

APPENDIX 8. INVESTIGATIONS – INTERIM AUDIT ADVICE

SITE CONTAMINATION AUDIT SYSTEM INTERIM AUDIT ADVICE FORM



INSTRUCTIONS

An audit is completed by the preparation of a site contamination audit report (audit report) and associated site contamination audit statement (audit statement) by the auditor.

There may be circumstances where a site contamination auditor (auditor), who has been commissioned to carry out a site contamination audit (audit), is not yet in a position to provide final audit determinations but is able to provide interim audit advice (IAA) based on the assessment of site contamination.

Interim audit advice is not an audit report. It is advice provided by the auditor prior to the completion of the audit to support development process, inform regulatory decision making or for other reasons. In providing interim audit advice, the auditor provides an opinion based on the knowledge available at that time.

In some instances, unforeseen or unpredictable circumstances may occur following the provision of the interim advice that may affect that advice. Interim audit advice does not pre-empt or constrain the final outcome(s) of the audit or any conditions that may be placed by the auditor in the audit report.

In order to provide interim audit advice, an auditor has to have been engaged to carry out an audit and be satisfied there has been sufficient assessment of the nature and extent of any site contamination to enable the auditor to make informed risk-based decisions. Further extensive assessment should generally not be required to delineate the nature and extent of site contamination, however remediation will generally not yet have been completed or may not be necessary. If the site has been identified as a source of offsite contamination, it is expected the nature and extent of the site contamination will have been delineated (subject to liability considerations). Where remediation is or remains necessary for a specified use or range of uses, a remediation options assessment and/or site remediation plan/strategy, which has been reviewed and endorsed by the auditor, should be provided to support the auditor's opinion.

Interim audit advice is to be completed by the 'responsible auditor' as defined by the *Environment Protection Act 1993* (the Act). This should be the same auditor who completes the site contamination audit report on completion of the audit.

The completion and submission of this form is not a requirement under the Act or the *Environment Protection Regulations 2023*. However, guidance on when this form should be used by auditors is detailed in the EPA publication, *Guidelines for the site contamination audit system*.

Please ensure that all sections of the form are completed, requested information and attachments (where necessary) are provided and labelled.

Please do not modify the form by moving or deleting sections or text, including these instructions.

Please ensure that you are using the current version of the form (check the [EPA website](#)).

Refer to the current version of the EPA publication [Guidelines for the site contamination audit system](#), for further information. For any enquiries or questions relating to the site contamination audit system, including requests for editable versions of this form, contact the EPA Site Contamination Branch.

Completed interim audit advice (IAA) must be submitted digitally to the Site Contamination Branch in pdf format by email or file transfer. Upon receipt of IAA by the EPA, the EPA will provide notification to relevant parties and review the document for consistency with relevant legislation and EPA guidelines.

The completed IAAs are also required to be submitted to the audit client, local council and any prescribed body when it is prepared to support a development application.

For any enquiries or questions relating to the site contamination audit system, contact the EPA Site Contamination Branch on:

Telephone: (08) 8204 2004

Email: EPAsitecontam@sa.gov.au

SITE CONTAMINATION AUDIT SYSTEM

INTERIM AUDIT ADVICE

SECTION A: AUDITOR DETAILS	
Name of auditor*:	
Auditor's accreditation number:	
Name of auditor's company or business:	
SECTION B: AUDIT SITE DETAILS	
Auditor's project reference:	
EPA reference:	
Name of audit site (if applicable):	
Address of audit site:	
Name of council for area in which audit site is situated (if within council area):	
Provide the following particulars** relating to the relevant land and the audit	
<i>** If insufficient space, details may be annexed to this form.</i>	
<ul style="list-style-type: none"> certificates of title of all the relevant land and an indication of whether the audit site comprises all or part only of the land shown on or described in the certificates of title 	
<ul style="list-style-type: none"> details sufficient to identify the location of the land, including section or allotment numbers, area and hundred and coordinates [GDA2020/MGA2020] and associated zone (52, 53 and 54) 	
<ul style="list-style-type: none"> if the audit site comprises part only of the land described in the certificates of title, or if there is no certificate of title for the land comprising the audit site – survey plans prepared by a licensed surveyor 	
<ul style="list-style-type: none"> audit plans indicating the location and extent of the audit site (which must comply with the guidelines issued by the EPA from time to time) 	

SECTION C: AUDIT DETAILS																
Name of owner of audit site:																
Name of occupier of audit site:																
Name, postal address and position of person who commissioned audit:																
Indicate authority of person who commissioned audit:	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">EPA</td> <td style="width: 15%;">Yes</td> <td style="width: 15%;">No</td> </tr> <tr> <td>Owner</td> <td>Yes</td> <td>No</td> </tr> <tr> <td>Occupier</td> <td>Yes</td> <td>No</td> </tr> <tr> <td>Developer</td> <td>Yes</td> <td>No</td> </tr> <tr> <td colspan="3">Other (specify)</td> </tr> </table>	EPA	Yes	No	Owner	Yes	No	Occupier	Yes	No	Developer	Yes	No	Other (specify)		
EPA	Yes	No														
Owner	Yes	No														
Occupier	Yes	No														
Developer	Yes	No														
Other (specify)																
Indicate reasons for audit (indicate all purposes):	<p>Required under the <i>Planning, Development and Infrastructure Act 2016</i> Yes No</p> <p>Required under the <i>Environment Protection Act 1993</i> Yes No</p> <p>Other (please specify)</p>															
Indicate audit purposes (indicate all purposes):	<p>Determining the nature and extent of any site contamination present or remaining on or below the surface of the site Yes <input type="checkbox"/> No</p> <p>Determining the suitability of the site for a sensitive use or another use or range of uses Yes <input type="checkbox"/> No</p> <p>Determining what remediation is or remains necessary for a specified use or range of uses Yes No</p> <p><i>NB: an audit may be required for all of the above purposes</i></p> <p><i>Where remediation is or remains necessary, a remediation options assessment and/or site remediation plan, which has been reviewed and endorsed by the auditor, should be provided to support the auditor's opinion.</i></p>															
Is a restricted scope being applied to the audit:	<p>Yes <input type="checkbox"/> No</p> <p><i>NB: An audit subject to a restricted scope is not suitable to be relied upon by a planning authority for the purpose of making decisions as to whether land may be suitable for a sensitive use or another use or range of uses.</i></p>															
Date of commencement of audit:																
Date of notification of commencement of audit to EPA:																
Estimated date of completion of audit:																

SECTION D: SITE USES AND ACTIVITIES	
Potentially contaminating activities (PCA) within the meaning of regulation 48 of the <i>Environment Protection Regulations 2023</i> are known to have occurred at the site:	Yes No If yes, identify the PCA(s)
Current site use(s), or if currently unoccupied, most recent site use(s):	

SECTION E: SOURCE AND AFFECTED SITES	
The site is a known source of offsite contamination:	Yes No
The nature and extent of any offsite contamination originating from the site has been delineated:	Yes No N/A <input type="checkbox"/> If no, specify reason(s)
Contamination at the site has arisen from another site/sites in the vicinity:	Yes No

SECTION F: TRIGGER FOR INTERIM AUDIT ADVICE	
To support a development application or development plan amendment (DPA):	Yes No If yes, complete section G
Required by a voluntary proposal (under section 103I or section 103K of the Act) or site contamination order (under section 103H or 103J of the Act):	Yes No If yes, complete section H
To support a Remediation Options Assessment (ROA) or site remediation plan/strategy:	Yes No If yes, complete section I
To support a waste derived fill or waste soil enhancer proposal:	Yes No If yes, complete section J
Other:	Yes No If yes, specify reason(s)

SECTION G: DEVELOPMENT DETAILS (complete this section only if interim audit advice is being prepared in relation to a development application or DPA)	
Name of relevant planning authority:	
Development application number (if applicable):	
Proposed site zoning (if applicable):	
Proposed land use:	
I have reviewed and have endorsed (where applicable) the following documents. List all documents.	

I am of the opinion, based on the knowledge available at this time, that the audit site should be able to be made suitable for the proposed use(s):	Yes No
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SECTION H: VOLUNTARY PROPOSALS AND SITE CONTAMINATION ORDERS (complete this section only if interim audit advice is being prepared to satisfy the requirements of a voluntary proposal under section 103I or section 103K of the Act, or a site contamination order under section 103H or s103J of the Act)

IAA required by:	Voluntary site contamination assessment proposal <input type="checkbox"/> Voluntary site remediation proposal <input type="checkbox"/> Site contamination assessment order <input type="checkbox"/> Site remediation order <input type="checkbox"/>
EPA reference number(s) [if applicable]:	
I have reviewed and have endorsed (where applicable) the following documents. List all documents.	
I am of the opinion based on the knowledge available at this time, that the works undertaken appear generally consistent with the EPA statutory requirements:	Yes No If no, specify reason(s)

SECTION I: REMEDIATION DETAILS (complete this section only if interim audit advice is being prepared to support a ROA or site remediation plan/strategy)

I have reviewed and have endorsed the following attached remediation options assessment and/or site remediation plan/strategy (cross out if not applicable) documents. List all documents.	
I am of the opinion based on the knowledge available at this time, that the proposed remediation options and/or site remediation plan/strategy (cross out if not applicable) have been developed in accordance with relevant guidelines issued by the EPA:	Yes No

SECTION J: WASTE DERIVED MATERIALS (complete this section only if interim audit advice is being prepared to support a waste derived materials proposal)

Type of waste derived material proposal:	Soil Soil enhancer
Does the IAA relate to a site which is a part of, or known to be considered as part of, 'One Site' which has been approved by the EPA?	Yes No
If yes, are there any EPA licensed sites currently or proposed to be within the 'One Site' boundary?	Yes No If yes, provide licensed site details
I have reviewed the following attached waste derived material proposal(s). List all documents.	

<p>I am of the opinion, based on the knowledge available at this time, that:</p> <ul style="list-style-type: none"> the proposal has been prepared in accordance with the EPA Standard for the production and use of Waste Derived Fill 	<p>Yes No</p>
<ul style="list-style-type: none"> the waste derived materials identified in the proposal should be suitable for the proposed use(s) and are not likely to cause harm. 	<p>Yes No</p>

SECTION K: AUDITOR OPINIONS

<p>I am of the opinion, based on the knowledge available at this time, that the assessment and/or remediation (cross out if not applicable) of site contamination at the audit site is consistent with guidance in the <i>National Environment Protection (Assessment of site contamination) Measure 1999</i> (as amended in 2013) and the EPA publication <i>Guidelines for the assessment and remediation of site contamination</i>:</p>	<p>Yes No</p> <p>If no, specify reason(s)</p>
<p>I am of the opinion the site has been sufficiently assessed to inform risk-based decisions in accordance with the <i>National Environment Protection (Assessment of site contamination) Measure 1999</i> and the EPA publication <i>Guidelines for the assessment and remediation of site contamination</i>:</p>	<p>Yes No</p> <p>If no, specify reason(s)</p>
<p>This interim audit advice has been prepared and completed consistent with the EPA publication <i>Guidelines for the site contamination audit system</i>:</p>	<p>Yes No</p> <p>If no, specify reason(s)</p>

SECTION L: SUMMARY OF INTERIM AUDIT FINDINGS

Provide a summary statement which addresses each of the following sections* as an annexure to this form.

1. Conceptual site model (CSM)
2. Auditor’s interim audit risk assessment
3. Auditor’s interim audit outcomes and determinations
4. Actions/recommendations

* Refer to Appendix 3 of the EPA publication *Guidelines for the Site Contamination Audit System*

DECLARATION

To the best of my knowledge, all information provided in this form is current and correct at the time of signing and dating.

Signed*:

Dated:

* This form must be completed and signed by the ‘responsible auditor’, being, under the Environment Protection Act 1993 and the Environment Protection Regulations 2023, the auditor who personally carried out or directly supervised the work involved in the audit.

SECTION M: INTERIM AUDIT ADVICE CHECKLIST

All of the following documents/information **must** be attached when required (please check):

A complete and accurate digital copy of any documents listed in section G	Yes	No
A complete and accurate digital copy of any documents listed in section I	Yes	No
A complete and accurate digital copy of any documents listed in section J	Yes	No
Summary of interim audit findings as listed in section L	Yes	No

EA1051 IAA letter 2024

7/08/2024

Attention: Wendy Boyce, SA EPA,

via email to Wendy.Boyce@epa.sa.gov.au

Cc: EPASitecontam@epa.sa.gov.au

**SITE CONTAMINATION AUDIT (EPA REF 63187)
SUMMARY OF INTERIM AUDIT FINDINGS
10-14 and 16-20 HALLS ROAD, HIGHBURY, SA
INTERIM AUDIT ADVICE**

1. INTRODUCTION

I am currently undertaking a site contamination audit of 10-14 and 16-20 Halls Road, Highbury, South Australia (the Site). As part of the Audit, the Client (Ms Belinda Monier) has requested an Interim Audit Advice (IAA) endorsing the Site Remediation Plan to support a code amendment application as the Site will require rezoning prior to its proposed Residential Land use.

This letter provides supporting information for the attached IAA.

The Site comprises the whole of two certificates of title (CT 5768/114, CT 5768/115) as presented on the Audit Site Boundary plan in **Attachment A**.

The proposed site use is residential consisting of up to 32 Torrens Titled allotments but a final development plan has not been finalised.

The site assessments (most recently documented by Land and Water Consulting (LWC)) have identified a localised area of soil contamination within subsurface soils and off-site landfill gas impacts that could pose a risk to the Audit Site.

The following LWC Site Remediation Plan (SRP) details the proposed remediation approach to render the Site suitable for the proposed land use and is the subject of this IAA:

- LWC, (2024b) 10 -20 Halls Road, Highbury, Site Remediation Plan, Reference LWC OO 03 FRO01, dated 22 July 2024.

2. STATEMENT OF INDEPENDENCE OF AUDITOR

The Auditor has no relationship with the Site Owner, the Client who commissioned the Audit, the Environmental Consultants or any Remediation Contractors/Consultants. In carrying out the Audit, the Auditor has exercised his own professional judgement and the audit determinations have been reached independently and have not been unduly influenced by the views or actions of others, particularly those who may have an interest in the outcome of the Audit.

3. BACKGROUND

3.1 On site

The Site has been owned by Hallan Nominees Pty Ltd (or Mercer Nominees Pty Ltd, which represents the same current owner – Helen Mercer) since 1975 and utilised for residential/farming purposes, with the southern portion remaining undeveloped. Property ownership was traced back to 1910 for each allotment with a series of private owners acquiring the allotments under the one certificate of title before it was split across two titles in 1986. Owners prior to 1975 were listed as gardeners, wood carters and contractors.

Aerial imagery showed the entire Site as undeveloped or potentially used for farming purposes until the 1970s after which the northern allotment hosted several structures including a residential dwelling and sheds. The southern allotment remained undeveloped.

3.2 Off site

The surrounding land has generally comprised residential and farming activities to the north and west and quarry/landfilling activities to both the east and south.

The landfill immediately south of the Site was recently (reportedly 2022, but exact date unknown) acquired by Veolia from SITA as part of a larger land/property portfolio.

The SITA/Veolia land was historically owned by Ms Mercer's family and was operated as a sand quarry. The land was sold to McMahan's in 1975 who then held a license for operation of a landfill facility. LWC stated within their report (2024a)¹ '*Review of available license document D0033 made out to Pacific Waste Management Pty Ltd for Halls Road Highbury dated 30 June 1991 indicated that the landfill was licensed to receive putrescible, non-putrescible and demolition wastes only from itself i.e. not municipal waste from the general public or councils.*'

By 1994 the landfill ceased accepting waste and was closed and capped. Aerial imagery indicated the landfill was almost fully revegetated by 2001². The current condition of the landfill (approx. 3.7 ha) is that it's fully vegetated with a domed surface. The surface generally follows the dip in landform from north to south, with the northern boundary having an approximate elevation of 161 mAHD (max. 166 mAHD) and the southern boundary having an approximate elevation of 149 mAHD, therefore a general fall of around 12 m over ~228 m from north to south (gradient of 0.05). Therefore, based upon the land gradient and likely base of the landfill, there is potential for landfill gas to migrate towards the Audit Site. A diagrammatic cross section of the Audit Site and off-site landfills to the south is presented as **Attachment B**.

It is understood the off-site landfill was not lined, consistent with general practice at the time of commencement of filling. Despite the off-site landfill being regulated and the presence of a flaring system, the depth of the landfill has not been well defined and operation details of the current LFG

¹ LWC (2024a) Conceptualisation and Data Gap Review, Ref LWC OO 02 (FR001), dated 11 July 2024.

² REM (2007) Phase 1 Environmental Site Assessment dated 5 January 1997.

management measures are not available. This has ramifications for the Audit Site in terms of thickness of waste mass off site that may give rise to a generation of landfill gases and the unknown details of the control mechanisms in place for such gases.

Based on above uncertainties there is insufficient data to inform a precise landfill gas mitigation design, however an indicative conservative design has been provided in the SRP.

The SRP states within Section 6.3.1.2 '*... Based on correspondence from the auditor, it is understood that Interim Audit Advice from the auditor, could be prepared, that does not specify the particular design of the vapour barrier given that not all data has been identified that would specifically inform the design of the ground gas barrier for dwellings.*

Therefore, a barrier is likely required due to uncertainties in the ground gas data (as a function of the nature and variability of the offsite gas source). Dwelling based ground gas protection measures must therefore be confirmed when further landfill data is provided / made available. The final design should consider the design parameters in Table 6-2 and an example barrier layer is provided in Table 6-3. The final design must be approved by an EPA accredited site contamination auditor.'

This IAA supports the current SRP measures with regard to soil remediation, but notes that further information to confirm the status of the off-site landfill and assessment of potential LFG may result in alternative measures being required. This data gap is managed via an SRP hold point that requires a Construction Environment Management Plan (CEMP) to be developed for the Site and submitted for review and acceptance by a Site Contamination Auditor prior to any remediation or redevelopment works commencing.

For this reason, the IAA is issued for the purposes of supporting the application for the change in land use. However, further information must be sought, regarding any LFG generation off site that has the potential to pose a risk to the on-site redevelopment, both currently and into the future. The Auditor must review and approve any additional information/assessment or lack thereof, prior to any alterations to the current SRP, future CEMP and prior to any site development.

3.3 Site Setting

The site setting in the immediately surrounding allotments is as follows:

- North – Residential.
- East – Former quarry, across Halls Road.
- South – Former quarries and landfills to immediate south (SITA/Veolia) and approximately 230 m south (Highbury Landfill Authority) – both now revegetated with the SITA/Veolia Landfill know to have a gas extraction system present.
- West – Residential.

3.4 Potentially contaminating activities and chemicals of concern

The Site History identified the main **on-site** potentially contaminating activities as being:

- **Agricultural Activities:** Any of the following activities undertaken in the course of agriculture:

- Burial of animals or parts of animals;
 - Burial of other waste;
 - Irrigation using wastewater; and
 - Intensive application or administration of a listed substance to animals, plants, land or water (excluding routine spraying, in accordance with a manufacturers' instructions, of pesticides used in broad acre farming);
- **Fill or soil importation:** Importation, to premises of a business, of soil or other fill originating from a site at which another potentially contaminating activity has taken place.

Historical site features are presented as **Attachment C**.

The Auditor considers that the **on-site** potential chemical substances of concern include:

- Metals, pesticides (OCPs and OPPs), carbamates (insecticides), chloropicrin (trichloronitromethane) and petroleum hydrocarbons associated with historical agricultural activities potentially across entire Site;
- Heavy metals, PAHs, petroleum hydrocarbons, phenols, termiticides, pesticides, (OCPs and OPPs) and asbestos associated with importation/disposal of fill across the Site.

The Site History identified the main **off-site** potentially contaminating activities as being:

- **Landfill sites:** Operation of sites for disposal of waste onto or into land;
- **Agricultural Activities:** Any of the following activities undertaken in the course of agriculture:
 - Burial of animals or parts of animals;
 - Burial of other waste;
 - Irrigation using wastewater; and
 - Intensive application or administration of a listed substance to animals, plants, land or water (excluding routine spraying, in accordance with a manufacturers' instructions, of pesticides used in broad acre farming);
- **Fill or soil importation:** Importation, to premises of a business, of soil or other fill originating from a site at which another potentially contaminating activity has taken place.

The Auditor considers that the primary **off-site** potential chemical substances of concern include:

- Heavy metals, PAHs, petroleum hydrocarbons, phenols, termiticides, pesticides (OCPs and OPPs), asbestos and landfill gas (e.g. methane, carbon dioxide) associated with landfill operations. LWC stated within their report (2024a)³ *'Review of available license document D0033 made out to Pacific Waste Management Pty Ltd for Halls Road Highbury dated 30 June 1991 indicated that the landfill was licensed to receive putrescible, non-putrescible and demolition wastes only from itself i.e. not municipal waste from the general public or councils.'*
- Metals, pesticides (OCPs and OPPs), carbamates (insecticides), chloropicrin (trichloronitromethane) and petroleum hydrocarbons associated with historical agricultural activities;

³ LWC (2024a) Conceptualisation and Data Gap Review, Ref LWC OO 02 (FR001), dated 11 July 2024.

- Heavy metals, PAHs, petroleum hydrocarbons, phenols, termiticides, pesticides (OCPs and OPPs) and asbestos associated with importation/disposal of fill; and
- Landfill gases primary carbon dioxide and methane.

4. CONTAMINATION ISSUES

4.1 Soil

A total of 28 grid-based test pits and seven (7) targeted bores were advanced in 2008. A further 16 bores were advanced in 2009. Targeted locations focused on former and current site features (i.e. AST, transformer and sheds) and to delineate elevated metals in the northern end of the Site (referred to as Zone A) and fill in the southern end of the Site (referred to as Zone B) as shown in **Attachment D**.

Most recently LWC advanced a further 14 soil bores to delineate elevated metals in the north and fill extent and depth in the south.

