeframe of concern, and it is less likely in the short term. Therefore, there is a low likelihood that the stated consequence will occur.
Unlikely	A credible linkage exists but circumstances are such that it is improbable that a trigger hazardous event would occur within the timeframe of concern. Therefore, it is unlikely that the stated consequence will occur.

Risk assessment

Based on the consequence and likelihood classifications identified for the proposed development the level of risk is classified as moderate, based on the risk matrix defined by NSW EPA (2020). The risk matrix and risk level identified for the proposed building are shown in **Table 4**.

Table 4: Qualitative risk assessment matrix (source NSW EPA 2020)

		Consequence			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high risk	High risk	Moderate risk	Moderate/low risk
	Likely	High risk	Moderate risk	Moderate/ low risk	Low risk
	Low likelihood	Moderate risk	Moderate/ low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

The identification of a moderate risk in a Level 1 assessment would trigger the requirement for further investigation and assessment or the implementation of mitigation measures for the propose development.

For this assessment, mitigation measures have been identified and recommended in **Section 4** as it is challenging to collect sufficient data that defines the risk for the proposed building over the life of the landfill.

Section 4. Gas mitigation

The Level 1 screening assessment presented in **Section 3** identified a potential moderate risk ranking for the building proposed to be constructed on the WRF. A moderate risk ranking requires the incorporation of gas mitigation measures in the building design to act as a break or a barrier to the migration of methane into the building, for the life of the building.

A moderate risk ranking is equivalent to a risk characteristic situation 3 (CS 3) (NSW EPA 2020). For both a commercial and an industrial building mitigating a moderate risk as CS3 requires a gas protection value of 2, as per NSW guidance (NSW EPA 2020) as shown in Table 5.

Table 5: Gas protection values relevant to buildings, based on risk ranking (source NSW EPA 2020)

CS	Required gas protection value				
	Low-density residential	Medium-to high-density residential (strata title)	Public buildings, schools, hospitals and shopping centres	Standard commercial buildings (offices, etc.)	Large commercial (warehousing) and industrial buildings
1	0	0	0	0	0
2	3	3	3	2	1[a]
3	4	3	3	2	2
4	6[b]	5[b]	5	4	3
5	-[b]	6[b]	6[c]	5	4
6	-[d]	-[d]	6[c]	6	6

Notes:
Shaded cells are the risk levels relevant to this site – and proposed development
(a) If maximum measured methane concentration exceeds 20% v/v, increase to CS 3.
(b) Residential development is not recommended at CS 4 and above without pathway intervention (for example, source depressurisation or control of lateral migration) external to the buildings and a high level of management. These requirements necessarily preclude low-density residential (NEPM HIL A residential) development.
(c) Evacuation issues and social risks must be considered.
(d) Level 3 risk assessment is required.

Mitigation systems for the proposed building that meet the required level of protection are as follows:

- Reinforced concrete ground-bearing slab or waffle pod slab (protection value of 0.5) or reinforced concrete ground-bearing raft slab with limited service penetrations **AND** installation of a passive sub-slab ventilation system (protection value of 1.5 to 2.5 depending on the performance of the ventilation system). The passive sub-slab ventilation system would act as a break, venting any methane gas prior to methane reaching the building slab.

  OR

- Installation of a suitable gas-resistant membrane (protection value of 2). Such a membrane needs to be suitable for the management of methane gas and be installed by a specialist with documented quality control and testing that the membrane does not leak (including around service penetrations). The membrane would need to be placed beneath all slabs and walls of the lower ground level in direct contact with the ground. A gas membrane acts as a barrier to minimise the migration of gas into the building.

The above mitigation systems would need to be designed prior to the construction of the building. It is recommended that a specialist is engaged to design and install the passive venting system or membrane to ensure that the system achieves the required level of gas protection.

Following the installation of the gas mitigation system and completion of the building, methane levels within the building, in particularly within the lower ground floor should be monitored for methane during conditions of falling atmospheric pressure. In addition, the monitoring of methane within he building should be conducted on a regular basis, at the same time as the sampling of surface emissions data from the landfill. The monitoring of methane in the building can be undertaken using a LFG meter (where methane, carbon dioxide and oxygen can be reported) or a methane-specific meter.

It is recommended that a methane level of 5000 ppm (EPA Victoria 2015) be adopted for the building as a trigger for further assessment of methane risks. This threshold is below the NSW EPA trigger for enclosed spaces of 1% for relocation, and well below the lower explosive limit (LEL) for methane of 5%.

A mechanical ventilation system has not been considered to be an appropriate mitigation measure for the building as the risk being evaluated is an acute or short-term risk and the failure of a ventilation system has the potential to result in increased or unacceptable acute risks occurring prior to knowledge about the operation of the failure of the ventilation system or prior to repair of such a system.

Section 5. Summary and conclusions

This report presents a risk assessment in relation to the presence of ground gas, specifically methane that may be present beneath the proposed construction and operation of a community recycling centre at the Muswellbrook landfill.

In relation to the proposed development, the key issue of concern relates to the potential migration of methane from the landfill to the proposed building, and accumulation of methane within the building to levels that may pose an explosive or asphyxiant hazard.

The proposed development relates to the construction of a new building on the southern side of the landfill. The new building includes:

- a lower ground floor that comprises a store and parking/storage for lawnmowers and tractors
- an upper ground floor that comprises administration, internal storage and workshop, kitchen and amenities.

The landfill has been operating since 1993 and remains operational receiving putrescible and non-putrescible waste that comprises organic matter. The former and current areas of the landfill have the potential to generate methane as a result of microbial biodegradation of organic matter. The data that is available in relation to levels of methane at the site generally indicates the presence of low levels of methane in surface emissions. The data, however, has identified that there is the potential for higher levels of methane to be present in surface emissions. Where conditions occur that result in higher levels of methane in surface emissions, it is expected that these would also result in the potential for higher levels of methane in the subsurface, and the lateral migration of methane from the landfill.

Based on information available in relation to the levels of methane reported, the potential consequences associated with the accumulation of methane in the proposed building and the likelihood or probability that such accumulation may occur, a Level 1 risk assessment concluded that the level of risk should be classified as moderate.

Where a moderate risk is identified additional data and assessment may be undertaken to better define the risk, or risk mitigation measures implemented and incorporated into the building design to minimise or prevent methane from entering the building. As it is considered complex to collect appropriate data to undertaken a more refined assessment of risk (due to the operational nature of the landfill), risk mitigation measures are recommended for the building.

<u>Recommended risk mitigation measures</u>

Mitigation systems recommended for the proposed building that meet the required level of protection are as follows:

- Reinforced concrete ground-bearing slab or waffle pod slab (protection value of 0.5) or reinforced concrete ground-bearing raft slab with limited service penetrations **AND** installation of a passive sub-slab ventilation system (protection value of 1.5 to 2.5 depending on the performance of the ventilation system). The passive sub-slab ventilation system would act as a break, venting any methane gas prior to methane reaching the building slab.

  OR

- Installation of a suitable gas-resistant membrane (protection value of 2). Such a membrane needs to be suitable for the management of methane gas and be installed by a specialist with documented quality control and testing that the membrane does not leak (including around service penetrations). The membrane would need to be placed beneath all slabs and walls of the lower ground level in direct contact with the ground. A gas membrane acts as a barrier to minimise the migration of gas into the building.

The above mitigation systems would need to be designed prior to the construction of the building. It is recommended that a specialist is engaged to design and install the passive venting system or membrane to ensure that the system achieves the required level of gas protection.

Following the installation of the gas mitigation system and completion of the building, methane levels within the building, in particularly within the lower ground floor should be monitored for methane during conditions of falling atmospheric pressure. In addition, the monitoring of methane within he building should be conducted on a regular basis, at the same time as the sampling of surface emissions data from the landfill. The monitoring of methane in the building can be undertaken using a LFG meter (where methane, carbon dioxide and oxygen can be reported) or a methane-specific meter.