The outcome of the soil investigations identified:

- All analytes were below the amended ASC NEPM 1999 HIL A land use scenario except:
 - Beryllium (80 mg/kg) and cobalt (130 mg/kg) at one and two surface locations, respectively, in the north-eastern corner (shed location) of the Site – noting that none of these exceedances were repeated in the following two sampling events (2009 and 2023) at the same area;
 - Lead (380 to 980 mg/kg) in surface soils in the north-eastern corner (shed location) of the Site, delineated via the 2023 bores;
 - Lead (400 mg/kg) in surface soils in the western side (driveway) of the Site;
- All analytes were below the amended ASC NEPM 1999 EIL residential land use scenario with exception of zinc at one location in surface soils in the north-eastern corner (shed location) of the Site;
- All analytes were below the amended ASC NEPM 1999 HSL A&B for vapour intrusion; and
- All hydrocarbons were below the relevant direct contact criteria and management limits.

No odours or staining have been reported at any of the investigation locations with exception of an organic/hydrocarbon odour at one surface location, no elevated chemicals concentrations were noted at this location.

Fill materials were reported across much of the Site. Fill in the northern half of the Site comprised general soil materials only, whereas fill in the central to south-eastern corner of the Site was reported to include waste materials such as brick, rubbish, plastic pipe (via test pitting by REM, 2009). Subsequent SKM soil bores DB4-DB16 in the same area, did not report any waste materials within the fill, with exception of brick.

LWC (2024) advanced ten bores in the southern end of the Site to verify fill inclusions and extent. Fragments of plastic plant labels, metal and hessian were identified in central southern bores – confirming anecdotal evidence of a historical plant nursery business and partial filling of the southern

end with fill containing some of this business waste. Maximum fill depth in the southern end of the Site was 3.8 mbgl (LWC, 2024) with an average depth of 0.65 mbgl and an estimated volume of 5,000 m³.

4.2 Groundwater

In 2008 REM installed one on-site bore to 30 mbgl (MW1 refer **Attachment D**). An existing bore, immediately off-site to the south (54 m deep), was also sampled. Standing water levels were recorded between 27.5 and 34 mBTC.

Based on the 2008 data and potential environmental values, marginal exceedances for chemicals including copper, phosphorus and ammonia were present. In November 2009, MW1_001 was sampled and analysed for nutrients, with similar results reported. Groundwater flow direction was inferred to be towards the south-west. No hydrocarbon odours or LNAPL were recorded.

In 2023 the on-site well was found to be dry and therefore unable to be sampled. Despite historical (PB, 2008) reports of perched water layers identified during the off-site landfill investigations, immediately south of the Site, no water was encountered during any of the on-site test pits or soil bores which were advanced to maximum depth of 6 mbgl.

Based on the lack of on-site soil impacts identified, depth to groundwater and lack of historically reported groundwater impacts it is considered unlikely that site-derived groundwater impacts exist.

Based upon the groundwater flow direction (to the south-west), location of off-site PCA sites (cross and down hydraulic gradient), and groundwater depth (>25-50 mbgl), it is considered unlikely that off-site derived groundwater impacts would pose an unacceptable risk to on-site land users. Further groundwater assessment is not considered warranted.

4.3 Landfill Gas

Immediately south of the Site is the Veolia owned former landfill, which is closed, and currently being managed to mitigate landfill gas (LFG). The Highbury Landfill is also closed and situated south of the Veolia property. The former off-site landfill depth and current gas management details of the Veolia landfill are not fully defined, and the impact of changing conditions off site must be considered with regard to on-site risk.

As per **Section 3.2** of this IAA, this data gap is managed via an SRP hold point that requires a CEMP to be developed for the Site and submitted for review and acceptance by the Auditor prior to any remediation or redevelopment works commencing. Further information must be sought, regarding any LFG generation off site that has the potential to pose a risk to the on-site redevelopment, both currently and into the future. The Auditor must review and approve any additional information/assessment or lack thereof, prior to any alterations to the current SRP, future CEMP and prior to any site development.

Landfill gas investigations have comprised the following:

- 2008 – gas screening for methane and carbon dioxide in well headspace of groundwater bores MW1_001 (on-site), LF8 and LF9 (immediately south off site); all concentrations were below EPA criteria 1.5% v/v;
- 2009 – gas screening for methane and carbon dioxide in well headspace of groundwater bore MW1_001 over six occasions (spanning approx. 2 months), all methane concentrations were below EPA criteria, however carbon dioxide concentrations exceeded EPA criteria (max 18.3 %v/v);
- 2023 – Six grid-based gas monitoring wells (MW01 to MW06) installed on southern half of the Site to 6 mbgl (4 m screen), reportedly to screen the adjacent Veolia waste mass;
- 2023 – Continuous LFG monitoring of the southern on-site boundary wells MW04-MW06 for approximately one month (Jan-Feb) with additional spot checks also undertaken:
 - Methane concentrations ranged from 0 to 0.2% v/v and carbon dioxide concentrations ranged from 6 to 15.6 % v/v. Flow rates ranged from 0.2 to 0.4 L/h;
 - Based upon this data an on-site Gas Screening Value (GSV, i.e. max conc x flow rate) of <0.07 (CS1) was calculated, but conservatively revised to CS2 given the maximum carbon dioxide concentrations recorded and uncertainties in current gas extraction at Veolia.

LWC conclude that potential LFG risks from off site are unable to be specifically calculated given the on-site gas gradient and driver for migration (pressure) within the waste mass is unknown. In LWC (2024a), LWC consider *‘a more proactive approach and indeed robust approach would be to focus less on future potential gas gradient and accept that a gradient could eventuate – this risk can then be mitigated using building controls, such as gas resistant membranes or under-slab depressurization or both, or more.’*

4.4 Summary

In brief, the contamination issues at the Site include:

- Elevated lead concentrations above HILs (and to a lesser extent zinc above EILs) in surface fill within a localised area of the north-eastern corner of the Site (Zone A). A single elevated lead concentration marginally exceeding site criteria was also reported in surficial soil in the west of the Site. Therefore, removal of surface soils and either reuse in less sensitive areas of future development, or off-site disposal are required;
- Aesthetically impacted fill within the southern area of the Site (Zone B) approximating 5,000 m³. These impacts (plastic, metal, brick) may be unacceptable within exposed soils such as future yards and garden beds, but are considered acceptable below future dwellings (pending geotechnical suitability); and
- Potentially unacceptable LFG (primarily carbon dioxide) as a result of off-site LFG migrating beneath the Site. Mitigation of these off-site risks via institutional and/or engineering controls at the time of site development and dwelling construction.

No remediation or redevelopment can occur prior to provision of a CEMP to a Site Contamination Auditor for their review and acceptance. The CEMP must include a final vapour mitigation design informed by the current and future landfill gas regime.

5. PROPOSED REMEDIATION APPROACH AND HOLD POINTS

Remedial options were assessed in the SRP which is provided in **Attachment E**. Ultimately the remediation proposed to make the Site suitable for the intended residential land use and the Hold points required to ensure adequate validation and integrity of the proposed remediation measures are as follows:

1. Preparation of a Construction and Environmental Management Plan (CEMP). This should include sufficient information to close out residual LFG data gaps or robust and sufficient LFG mitigation measures to account for any residual data gaps;
 - HOLD POINT – CEMP to be reviewed and approved by the Auditor prior to any Site remediation and redevelopment (Section 7 of LWC SRP, 2024b).
2. Soils in Zone A – excavation of surface soils to 0.2 mbgl (approximately 5 m³) and either on-site reuse in an acceptable location or off-site disposal to a suitable facility;
 - HOLD POINT – The final remedial extent will be confirmed, based upon analytical results to verify removal of the localised lead impacts (Zone A) – (Section 6.6.2 of LWC SRP, 2024b).
3. Soils in Zone B – excavation of aesthetically impacted fill to 1 mbgl for off-site disposal to a suitable facility. Excavation beyond this depth is not considered necessary based upon the proposed land use;
 - HOLD POINT – The final remedial extent will be informed based upon field observations, to confirm removal of unacceptable aesthetics within the upper metre of fill (Zone B) – (Section 6.6.2 of LWC SRP, 2024b).
4. Mitigation of potential off-site LFG migration to on-site area via: Mitigation measures to be outlined within the future CEMP, which must be reviewed and accepted by the Site Contamination Auditor. The CEMP must include site-specific HOLD POINTs relating to the installation and verification of all LFG mitigation measures.
5. All materials to be tracked and records kept of volumes retained on site versus loads sent off site. Should any of the excavated soils be reused on site, reuse locations must be surveyed and deemed appropriate i.e. beneath roads or building slabs.
6. Final validation report to be provided to document (at a minimum) all remediation activities, materials tracking including any waste disposal records for soils or other (tanks etc.), survey data of any reuse locations, photographic evidence and final data set.

The remediation strategy is detailed in the SRP, provided in **Attachment E**.

6. COMPARISON OF APPROACH TO EPA GUIDELINES

The remediation approach detailed in the SRP addresses the following key aspects outlined in the *EPA 2019, Guidelines for the Assessment and Remediation of Site Contamination*. Updated November 2019:

Key aspects	SRP approach
Sets remediation Goals	Goals include providing adequate protection of human health, property and the environment for the proposed development.
Auditor's role	This is noted in the SRP.
Documents the nature and extent of remediation necessary	The nature and extent of the contamination has been suitably documented in the SRP, noting information regarding the off-site former landfill has been limited and on-site remediation has taken these data gaps into consideration.
Procedures and plans to reduce human health and environmental risks	<p>Human Health</p> <p>Procedures are in place to minimise impacts to on-site workers and result in no future risk to residents.</p> <p>Off-site risks to surrounding land users will be limited based on the site setting, however general site safety measures and dust control procedures are documented within the SRP.</p> <p>Environment</p> <p>Safeguards/controls are proposed in the plan.</p> <p>A CEMP, including a Work Health and Safety document, is also required as part of the SRP.</p>
Rationale of the remedial approach	The approach comprises excavation of impacted soils and on-site reuse or off-site disposal. Off-site LFG risks will be mitigated via preventative engineering controls during on-site construction stages, to be determined prior to the CEMP and documented within the CEMP.
Environmental safeguards	The SRP includes a section on Environmental Management and Health and Safety, which outlines the environmental controls to be implemented during remediation works. It is recommended that the remediation contractor prepare their own health, safety and environmental plan and controls which must not be less protective than those detailed in the SRP.
Approvals required	EPA administrative review of IAA. Development and demolition approval from Council. Progressive resolution of the Auditor HOLD points to the satisfaction of the Auditor.
Timelines	No timelines are specifically mentioned, but will be informed by relevant approvals, soil remediation and development stages, if relevant, of the Site.

Key aspects	SRP approach
Endpoints/hold points	<p>The SRP includes HOLD points where the Environmental Consultant/Developer will need to provide information to the Auditor and obtain the Auditor’s endorsement before continuing to the next stage of remediation. These are detailed above and generally cover:</p> <ul style="list-style-type: none"> • Auditor review and approval of a CEMP; • Verification of soil sampling within Zone A to confirm acceptable lead concentrations; • Visual verification of adequate removal of Zone B aesthetic impacts; • Appropriate LFG mitigation measures, as outlined within the CEMP (HOLD point 1), followed by inspection and verification of all measures; and • Inspection of the Site post-remediation. <p>General Site inspections will be carried out during remedial works to ensure compliance with the SRP.</p>
Contingency	<p>Contingencies are presented in the SRP, generally in relation to encountering unknown buried infrastructure, asbestos, odorous or stained soils, or inclusions not previously documented.</p>

7. CONCEPTUAL SITE MODEL

The table below presents the Auditor's summary of the CSM based on both information provided by the Consultant and some minor information gaps filled by the Auditor as necessary.

CSM Aspect	Summary of Information Provided
Source	
Known and potential sources of contamination	<p><u>On site</u>: Known and potential sources and their location are detailed in Section 3. The primary potential sources of contamination are activities associated with historical agricultural activities and importation and/or reuse of fill.</p> <p><u>Off site</u>: Potential off-site sources are detailed in Section 3 and include former landfill sites to the immediate south and further south, located down gradient topographically and to a lesser extent historical agricultural activities and importation and/or reuse of fill.</p>
Chemical of concern/interest	<p><u>On site</u>: Potential chemical substances of concern are detailed in Section 3. The primary substances of concern are heavy metals, PAHs, petroleum hydrocarbons, phenols, volatile chlorinated hydrocarbons, termiticides, pesticides and asbestos.</p> <p><u>Off site</u>: The off-site potential chemical substances of concern are detailed in Section 3 and primarily pertain to landfill gases (e.g. methane and carbon dioxide) and also include those similar to on site, being heavy metals, PAHs, petroleum hydrocarbons, phenols, volatile chlorinated hydrocarbons, termiticides, pesticides and asbestos.</p>
Mechanisms of contamination	<p>The most likely mechanism of contamination from imported/reuse of fill is considered to be dry weight and leachable contaminants.</p> <p>The most likely mechanism for contamination from disposal, storage and supply of chemicals and fuel is '<i>top down</i>' spills.</p> <p>The most likely mechanism from off-site contamination to impact the Site is from potential migration of landfill gas beneath the Site.</p>
Types of contaminant	<p><u>Solid phase</u>: Particles of contaminants such as bitumen, charcoal, ash, cinders and asbestos.</p> <p><u>Sorbed phase</u>: Contaminants sorbed onto soil particles are anticipated such as heavy metals, pesticides and hydrocarbons.</p> <p><u>Dissolved phase</u>: Contaminants dissolved in groundwater are anticipated, particularly heavy metals, inorganics and hydrocarbons.</p> <p><u>Free phase</u>: Contaminants present in soil and/or porosity as non-aqueous phase liquid (NAPL) in above and within groundwater, particularly hydrocarbons.</p> <p><u>Vapour phase</u>: Contaminants as vapour/gas in soil, particularly hydrocarbons and landfill gases.</p>

CSM Aspect	Summary of Information Provided
Nature of chemical substances	<p>Mobility: Heavy metals cannot be readily degraded (discounted oxidation states) and exist in either mobile or immobile forms (primarily adsorption and precipitation) within the soil matrix. They are normally retained in the soil surface as long as the retention capacity of the soil is not exceeded. The retention is governed by soil properties which include pH, redox potential, surface area, organic and clay content, CEC and carbonate levels.</p> <p>Metals, once in the aqueous phase of soils, are subject to movement with porewater, and may be transported through the vadose zone to groundwater, plant uptake or for some metals (arsenic, selenium, mercury) volatilisation mechanisms.</p> <p>The mobility and rate of degradation of hydrocarbons depend on the size and structure of the hydrocarbon molecule, but in general, light end hydrocarbons are relatively mobile and heavy end hydrocarbons are less mobile.</p> <p>Vapour and gas migration are dependant upon the concentration/generation potential of the source material and affected by soil lithology and preferential pathways.</p> <p>Persistence: The chlorinated chemicals do not generally bind well to soil particles. Concentrations in the subsurface generally dissipate over time via volatilisation and biodegradation if conditions are favourable (i.e. anaerobic with the presence of carbon), but may persist for many years in certain conditions.</p> <p>The more volatile components (i.e. TPH C₆-C₉) are generally more soluble and therefore have a lower adsorption and higher mobility. They are also readily available for biodegradation. The opposite is true for the heavier components (i.e. TPH C₁₀-C₃₆) which can persist in the environment for a much longer period.</p> <p>Toxicity: The toxicity of chemical substances varies depending on the contaminant, exposure pathway and sensitivity of the receptor. Concentrations were initially compared to published investigation criteria which take toxicity into consideration.</p> <p>Volatility: Volatility is particularly a concern for short chained hydrocarbon compounds (i.e. TPH C₆-C₉). The volatility of contaminants has been taken into consideration when assessing the suitability of Consultants' sampling plans. The risk from volatile contaminants was initially compared to ASC NEPM HSLs which take contaminant volatility into consideration.</p>
Potentially affected element of environment	<p>Based on the audit purpose, the Auditor considers the potentially affected elements of the environment include:</p> <ul style="list-style-type: none"> • land (soil, sediment and soil vapour/gas); • air, particular contaminated dust, asbestos fibres and emissions from volatile contaminants; • water, specifically surface water bodies and groundwater; • organisms; • ecosystems; • human-made or modified structures or areas; and • amenity values (e.g. odour, aesthetics).
Potentially affected media	<p>Based on the potential chemical substances of concern and site setting, the Auditor considers the potentially affected media to be soil, soil gas (LFG) and groundwater.</p>
Human (on site)	<p>Construction workers associated with the proposed development.</p> <p>Future users of the Site including residents, visitors and construction/maintenance workers (particularly those associated with underground services).</p>
Human (off site)	<p>Residents and visitors to neighbouring residential and commercial properties (although limited).</p> <p>Possible off-site groundwater users of the uppermost aquifer (considered unlikely).</p>
Ecological (on site)	<p>There are no significant environmental receptors on site and none are proposed as part of the development.</p>

CSM Aspect	Summary of Information Provided
Ecological (off site)	<p>The Auditor generally considers that the ecological receptor of most concern is the nearest surface water body that receives groundwater and/or surface water run-off from the Site.</p> <p>The closest water body is Torrens River located approximately 1.5 km to the south at its closest point.</p> <p>Water bodies are noted to exist to the east of the Site, within low lying areas of the former Quarry, however water is inferred to flow to the south-west and therefore these seasonal water bodies are up or cross hydraulic gradient of the Site.</p>
Pathway	
Unsaturated zone pathway characteristics (soil)	<p><u>Regional geology:</u></p> <p>The Department of Environment, Water and Natural Resources (DEWNR) surface geological map (1:100,000), indicates that the Site is underlain by undifferentiated Tertiary rocks. The upper lithology is known to comprise sands.</p> <p>The sands were historically excavated at various quarry locations along Halls Road, resulting in excavations which were then, in some instances, sold off for use as landfills.</p> <p><u>Site geology:</u> The Site comprised fill generally to depths of 0.2 mbgl, however deeper fill was encountered in the southern end of the Site, particularly the south-central and southern-eastern corner, to depths of 3.8 mbgl. Shallow fill comprised gravelly sands and silts. Deeper fill comprised sands, grey-brown, fine to medium grained with inclusions of brick, metal, plastic, hessian and gravels.</p> <p>Underlying natural soils comprised sand and sandy clay, moderate plasticity, fine to medium grained.</p> <p><u>Preferential pathways:</u> Migration along porous lithologies and underground services and are considered to be the primary preferential pathway for contaminant migration in the unsaturated zone. No significant groundwater impacts have been encountered, based upon the existing site soil and groundwater data.</p>
Saturated zone pathway characteristics (groundwater)	<p><u>Elevation:</u> Standing water was not encountered within the on-site well (30 m deep) during the 2023 gauging event, but was historically recorded between 27.5 and 34 mBTOC.</p> <p>A search of WaterConnect (May 2024) indicated the closest wells to the Site (within 0.5 km) were installed within the T1 aquifer (where listed) to depths to 96 metres. Standing water levels were at least 19 mbgl. Wells installed for 'construction materials' at the former Holcim Quarry to the east (across Halls Road) were installed shallower (T1 listed) however no mAHD was provided. No evidence of perched water zones were identified in the WaterConnect data.</p> <p><u>Flow direction:</u> Local flow direction of groundwater beneath the Site is anticipated to be south-westerly, consistent with regional flow.</p> <p><u>Gradients:</u> Not required.</p> <p><u>Hydraulic conductivities, porosities and velocity:</u> Not required.</p> <p><u>Aquitards and deeper aquifers:</u> No driver to investigate deeper aquifers has been identified as part of the Audit.</p> <p><u>Preferential pathways:</u> Preferential pathways may exist within the water bearing zone within porous lithologies that are present (i.e. gravelly/sand lenses).</p>
Pathways (Human Health)	<p><u>Ingestion – soil:</u> Potentially complete pathway on site during remediation.</p> <p><u>Ingestion – groundwater:</u> Unlikely to be a complete pathway on site based on proposed use and depth to groundwater.</p> <p><u>Dermal contact – soil:</u> Same as Ingestion – soil.</p> <p><u>Dermal contact – groundwater:</u> Same as Ingestion – groundwater.</p> <p><u>Inhalation – dust:</u> Potentially complete pathway on site during construction and to a lesser degree off site.</p> <p><u>Inhalation – volatilisation/LFG:</u> Complete pathway on site and off site.</p>

CSM Aspect	Summary of Information Provided
Pathways (Ecological)	<p><u>Migration into on-site ecological receptors</u>: No on-site ecological receptors identified.</p> <p><u>Leaching into groundwater</u>: No evidence to indicate on-site soil impacts (localised) have leached to groundwater. Unlikely based on minor impacts and depth to groundwater.</p> <p><u>Off-site migration in groundwater</u>: Same as Leaching into groundwater.</p> <p><u>Off-site migration in surface water</u>: Unlikely to be a complete pathway.</p> <p><u>Migration into off-site ecological receptors</u>: Unlikely a complete pathway due to the distance to nearest receptor (Torrens River located 1.5 down gradient of the Site).</p>
Additional Information	
Data gaps in CSM refinements	Data gaps identified pertain to the lack of data available for the immediate off-site former landfill (currently Veolia owned). Details such a landfill depth, waste content and gas generation potential and mitigation measures are not defined, however a current gas management system is evident based upon observed flaring equipment and structures. These data gaps will be managed as part of the SRP.
Written presentation of CSM (illustrated if necessary)	A written CSM has been included within the LWC (2024a) Report, and is provided in Attachment E .
Auditor's comment	<p>The Auditor has reviewed the CSM information provided in the Consultants' Reports against the requirements detailed in SA EPA Guidelines, <i>Section 4 of Schedule B(2) of the ASC NEPM and ASTM Standard Guide for Development Conceptual Site Models for Contaminated Sites</i> (E1689, 2014).</p> <p>The Auditor considers that sufficient information has been provided to define a conceptual site model for the Site for the purpose of this IAA.</p>

8. AUDITOR'S INTERIM AUDIT RISK ASSESSMENT

The intrusive site investigations comprised the following:

- Advancing a total of 65 soil investigation locations, one groundwater bore and six gas bores, both grid-based and targeting areas of interest. Soil samples were analysed for identified contaminants of concern along with broad suites of analysis;
- The number of sampling locations exceeds the number recommended in NSW EPA 2022 *Sampling design part 1 – application, Contaminated Land Guidelines for an area of 1.85 hectares* (n = 28);
- Groundwater investigations undertaken based upon soil findings and to establish background conditions. Results indicate a low risk of contamination from on-site sources. Minor on-site concentrations of metals and nutrients in the groundwater have been reported but are considered to be the result of background concentrations; and
- Landfill gas investigations at seven on-site and two off-site locations, comprising various forms of LFG monitoring including collection of continuous and isolated LFG data. No elevated methane concentrations have been recorded, however some elevated carbon dioxide readings have been identified at one or more monitoring events. Limited off-site data has been able to be acquired, despite the efforts of LWC and AEA, therefore as part of the CEMP (which is a pre-remediation and redevelopment requirement of the SRP and this IAA) either further information must be acquired to close any residual data gaps and/or the final

LFG mitigation measures must be robust to mitigate risk posed by any migration of off-site LFG to beneath the Site, currently and into the future, for the proposed land use criteria.

The Auditor considers that the site assessments meet the requirements provided in ASC NEPM 1999 (as amended 2013) and current EPA guidelines and that the Areas of Concern identified in the Site History have been adequately assessed (with exception of LFG data gaps to be closed as part of the subsequent CEMP).

The Auditor considers that there has been sufficient assessment of the nature and extent of any site contamination to enable appropriate informed risk-based decisions aside from data gaps relating to the former off-site landfill depth and current gas management details, however these data gaps will be closed by the subsequent CEMP or managed via conservatism in any proposed on-site pre-construction measures.

Human Health

The Auditor considers that following the proposed remediation strategy, human health risks from site soils and landfill gas will be acceptable.

Environment

The Auditor considers that following the proposed remediation strategy, the remaining risks to the on-site environment will be acceptable.

Water

The Auditor considers that following the proposed remediation strategy, the risks to surface water or groundwater will be acceptable (as they are now).

9. AUDITOR'S INTERIM AUDIT OUTCOMES AND DETERMINATIONS

The Auditor considers that there has been sufficient assessment of the nature and extent of any site contamination present to form an opinion regarding what remediation may be necessary at the Site, with the exception of some data gaps relating to the off-site former landfill. The hold points in the SRP (specifically that requiring a CEMP, reviewed and approved by the Auditor) are considered adequate to ensure any data gaps and the current site soil contamination and can be sufficiently remediated.

This opinion is based on the investigations undertaken at the Site and the steps outlined in the site remediation plan which will close residual data gaps, and verify acceptable remediation outcomes.

The proposed remediation approach has been prepared in accordance with current SA EPA guidelines. The environmental management controls detailed in the SRP should adequately protect the environment from adverse impacts as a result of the remediation works, including off-site dust issues.

10. ACTIONS/RECOMMENDATIONS

The Consultant will need to prepare a CEMP that is submitted for review and endorsement by the Site Contamination Auditor prior to any remediation or redevelopment works commencing. The CEMP must include the vapour mitigation measures and appropriate construction quality assurance plan.

An Land Management Agreement (LMA) will need to be written that provides sufficient detail for the vapour mitigation works so that the consent authority can ensure it these works are implemented as part of construction of future dwellings. The LMA should be reviewed and endorsed by a Site Contamination Auditor and a letter provided from Council noting acceptance of the responsibilities in the LMA.

At the completion of the remediation, the Environmental Consultant will need to provide a completion/validation report(s) including material tracking documentation, a description of the remediation, laboratory certificates and chain of custody documentation of soil sampling, compliance and inspection note relating to any LFG mitigation measures, photographs of the works and final surveys where required, and a detailed report of the works undertaken.

11. CLOSURE

As the responsible Auditor, I am of the opinion that based on current knowledge, the proposed remediation approach should be able to make the Site suitable for the proposed use and the signed Interim Audit Advice is attached.

Please note that Interim Audit Advice does not constitute a Site Contamination Audit Report (SCAR) or Statement (SCAS) nor pre-empt or constrain the final outcome(s) of the Audit and any audit conditions. A SCAR and SCAS will be finalised when the remediation is complete.

Should you have any questions, please don't hesitate to contact me via phone (08 8223 2523) or email (phitchcock@envaud.com.au).

Yours faithfully



Phillip Hitchcock

Site Contamination Auditor (accredited pursuant to Division 4 of Part 10A of the *Environment Protection Act 1993*, No. 2009014)

Attachments

Attachment A: Audit Site Boundary

Attachment B: Diagrammatic Cross Section of Site and Off-site Landfills

Attachment C: Historical Site Features Plan

Attachment D: Soil Investigation Location Plan and Remediation Zones

Attachment E: Consultant Reports

DOCUMENT CONTROL	
Draft By / Date	Review By / Date
KK, 29 July 2024	PWH, 7/8/2024

Abbreviations

Abbreviation:	Description
ASC NEPM:	National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)
AST:	Aboveground Storage Tank
CEC:	Cation Exchange Capacity
CEMP:	Construction Environment Management Plan
CSM:	Conceptual Site Model
EPA:	Environment Protection Authority
HIL:	Human Health-based Investigation Level
HSL:	Human Health Screening Level
IAA:	Interim Audit Advice
LFG:	Landfill gas
LMA:	Land Management Agreement
LNAPL:	Light non-aqueous phase liquid
LWC:	Land and Water Consulting
mAHD:	metres Australian Height Datum
mbgl:	metres Below Ground Level
mBTOC:	metres Below Top Of the bore Casing
NAPL:	Non-aqueous phase liquid
OCPs:	Organochlorine Pesticides
OPPs:	Organophosphate Pesticides
PAHs:	Polycyclic Aromatic Hydrocarbons
PCA:	Potentially Contaminating Activity
SCAR:	Site Contamination Audit Report
SCAS:	Site Contamination Audit Statement
SRP:	Site Remediation Plan
TPH:	Total Petroleum Hydrocarbons



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Attachments



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Attachment A: Audit Site Boundary

SAPPA Parcel Report

Date Created: September 4, 2023

The South Australian Property and Planning Atlas is available at the Plan SA website <https://sappa.plan.sa.gov.au/>



Address Details

Scale ≈ 1:2257 (on A4 page)

Unit Number:

Street Number: 10

Street Name: HALLS

Street Type: RD

Suburb: HIGHBURY

Postcode: 5089

100 metres≈

The information provided, is not represented to be accurate, current or complete at the time of printing this report.

Property Details:

Council: CITY OF TEA TREE GULLY

State Electorate: MORIALTA (2014), MORIALTA (2018), MORIALTA (2022)

Federal Electorate: STURT (2013), STURT (2016), STURT (2019)

Hundred: YATALA

Valuation Number: 2800181179

Title Reference: CT5768/114

Plan No. Parcel No.: D17357A11

Zoning details next page

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Attorney-General's Department

Zone Details

Zones

Resource Extraction (Z5416) - RE

Overlays

Hazards (Bushfire - Urban Interface) (O2408) - Urban Interface

The Hazards (Bushfire - Urban Interface) Overlay seeks to ensure urban neighbourhoods adjoining bushfire risk areas allow access through to bushfire risk areas, are designed to protect life and property from the threat of bushfire and facilitate evacuation to areas safe from bushfire danger.

Hazards (Flooding - Evidence Required) (O2416)

The Hazards (Flooding - Evidence Required) Overlay adopts a precautionary approach to mitigate potential impacts of potential flood risk through appropriate siting and design of development.

Prescribed Wells Area (O4804)

The Prescribed Wells Area Overlay seeks to ensure sustainable water use in prescribed wells areas.

Regulated and Significant Tree (O5404)

The Regulated and Significant Tree Overlay seeks to mitigate the loss of regulated trees through appropriate development and redevelopment.

Traffic Generating Development (O6001)

The Traffic Generating Development Overlay aims to ensure safe and efficient vehicle movement and access along urban transport routes and major urban transport routes.

SAPPA Parcel Report

Date Created: September 4, 2023

The South Australian Property and Planning Atlas is available at the Plan SA website <https://sappa.plan.sa.gov.au/>



Address Details

Scale ≈ 1:2257 (on A4 page)

Unit Number:

Street Number: 16

Street Name: HALLS

Street Type: RD

Suburb: HIGHBURY

Postcode: 5089

100 metres≈

The information provided, is not represented to be accurate, current or complete at the time of printing this report.

Property Details:

Council: CITY OF TEA TREE GULLY

State Electorate: MORIALTA (2014), MORIALTA (2018), MORIALTA (2022)

Federal Electorate: STURT (2013), STURT (2016), STURT (2019)

Hundred: YATALA

Valuation Number: 2800181195

Title Reference: CT5768/115

Plan No. Parcel No.: D17357A12

Zoning details next page

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Government of South Australia
Attorney-General's Department

Zone Details

Zones

General Neighbourhood (Z2102) - GN

Resource Extraction (Z5416) - RE

Overlays

Affordable Housing (O0306)

The Affordable Housing Overlay seeks to ensure the integration of a range of affordable dwelling types into residential and mixed use development.

Hazards (Bushfire - Urban Interface) (O2408) - Urban Interface

The Hazards (Bushfire - Urban Interface) Overlay seeks to ensure urban neighbourhoods adjoining bushfire risk areas allow access through to bushfire risk areas, are designed to protect life and property from the threat of bushfire and facilitate evacuation to areas safe from bushfire danger.

Hazards (Flooding - Evidence Required) (O2416)

The Hazards (Flooding - Evidence Required) Overlay adopts a precautionary approach to mitigate potential impacts of potential flood risk through appropriate siting and design of development.

Prescribed Wells Area (O4804)

The Prescribed Wells Area Overlay seeks to ensure sustainable water use in prescribed wells areas.

Regulated and Significant Tree (O5404)

The Regulated and Significant Tree Overlay seeks to mitigate the loss of regulated trees through appropriate development and redevelopment.

Stormwater Management (O5710)

The Stormwater Management Overlay seeks to ensure new development incorporates water sensitive urban design techniques to capture and re-use stormwater.

Traffic Generating Development (O6001)

The Traffic Generating Development Overlay aims to ensure safe and efficient vehicle movement and access along urban transport routes and major urban transport routes.

Urban Tree Canopy (O6302)

The Urban Tree Canopy Overlay seeks to preserve and enhance urban tree canopy through the planting of new trees and retention of existing mature trees where practicable.



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Attachment B: Diagrammatic Cross Section of Site and Off-site Landfills

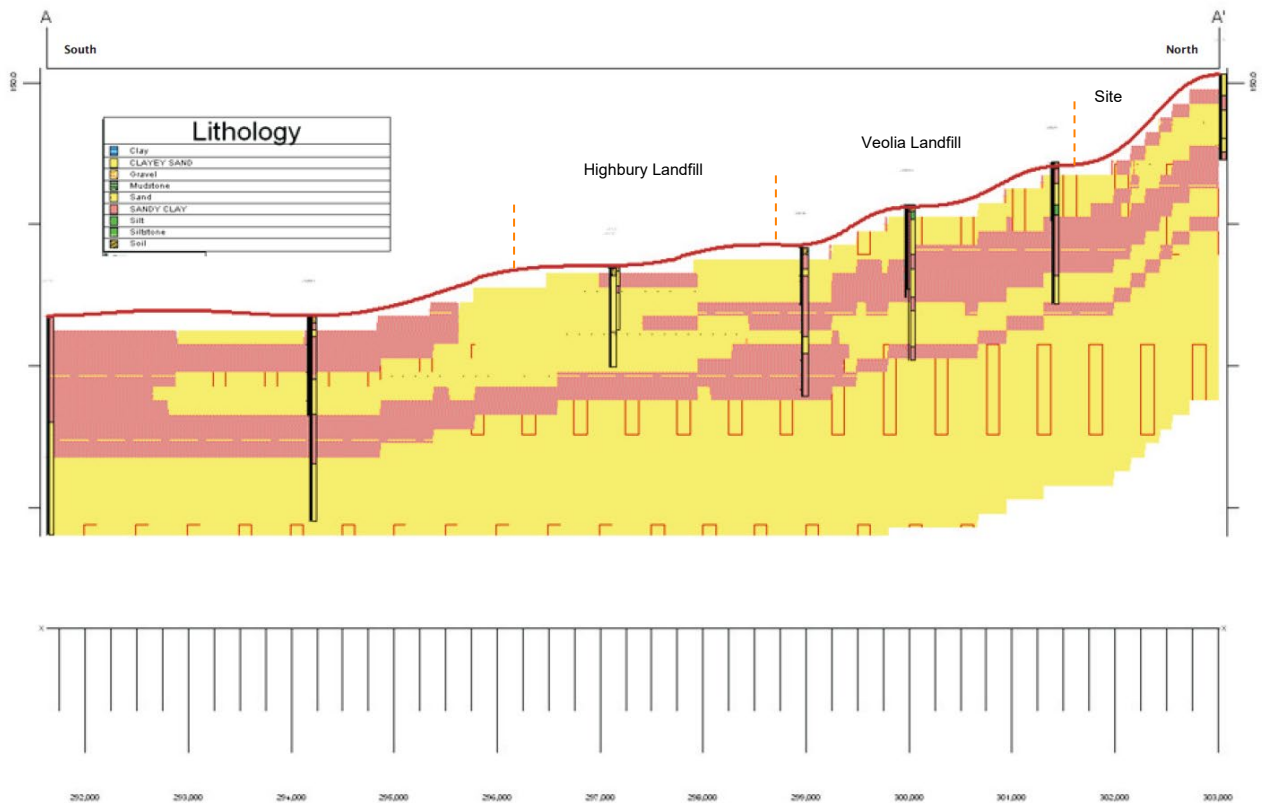


Figure 3-3 Geological Cross-Section from South to North (from SKM (2010)) – approximate boundaries added by LWC (2024)

3.3 Hydrogeology

The uppermost groundwater aquifer beneath the Site comprises sedimentary rock basins, including cavernous limestone, sandstone, sand, shale, and clay. Groundwater is expected to flow in a west to north-westerly direction, towards *Gulf St Vincent*, though there may be local complexities due to the quarrying activities in the area.

With reference to DEW (2022) *Water Connect* records, the depth to the uppermost aquifer within the vicinity of the Site is expected to be ≥ 20 m below ground level (BGL).

The DEW (2022) *Water Connect* database for a 2 km radius around the Site indicates that there are 227 registered bores, for which:

- recorded depths range from ~1 to 203.7 m BGL;
- standing water levels (SWLs) range from 1.2 to 103 m BGL;
- salinity values range from 171 to 7,479 mg/L total dissolved solids (TDS); and
- listed purposes (for groundwater bores) include:
 - domestic
 - domestic/stock
 - environmental, investigation, observation, and monitoring



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Attachment C: Historical Site Features Plan



Figure 4-1 SKM (2008a) Investigation Locations



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Attachment D: Soil Investigations Location Plan and Remediation Zones



Figure 4-3 Delineation bores 2023

The soil bores were advanced using push tube techniques with plastic inserts (i.e. rinsate check blanks not required). Samples were collected from select bores for cross check (23-3) or where anthropogenic items were observed in the recovered cores (23-6) (Table 4-2).



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Attachment E: Consultant Reports



10 – 20 Halls Road, Highbury


Site Remediation Plan

Ms Helen Mercer

July 2024



Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
DR001	Report	Dr James Fox	Dr James Fox	1 May 2024
DR002	Update inclusive of auditor comments 13 May 2024		Dr James Fox	26 June 2024
FR001	Final			22 July 2024

Project Details

Project Name	Site Remediation Plan
Project Location	10 – 20 Halls Road, Highbury
Client	Ms Helen Mercer
Client Project Manager	Belinda Monier
LWC Project Manager	Dr James Fox
LWC Project Director	Dr James Fox
Authors	Dr James Fox
File Reference	LWC OO-03 Site Remediation Plan FR001

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INDUCTION FORM

SITE REMEDIATION MANAGEMENT PLAN ACKNOWLEDGMENT RECORD LOG

All employees and contractors working in the subject area must sign the master copy of this document, indicating they have read and understand it. The signature indicates acceptance and compliance with the requirements of the Site Remediation Plan (SRP). Copies of this document must be made available for them review and readily available at the site.

Name/Job Title	Date Inducted	Signature of Acknowledgement

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1 INTRODUCTION

1.1 Background

Land and Water Consulting (LWC) was engaged by Future Urban/Hallan Nominees to prepare a site remediation plan (SRP) following the completion of a Preliminary Site Investigation (PSI ¹), additional ground gas assessment and conceptualisation / data gap review of the property located at 10-20 Halls Road, Highbury, South Australia (the Site – refer to Table 1-1). A site plan is attached.

The Site is situated within the Torrens River Catchment, approximately 14 km north-east of the Adelaide CBD, and comprises an area of approximately 1.85 hectares.

Table 1-1 Site Details

Parcel Identifier	Certificate of Title	Property Number	Street Name	Suburb
D17357A11	CT 5768/114	10-14	Halls Road	Highbury
D17357A12	CT 5768/115	16-20	Halls Road	Highbury

The northern portion of the Site (Allotment 11) is currently in use for residential purposes whereas the southern portion is vacant and undeveloped – with respect to Table 1 of *State Planning Commission Practice Direction 14 (Site Contamination Assessment 2022)* (“Practice Direction 14”), the current use of the northern portion is aligned with *Item 1: Residential Class 1 – Domestic Residential* (defined as a sensitive land use in Section 3-1 of the *Environment Protection Act 1993*).

Despite its current use, the land is zoned as Extractive Industry – it is understood that Future Urban plan to apply for residential rezoning of the Site.

A closed landfill owned and managed by Veolia is present on the immediate southern boundary of the Site and a further larger landfill owned and managed by the Highbury Landfill Authority (HLA) is present to the south of this.

The PSI identified potentially contaminating activities (PCA) associated with the Site – these were largely assessed in an extensive soil investigation/delineation program undertaken 2008 – 2010, as well as limited groundwater and landfill gas investigations at such time. However it has been ~12 years since this work was completed but both the aerial imagery and the recent site inspection observations indicate that no major changes have occurred with respect to the layout and use of the Site. The previous assessment programs did identify the following:

1. localised surficial heavy metal contamination in the north-western corner;
2. aesthetically impacted fill material in the south-eastern corner; and
3. the presence of a former landfill immediately adjacent to the southern Site boundary where the concentrations of CO₂ in landfill gas may present a risk with respect to a sensitive land use.

¹ in accordance with Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure* (1999 as amended 2013) – the ASC NEPM (1999)

Although two groundwater monitoring events were undertaken in 2008-09 (with respect to a single well located on the southern Site boundary), and there was some indication of ammonia impacts potentially associated with the adjacent landfill, the current status of groundwater beneath the Site is unknown.

The assessment/ site is under audit by Mr Phil Hitchcock as EPA GENI reference 63187.

1.2 Contaminant linkages

The (2022) PSI concluded that there were 16 potentially significant contaminant linkages/ exposure pathways associated with a sensitive land use that were unresolved since the previous Site assessment program undertaken in 2008-2010 – ten of these – L3, L4, L5, L6, L7, L8, L9, L10, L11, L12 were considered to be relatively insignificant. The other six linkages required further assessment to facilitate residential rezoning/development of the Site; these are summarised in Table 1-2.

Table 1-2 Summary of 2022 linkages

Linkage	Sources	Receptor	Pathway	Potential Significance	Status
L1	S1 - Fill	Future residents (adults and children)	Dermal contact with impacted soils	The 2008 soil investigation program involved an extensive grid-based and targeted sampling program across the Site, with only isolated/limited exceedances of Tier 1 health-based screening criteria for a low density residential land use. The detected impacts were surficial in nature and further delineated in 2009 as limited to the north-western portion of the Site. Although this issue should be addressed further, it is not considered to be significant in terms of limiting the re-zoning and/or development of the Site for residential purposes.	Soil in place – to be managed as per this SRP
L2	S1 - Fill	Future residents (adults and children)	Ingestion of impacted soils	No PCAs appear to have occurred on the Site over the period since the 2008-09 soil investigations were undertaken.	Soil in place – to be managed as per this SRP
L3	S1 - Fill	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	This issue is not considered to be significant in terms of limiting the re-zoning and/or development of the Site for residential purposes – although antimony concentrations in surficial soils exceeded the adopted Tier 1 ecological criterion in 2008, this appears to be limited to a relatively localised area and the adopted criterion may also have been overly-conservative.	Soil in place – to be managed as per this SRP

Linkage	Sources	Receptor	Pathway	Potential Significance	Status
L4	S1 - Fill	Groundwater beneath the Site	Leaching from soil	During the 2008-09 soil investigation programs, no chemical substance was reported at a concentration that would indicate the potential for leaching to groundwater.	Not significant, no further action.
L5	S2 – Coke Works	Future residents (adults and children)	Dermal exposure to impacted soils	<p>The occurrence of this PCA has not been confirmed and the activity identified (on the basis of anecdotal information only) may actually have been the use of activated carbon for water filtration rather than a “coke works”.</p> <p>In addition, no evidence of impacts likely to have stemmed from such an activity were identified during the 2008-09 soil investigation programs.</p>	Not significant, no further action.
L6	S2 – Coke Works	Future residents (adults and children)	Ingestion of impacted soils		
L7	S2 – Coke Works	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation		
L8	S2 – Coke Works	Groundwater beneath the Site	Leaching from soil		
L9	S3 – ASTs	Future residents (adults and children)	Dermal exposure to impacted soils	<p>The 2008-09 soil investigation program included sampling locations that targeted the locations of the ASTs – no potential impacts were identified and it is noted (but not confirmed) that the 5,000 L AST and bowser were stated to have never been used whereas the 20,000 L AST is understood to have been used only as a water cart.</p>	Not significant, no further action.
L10	S3 – ASTs	Future residents (adults and children)	Ingestion of impacted soils		
L11	S3 – ASTs	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation		
L12	S3 – ASTs	Groundwater beneath the Site	Leaching from soil		

Linkage	Sources	Receptor	Pathway	Potential Significance	Status
L13	S4 – landfill	Future residents (adults and children)	Migration of landfill gas to indoor air	<p>The 2010 landfill gas monitoring results for MW1_001, as well as Veolia's May 2022 results for the adjacent landfill, indicate that CO₂, and not CH₄, is the main gas now generated by the closed landfill. Although the May 2022 results indicate that the CO₂ concentrations were relatively low along the southern boundary of the Site (compared to other areas of the former landfill), one of the concentrations (2.5 %v/v at boundary location HBYPW009) exceeded the SA EPA (2019b) criterion of 1.5% v/v.</p> <p>Confirmatory monitoring would therefore be required to check the long term trends under various climate conditions/atmospheric pressures.</p>	Manage as per this SRP
L14	S4 – landfill	Future residents (adults and children)	Migration of vapour from impacted groundwater to indoor air	<p>The 2008-09 groundwater investigations involved a single well located on the southern Site boundary. With respect to the potentially relevant groundwater environmental values, the only impacts detected at that time were ammonia concentrations (during each sampling event) that exceed the current aesthetic criteria for potable and recreational water use. While it seems likely that this may be related to the adjoining landfill, the current state of groundwater beneath the Site is unknown and the limited 2008-09 testing program did not include potential volatile contaminants.</p> <p>Further monitoring is therefore recommended to assess the current state of groundwater and identify any potential associated risks.</p>	
L15	S4 – landfill	Future residents (adults and children)	Ingestion of impacted groundwater		
L16	S1 – Fill	Fill – aesthetic impacts	Not aesthetically appropriate for residential development	Fill material that is aesthetically unsuitable for a sensitive land use could be recovered and sifted to remove bricks and oversize materials for disposal.	Manage as per this SRP

The most significant (i.e. potential ability for adverse outcome with highest magnitude of harm) of these potential linkages was Linkage 13 - migration of landfill gas from the former landfill located immediately south of the Site (currently owned by Veolia – landfill is a Class 1 activity pursuant to Schedule 1 of Practice Direction 14 and is located within 60 m of the Site). There are, in fact, two former landfills within 500 m of the Site, with the Highbury Landfill being located immediately south of the Veolia Landfill.