It is recommended that a methane level of 5000 ppm (EPA Victoria 2015) be adopted for the building as a trigger for further assessment of methane risks. This threshold is below the NSW EPA trigger for enclosed spaces of 1% for relocation, and well below the lower explosive limit (LEL) for methane of 5%.

Section 6. References

enHealth 2012a, *Environmental Health Risk Assessment, Guidelines for assessing human health risks from environmental hazards*, Commonwealth of Australia, Canberra. <https://www1.health.gov.au/internet/main/publishing.nsf/Content/A12B57E41EC9F326CA257BF0001F9E7D/$File/Environmental-health-Risk-Assessment.pdf>.

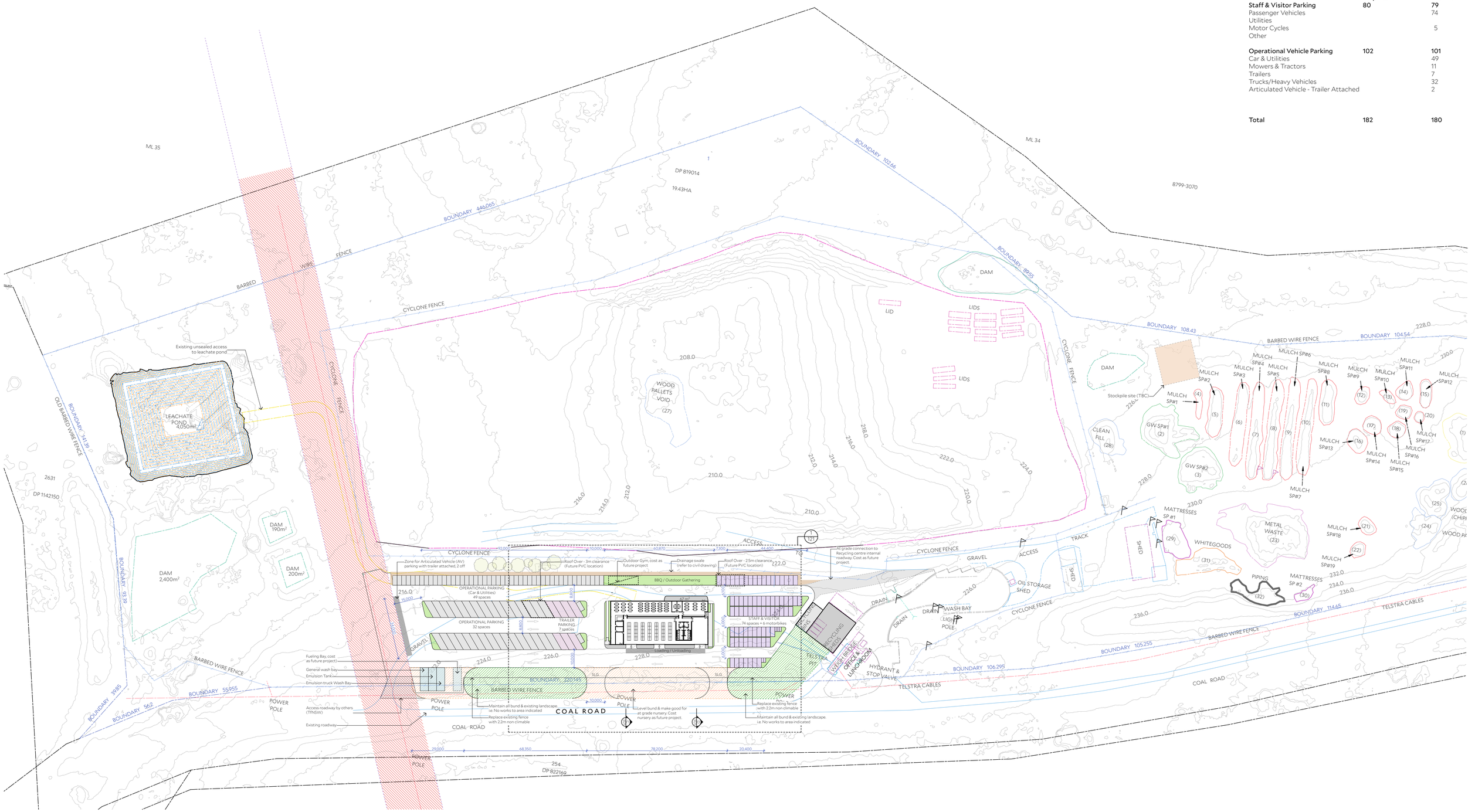
enHealth 2012b, *Australian Exposure Factors Guide*, Commonwealth of Australia, Canberra. <http://www.health.gov.au/internet/main/publishing.nsf/Content/health-pubhlth-publicat-environ.htm>.

EPA Victoria 2015, *Siting, design, operation and rehabilitation of landfills. Best practice environmental management note.*, EPA Victoria.

NSW EPA 2020, *Assessment and management of hazardous ground gases - Contaminated Land Guidelines 2020 update*, NSW Environment Protection Authority. <https://www.epa.nsw.gov.au/your-environment/contaminated-land/statutory-guidelines>.

UK Environment Agency 2004, *Guidance on the management of landfill gas, LFTGN 03*.

Appendix A Selected development plans



Option 12 - Parking Schedule

	Required	Provided
Staff & Visitor Parking	**80**	**79**
Passenger Vehicles		74
Utilities		
Motor Cycles		5
Other		
Operational Vehicle Parking	**102**	**101**
Car & Utilities		49
Mowers & Tractors		11
Trailers		7
Trucks/Heavy Vehicles		32
Articulated Vehicle - Trailer Attached		2
Total	**182**	**180**

Legend

- Retain Ex Bund
  Batter as required for new works
- Bemove Ex Bund
  (By Others)

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Notes

01 Do not scale; dimensions govern
02 All dimensions are in millimeters
03 All dimensions to be verified on site
04 Collins and Turner is to be notified of any discrepancies

No	Date	By	Note
13	12/4/2023	MR	For Information
14	9/5/2023	AC	For Information
15	12/5/2023	AC	For Information
16	26/5/2023	AC	For Information
17	30/5/2023	AC	For Information
18	20/6/2023	AC	For Information
19	29/6/2023	AC	Option 19 - For Costing

Client

Muswellbrook Shire Council

North

Scale

10 50m 90

Project

332
Muswellbrook Shire Council Depot
Community Recycle Centre
Muswellbrook, NSW

Drawing title	Coal Road Community Recycle Centre Site Plan Option 19
Scale	1:1000
Date	03/04/23
Drawn by	MR
Drawing Number+ Revison	332_SK_111 19

CYCLONE FENCE

10,000 | 60,870 | 7,300 | 44,400

Roof Over - 3m clearance
(Future PVC location)

Levels & parking grade to be
confirmed with Traffic/Civil
Engineer

Outdoor Gym, cost as
future project

Drainage swale
(refer to civil drawing)

Roof Over - 2.5m clearance
(Future PVC location)

BBQ
Area

BBQ / Outdoor Gathering

Bollard

Bollard

216.0

218.0

8,800

6,100

BAL

CONC1

Deck
67 m²

ALW + SSH

Storage
Joinery

Reception

Offices

GLCL

Lunch /
Meeting
Room

ADMIN

GLCL

Kitchen

AD

AD

ALW + SSH

Storage
racking

Access
requirements
TBC

Meeting
Room

Meeting
Room

GLCL

INTERNAL STORE

AMENITIES

WORKSHOP

ALW + SSH

8,800

6,000

TRAILER
PARKING
7 spaces

STAFF & VISITOR
74 spaces + 6 motorbikes

Entry

AD

AD

DFOLD

DFOLD

DFOLD

RL225,000

Loading / Unloading

GRA

10,000

6,000

226.0

224.0

228.0

222.0

SLG

SLG

BOUNDARY 320.145

BARBED WIRE FENCE

POWER

10,000

POWER

POLE

POLE

COAL ROAD

Level bund & make good for
at grade nursery. Cost
nursery as future project.