Accounting for the Class 1 activity immediately adjacent to the Site, it was considered that a site contamination audit would likely be required, in addition to the recommendations presented below.

1. Undertake further monitoring of the landfill gas regime to assess its current status beneath the Site and confirm that the regime will not change under seasonal conditions.
2. Undertake groundwater monitoring, particularly in the vicinity of the southern Site boundary, to assess the current state of the uppermost aquifer beneath the Site, the groundwater depth and flow direction and any potential seasonal variations (i.e. in depth, flow and/or chemical status).
3. Prepare a Site Remediation Plan (SRP) to render the site suitable for the proposed residential rezoning/development (i.e. with reference to the north-western area of elevated soil metal concentrations and the south-eastern area of aesthetically unacceptable fill).
4. Prepare a report to detail the additional assessment/remediation work and assess the potential risks to the environment and human health under a sensitive land use scenario.

Task 1 has been completed though Task 2 is negated by groundwater level decrease. Task 3 has not been completed and will follow this task (Task 4). This document presents the additional assessment component of Task 4.

1.3 Purpose

The purpose of the SRP is to provide information about the project and document the remediation aims, chosen remediation option and procedures that must be implemented to achieve the remediation goals and objectives for the Site. The SRP details procedures and plans to eliminate human health risks accounting for the proposed sensitive land use and eliminate risk to both water and the environment to the extent reasonably practical.

The SRP also sets out environmental management protocols that must be implemented by all contractors/employees, to ensure that remediation actions do not contravene Section 25 (General Environmental Duty) of the *Environment Protection Act 1993*. The remedial activities must be managed such that they do not adversely impact on the health and environment of surrounding human and ecological receptors.

1.4 Key Project Stakeholders

This project relates to the future development of the Site. Key project stakeholders are considered to comprise:

- Ms Helen Mercer – Site Owner and Developer;
- Land & Water Consulting (or similar environmental consultant) – SRP Manager/ Site Representative - direct and validate the remediation works;
- The appointed site contamination auditor (review of this SRP, review of the actual remediation works and validation process/ reporting and potentially the provision of a Site Contamination Audit Report (SCAR) stating that the Site is suitable for intended use); and
- Contractor – appointed by the Site Owner to undertake demolition and earthworks (remediation).

1.5 SRP Structure

The SRP has been prepared to direct remedial works accounting for:

- Section 2: Responsibilities;
- Section 3: Site Information;
- Section 4: Site Contamination;
- Section 5: Conceptual Site Model
- Section 6: Remediation Action Plan;
- Section 7: Environmental Management Plan;
- Section 8: Work Health and Safety Considerations; and
- Section 9: SRP Monitoring.

1.6 Guidelines

A number of relevant guidelines and reference documents were referred to in preparing the SRP and include:

- **South Australian EPA (2019a), Guidelines for the Assessment and Remediation of Site Contamination** (“GAR”, see Appendix D for compliance with the GAR Remediation Reporting Checklist);
- *Environmental Protection Act 1993*, Regulations and Environment Protection Policies (EPPs):
 - Environmental Protection Regulations 2009.
 - Environmental Protection (Air Quality) Policy 2016.
 - Environmental Protection (Noise) Policy 2007.
 - Environment Protection (Water Quality) Policy 2015.
- South Australian EPA Guidelines, Technical Bulletins and Information Sheets for advice on items such as waste tracking and construction noise:
 - SA EPA, Guidelines for the Assessment of Underground Storage Systems, 2019c
 - SA EPA, General environmental noise, Updated May 2013 (EPA 424/13)
 - SA EPA, Waste Transport Certificate Guidelines, 2010.
 - SA EPA, Stormwater Pollution Prevention – Code of Practice for the Building and Construction Industry, 1999
 - SA EPA, Handbook for Pollution Avoidance on Commercial and Residential Building Sites, 2004
 - SA EPA, Guideline for Stockpile Management: Waste and Waste Derived Products for Recycling and Reuse, 2010 updated October 2020
 - SA EPA Environmental management of dewatering during construction activities (updated June 2021 – EPA 1093/21)
- Relevant South Australian Occupational, Health, Safety and Welfare legislation and guidelines:
 - *Work Health and Safety Act 2012* (South Australian State Legislation); and
 - *Work Health and Safety Regulations 2012* (South Australian State Legislation).
- SA EPA, Waste Disposal Information Sheet - Current criteria for the classification of Waste – Including Industrial and Commercial Waste (Listed) and Waste Soil, March 2010;
- National Environmental Protection (Assessment of Site Contamination) Measure produced by the National Environment Protection Council, December 1999 (as amended 2013);
- AS 4976-2008 - The removal and disposal of underground petroleum storage tanks; and
- EPA Victoria, The Design, Installation and Management Requirements for Underground Petroleum Storage Systems (UPSS), 2015.
- NSW EPA Guidelines for the assessment and management of sites impacted by hazardous ground gases (May 2020).

1.7 Relevant Documents

The requirements (scope) of the SRP were based on the conclusions / findings of the following assessment reports undertaken in relation to the Site:

- LWC (2022) Preliminary Site Investigation 10 – 20 Halls Road, Highbury SA. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees August 2022 – reference OO-01
- LWC (2023) In Situ Ground Gas Assessment 10 – 20 Halls Road. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees, September 2023 OO-01 DR003
- LWC (2024) Conceptualisation and Data Gap Review 10 – 20 Halls Road. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees, 1 May 2024 OO-02 DR003
- REM (2007) Phase 1 Environmental Site Assessment – Halls Road Highbury Hallan Nominees Land.
- SA EPA Site Contamination Index:
https://www.epa.sa.gov.au/public_register/site_contamination_index.
- SA EPA (1994) Environment Protection (Air Quality) Policy (updated in 2016).
- SA EPA (2015) Environment Protection (Water Quality) Policy.
- SA EPA (2019a) Guidelines for the Assessment and Remediation of Site Contamination.
- SA EPA (2019b) Environmental Management of Landfill Facilities: Solid Waste Disposal.
- SKM (2008a) Phase II Program - 10-14 and 16-20 Halls Road, Highbury. Report prepared for Hallan Nominees Pty Ltd, dated July 2008.
- SKM (2008a) Development Plan Amendment, Environmental Investigations Executive Summary – Highbury Residential and Open Space Development. Report prepared for Dequetteville Pty Ltd, dated 7 July 2008.
- SKM/ REM (2008). Final Report – Additional Environmental Investigations, Readymix Highbury. Prepared for Dequetteville Pty Ltd. 14 July 2008
- SKM (2010a) Additional Landfill Gas Monitoring and Soil Investigation Program - 10-14 and 16-20 Halls Road, Highbury. Draft report prepared for Hallan Nominees Pty Ltd, dated 24 February 2010.
- SKM (2010b) Voluntary Site Contamination Assessment Proposal – SITA Landfill Halls Road, South Australia Final Rev 2 21 May 2010

2 SITE DETAILS

2.1 Identification

A summary of Site particulars is presented as Table 2-1.

Table 2-1 Summary of Site Particulars

Site Location	10-14 and 16-20 Halls Road, Highbury, South Australia 5089
Property Description	The subject area of the Site is defined by the following Certificate of Titles: <ul style="list-style-type: none"> ▪ D17357AL11 Volume 5768 Folio 114 ▪ D17357AL12 Volume 5768 Folio 115 In the Area Named Highbury Hundred of Yatala Copies of the current CT are provided in Appendix B of the PSI.
Area of Site	Approximately 18,500 m ² (1.85 hectares)
Local Government Authority	City of Tea Tree Gully
Zoning	Resource Extraction (RE)
Current Site Usage	Northern portion – residential (sensitive land use) Southern portion – vacant
Ownership	<i>Hallan Nominees Pty Ltd</i>
Proposed Land Use	Re-zone to Residential

2.2 Site setting

The current surrounding land uses are detailed in Table 2-2. Generalised land use is shown in Appendix C of the PSI.

Table 2-2 Surrounding Land Uses

Boundary	Description of Surrounding Land Use
North	Residential properties
East	Former quarry, across Halls Road
South	Former landfills to immediate south (SITA/Veolia) and approximately 230 m south (Highbury Landfill Authority)
West	Residential properties

2.3 Site description

The Site comprises two allotments and slopes from north to south, with a fall of ~ 20 m along an axis approximately 150 m long. Halls Road, to the east, provides access to the Site.

The northern Allotment 11 hosts the following infrastructure:

- a two storey dwelling with garden areas that include children's outdoor play equipment;
- sheds;
- general inert materials associated with farming or earthmoving;
- two aboveground storage tanks (ASTs) understood to have been used as water tanks for dust suppression etc.; and
- an old caravan.

The southern Allotment 12 has not been subjected to any development/ improvements and hosts heathy vegetation (grass, bushes, trees).

2.4 Topography & hydrology

The survey marks dataset (detailed on The Atlas of South Australia database) indicates that the northern boundary of the Site is located at an elevation of approximately 180 m Australian Height Datum (AHD) and the southern boundary is approximately 160 m AHD – i.e. a 1 in 8 gradient, decreasing from north to south across the Site. The land to the west is generally of similar elevation whereas, to the east, the land surface falls away sharply due to the presence of a former quarry. Further to the east, the land elevation increases due to the Adelaide Hills. The land surface in general decreases to around 140 m AHD at the bottom of Halls Road.

The nearest fresh surface water body to the Site is an unnamed creek to the north which flows from east to west, down through Anstey Hill and parallel with Barracks Road. This creek would be located hydraulically up-gradient of the Site, given the reasonably sharp fall in elevation from north to south. The former quarry to the east and south-east of the Site contains various water bodies that have accumulated within the open pits.

The closest marine surface water body to the Site is Gulf St Vincent, located over 20 km to the west.

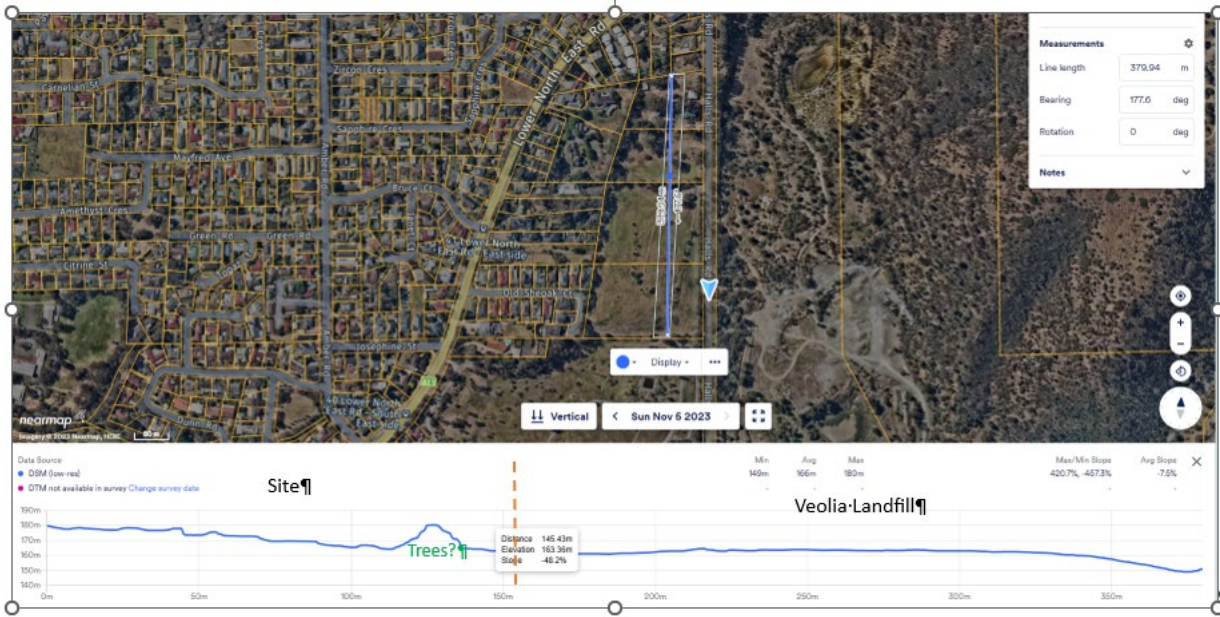


Figure 2-1 General elevation profile of the Site and the Veolia Landfill south of the Site

2.5 Geology

The Department of Environment, Water and Natural Resources (DEWNR) surface geological map (1:100,000), indicates that the Site is underlain by undifferentiated Tertiary rocks. The upper lithology is known to comprise sands that were excavated for a sand and gravel business along Halls Road, resulting in excavations which were then sold off for use as landfills.

The Atlas of Australian Soils classifies these sands as Tc1, being:

- Hilly to steep hilly, small valley plains: hard acidic yellow mottled soils (Dy3.61) with shallow grey-brown sandy soils (Uc6.11) and rock outcrops in association with variable areas of (Dy3.41 and Dy3.42), (Dy3.22), (Dr2.12 and Dr2.22) on hills and hill slopes, and minor areas of (Dy3.61) containing ironstone gravel in the A horizons on some ridge tops; unclassified alluvial soils, peats (0), and acid swamp soils (0) in the wetter valleys.

The CSIRO Atlas of Australian Acid Sulfate Soils indicates that there is an extremely low probability (1-5%) of occurrence of acid sulfate soils.

Table 2-3 Geology of the Site and Surrounding Area

Name	Description	Parent Name	Province	Age	Distance (m)	Direction
Unnamed	Undifferentiated Tertiary rocks		Unknown	Tertiary	0	On-site
Stonyfell Quartzite	Quartzite, feldspathic, with shale interbeds; silty sandstone in part schistose and calcareous	Bungarider Subgroup	Adelaide Geosyncline	Neoproterozoic	306	East
Unnamed	Undifferentiated calcrete	Unnamed	Unknown	Pleistocene	769	West
Keswick Clay	Clay, smectite-rich, grey green, with red or yellow mottling and rare sand lenses	Unnamed	St Vincent Basin	Pleistocene	833	West

Name	Description	Parent Name	Province	Age	Distance (m)	Direction
Woolshed Flat Shale	Shale, black; dolomitic siltstone; dolomite; grey laminated siltstone	Bungarider Subgroup	Adelaide Geosyncline	Neoproterozoic	901	East
Unnamed	Undifferentiated Quaternary rocks		Unknown	Pleistocene-Holocene	932	South-west

2.6 Hydrogeology

A shallow perched discontinuous aquifer is present across the Site at a depth of perhaps around 6 – 9 m below the surface. However, the uppermost groundwater aquifer beneath the Site comprises sedimentary rock basins, including cavernous limestone, sandstone, sand, shale, and clay. Groundwater is expected to flow in a west to north-westerly direction, towards *Gulf St Vincent*, though there may be local complexities due to the quarrying activities in the area.

With reference to DEW (2022) *Water Connect* records, the depth to the uppermost aquifer within the vicinity of the Site is expected to be ≥ 20 m below ground level (BGL).

3 RESPONSIBILITIES

The SRP provides details of responsibilities and procedures for managing environmental issues during remediation works at the site, with consideration to contamination exposure risks and environmental impacts at the site.

A number of personnel will be responsible for the implementation of the SRP:

3.1 Environmental Consultant

Land & Water Consulting – SRP Manager and SRP Environmental Consultant

The SRP has been formulated by LWC. LWC is responsible for ensuring compliance with the SRP by all employees, site visitors and sub-contractors. LWC will document progress in terms of environmental compliance as required.

The SRP Manager is responsible for ensuring that all site works adhere to the requirements outlined in the SRP and ensure that any activity on the Site involving exposure to potentially contaminated areas is undertaken in a controlled and safe manner (including all necessary workplace health and safety (WHS) and environmental requirements). This is achieved by:

- Ensuring relevant parties are made aware of the content and requirements of the SRP, including the Site procedures and forms, and environmental awareness induction (including importance of incident reporting); and
- Implementing a formal process of approval and documentation.

The SRP Site Representative will supervise all remediation works and work collaboratively with the appointed Site Contamination Auditor and all sub-contractors.

The SRP Manager is required to verify on the completion of the works that works were undertaken in accordance with the SRP.

The SRP Manager is responsible for ensuring that all employees and contractors are made aware and act within the requirements of the SRP.

The environmental consultant is responsible for:

- Direction of the implementation of the remedial scope;
- Environmental monitoring during the remediation;
- Environmental incident documenting and reporting (to the site owner, the site contamination auditor and the Environment Protection Authority, including any regulatory notifications);
- Identification of corrective action;
- Oversight of implementation of corrective action;
- Validation of remedial works (sampling and analysis, environmental observations);
- Remediation Validation Reporting.

3.2 Site Contamination Auditor

Mr Phil Hitchcock (Australian Environmental Auditors) - Site Contamination Auditor

The role of the Site Contamination Auditor (the Auditor) is to independently and objectively examine and review the accuracy and completeness of the remediation and/ or assessment work carried out by the SRP Manager/ Environmental Consultant and to complete a site contamination audit report (and statement), in accordance with the requirements of the EP Act, the EP Regulations and relevant guidelines issued or approved by the EPA. The Auditor is required to:

- Review and endorse the SRP;
- Confirm that the proposed remediation should achieve an acceptable outcome that will enable the completion of the audit;
- Confirm that the proposed strategies for environmental management of any on-site remediation adequately protects human health, property and the environment during remediation activities.

Further information regarding the roles and responsibilities of the Auditor are detailed in EPA (2015) Site contamination auditors information sheet (EPA 664/15).

3.3 Earth-moving Contractor

Employees and Contractors

Each employee and contractor shall be responsible for working within the requirements of this SRP, endeavour to avoid work practices that are damaging to the environment and identify and report any environmental problems to the SRP Manager. Each contractor and employee undertaking remediation works shall:

- be responsible for working within the requirements of the SRP;
- avoid work practices which may adversely impact on the health and environment of surrounding human and ecological receptors.; and
- identify and report any environmental problems to the SRP Manager.

Contractors, employees and anyone involved in undertaking or observing the remediation works will be required to be appropriately inducted on how the issue of exposure to any contamination will be managed (including any WHS and environmental precautions).

3.4 Environmental Awareness Induction

All parties/ personnel involved in remediation works shall be made aware of the requirements of the SRP including incident reporting and prior to commencing site works shall sign a compliance agreement.

The induction shall be facilitated by the SRP Manager and shall be undertaken by all site workers likely to be present during the bulk of the remediation works.

Subcontractors and other personnel that are likely to have only limited involvement with the remediation process shall undergo a site induction on arrival to site with the SRP Site Representative (appropriate person appointed by the SRP Manager).

Copies of the SRP, induction notes (and associated documents) shall be made available and accessible to all site personnel for reference and review.

The purpose of the induction is to ensure that employees and contractors are made aware of the environmental and health risks associated with remediation activities on-site and how best to manage these risks. The induction shall also address how to manage work practices that may adversely impact on the health and environment of surrounding human and ecological receptors. Records detailing training attendees and the content of the training/induction will be kept.

The induction shall cover:

- Schedule of activities and personnel responsibilities;
- Site control procedures;
- Contaminants and hazard identification;
- Exposure risk;
- Protective equipment usage;
- Decontamination procedures;
- Implementation of environmental controls;
- Incident reporting;
- Enterprise management (public relations);
- Designated areas and other requirements (e.g. parking, site access, etc.);
- Prohibitions (e.g. smoking, eating, etc.); and
- Emergency response.

4 SITE CONTAMINATION

4.1 Overview

Accounting for the proposed sensitive use of the Site (low density residential), the environmental values of groundwater, the outcomes of the intrusive site investigations to date (refer LWC, 2018b & LWC, 2021), and in accordance with Section 5B of the *Environment Protection Act 1993*, it is considered that:

Human Health

- Site contamination is present at the Site with respect to potential harm to the health or safety of human beings, on the grounds of concentrations of cobalt and lead in fill denoted as Zone A in the northwest corner of the Site.

Environment

- Site contamination is present at the Site with respect to potential harm to the environment, with respect to reported concentrations of copper, lead, zinc, benzo(a)pyrene and TRH in soil, accounting for the proposed land use (sensitive, low density residential).

Water

- There is no indication that actual or potential harm exists with respect to water beneath the Site.