Replace existing fence
with 2.2m non climable

Maintain all bund & existing landscape.
i.e. No works to area indicated

105

105

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18	20/6/2023	AC	For Information
19	29/6/2023	AC	Option 19 - For Costing

Client

Muswellbrook Shire Council

North

Scale

0 5 10m 15

Project

332
Muswellbrook Shire Council Depot
Community Recycle Centre
Muswellbrook, NSW

Drawing title Upper Ground Level Option 19

Scale 1:200
Date 03/04/23
Drawn by MR

Drawing Number+ Revison 332_SK_121 | 19

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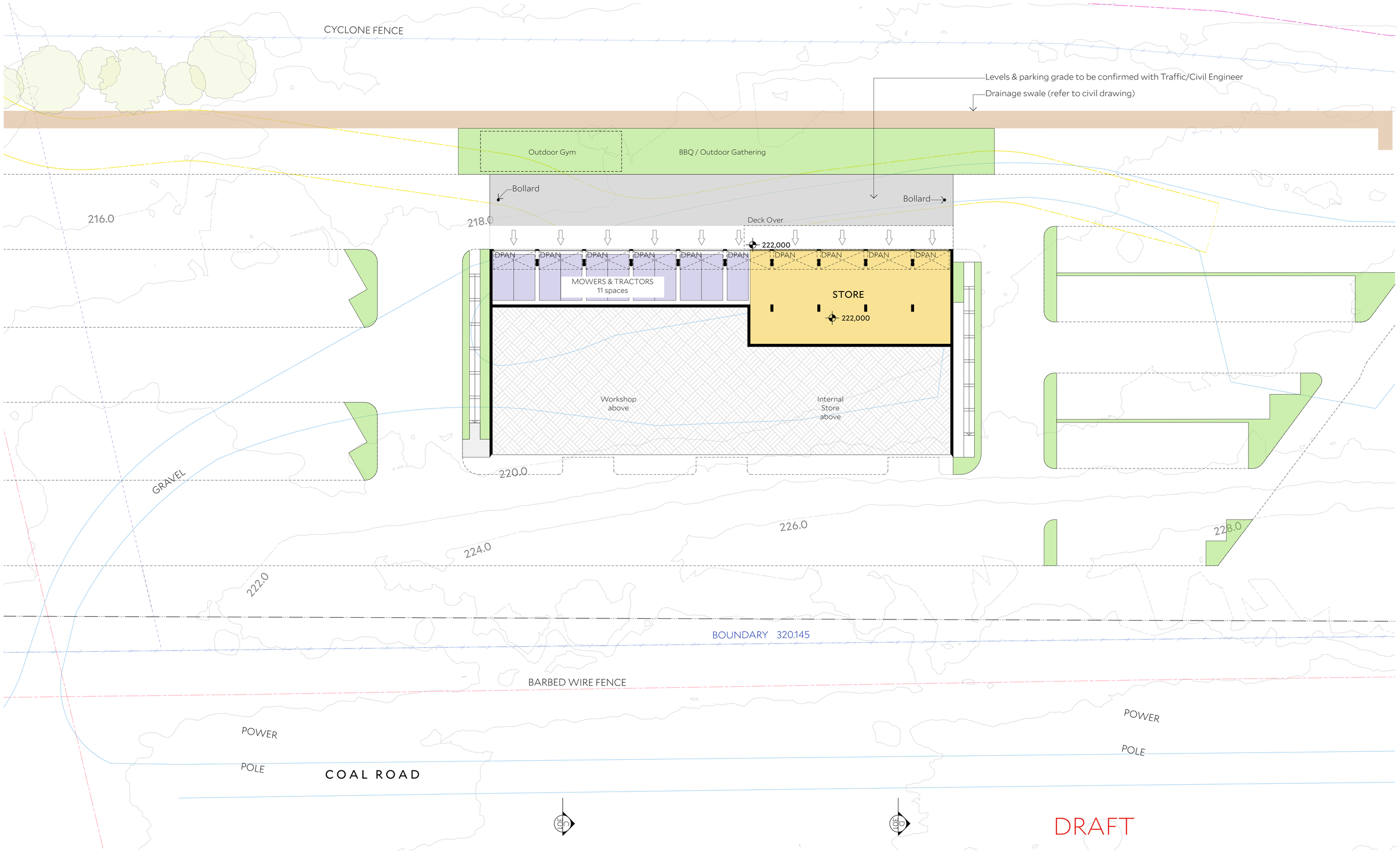

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16	26/5/2023	AC	For Information
18	20/6/2023	AC	For Information
19	29/6/2023	AC	Option 19 - For Costing

Client

Muswellbrook Shire Council

North

Scale

0 5 10m 15

Project

332
Muswellbrook Shire Council Depot
Community Recycle Centre
Muswellbrook, NSW

Drawing title Lower Ground Level Option 19

Scale 1:200
Date 03/04/23
Drawn by MR

Drawing Number+ Revison 332_SK_122 | 19

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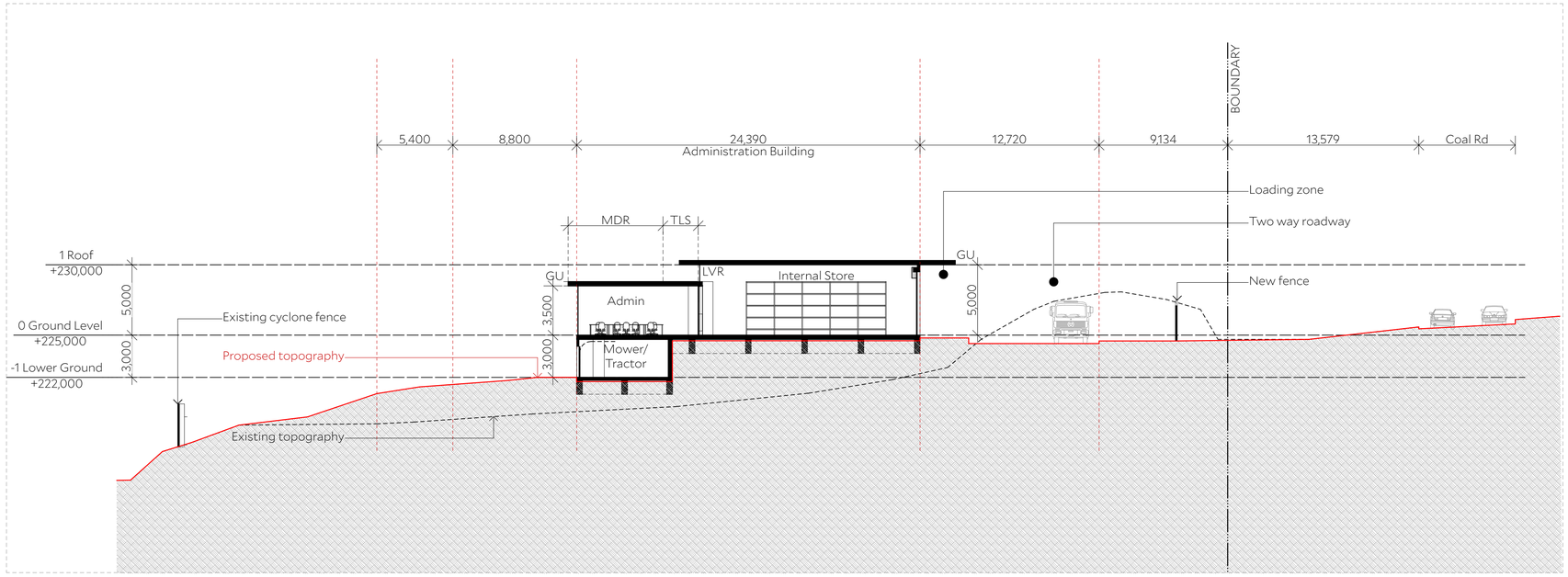