4.2 Fill Zones A and B – Soil Contamination

These linkages relate to exposure pathways associated with chemical substances in fill, within the northwest corner of the Site.

The 2008 soil investigation program involved an extensive grid-based and targeted sampling program across the Site, with only isolated/limited exceedances of Tier 1 health-based screening criteria for a low density residential land use. The detected impacts were surficial in nature and further delineated in 2009 as limited to the north-western portion of the Site.

Only three locations reported concentrations of metals (cobalt, lead, zinc and antimony) that exceeded one or more of the adopted health-based and/or ecological guidelines in 2008 (prior to revision of soil screening criteria in 2013 – the exceedances (as detailed in Table 4-1) were identified in the north-western corner of the Site (adjacent to a storage shed) and in the roadways adjacent to the shed.

The ASC NEPM (1999) Tier 1 soil screening levels were revised in 2013, resulting in the following reinterpretation of the results:

- Tier 1 criteria for cobalt and lead in a low density residential land use scenario was unchanged (i.e. 100 mg/kg and 300 mg/kg, respectively); identified exceedances remained.
 - Cobalt only marginally exceeds the tier 1 criteria and is relatively trivial
- Zinc would not exceed the current Tier 1 health investigation level (HIL) of 7,400 mg/kg for residential land use, the highest concentration (1,000 mg/kg) result may exceed a site-specific ecological criterion (which would need to be calculated based on site-specific soil parameters).

The concentrations of antimony were compared to a Tier 1 ecological screening criterion provided by the Netherlands Ministry of Housing, Spatial Planning, and the Environment (MHSPE) – i.e. the intervention value of 15 mg/kg, as opposed to the soil target value of 3 mg/kg. By comparison the United States Environment

Protection Authority (US EPA, 2005) lists an ecological screening level of 78 mg/kg for soil invertebrates and 0.27 mg/kg for mammalian receptors, the latter being generally lower than laboratory detection limits (so its suitability is questionable).

Additionally, low pH soil was encountered in two locations. As the lowest pH (4.9) was reported at a depth of 1.6-1.9 m BGL, it would not be expected to have a significant impact on a future residential site use. The other low pH value, reported in a surficial soil sample, was the only evidence of low pH within the upper 1.6 m of the soil profile and was therefore not considered significant. In addition, a total of 13 of the 33 soil samples tested reported a soil pH greater than 8.5.



Figure 4-1 SKM (2008a) Investigation Locations

Table 4-1 Summary of Chemical Substances Exceeding a Soil Screening Level in the 2008 data (SKM, 2008a) (mg/kg)

2008 Location	Antimony	Cobalt	Lead	Zinc
Guideline Criteria	15 ¹	100 ²	300 ²	200 ³
SB1_004	51	No exceedance	380	No exceedance
SB1_006	37	130	No exceedance	1000
SB1_007	110	130	530	560

Notes

¹ Dutch Intervention Level

² ASC NEPM Health Investigation Level A

³ ASC NEPM Ecological Investigation Level (urban residential and public open space)

As reported in SKM (2010), soil delineation works were undertaken in 2009, with respect to exceedances of the Tier 1 soil criteria reported in 2008 and the potential aesthetic issues associated with the fill material. This work comprised the drilling of 16 delineation soil bores (Figure 4-2).

Delineation soil bores DB01 to DB03 were drilled in the north-western corner of the Site to vertically delineate the heavy metal contamination identified in surficial samples (0.0-0.1 m BGL) obtained from soil bores SB01_004, SB01_006 and SB01_007 drilled by SKM in 2008 (Table 4-1).

Although DB01 and DB02 did not report any elevated concentrations of heavy metals throughout the entire soil profile, and therefore did not reflect the heavy metal concentrations reported by SKM (2008a), this may be attributable to the heterogeneity of the fill material located in the top 10 cm of the soil profile in this area.

Delineation soil bore DB03 reported a lead concentration of 980 mg/kg, in excess of current ASC NEPM (1999 revised 2013) HIL A of 300 mg/kg, in fill soil sample from depth 0-0.1 m BGL (surface). However, soil samples from 0.1-0.3 m BGL and 0.6-0.8 m BGL reported lead concentrations below adopted guideline values, thereby indicating that elevated lead concentrations are not present within the natural soil profile and are surficial (possibly attributable to flakes of lead paint from the shed or inherent to the fill material). All remaining heavy metal concentrations were reported below laboratory limits of reporting (LOR) and/ or adopted guidelines.

It was considered unlikely that elevated heavy metal concentrations are present within the natural soil profile.

Potential aesthetic issues were also identified in fill material, mainly located in the central and south-eastern portions of the Site, and associated with the presence of cement, bitumen, bricks and plastic – the extent of which was delineated by a combination of the initial 2008 and supplemental 2009 works (i.e. DB04-DB09 and DB12-DB16). Soils within the central portion of the Site generally consisted of brown sandy clay underlain by brown, orange, or cream sand/clayey sand – aesthetically impacted material (comprising bricks) was observed in soil bore DB10 only. However fill material consistent with that observed during the 2008 investigation was encountered in soil bores DB07 to DB12. The depth of fill material in these soil bores ranged between 1.4 m BGL (DB08) to 2.1 m BGL (DB07). The volume of aesthetically impacted fill material in the area outlined in Figure 4-2 was approximated at 4,700 m³.

Delineation soil bores DB10 and DB11 were installed in the vicinity of groundwater monitoring well MW1_001 to assess whether soil beneath the Site was acting as a source of ammonia to groundwater. The analytical results reported ammonia, nitrate, and nitrite concentrations below LOR in all of the soil samples analysed. Based on total Kjeldahl nitrogen (TKN) analysis (and noting that ammonia was below LOR), it was considered that the soil nitrogen was present as organic nitrogen. This form of nitrogen is a result of both fixation of N₂ from the atmosphere (hence highest concentrations in the surficial layer, which most likely represents the nitrogen component of the organic matter content of the soil) and the breakdown of amino acids and other organic nitrogen sources (e.g. proteins and urea). Based on the low TKN concentration at depth it was considered unlikely that the nitrogen identified in the surficial soil would impact groundwater quality beneath the Site.

No potentially contaminating activities (PCAs) appear to have occurred on the Site over the period since the 2008-09 soil investigations were undertaken (LWC, 2022).

LWC undertook further soil bores in October 2023 to delineate the northwestern metals and tighten up the aesthetic fill estimation. Bores 23-1 to 23-10 were advanced to confirm and tighten up the aesthetic fill volume referred to as Linkage 16. Bores 23-11 to 23-13 were targeted to delineate lead in the northwest corner (Figure 4-3) as reported in SB01_004 and SB01_007 drilled by SKM in 2008 and in DB03 (SKM, 2010).



Figure 4-2 Delineation bores and aesthetic fill extent (2009)



Figure 4-3 Delineation bores 2023

The soil bores were advanced using push tube techniques with plastic inserts (i.e. rinsate check blanks not required). Samples were collected from select bores for cross check (23-3) or where anthropogenic items were observed in the recovered cores (23-6) (Table 4-2).



Figure 4-4 Coordinates of Zone A

Table 4-2 2023 sample analysis rationale

Sample	Analysis	Rationale
23-3 0.0-0.1	Metals and Total Recoverable Hydrocarbons (TRH)	Check sample for natural
23-3 0.4-0.5	Metals and Total Recoverable Hydrocarbons (TRH)	Check sample for natural
23-3 0.6-0.7	Metals and Total Recoverable Hydrocarbons (TRH)	Check sample for natural
23-6 1.9-2.1	Metals, TRH, pesticides, PAH, PCB, phenol	Anthropogenic items observed in the core: <ul style="list-style-type: none"> ▪ Trace plastic label (plant pot label) ▪ Metal fragment ▪ Hessian sack
23-11 / 0.0-0.1	arsenic cadmium chromium copper lead mercury nickel zinc	Delineation of previously identified lead (Pb)
23-12 / 0.0-0.1		
23-13 / 0.0-0.1		

No chemical substance was reported above either laboratory limit of reporting and/ or tier 1 soil screening criteria selected for screening for suitability for sensitive land use (i.e. human or ecological receptors) (refer Table 1 at rear) other than Lead in surface soil in and around the northwest shed reported at concentrations above the ASC NEPM Health Investigation Level A (300 mg/kg) in previous assessment and required further delineation (Linkage 1 and 2). This was achieved and the lead in soil here is adequately delineated laterally to be below Health Investigation Level A. Vertically, lead is delineated to within the top 10 cm of the soil. The maximum concentration of lead identified (2008 onwards) was 980 mg/kg therefore soil in this area (following

the removal of the shed) can be skim stripped and disposed off-site as Intermediate Waste Soil (IWS; note the IWS criterion for lead is 1200 mg/kg).

The aesthetic soil in the southeastern corner of the Site may also be removed from Site if not able to be placed beneath dwelling footprints or roadways and could be managed as Intermediate Waste Soils also given the chemical concentrations are less than the IWS criteria. The aesthetically impacted fill is not chemically onerous.

The fill here is understood to be from a plant nursery owned by the Mercer family and this was supported as inclusions observed in recovered soil cores included plant labels typical of potted plants being sold at a plant nursery. Where such soil is 'covered' by the footprint of a dwelling then there would be no aesthetic limitations (though geotechnical issues may need to be discussed with a suitably qualified geotechnical engineer). This issue can be reviewed where a specific development plan is being contemplated.

The nature and extent of soil contamination referred to as Fill Zones A and B are summarised in Table 4-3.

Table 4-3 Soil contamination nature and extent

Nature	Extent	Requires Management?
Fill Zone A Comprising chemicals (lead – human health). Human health lead environment (ecology) copper, zinc	Laterally – 50 m² Vertically – 0.1 m	Yes – see section 6 (note – could be excavated and replaced under roadways)
Fill Zone B Human health aesthetics environment (ecology) none	Laterally – 5000 m² Vertically – average of 0.5m	Potentially if material is in gardens / accessible – potentially not if beneath dwellings and not accessible (visible). Could be sieved and replaced.

4.3 Ground gas

Linkage 13 considered risk of migration of ground gas to indoor air of future sensitive land use. The objective of the January 2023 in situ ground gas assessment was to characterise the ground gas at the Site in association with varying atmospheric pressures. This was achieved using GasClam continuous ground gas loggers. The ground gas does show variability as a function of atmospheric pressure. The lowest pressure recorded was 981 mb – this is considered a suitably low pressure to represent a worst case ground gas regime.

The characteristic situation (CS) for ground gas beneath the Site is driven by carbon dioxide and is calculated as CS2 on the basis that carbon dioxide in the ground exceeds 5% vol/vol (maximum is 15.6%). The 2023 ground gas monitoring data plus previous 2008-2010 data and data obtained from Veolia for May 2022 regarding landfill monitoring bores (around the periphery of the landfill) indicates methane is not present – the gas generation stage of the landfill is not clear but is likely to be quite progressed given it was capped in ~1994.

As landfill gas flaring is currently undertaken, the post flaring gas scenario is unknown.

Passive venting and low calorie flaring are expected to continue for several years / indefinitely. It is expected that the EPA regulatory guidance (SA EPA 2019) would be in force which requires limitation of gas concentrations in monitoring bores at the boundary of the landfill facility or within structures located on or off site to less than 1% methane by volume or 1.5% carbon dioxide by volume. The latter is somewhat ambiguous to control given natural soil respiration / organic matter degradation can provide an elevated background CO₂ signature.

A theoretical calculation of the methane in the adjacent landfill is provided in Appendix E-2 of LWC (2024) in lieu of direct information provided by the current apparent operator (Ennovo). Such calculation indicates that boundary methane at the boundary between the Site and the VL may be between 0.3 and 0.6 % assuming no extraction, which would fit the current profile of measurements on site and in northern perimeter bores, noting extraction is taking place; the benefits of extraction may not be truly seen in an ageing low calorie landfill at perimeter where highest content of methane is likely to be in the most dense / voluminous zones of the waste mass e.g. centrally.

LWC (2024) considered that there is no further benefit to additional monitoring of the landfill gas generation source nor on site ground gas profile, and that resources are best focused on developing building controls sympathetic to the future residential development mindful of a post flaring scenario.

LWC (2024) considered that the CS2 classification may be reconsidered in light of future potential risk from offsite gas post cessation of landfill gas flaring, to provide an increased level of ground gas protection.

5 RISKS POSED BY SITE CONTAMINATION

A detailed conceptual site model is presented in LWC, 2023 and is not re-iterated in its entirety here. A summary is presented in Section 5.2 highlighting those contaminant linkages that require remediation. It is assumed that any person reading this is of a sufficient technical background to understand the nature and purpose of a conceptual site model and the term 'linkages'. Please refer to Table 5-1.

As a result of risks associated with ground gas, all dwellings must have gas mitigation measures installed prior to occupation.

Table 5-1 Risks from the identified site contamination

Contamination	Hazard
Lead in surface soil at concentrations above ASC NEPM Health Investigation Level A	<p>Exposure to lead can lead to a range of health problems, especially in children, including:</p> <ol style="list-style-type: none"> 1. Developmental Delays: Lead exposure can affect a child's cognitive development, leading to learning difficulties and behavioural problems. 2. Lower IQ: Chronic exposure to lead can result in a decrease in intelligence quotient (IQ). 3. Nervous System Damage: Lead can cause damage to the nervous system, leading to symptoms such as headaches, irritability, and fatigue. 4. Anaemia: Lead exposure can interfere with the production of haemoglobin, leading to anaemia. 5. Kidney Damage: Prolonged exposure to lead can damage the kidneys. 6. Reproductive Effects: Lead exposure can affect fertility in both men and women.
Potential elevated concentration of methane	<p>Elevated concentrations of methane in soil gas can pose several risks to dwellings and their occupants, particularly when methane migrates into confined spaces within buildings. Methane is a colourless, odorless gas that is highly flammable and can displace oxygen, leading to potential safety hazards. Here are some of the risks associated with elevated concentrations of methane in soil gas:</p> <ul style="list-style-type: none"> ▪ Fire and Explosion Hazard: Methane is highly flammable, and when present in sufficient concentrations in enclosed spaces within buildings, it can create an explosion risk. Even a small spark, such as from electrical

Contamination	Hazard
	<p>appliances or a pilot light, can ignite methane gas if it has accumulated to dangerous levels.</p> <ul style="list-style-type: none"> ▪ Asphyxiation: Methane is lighter than air and can displace oxygen in enclosed spaces, leading to a decrease in oxygen levels. In extreme cases, this can result in oxygen-deficient atmospheres, which pose a risk of asphyxiation to occupants. ▪ Structural Damage: In some cases, the migration of methane into buildings can lead to corrosion of metal components, such as piping or structural supports, particularly if hydrogen sulfide is also present in the soil gas. This corrosion can compromise the structural integrity of the building. ▪ Indoor Air Quality: Even at non-dangerous levels, methane gas can contribute to poor indoor air quality, leading to discomfort and potential health effects for occupants. Additionally, methane can serve as an indicator of the presence of other potentially harmful gases, such as volatile organic compounds (VOCs)
<p>elevated concentration of carbon dioxide</p>	<p>Elevated concentrations of carbon dioxide (CO₂) in soil gas can pose several risks to dwellings and their occupants, although these risks are generally less acute compared to those associated with methane. However, high levels of CO₂ can still have significant implications for indoor air quality and occupant health. Here are some of the risks associated with elevated concentrations of carbon dioxide in soil gas:</p> <ul style="list-style-type: none"> ▪ Indoor Air Quality: Carbon dioxide is a colourless, odorless gas that can accumulate indoors when it migrates from the soil into buildings. Elevated levels of CO₂ can contribute to poor indoor air quality, leading to discomfort, headaches, dizziness, and fatigue among occupants. Prolonged exposure to high CO₂ levels may also impair cognitive function and decision-making ability. ▪ Health Effects: While CO₂ itself is not toxic at typical indoor concentrations, prolonged exposure to elevated levels can lead to health effects, especially in sensitive individuals such as children, the elderly, and those with respiratory conditions. Additionally, high CO₂

Contamination	Hazard
	<p>levels may exacerbate symptoms of asthma and other respiratory ailments.</p> <ul style="list-style-type: none"> ▪ In extreme circumstances in small / enclosed spaces with little or no airflow, CO₂ can lead to asphyxiation by exclusion of oxygen in the space. ▪ Building Pressurization: In buildings with inadequate ventilation, elevated CO₂ levels can indicate poor air circulation and ventilation. This can lead to a buildup of other indoor air pollutants and contribute to the proliferation of mold, mildew, and other indoor contaminants. ▪ Occupant Comfort and Productivity: High levels of CO₂ can impair indoor air quality and comfort, leading to reduced productivity and concentration among occupants. Studies have shown that elevated CO₂ levels can negatively impact cognitive function and decision-making ability, potentially affecting work and academic performance.

6 REMEDIATION ACTION PLAN

6.1 Remediation Objective

The primary objective of this remediation program is to remediate the Site in accordance with the definition of remediation provided in Section 3(1) of the EP Act.

The EP Act defines remediation as:

Treat, contain, remove or manage chemical substances on or below the surface of the site so as to –

- a) *Eliminate or prevent actual or potential harm to the health and safety of human beings that is not trivial, taking into account current or proposed land uses; and*
- b) *Eliminate or prevent, as far as reasonably practicable –*
 - i. *actual or potential harm to water that is not trivial; and*
 - ii. *any other actual or potential environmental harm this is not trivial, taking into account current or proposed land uses.*

With reference to EPA (2019a), the soil works to be undertaken at the Site are considered to meet the definition of an active remediation approach ('remove').

With respect to an offsite ground gas source, the remedial approach is likely to be 'manage' as the idea would be to prevent ingress to buildings, but not treat, contain nor remove.

6.2 Remediation Goals

The goals of the remediation works are to address the following:

1. Remove potential risks to the proposed sensitive land use posed by the presence of small volume of lead in surface soils in the northwest corner to render the Site suitable for sensitive land use.
2. Eliminate on site risk to future human receptors in a sensitive land use setting that may occur via ground gas intrusion to future dwellings.
3. Undertake the remedial works such that:
 - a) The risks to human health from such site contamination are eliminated; and
 - b) All works are undertaken in accordance with relevant regulatory provisions and guidance.

In essence, the remediation goals are to:

- **Eliminate or prevent risks posed to human health by soil (lead) and ground gas contamination on and under the Site.**

6.3 Remedial Options Assessment

CRC CARE (2018) notes that a screening exercise should be undertaken to assess what contaminants particular technologies can treat, and what medium they are effective in (i.e. soil, groundwater) to assemble a list of potential treatment options. Preliminary screening allows multiple remediation options to be appraised, and efficiently discounts those which are clearly not viable for the site, or will not meet the established remediation objectives.

6.3.1 Soil and Ground Gas Remediation

The chemical substances requiring remediation in soil are:

- Lead; and
- Methane and carbon dioxide

For soil-borne metal contaminants, the following remedial options are considered:

- Containment
- Chemical immobilisation and solidification
- Excavation (and disposal)

A detailed description of these remedial technologies can be found in Appendix A of CRC CARE (2018). A screening matrix of suitability of such technologies per chemical substance type is presented as Table 6-1.

Table 6-1 Remedial options summary (after CRC CARE, 2018) for groundwater and soil based contamination

Media	Technology	Inorganics (including metals)	Petroleum hydrocarbons	Volatile organic compounds	Semi volatile organic compounds	PAHs
Soil	Bioremediation	?	Y	Y	Y	?
	Chemical immobilisation and solidification	Y	?	?	?	?
	Containment	Y	Y	Y	Y	Y
	Excavation	Y	Y	Y	Y	Y
	Soil vapour extraction	N	Y	Y	?	?
	Soil washing	?	?	?	?	?
	Thermal desorption	N	Y	Y	Y	Y
Groundwater	Barrier systems	Y	Y	Y	Y	?
	In-situ air sparging	N	Y	Y	Y	Y
	In-situ chemical oxidation	N	Y	Y	Y	?
	Monitored Natural Attenuation	?	Y	Y	?	Y
	Pump and treat	Y	Y	Y	Y	Y
	Skimming	N	Y	Y	Y	N
Legend: Y - Viable remediation option ? - Potentially viable remediation option (less common or demonstrated) N - Not viable remediation option (or not known / demonstrated)						

6.3.1.1 Fill Zone Remediation

With respect to the fill material containing lead, given that the proposed site layout design for the proposed development is not available (not yet formulated), Table 6-1 indicates the following options are likely appropriate based on volume:

1. Containment beneath roadways or within open space area; and
2. Excavation and disposal

It may be possible to excavate the fill and contain within an open space area and managed using a Site Management Plan (this could be difficult to enforce across privately held land). Alternatively, such fill could be placed beneath roadways, which would not then require a Site Management Plan as concentrations would be less than Health Investigation Level D.

This containment option could be considered later (when development plans become available) and submitted to the auditor for review and approval. For now excavation is preferred

6.3.1.2 Ground gas

Due to the offsite source of ground gas, physical intervention is the appropriate option to protect indoor / enclosed air spaces: Gas mitigation systems are required.

CRC CARE (2018) notes that a screening exercise should be undertaken to assess what contaminants particular technologies can treat, and what medium they are effective in (i.e. soil, groundwater) to assemble a list of potential treatment options. Preliminary screening allows multiple remediation options to be appraised, and efficiently discounts those which are clearly not viable for the site or will not meet the established remediation objectives.

Wilson et al., 2014 provides guidance on selecting a membrane, considering the most appropriate combination of properties and ensure that the desired performance can be achieved and demonstrated.

Membrane selection criteria are summarised in Figure 6-1 which is reproduced from Wilson et al., 2014.

Based on correspondence from the auditor, it is understood that Interim Audit Advice from the auditor, could be prepared, that does not specify the particular design of the vapour barrier given that not all data has been identified that would specifically inform the design of the ground gas barrier for dwellings.

Therefore, a barrier is likely required due to uncertainties in the ground gas data (as a function of the nature and variability of the offsite gas source). Dwelling based ground gas protection measures must therefore be confirmed when further landfill data is provided / made available. The final design should consider the design parameters in Table 6-2 and an example barrier layer is provided in Table 6-3. The final design must be approved by an EPA accredited site contamination auditor.