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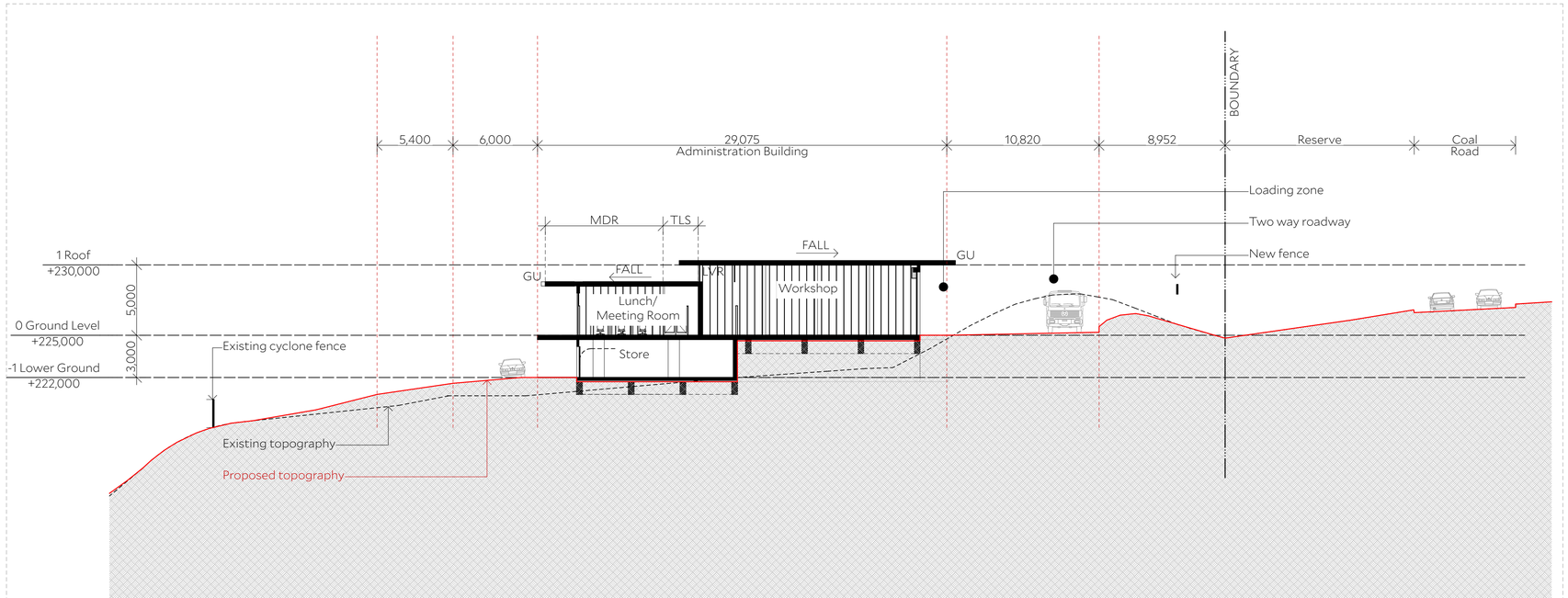

D Section D
1:200

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Notes

01 Do not scale; dimensions govern
02 All dimensions are in millimeters
03 All dimensions to be verified on site
04 Collins and Turner is to be notified of any discrepancies

No	Date	By	Note
13	12/4/2023	MR	For Information
16	26/5/2023	AC	For Information
18	20/6/2023	AC	For Information
19	29/6/2023	AC	Option 19 - For Costing

Client

Muswellbrook Shire Council

North

Scale

0 5 10m 15

Project

332
Muswellbrook Shire Council Depot
Community Recycle Centre
Muswellbrook, NSW

Drawing title Sections - Option 19

Scale 1:200
Date 04/03/23
Drawn by MR

Drawing Number+ Revison 332_SK_301 19

COLLINS AND TURNER