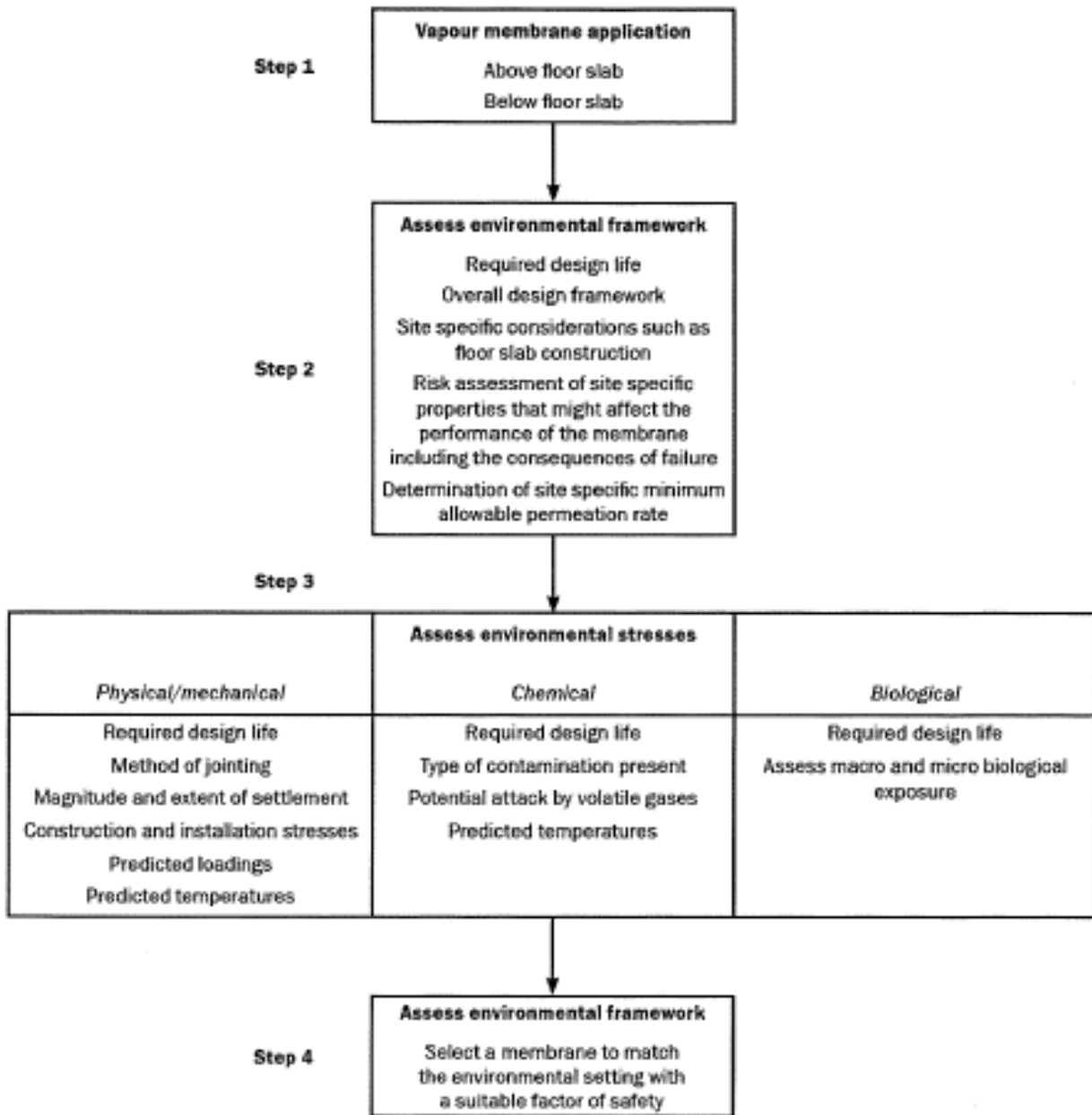


Figure 6-1 Flow chart for choosing appropriate membrane (Wilson et al., 2014 adapted from Environment Agency)

Table 6-2 Membrane design parameters to be considered (Wilson et al., 2014)

Design parameter	Discussion
Design life	Design life of chosen membrane/ components must be suitable for the development in conjunction with predicted (validated) life term of the offsite source.
Degeneration	<p>Some degeneration will occur over time due to oxidation, biological action and so forth. In practise Wilson et al., 2014 states that the reduction in performance over the design life will be minimal and unlikely to affect performance for most buildings.</p> <p>Exposure to UV light during installation should be minimised, i.e. no significant delays between membrane laying and slab pour (< 1 month).</p>
Reliance on membrane	The consequence of failure – maximum permeation rate needs to be defined.
Tensile strength	Tensile strength should be sufficient to absorb any settlement effect
Quality and robustness of installation	Verification and integrity testing required to maximise the quality of installation. Installation of any gas protection measures must be verified on accordance with CIRIA C735 92014) Good practice on the testing and verification of protection systems for buildings against hazardous ground gases as required by BS8485:2015 + A1:2019 and should be undertaken using a verification plan with hold points for inspection and testing.
Damage during and after construction	Puncture resistance, impact resistance and tear strength are important parameters – higher the better to support damage minimisation during installation.
Welded or taped seams	Overlapping method can dictate minimum thickness of membrane.

Table 6-3 Key membrane performance properties (Wilson et al., 2014)

Properties	Requirements	Example Membrane Layer: Stego Drago Wrap
Thickness	<p><1mm thick are prone to welding problems. Membrane thickness should be 1 mm if welding.</p> <p>Thinner membranes are easier to install (corners, details).</p> <p>Wilson et al 2014 suggests minimum thickness with taped joints of 0.5 mm (20 mil) provided taped joints have same permeation as the membrane proper.</p>	20 mil
Permeation rate of TCE	Defined on site specific risk assessment.	0.0078 g/m ² /hour has permeation rate of 3.5 mg/m ² /hr based on Stego documented permeation coefficient of 8.9 x 10 ⁻¹³ m ² /sec for trichloroethene.
Tensile strength	Robustness under slab where settlement is an issue – load stress. Wilson et al., 2014 suggests a tensile strength of >0.03 kN/ m width is ideal.	9.37 kN/m
Puncture resistance	<p>Most likely to occur during construction.</p> <p>Wilson et al, 2014 suggest a CBR puncture resistance of >824 N is ideal.</p>	184
Impact resistance	Wilson et al., 2014 suggest that the actual value specified for a site should be based on the risk of impact occurring and whether any damage is likely to be observed and repaired (aligns with verification and integrity testing).	These values not readily given for most market membrane – can be checked / managed via verification and integrity testing.
Tear strength	Possible tear forces during installation (plus sharp edges) Wilson et al., 2014 suggests >350N in both machine and cross direction is desirable.	These values not readily given for most market membrane – can be checked / managed via verification and integrity testing.

6.4 Preferred Remediation Options

6.4.1 Soil Contamination

The specific lay out / nature of future development is unknown at time of the development of this SRP therefore the proposed management option is removal of fill to a licensed facility.

Future development proposals may wish to consider amending this option to one of on-site retention beneath roadways, subject to site contamination auditor approval.

6.4.2 Ground Gas Contamination

Awaiting further information hopefully to be sourced from EPA regarding the Veolia Landfill and residual landfill gas profile within such landfill.

It is likely that implementation of passive ground gas extrusion membranes (or some such system) is required on residential dwellings.

The final gas ingress protection / mitigation design should consider the design parameters in Table 6-2 and an example barrier layer is provided in Table 6-3. The final design must be approved by an EPA accredited site contamination auditor.

6.5 Preparation Tasks

6.5.1 Stakeholder Engagement

All communication is to be undertaken in accordance with SA EPA (2018) Site Contamination: Guideline for Communication and Engagement. In the first instance, nearby residences are to be notified via a letter drop. A letter will be prepared by the SRP Manager in conjunction with the Site Owner and provided to the appointed site contamination auditor.

Additional community involvement and consultation may be necessary where possible nuisance or effects on the amenity of the locality, e.g. from noise, dust or odour might occur. Nuisances for short periods are generally more tolerable, but nuisance over periods of time can result in increased frustration. Hence additional measures to minimise impacts to the community may be required.

Stakeholder engagement should also include the EPA and Council and consider relevant information on off-site contamination from the site.

6.5.2 Preliminary works

The following preliminary works are to be undertaken prior to the commencement of the remediation works:

- A Site-specific Work Health and Safety Management Plan (WHSMP) including a Job Safety Environmental Assessment (JSEA) will be prepared for the remediation works **PRIOR TO MOBILISATION (See Appendix A)**.
- All underground services will be located prior to the inception of site works. Ground Penetrating Radar (GPR) will be utilised to assist in locating services and/ or the location of any underground tanks following removal of above ground buildings.

6.5.3 Site Preparation, Access and Security

Site access to the area of the proposed remediation works shall be restricted to personnel inducted into the SRP. The Site will be appropriately fenced off prior to commencement of works, using temporary fencing, bunting and warning signs, in order to restrict unnecessary workers and the general public from the work area. It is expected that the demolition contractor will affix a suitable safe work SA approved notice board to the secure perimeter fencing alerting of relevant emergency contact numbers.

Where the chainage/ continuation of the permanent fencing is not complete, temporary fencing suitable to prevent site access must be installed.

6.5.4 Demolition

All asbestos containing materials (ACM) and any other hazardous materials must be removed from any buildings scheduled for removal; such removal must be by appropriately licensed practitioners and in accordance with relevant South Australian and National Guidance. The following resource should be consulted prior to works to ensure latest regulations and guidance are adhered to:

<https://www.asbestos.sa.gov.au/>

The remediation works will occur once the above ground improvements have been demolished and removed and all ACM and hazardous materials have been removed.

Appropriate ACM clearance certificates must be provided by the independent licensed ACM inspector by the licensed ACM practitioner undertaking the works, to the SRP Manager, prior to breaking ground so as to mitigate burial/ transfer of ACM to the subsurface.

6.6 Soil Remediation Tasks

6.6.1 Fill Zones

The proposed redevelopment includes residential land use. Soil contamination that exists at the Site will be managed by excavation of contaminated material for disposal off-site, as set out in Table 6-2.

Please note, the final remedial extents shall be based on field observations and analytical results.

Soils that are considered to not be aesthetically suitable shall be excavated and stored on site separate to chemically impacted soils. This soil will be identified for re-use beneath future building slabs, footpaths, roadways.

Table 6-4 Fill Management

Nature	Extent	Approximate Volume (m ³)	Management Action
Fill Zone A Comprising chemicals (lead – human health). Human health lead environment (ecology)	See Figure 4-3 Delineation bores 2023	5 m ³	Excavate the material to 200 mm depth and transport / dispose to a licensed facility under SA EPA waste transfer protocol. Validate area (Section 6.6.2)
Fill Zone B Comprising aesthetics Human health environment (ecology)	Figure 4-2 Delineation bores and aesthetic fill extent (2009)	2500 m ³	IF REQUIRED Excavate the material to depth of 1 m but maintain careful visual assessment as some fill has been reported as deep as 2.9 m BGL. Consider: transport / dispose to a licensed facility under SA EPA waste transfer protocol; or sieve and re-compaction (likely more economical than offsite disposal). No validation required other than visual assessment.

6.6.2 Soil Contamination Validation

Following the removal of the fill the exposed fresh surface of soil must be sampled using the sampling density presented in Table 6-3.

Table 6-5 Validation Sampling Density and Analysis per Fill Zone

Nature	Approximate Area / Volume	Sample number	Analysis
Fill Zone A Comprising chemicals (lead – human health). Human health lead environment (ecology)	50 m ²	5	Lead (Pb)
Fill Zone B Comprising aesthetics Human health environment (ecology)	Not required		

Validation and stockpile soil samples will be collected using a fresh pair of nitrile disposable gloves and screened with a PID (capable of detecting VOC and TRH) in order to detect the presence of VOC (not

expected however good practice – samples >20 ppm should be considered for assessment of VOC). Soils will be logged in accordance with Australian Standard 1726:2017 Geotechnical Site Investigations.

Soil samples will be placed into chilled clean laboratory jars and sent under chain of custody protocol to appropriately accredited laboratories.

Field QA/QC samples will include the following:

- A minimum of one blind coded intra-laboratory duplicates and one blind coded inter-laboratory duplicate (i.e. 1:20 intra-laboratory and 1:20 inter-laboratory duplicates).
- Laboratory supplied trip blanks will accompany both the primary and secondary samples for testing of volatile analysis (TRH Fraction C6-C10). The purpose of a trip blank is to confirm that no contamination is being introduced during shipping and field handling procedures and are typically only analysed for volatile compounds.
- Use fresh pair of disposable gloves per sample, it is considered that the potential of cross-contamination between sample locations will be mitigated and, as such, no rinsate samples are required to be collected/ analysed.

LWC will submit validation samples to a National Association of Testing Authorities (NATA) accredited laboratory for the above analysis.

Sampling of the walls of the excavations (not just base) will be completed to demonstrate that the full lateral extent of contaminated soils has been removed.

6.6.3 Validation Criteria

The validation criteria to be adopted for this scope of works is presented in Table 6-6 and is sourced from Schedule B1 of the National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) (1999, as amended 2013) human health and ecological protection criteria for low density residential land use (sensitive land use). These are summarised as follows:

Human Health – Sensitive Land Use: Low Density

- ASC NEPM (1999, as amended 2013) Health Investigation Level (HIL) A and Health Screening Levels (HSL (0-1 m) A/ B SAND (in first instance).
- ASC NEPM (1999, as amended 2013) Management Limits for TPH Fractions F1-F4 in soils for residential, parkland and public open space.
- Friebel, E and Nadebaum, P. (2010) Soil Health Screening Levels for Direct Contact Criteria and HSLs for vapour intrusion for intrusive workers – Appendix A of CRC CARE (2010).

Environment (Ecology) Protection

- ASC NEPM (1999, as amended 2013) Ecological Investigation Limits and Ecological Screening Levels (EILs and ESLs) for urban residential land use and public open space (including site specific derived EIL) (Schedule B1).

The following is noted regarding the ASC NEPM (1999, as amended 2013) ESL for benzo(a)pyrene (BaP; a PAH) for urban residential land use:

- The ESL for BaP presented in Schedule B1 of the ASC NEPM (2013) is 0.7 mg/kg however this is directly based on the Canadian ecological soil quality guideline (SQGE) that was rescinded in 2010. The revised Canadian SQGE is 20 mg/kg.
- On 2 July 2015, the EPA issued advice to site contamination auditors advising that a new BaP ESL is under review for inclusion in the ASC NEPM, but in the interim, given that the ASC NEPM HIL A (most conservative of the presented HIL criteria) human health risk screening level of 3.0 mg/kg for BaP_{TEQ} is much lower than the Canadian SQGE, the risk driver will be protection of sensitive human health receptors. Application of the 3.0 mg/kg BaP_{TEQ} criterion for evaluation

of risks to ecology is considered to be suitably protective of ecological receptors. Thus, where soils fail the human health criterion, they are also judged to be potentially problematic to ecological receptors, in the first instance, pending further ecological assessment / risk assessment.

Table 6-6 Soil Validation Criteria

Chemical Substance	ASC NEPM HIL A (mg/kg)	Ecological Protection Criterion (mg/kg) (urban residential and public open space)	Adopted Criterion assuming HIL A scenario (mg/kg) in the first instance	Comment
lead	300	1,100	300	HIL A criterion selected. Most conservative and protective value.

6.6.4 Aesthetics

The SA EPA Guidelines for the Site Contamination Auditor System, August 2019 identifies the need for Auditor's to consider aesthetic impacts when considering the suitability of a site with reference to the amended ASC NEPM 1999. The presences of small amounts of solid, inert waste materials such as minor building and other debris that is typically found in developed urban areas can be considered by the Auditor without specific management requirements or remediation.

However, the presence of extensive rubble or waste (for example building waste) may require remediation on the basis of detriment to the aesthetic enjoyment and reasonable use of the Site.

The amended ASC NEPM 1999 recognises that while there are no numeric aesthetic guidelines, the site assessment nevertheless requires balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity. For example, higher expectations for soil quality would apply to residential properties with gardens compared to industrial settings.

Aesthetic consideration set out in the amended ASC NEPM 1999 include the following:

- Chemically discoloured soils or large quantities of various types of inert refuse, particularly if unsightly, that may cause ongoing concern to site users.
- The depth of the materials, including chemical residuals, in relation to the final surface of the Site; and
- The need for, and practicality of, any long-term management of foreign material.

The amended ASC NEPM 1999 advises that caution should be used for assessing sensitive land uses, such as residential, when large quantities of various fill types and demolition rubble are present.

The NSW EPA, Excavated Natural Material Exemption 2012 is referenced in the SA EPA Standard for the Production and Use of Waste Derived Fill, October 2013 and provides the following additional criteria on acceptable levels of foreign inclusions in 'natural material' which is typically suitable for sensitive land uses; excavated natural material is 'naturally occurring rock and soil (including but not limited to materials such as sandstone, shale, clay and soil) that has:

- been excavated from the ground, and
- contains at least 98% (by weight) natural material, and
- does not meet the definition of Virgin Excavated Natural Material in the Act'.

Within the course of an audit, auditors generally determine that the following physical and aesthetic screening criteria apply to the top 2.0m of soils remaining onsite:

- Should consist of clay, rock, sand, soil or other inert mineralogical matter.
- The combined concentration of natural and foreign inclusions in soils should not exceed 2% v/v.
- No visible asbestos should be present; and
- Soil staining or odorous contamination should not be present.

Should these aesthetic screening criteria be exceeded, further consideration of the detrimental impact on the aesthetic enjoyment and reasonable use of the Site will be undertaken.

Zone B comprises a zone of fill that is not aesthetically compatible with a proposed future sensitive use. Such material can either be:

1. Excavated and disposed of Site²; or
2. Sieved, sorted and recompacted.

The second option is likely to be more economical as no material has to be transported off site and no additional clean soil would specifically be required to backfill the resulting excavation.

When excavating, a visual assessment is required to ensure removal of none-natural soil (fill) that is aesthetically impacted.

The vertical extent is likely to be somewhere between 1 m and 2.9 m below the ground level and the extent is set out earlier in this Plan (Figure 4-2).

Any material used to backfill, whether recovered material or clean fill sourced from an appropriate source (refer Section 7.5).

No worker should enter the excavation – all works must be undertaken in accordance with the *Work Health and Safety Act 2012* and Work Health and Safety Regulations 2012 in terms of entering excavations.

It would be prudent to have a portable gas monitor available adjacent the excavations, such as an MX6 iBrid or similar³.

6.7 Ground Gas Management

The proposed development will comprise occupied spaces.

6.7.1 Review of Nature of Development

The occupied spaces are likely to be sensitive (residential) in nature.

Schedule B7 of the National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) describes four generic land-use scenarios (Health Investigation Level (HILs) A, B, C and D) that form the basis for the HILs and Health Screening Levels (HSLs) developed for soil and soil vapour contamination. These are:

HIL A – residential with a garden or accessible soil; childcare centres and primary schools

HIL B – residential with minimal opportunities for soil access; secondary schools

HIL C – public open spaces and recreation areas

HIL D – commercial and industrial premises.

² Refer Section 7.1 – 7.4

³ [MX6 iBrid Portable Multi Gas Monitor | Air-Met Scientific \(airmet.com.au\)](https://www.airmet.com.au)

HILs A, B and D are generally relevant to buildings, with construction of buildings (such as clubhouses and toilets) within an HIL C scenario being a special case. The risks associated with direct exposure to contaminated soil were a primary consideration in the definition of the HIL scenarios; there is a partial but not full correlation with the risks due to exposure to ground gases. BS 8485:2015+A1:2019 describes four building types (types A, B, C and D) that form the basis for selecting ground gas protection measures in the UK. These are:

Type A building – private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building; some small rooms present

Type B building – private or commercial properties with central building management control of any alterations to the building or its uses but limited or no central building management control of building maintenance, including the gas protection measures; multiple occupancy; small- to medium-sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas

Type C building – commercial buildings with central building management control of any alterations to the building or its uses and central building management control of building maintenance, including the gas protection measures; single occupancy of ground floor and basement areas; small- to large-sized rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas

Type D building – industrial-style buildings having large volume internal space(s) that are well ventilated; corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures.

Australia has developed styles of building construction, occupancy and use that accord with the local climate and lifestyles, which differ in some respects from those common in the UK. For the purpose of the NSW EPA (2020) guidelines, five types of building have been defined. These are:

Low-density residential – usually but not exclusively single-storey dwellings on a separate land title (commonly Torrens title) with single occupancy; no building management and no post-occupancy controls on room use, ventilation or alterations to the internal structure; limited controls on building design and construction due to exempt and complying development provisions in NSW; construction for new buildings is predominantly slab-on-ground, but also suspended floors with crawl space and partial or full basements, particularly on sloping sites; correlates closely with residential component of HIL A and with BS 8485:2015+A1:2019 Type A, but the median size (footprint area) of new houses in Australia is significantly larger than in the UK.

medium- and high-density residential – multiple-occupancy low-, medium- or high-rise townhouses and apartments; usually on a strata title and subject to by-laws, with maintenance of the external structure of the building and common areas managed and controlled by an owner's corporation; includes some public housing and some mixed-occupancy developments, and developments with commercial occupancy of the ground floor; frequently includes basement or undercroft car parking; may involve ground-bearing or piled foundations; usually air-conditioned, with active ventilation of basement car parking; correlates reasonably well with HIL B and partially with BS 8485:2015+A1:2019 Type B.

public buildings, schools, hospitals and shopping centres – similar in many respects to standard commercial buildings; generally low- to medium-rise rather than high-rise; particular constraints regarding building evacuation in an emergency; frequently includes basement or undercroft car parking; may involve ground-bearing or piled foundations; almost always air-conditioned, with active ventilation throughout (does not apply to many existing schools); correlates generally with HIL D but includes primary schools and childcare centres, which are HIL A; correlates partially with BS 8485:2015+A1:2019 Type C.

standard commercial buildings – includes offices and some shops, industrial subdivisions and smaller showrooms; building management control of any alterations to the building or its uses and central building

management control of building maintenance, including gas protection measures; single or multiple occupancy of ground floor and basement areas; frequently includes basement or undercroft car parking; may involve ground-bearing or piled foundations; small to large-sized rooms with active ventilation or air-conditioning in all buildings, except those on industrial subdivisions, which will have good passive ventilation; correlates generally with HIL D and BS 8485:2015+A1:2019 Type C.

large commercial and industrial buildings – includes warehouses, most factories, big-box retail stores, large showrooms, and hardware or garden centres; characterised by large, open, high-volume buildings; often single-storey; may have basement, roof, or exterior parking; corporate ownership, owner-occupied or leased; generally easy evacuation; may involve ground-bearing or piled foundations; correlates well with HIL D and BS 8485:2015+A1:2019 Type D.

Based on intent as understood, development post re-zoning would comprise BS 8485:2015+A1:2019 Type A building – private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building; some small rooms present.

6.7.2 Determining the Gas Screening Value

For bulk ground gases, the approach to Level 2 risk assessment is based on the method proposed by Wilson and Card (1999) and outlined in CIRIA C665 and BS 8485:2015+A1:2019. The objective is to assess risks to buildings (and their occupants) constructed, or intended to be constructed, on the site; the approach applies regardless of the gas source, but the results must be interpreted in the context of the CSM.

The Wilson and Card method uses both gas concentrations and borehole flow rates to define a characteristic situation (CS) for a site based on the limiting borehole gas volumetric flow for methane and carbon dioxide, as measured in the gas monitoring boreholes on the site. The measured borehole flow rates represent gas flow through the surface of the site, forming the basis for this approach. The gas flow from a 50-mm borehole is, very conservatively, assumed to represent the upward flow of gas through soil across a site surface area of 10 square metres (m²) (Pecksen 1986).

CIRIA C665 and BS 8485:2015+A1:2019 use the term ‘gas screening value’ (GSV) for the site representative value assessed from the set of limiting borehole gas volumetric flow measurements. GSV is also used in these guidelines. GSV uses units of litres of gas per hour (L/hr).

$$\text{GSV} = \text{maximum borehole flow rate (L/hr)} \times \text{maximum gas concentration (\% v/v)}$$

For example, if data from site monitoring indicated a maximum flow rate of 3.5 L/hr and a maximum methane concentration of 20% v/v, the site would have a methane GSV of 0.7 L/hr ($20/100 \times 3.5$).

The GSV is an overall site value, not an individual borehole value or an event value. As is the case for other aspects of contaminated land assessment and management, a large site may be stratified (subdivided) where it is appropriate to do so and the rationale underpinning the stratification is explained. A GSV may then be calculated for each subdivision. The rationale must reflect the gas regime and engineering considerations.

The calculation is carried out for both methane and carbon dioxide, and the worst-case value is adopted.

The assumption of equivalence between methane and carbon dioxide is made on the basis that the LEL for methane in air is similar to the concentration at which carbon dioxide becomes acutely toxic in air (5% v/v). Because ground gas with a high carbon dioxide content is denser than air and may remain segregated at low points, particularly in basements and other in-ground structures, this is a reasonable precautionary approach. However, experience in NSW has indicated that it may sometimes produce over-conservative outcomes, as has been the case elsewhere. It is, therefore, appropriate to review the outcome of a Level 2 risk assessment against the CSM, taking into account source and pathways factors, and the details of the current or proposed development.

6.7.3 Determining the Characteristic Situation (CS)

The CS classification was derived by Wilson and Card and is determined directly from the GSV – it is used in NSW EPA (2020) (Table 10-4).

- Where the CS is 1, no further action is required.
- Where the CS is 2 or 3, gas protection measures are required. Appropriate gas protection measures for the site should be selected as outlined in Section 5 of these guidelines.
- Where the CS is 4, gas protection measures are required, and the need for a Level 3 risk assessment should be considered. If a Level 3 risk assessment is not considered necessary, the reasons for this decision should be documented, and appropriate gas protection measures for the site should be selected, as outlined in Section 5 of these guidelines.
- Where the CS is 5 or 6, gas protection measures are required, and a Level 3 risk assessment must be carried out to assess the maximal risk, inform the design of gas protection measures and determine the residual risk following implementation of those measures.

If it is considered appropriate to modify the CS based on a weight-of-evidence approach, an initial CS should be determined in the usual way. That value should then be adjusted based on the evidence presented, ensuring the adjustment is fully justified. It is not expected that the CS would be adjusted up or down by more than one unit (NSW EPA, 2020).

Table 6-7 Copy of Table 7 from NSW EPA (2020)

	GSV threshold (L/hr)	CS	Risk classification	Additional factors	Typical sources
	<0.07	1	Very low risk	Typically, methane <1% v/v and/or carbon dioxide <5% v/v; otherwise consider increase to CS 2	Natural soils with low organic content Typical fill
	<0.7	2	Low risk	Borehole flow rate not to exceed 70 L/hr; otherwise consider increase to CS 3	Natural soils with high organic content Recent deep fill
	<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
	<15	4	Moderate to high risk	Consider need for Level 3 risk assessment	Mine workings susceptible to flooding Closed putrescible waste landfill
	<70	5	High risk	Level 3 risk assessment required	Shallow, unflooded abandoned mine workings
	>70	6	Very high risk		Recently used putrescible waste landfill

1. Site characterisation should be based on monitoring of gas concentrations and borehole flow rates for the minimum periods defined in Section 3.4.
2. The CSM must identify the source of gas and its generation potential.
3. Soil gas investigations should be conducted in accordance with the guidance provided in Section 3.4.
4. Where there is no detectable flow, the lower measurement limit of the instrument should be used.
5. To determine a GSV of <0.07, instruments capable of accurately measuring concentration to 0.5% v/v and flow to 0.1 L/hr are recommended.

6.7.3.1 On Site

Onsite GSV correspond to CS 2 (LWC 2023) (noting CO₂ >5%) and CS 3 assuming worst case from adjacent landfill (contrary to theoretical calculations in Appendix E-2 of LWC 2024).

6.7.3.2 Offsite (Landfill)

Average values for the waste mass (located largely west of the development) yield CS2 measurements from CMW1 and CMW2 in the footprint of Stage 1 enclosed space yield CS2.

6.7.4 Gas protection values

The CS obtained on site (CS2), the maximum and average CS obtained offsite (CS2 – 4) and the nature of the existing buildings or proposed development on the site can be used to obtain an appropriate gas protection guidance value from Table 8 of NSW EPA (2020). The CS4 classification based on offsite methane exceeds the classification boundary of CS3 by 0.5, so is reasonably borderline CS4.

NSW EPA (2020) states where methane exceeds 20% then increase the CS to CS3 for large commercial buildings. Note that this doesn't change the points required as CS2 and CS3 both require 2 gas protection points for these types of building.

Table 6-8 Copy of Table 8 from NSW EPA (2020)

Table 8 Guidance values for gas protection

CS	Required gas protection guidance 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

(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.

6.7.5 Protection measures

When a guidance value has been obtained from Table 8 of NSW EPA (2020) (Table 6-7), proposed gas protection measures, and combinations of measures, may be evaluated using the scores listed in **Table 9 of NSW EPA (2020)**.

A combination of two or more protection measures (no more than one of each type) that are appropriate for the site conditions must be selected so that the combined score equals or exceeds the required guidance value.

- Development requires **NSW EPA (2020)** gas protection value = 3

Consulting NSW EPA (2020) Table 9 (reproduced here as Table 6-8) then the following combination would be sufficient:

Reinforced concrete cast in situ or post-tensioned suspended slab with minimal service penetrations and water bars around all penetrations and at joints (score of 1.5)

AND

Proprietary gas-resistant membrane with a gas transmission rate for the gases of concern on the site that is certified and appropriate to the overall design of the gas protection system (score of 3) (see Section 6.7.5.1 and 2)

NSW EPA (2020) notes that at a minimum, it is good practice to install ventilation in all foundation systems to relieve pressure. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain performance.

Table 6-9 Copy of Table 9 from NSW EPA (2020) – scores for protection measures

Measure or system element	Score	Comment
Venting or dilution measures		
Passive sub-floor ventilation with very good performance – the steady-state concentration of methane over 100% of the ventilation layer remains below 1% v/v at a wind speed of 0.3 metres per second (m/s) ^(a)	2.5	The design of the venting layer (i.e. granular medium with inlet/outlet pipes versus open-void or modular drainage system)(b) must be considered when modelling steady-state concentrations
Passive sub-floor ventilation with good performance – the steady-state concentration of methane over 100% of the ventilation layer remains below 1% v/v at a wind speed of 1 m/s and below 2.5% v/v at a wind speed of 0.3 m/s) ^(a)	1.5	If post-installation testing of passive ventilation indicates that it cannot meet this requirement, inlets and outlets must be upgraded. If this is unsuccessful, it will be necessary to retrofit an active system
Sub-floor ventilation with active abstraction or pressurisation	2.5	Not appropriate for NEPM HIL A residential settings because robust management systems, including alarms, must be in place to ensure long-term operation and maintenance... Achieving the full score requires a design with adequate redundancy and full coverage of the building footprint.

Measure or system element	Score	Comment
Ventilated car park (basement or undercroft)	4.0 (d)	Assumes that the car park is vented to deal with exhaust fumes in accordance with BCA ^(c) requirements. The design of a car-park and the specifications of its ventilation system need to be considered in assigning an appropriate score of up to four.
Horizontal soil barriers beneath building footprint		
Horizontal clay or amended soil barriers designed to achieve defined permeability and diffusivity of the gases of concern placed, compacted and tested under appropriate engineering supervision	(d)	Requires appropriate engineering input and integration with the building design from the earliest possible stage. This must consider the effects of any proposed piling on the gas regime
Floor Slabs		
Reinforced concrete ground-bearing floor slab or waffle pod slab	0.5	At a minimum, it is good practice to install ventilation in all foundation systems to relieve pressure. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain performance.
Reinforced concrete ground-bearing foundation raft slab with limited service penetrations cast into slab	1.0	
Reinforced concrete cast in situ or post-tensioned suspended slab with minimal service penetrations and water bars around all penetrations and at joints	1.5	
Fully tanked basement	2.0	The design of a basement and the specifications of its ventilation system need to be considered in assigning an appropriate score. Fully tanked means designed to be waterproof under the range of groundwater conditions likely at the site, to the extent that supplementary internal drainage is not required.
Membranes		
Proprietary gas-resistant membrane with a gas transmission rate for the gases of concern on the site that is certified and appropriate to the overall design of the gas protection system. It should be installed by a specialist to an appropriate level of	2.0	Membrane performance depends on the membrane material and thickness specified, design and quality of the installation, protection from and resistance to damage after installation, and the integrity of joints in membranes that require joints.

Measure or system element	Score	Comment
workmanship with documented internal CQC, including integrity testing (e.g. tracer gas or smoke testing), under independent CQA carried out by a certified specialist(e) or appropriately qualified and experienced professional with independent verification of the entire process ^(f)		Materials that offer some degree of self-sealing and repair are preferred. Long term performance depends on the durability of the material, including its resistance to chemical degradation in the environment in which it is installed.
Monitoring and detection		
Intermittent monitoring using hand-held equipment	0.5	Monitoring and alarm systems are only valid as part of a combined gas protection system. Where fitted, permanent systems should be installed in the underfloor venting system but can also be provided in the occupied space as a back-up
Permanent monitoring system installed in the occupied space of the building	1.0	
Permanent monitoring system installed in the underfloor venting or dilution system	2.0	
Pathway intervention external to building footprint		
Vertical barriers	(g)	Required for residential and public buildings at CS 4 and above
Vertical venting system	(g)	
<p>(a) Verified by post construction monitoring</p> <p>(b) Refer Appendix 6 of NSW EPA (2020)</p> <p>(c) Building Code of Australia</p> <p>(d) Score depends on site specific conditions and design</p> <p>(e) For example, Geosynthetic Certification Institute</p> <p>(f) Refer Appendix 7 of NSW EPA (2020)</p> <p>(g) Score depends on site specific conditions and design, but scores of 4.0+ should be achievable</p>		

6.7.5.1 Task – Mitigate Preferential Pathways

The following actions are required within the development of the Site for the proposed specific sensitive use:

1. Use of a low permeability vapour membrane as a *sealed* wrap around all buried subsurface services that have a potential headspace with connecting aperture from service to indoor air – this is considered to be limited to wastewater (sewer).
2. Membrane must comply with CIRIA C748 and BS8485:2015 +A1 2019 and have a permeation rate meeting or less than the value listed in Table 7-3.

3. Avoid high permeability backfill around buried subsurface services, i.e. use lean mix concrete in service trenches. If the use of use lean mix concrete is achievable then services do not need to be wrapped as per #1.
4. Appropriate sealing of any apertures with vapour mitigation tape, associated with ALL services coming up through the slab.

The proposed development should not include basements. Basements should not be allowed at the Site.

HOLD POINT

The installation and completion of wrapped wastewater services and backfill of services must be inspected by the Environmental Consultant and found to be of a suitable quality and in accordance with Wilson et al., 2014 (and pass provided) prior to proceeding.

6.7.5.2 Task – Installation of Barrier Membrane to Enclosed Space Footprints

The following actions are required within the development of the Site for sensitive use:

1. In addition to standard damp proof membrane, a low permeability vapour membrane must be installed beneath the poured concrete slab of the building footprints.
2. The required membrane is likely to be no less than a minimum of 20 mil (0.5 mm) thickness and conforming to ASTM E1745. Membrane must comply with CIRIA C748 and BS8485:2015 +A1 2019.
3. Membrane must be installed in accordance with manufacturers requirements / guidelines and guidance presented in CIRIA C748⁴ - (i.e. satisfactory overlapping of sheets, sealing of sheets etc.). Installation must be observed/ inspected independently (refer Section 7.6) and must be written up in the Remediation Validation Report (RVR).

HOLD POINT

Each membrane / area of membrane must be visually and physically inspected by the environmental consultant and a round of leak detection undertaken (and pass provided) prior to proceeding with the build.

It is essential that the integrity of all gas membranes and gas protection measures once installed and verified is maintained post verification and not damaged by any subsequent works.

Follow on contractors should be made aware of the ground gas protection systems in place, in order to ensure they work towards their safeguard and upkeep.

⁴ Wilson, S, Abbott, S, Mallett, H (2014) Guidance on the use of plastic membranes as VOC vapour barriers, CIRIA C748 London 2014

6.7.5.3 Inspection

The following must be observed and inspected by an appropriately experience and qualified environmental consultant:

1. The construction quality of the laying / installation and overlapping of all the membranes (prior to slab pour); and
2. The quality of the laying / installation wrap of membranes for services.

All remedial management measures must be inspected and verified by an independent suitably experienced consultant in accordance with:

CIRIA Good practice on the testing and verification of protection systems for buildings against hazardous ground gases (Mallett et al., 2014)

The membrane installations must be subject to a visual verification inspection by a suitable independent party (environmental consultant) to establish the adequacy of the ground preparation and subsequently possible damage to the installed gas membrane.

The inspection must cover:

1. The ground prepared for the membrane
2. The membrane itself over the whole floor area – this should be after reinforcement is placed and before slab pour.

Any discrepancies with the installation method recommended by the membrane supplier must be noted and highlighted to the installer. Such discrepancies may entail:

- small or large hole
- rips, tears and punctures
- absence of tape on the lapped areas
- loose or unstuck tape
- inadequate corner details and unbounded seams such as loose edges and ‘fish mouths’ in the membrane.
- Tapes used to join gas membranes should be inspected to make sure they are compatible with the gas membrane being joined and are as specified by the gas membrane supplier or specifier.
- Where welded joints are used the verifier must ensure they are correctly tested.
- Repairs must be instructed and observed on the same day as the visit or inspected at a later date and closed out.

Verification activities should be explained to contractors at the start of the development at site induction. Communication between the installer and verifier as early as possible will help avoid and mitigate potential conflict and additional costs due to poor or inadequate gas membrane installation and protection.

The biggest threat to a membrane following appropriate installation is by subsequent construction activity by others taking place before the membrane is covered. The slab should be poured as soon as possible after inspection has occurred and installation approved.

All verification visits must be recorded including photographs as supporting evidence. The record must be prepared / completed for each inspection and retained for inclusion in the validation report to demonstrate the involvement of the verifier throughout the process and provide evidence of the appropriate installation of the gas protection measures.

6.7.5.4 Integrity testing

Integrity testing must be completed on overlapped seams and membrane as per Table 6-9.

Table 6-10 Membrane test method

Component	Test Method
Lapped seams of flat membrane in final position	<p>Mechanical point stress test</p> <p>Run a blunt instrument (e.g. screwdriver) along the edge of the seam to identify any unbonded portion of seam but do not puncture the membrane.</p>
Large Areas of flat membrane in final position	<p>Smoke test</p> <p>Smoke is introduced below the gas membrane and a visual inspection made to see if it is passing through defects in the membrane.</p> <p>This must be completed on a still day with a dry membrane (water may seal small holes due to surface tension).</p> <p><u>Equipment</u></p> <p>Blower, pump or fan capable of moving smoke and air at a rate in the range of 4 to 25 m³/min.</p> <p>A smoke generator producing non-toxic odourless smoke</p> <p>A marking device to identify defects</p> <p>Testing proforma</p> <p><u>Procedure</u></p> <p>Do not undertake when weather conditions or visibility may obscure the results. Wind speed must be less than 24 km/hour.</p> <p>Test area must be less than 500 m² per test.</p> <p>Edges of membrane should be sealed with smoke egress points located at dictated distances around the edge of the membrane.</p> <p>Test injection point should be formed comprising an X shaped cut in the membrane at a sensibly located position (i.e. centre).</p> <p>The pipework from the smoke generator should be inserted through the insertion and sealed to prevent leakage.</p> <p>Ensure smoke has permeated the whole of the test area by observing the smoke egress points for a minimum of two minutes.</p> <p>Input pressure should not be so great as to provide lift to the membrane in a manner that stresses seams.</p>

Component	Test Method
	<p>Carefully inspect the membrane and mark any points of smoke coming through the membrane – photograph and record.</p> <p>All identified defects should be repaired and the repair recorded.</p> <p>The test should be re-run to check the repair.</p> <p><u>Reporting</u></p> <p>All reports must be collated in the validation report.</p> <p>The following details must be recorded:</p> <ol style="list-style-type: none"> 1. Site name 2. Location 3. Date and time 4. Name and company of tester 5. Detail on membrane type 6. Location on the site and dimensions of the test area 7. Weather conditions 8. Location of the smoke ingress and test egress points 9. Location of any detected defects and the nature and extent of repair 10. The results of any retest 11. Signed off

6.7.6 Non-site Contamination Issues

Guidelines for the Site Contamination Audit System (2019) – provides additional non-site issues that an Auditor is expected to consider in relation to understanding the condition of the Site and its suitability for its intended use(s). These considerations include:

- Unexploded ordnance.
- Radioactive substances that may have been used or added to the Site.
- Biological substances, e.g. pathogens that may have been used or added to the Site.
- Any chemical substances (including waste) on or added to the Site that are noxious, poisonous, or dangerous to human health and/or the environment; and
- Contaminated sediments.

These issues will be assessed by the Auditor on the basis of the site-specific requirements.

6.7.7 Validation Reporting

At the conclusion of the remediation works, LWC shall prepare a remediation validation report (RVR).

Validation reporting will be in accordance with Schedule B2 of the ASC NEPM (1999, as amended 2013) and as per Remediation Reporting Checklist presented as Appendix 6 of EPA (2019a).

The RVR will include all necessary and relevant sub-documentation and detail the following:

- A summary of the project objective, scope of works undertaken, and methodology adopted.
- A detail summary of site conditions including infrastructure volumes, presence of product, site layout figures, descriptions, excavation extents and quantities and material tracking information.
- Laboratory analysis presented in tabular form and including comparison to adopted guidelines.
- Data quality assessment and quality control evaluation and conclusions.
- Documentation regarding ground gas protection measures (verification testing, construction quality assurance detail/ reporting).
- Clear statements regarding the remediation of the Site, including site suitability, remaining site contamination and need for further management (unlikely);
- Supporting documentation including lithological logs, certified laboratory results, chain of custody documentation, disposal documentation for the potential source infrastructure and soils as well as purchase receipts (including volume and source information) for any imported backfill material/s provided as appendices.

6.8 Excavation back fill works

The contractor will back fill excavations with re-usable (as determined by the Environmental Consultant and cleared by the site contamination auditor) exhumed material⁵ and/ or appropriate clean backfill material noting the proposed sensitive land use of the Site, and noting the following:

- Backfilling to be conducted in 300-millimetre (mm) lift achieving a minimum 95% compaction at each lift.
- Each backfill compaction must be overseen by a suitably qualified geotechnical contractor.

The above is consistent with Level 2 compaction requirements as per *Australian Standard AS 3798–2007 Guidelines on Earthworks for Commercial and Residential Developments*.

Backfill material proposed to be brought onto the Site must be validated to the satisfaction of the site contamination auditor prior to the material being received at the Site and will comprise the following:

- Adoption of sampling density as per *VIC EPA (2001) IWRG702*.
- Sample collection methodology to be consistent with that outlined in Section 6.8.1 and the *ASC NEPM (1999, as amended 2013)*.
- Analytical schedule to comprise analysis of one (1) sample for the broad NEPM (2013) HIL A Screen⁶ and 2 samples for the SA EPA Waste Fill Screen, with the remaining samples to be analysed for TRH, BTEX, PAHs and eight (8) metals (arsenic, cadmium, chromium, copper, nickel lead, mercury and zinc); and
- Must meet SA EPA (2013) Standard for the Production and Use of Waste Derived Fill waste fill criteria (chemical and aesthetic).

Where backfill material is not sourced from a quarry (i.e. is Waste Derived Fill – WDF from a ‘sensitive’ site (a site that has been confirmed to have no potentially contaminating activity)), the required supporting documentation will be reviewed by the SRP Manager and the Auditor to confirm suitability for re-use on Site prior to acceptance on Site and re-use. Verification testing or existing laboratory reports will be required for any WDF to potentially be received at the Site. This will be determined on a case by case basis in consultation with the auditor.

6.9 Remediation Timeframes

In accordance with Appendix 5 of EPA (2019a), the SRP is required to document the timeframes applicable to the remediation project. Note that demolition of structures is required prior to commencement of remedial works.

Specific dates are currently unknown.

⁵ Results to be compared against the validation criteria to determine suitability of the material to be used at the Site.

⁶ The screen includes As, B, Ba, Be, Cd, Cr, Co, Cu, Mn, Ni, Pb, Se, V, Zn, Hg, Cr VI, WAD CN, Organics as listed in the guideline including OCPs, Mirex, Atrazine, Chlorpyrifos, Bifenthrin, TRH/BTEXN PAHs/Phenols & PCBs, 16 Herbicides incl' 2,4,5-T, 2,4-5, MCPA, P-21/2 MCPB, Mecoprop & Picloram.

7 ENVIRONMENTAL MANAGEMENT PLAN

All work will be carried out in strict accordance with the Environmental Management Plan (EMP) to mitigate potential risk to the current users of the site, site contractors, surrounding environment, surrounding residents and business community that may arise as a result of the works.

SA EPA (2019d) was consulted in developing the EMP component for remediation. Note that a site specific Construction Environmental Management Plan must be prepared and submitted to the auditor and approved by the auditor prior to the commencement **of any remedial works**, with respect to detailed environmental management measures, monitoring protocols and compliance criteria. The CEMP must be prepared in accordance with SA EPA 1095/19 Construction environmental management plan (CEMP) September 2019.

7.1 Soil Management Procedures

Management of the soil from excavation areas will be of utmost importance to control the potential exposure to and migration of contaminants.

All soil from the proposed excavation area(s) on the Site is a potential source of contamination and for the purposes of this EMP is to be considered as contaminated material. The following procedure, as a minimum, will be adopted to manage the contaminated soils:

1. Exposure and contact with the soils will be minimised to the extent practicable by suitable planning of work activities by the SRP Manager in consultation with the contractor.
2. All persons handling or working on the soils will adhere to appropriate WHS standards to minimise exposure, wearing appropriate personal protective equipment including:
 - a) Gloves.
 - b) Disposable Coveralls; and
 - c) Dust masks.

Taking care to prevent cross-contamination of nearby clean soils is important so as to avoid the spread of chemical substances, and to minimise the amount of soil needing to be treated and the resources required to undertake the project. Similarly, care should be exercised so that polluted surface water does not affect clean soils.

Consider:

1. likely sources of cross-contamination.
2. types and concentrations of chemical substances and by-products of decomposition.
3. extent of the remediation area.
4. duration and timing of the remediation works.
5. remediation work methods and staging of the works.
6. proper classification of waste material for off-site disposal, material tracking and contaminated soil landfill licensing requirements.
7. aesthetics; and
8. sensitivity of surrounding environments.

7.2 Temporary Soil Stockpiling

Any soil materials excavated during remediation will be temporarily stockpiled onsite in accordance with:

- **SA EPA (2019a), Guidelines for the Assessment and Remediation of Site Contamination**

Although prescribed for management of stockpiles at waste transfer / sorting stations, and not readily for temporary stockpile storage at development sites, the management of stockpiles should not contravene the following guidance:

- **SA EPA (2010) Guideline for stockpile management: Waste and waste derived products for recycling and reuse (Updated October 2020) and SA EPA (2018) Guidelines for Construction environmental management plans (CEMPs).**

The temporary nature of the stockpiles reduces the potential for chronic environmental exposures. Any stockpiles that are required to be maintained longer than the working day will be managed by initial emplacement on impermeable surfaces such as hard-standing or an impermeable layer such as plastic, and located away from potential environmental exposure routes such as drains, culverts etc. Tamping of the stockpile surface with mechanical plant (i.e. backhoe bucket) shall be undertaken to compact the stockpile and reduce the potential for wind driven erosion / dust generation.

Stockpiles must be:

1. Located away from any sensitive receptors (Adjacent residents need to be considered in determining the placement and management of stockpiles on-site). Temporarily stockpiled material can cause adverse impacts via dispersion of dusts or migration of stockpiled materials to surface/ groundwater and management is required to avoid such impacts.
2. Located away from any groundwater wells currently on site, which should be sealed with gatic covers already but should also be covered / or marked to avoid destruction, and to avoid seepage of any leach / run off from stockpiled material, for example using traffic cone and absorbent socks.
3. Not piled to a height greater than 3 m.
4. Stockpile height should reduce as it approaches the site boundary. Stockpile heights should be below fence lines when within about 5 m of the boundary.
5. Stockpiles should be covered with an effective covering. The contents of the stockpile will dictate the level of cover, i.e. complete enclosure or the formation of a crust layer.
6. Temporary bunding should be installed around stockpiles, and stockpiles should be located on waterproof surfaces such as asphalt or concrete, or under cover where available (i.e. beneath the current on-site cover near the UST location or located both on top of a covered by an impermeable cover).
7. Stockpiles should have sufficient moisture content before being handled. Water can be applied the night before and allowed to infiltrate the stockpile. Applying water to a stockpile during handling has little effect on reducing dust emissions. Using water jets or sprays has minimal effect in capturing airborne dust, especially when out in the open.

7.3 Dust Control

Dust control measures shall be implemented for all intrusive works, in particular work where contaminated soils within the excavation areas are being excavated and where movement of soil is required. For the purpose of this document, dust refers to particulate matter including airborne dust and organic solids (e.g. soot).

Dust generated from contaminated soil may cause risks to human health through contact with the skin, inhalation and through ingestion. Dust dispersion may also cause problems with soiling the surrounding area, particularly where dust becomes wet and/ or enters the stormwater system.

Dust suppression, as part of all site works, will be adequate at all times during and outside of normal working hours. Dust suppression mechanisms will be applied by the excavation contractor to prevent dust generation during remediation activities on the site.

The following dust control measures shall be adopted by the excavation contractor as required and as directed by the SRP Manager:

- Restrict excavation activities during adverse weather conditions (i.e. too windy); and
- Use of water to suppress dust (hosing and spraying).

7.4 Transport of Material to Licensed Landfill

Any excavated soils required to be transported offsite for disposal will be transported by an appropriately licensed transport contractor adopting the required SA EPA waste transport documentation / protocol. All loads must be covered during transport. All soils to be removed from the Site will be appropriately classified by the SRP Manager.

- Only appropriately licenced trucks and facilities will convey and receive waste.
- Waste disposal certificates must be retained and included in the validation report.

7.5 Imported soil

Any soil imported to the Site that is not virgin excavated natural material from a certified quarry must meet the chemical, geotechnical and aesthetic requirements and all / any other requirements set out in:

- Standard for the Production and Use of Waste Derived Fill (2013) – Environment Protection Authority

7.6 Wash Down/ Drag Out

Measures shall be taken to prevent and clean any drag-out of mud and soil from the Site onto surrounding roads via vehicle tyres. Wash down of tyres (and/ or vehicles if necessary) will be undertaken if necessary, using a hose in the area of hard standing away from any surface water runoff receptors. In the event that the current infrastructure (i.e. hardstand area) is removed, a single entry/exit point should be established for vehicles with a tyre cleaning facility made available.

In the event of spillage of spoil or run-off from the Site occurs along with sediment accumulation, clean up as soon as practical will occur. In areas of public roads, any material tracked off-site by the contractors or any other vehicles will be cleaned up with the use of a mechanical street sweeper, as necessary.

7.7 Air Quality and Odours

The preferred strategy for protecting air quality during remediation of site contamination is prevention, minimisation, followed by environmental controls. Potential mitigation measures may include:

- minimising the exposed surface area of odorous/ noxious materials.
- timing excavation activities to minimise off-site nuisance (noting close proximity to residential structures).
- undertaking work in favourable weather conditions (e.g. lower temperatures, favourable winds) covering exposed surfaces overnight or during periods of low excavation activity.

- no stockpiling of odorous material near the boundary of the site adjacent the residential allotment.
- covering of all stockpiled odour material; and
- removing offensive odorous material offsite as soon as practicable.

7.8 Other Issues

7.8.1 Site Access and Security

Site access to the area of the proposed remediation works shall be restricted to personnel inducted into the SRP. The excavation contractor will ensure that the site is appropriately fenced off prior to commencement of works, using temporary fencing, bunting and warning signs, in order to restrict unnecessary workers and the general public from the work area.

7.8.2 Stormwater and Erosion

All effort will be made by the excavation contractor to prevent or minimise the potential for the generation of contaminated water and sediment as a result of remediation activities, including any water used during dust control.

Discharges to the local stormwater system will be prevented where the potential for run-off is identified. Site management procedures will be in accordance with the EPA Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry. If necessary, measures for control of discharge may include:

- The provision of silt traps and 'socks'.
- Providing temporary Hessian (or similar) coverings to exposed surfaces where there is potential for surface water generation.
- Construction of temporary stormwater catch/ diversion drains; and
- Measures shall be taken to prevent and clean any drag-out of mud and soil from the site onto surrounding surfaces via worker boots, vehicles etc.

Given that works are anticipated to occur during summer, water collecting in excavations or earthworks is not likely to occur.

If water does build up in such excavations, and requires discharge, the management/ discharge of such water shall be in accordance with EPA "Environmental management of dewatering during construction activities (updated June 2021 – EPA 1093/21)".

7.8.3 Noise

Noise shall be managed to ensure impacts to on-site workers and neighbouring residences and/or businesses are reduced as practicable. This can be achieved through selection of appropriate equipment, noise suppression equipment on any excessively noisy machinery (e.g. compressors) and keeping machinery in good repair and condition. In addition, cartage trucks will be encouraged not to reverse so as to avoid noise impacts associated with reversing audio alerts. Traffic management/ flow on site may be planned to support this.

Working hours are to be prescribed by the excavation contractor prior to the commencement of site works.

Construction activities will be limited to the hours of 7:00 am to 7:00 pm Monday to Saturday, which is in accordance with the SA EPA Construction noise information sheet.

7.8.4 Chemicals, Oils, Diesel

All equipment on-site shall be appropriately managed to reduce the emission of fumes, smoke and chemicals into the atmosphere. It is important to ensure that leaking vehicles and/ or machinery are not used on-site.

No plant refuelling is expected to be undertaken on Site. Where plant refuelling is necessary then a dedicated refuelling station / area is required to isolate refuelling to one location. Care should be taken during refuelling to avoid over-spill. A 'spill kit' must be stored on site and available for use.

7.8.5 Waste Control

Waste materials that may be generated during the remediation works include concrete, steel, aluminium, and potentially fragments of foreign material that may be present in fill soil material (possible ash/ cinders, asbestos containing material, bricks etc.).

Effective construction planning can minimise the production of waste, and appropriate storage of wastes particularly suitable source separation of waste materials, can greatly improve recycling rates and potentially lower disposal fees.

The waste management hierarchy provides a framework to maximise the useful life of materials for instances in which waste cannot be avoided. Waste from construction and building sites should be managed in accordance with the waste management hierarchy.

Waste that is produced must be kept on-site and managed to prevent nuisance such as litter, dust and vermin, and to stop leachate from entering stormwater drains.

All waste generated during the remediation works shall be removed from the Site and disposed of in an appropriate and environmentally safe manner. Such waste includes any waste resulting from site activities and human presence.

The Site shall be adequately cleaned after completion of works and prior to vacation by the contractor.

All waste material generated on Site is to be disposed off-Site to a suitably licenced facility.

7.8.6 Traffic Management

Traffic entering and leaving the Site should adhere to a site specific simple traffic management plan to avoid trucks queuing in the Street and causing noise and exhaust related odour / nuisance.

7.8.7 Dewatering of Excavations

Dewatering is not expected to be required. However, if required, dewatering works are to be undertaken in accordance with relevant South Australian legislation for the management of liquid waste, principally in the first instance in strict accordance with EPA "Environmental management of dewatering during construction activities (updated June 2021 – EPA 1093/21).

Where required, dewatering works will involve the removal of liquid from the excavation pits by an appropriately licenced vacuum truck operator for disposal to an appropriately licenced facility.

Alternatively, discharge of dewatered liquid to sewer may be undertaken provided that a once off trade waste agreement with SA Water has been obtained.

Consult EPA "Environmental management of dewatering during construction activities (updated June 2021 – EPA 1093/21 in the first instance.

7.9 Asbestos Containing Material

In the event that suspect asbestos containing materials are encountered during site remediation works including ACM in soil, the steps outlined in Table 7-1 must be followed.

Table 7-1 Actions should Asbestos Containing Material be Identified (or suspected)

Action	Description	Who
1. Stop Work	Stop work immediately. <i>Proceed to Action 2.</i>	Contractor/ site staff (or others) discovers or suspects PACM is present
2. Restrict Access to Affected Area	Restrict access to the area by installing temporary signage to prevent site occupants or members of the public from entering the immediate area, and to prevent any further disturbance of asbestos materials in the area. <i>Proceed to Action 3.</i>	Contractor/ SRP Site Representative
3. Notify the Site Owner and the Auditor	SRP Manager are to contact and update the Site Owner and the Auditor within 24 hours. <i>Proceed to Action 4.</i>	SRP Manager
4. Risk Assess and Sample Material (if required)	SRP Manager to assess material and if necessary, take samples of any suspected asbestos materials: <ul style="list-style-type: none"> Notify Site Owner and Auditor of results. Negative result → resume works <i>Positive result → Go to Action 5</i> 	SRP Manager
5. SRP Manager to Engage Asbestos Removal Contractor for Clean-up (if required)	Consideration should be given to undertaking asbestos removal works. This will be dependent on the type, nature and amount of ACM identified and should be based on advice provided by the asbestos consultant. <ul style="list-style-type: none"> Removal required → <i>Go to Action 6</i> No removal deemed necessary → <i>Go to Action 7</i> 	SRP Manager
6. Conduct Asbestos Fibre Air Monitoring and Independent Visual Clearance Inspection	Asbestos removal works are to be undertaken by appropriately licenced contractors in accordance with SafeWork SA guidance. Conduct asbestos fibre air monitoring adjacent to the contaminated work area (in a down-wind location) during any removal works to ensure that fibre levels do not exceed acceptable levels. After clean-up works have been completed, an independent visual clearance inspection (undertaken by SafeWork Licenced Inspector) shall be conducted to ensure that the asbestos removal has been completed to a satisfactory standard. Airborne asbestos fibre clearance monitoring shall also be conducted as required within removal work areas to ensure areas are safe for re-occupation by unprotected personnel. Asbestos Contractor to issue clearance documentation. Photographs are to be taken and retained for each area from which ACM has been removed. <i>Go to Action 7.</i>	SRP Manager (in conjunction with Asbestos Removalist/ Inspector)
7. Review SRP and Staff Debrief	SRP Manager to review the SRP procedures and controls to ensure they were being followed correctly. <i>Go to Action 8.</i>	SRP Manager

Action	Description	Who
8. Document Works Undertaken and Archive Documents	SRP Manager to update SRP if required and provide written documentation of any removal works (if undertaken) or information regarding the location of any additional ACM identified. Clearance certificates are to be retained and included in the validation report to be provided to the Auditor.	SRP Manager

Pending the outcomes of the process detailed in Table 7-1, further instruction regarding removal of asbestos containing material (and required monitoring) will be provided to the Auditor/ Site Owner.

ACM (and potentially other hazardous materials) is present in building fabric. Evidence of appropriate removal of these materials during demolition must be provided in the validation report.

7.10 Unexpected Finds

Unexpected finds include materials that have site contamination implications including, but not limited to:

- Unexpected or most extensive foreign material than anticipated, or different types of foreign material not previously encountered nor contemplated.
- Structures such as additional underground storage tanks or buried drums.
- Buried asbestos containing material; and
- Odorous, stained or oily soil material.

Where unexpected conditions are encountered at the Site during the remediation works, the following process shall be adopted:

- Remediation works are to cease in the area of the unexpected find. The area is to be barricaded/ demarcated with temporary fencing/ bunting and covered.
- The SRP Manager is to notify the Site Owner and the Site Auditor within 2 hours of the encountering the unexpected find.
- An inspection of the unexpected find shall be undertaken. Field testing will be undertaken as required to determine the nature and extent of the find. Works will be undertaken in accordance with relevant available guidance documentation (refer to Section 1.5). An assessment of required management and/ or remediation will be undertaken.
- The SRP Manager will provide written notification to the Auditor and the Site Owner summarising the outcomes of the site inspection/ assessment as soon as reasonably practicable following the site inspection. The SRP Manager will also provide details of the approach to remediation and the validation of the unexpected find to the Auditor.
- The SRP Manager will ensure that additional controls/ management measures are adopted (if required).
- Records of the unexpected find, field testing, results and implemented management strategies are to be recorded by the SRP Manager for inclusion in the validation report.

Note that depending on the nature of the unexpected find, additional work health and safety, environmental controls and validation works may be required.

7.11 Monitoring

Table 7-2 explains the monitoring, triggers, management and consequential actions of impacts that may occur at the Site during remediation or development processes.

Note that a site specific Construction Environmental Management Plan must be prepared and submitted to the auditor and approved by the auditor prior to the commencement of works, with respect to detailed environmental management measures. The CEMP must be prepared in accordance with SA EPA 1095/19 Construction environmental management plan (CEMP) September 2019 and will include monitoring protocols, frequencies, and compliance criteria for relevant environmental parameters (e.g. for water, noise and dust).

Table 7-2 – Monitoring and Contingency Protocols

Monitoring or Trigger	Type of impact	Management		Consequent Actions
		SRP Manager	Contractor	
Site Supervisor observes while on-site.	Any impact as measurable by 1 – 7 below	Cease operations, record date and time of incident for future reference.	Cease operations, record date and time of incident for future reference.	Review operations and controls to mitigate impacts generated. Contractor communicates with Site owner contact for significant ²⁴ impacts.
Neighbouring occupant or public complaint	Any impact as measurable by 1 – 7 below	Site supervisor contact and review all messages and enquiries the same or following working day. Obtain full details and log. If deemed urgent contact Contractor Site Supervisor and Site owner.	Review impacts from previous activities. Cease or modify future operations to reduce impacts, if necessary.	Site owner to contact complainant detailing action taken, if any, and log response.
Occupant or public - general enquiry/ concern.	No specific impact	Obtain full details and log. Site Owner contact to discuss concerns with enquirer.	NA.	Implement changes to operations, if necessary, and log.

-
- 1 If visible dust is crossing the property boundary the potential for adverse dust impacts exists and control measures should be implemented.
 - 2 If the Site Supervisor is required to speak loudly at the perimeter of the fence in order to be heard this is deemed to be excessive noise or noise complaints are received from surrounding occupants.
 - 3 Excessive vehicle movement or queuing.
 - 4 Objectionable odour at or beyond the perimeter fence.
 - 5 Surface water and sediment run-off beyond the boundaries of the site (including tracking of mud onto public roads).
 - 6 The loss of liquid or solid waste containment. Any impacted soils must be assessed and managed using the approach detailed in the SRP.
 - 7 Can be a perception of a negative impact which may not be measurable or have guidelines or standards to determine.

7.12 Emergency and Incident Response - Pollution

Emergency situations may include incidents such as a truck rollover while transporting contaminated soil to landfill, strong winds or rain which accelerates surface erosion of contaminated soil material.

An asbestos material 'incident' will typically involve the discovery or dislodgment of asbestos materials that do not pose an immediate threat of asbestos fibre being inhaled.

Emergency and incident response entails restriction of access to the area, notification to the Site Owner and the EPA:

EPA Pollution Reporting

Call: 8204 2004

The protocols described in Appendix A comprise the Environmental Management Plan/ Emergency and Incident Response plan. These protocols should only be conducted where safe to do so.

8 WORK HEALTH AND SAFETY CONSIDERATIONS

The WHS procedures outlined below only apply to inducted site users including earthmoving contractors.

The contaminants potentially present within the investigation area are not considered likely to represent a significant risk to the health of workers at the site associated with the scope of work of the SRP, however basic WHS procedures as outlined herein should be adopted, and should be consistent with current WHS legislation and practices.

The following standard WHS procedures shall be implemented for the duration of the remediation works:

- WHS induction for all Contractor personnel.
- Workers are made aware of the potential contamination status of the site.
- Appropriate personal protection equipment should be worn including:
 - Gloves worn if soil is being handled.
 - Long sleeve shirts and pants worn to minimise skin contact with soils.
 - Dust generation is minimised during excavation activities. However, dusk masks may be required by some personnel depending on the conditions at the faces of excavations.
- Eating, drinking or smoking is prohibited within designated intrusive work zones; and
- Any environmental or WHS incidents shall be reported immediately and a stop work implemented at the site.

A site specific WHS document must be prepared by the earthworks contractor and signed off on by all relevant site personnel. This plan must consider general hazards of working on a construction site e.g. trips, falls, traffic).

Workers on site are expected to hold a 'White Card'.

9 SRP MONITORING

The effectiveness of the SRP will be reviewed periodically through a review process that checks each aspect of the SRP as outlined in the previous sections against its requirements and objectives to ensure that it is operating in a manner for which it was prepared.

Monitoring and review shall be the responsibility of the SRP Manager.

9.1 Non-Conformances

A register of non-conformances shall be established and maintained by for all active and resolved non-conformances. All non-conformances will be reviewed, and corrective actions developed to prevent recurrence. The SRP will be revised wherever appropriate to reflect these corrective actions.

9.2 Complaints

All complaints will be referred to the SRP Manager will be recorded in a complaint register with the following details:

- the name and address of any complainant.
- the time and date the complaint was received.
- a description of the complaint.
- the activity or activities and any associated equipment that gave rise to the complaint.
- the action that was taken to resolve the issues that led to the complaint.
- the date the complaint was resolved and documentation of complainant's level of satisfaction with the actions to resolve the issue; and
- notifying the relevant authority or the EPA of complaints regarding environmental nuisance (particularly noise and dust) and the actions undertaken to resolve the complaint, and of any non-conformance with the SRP that results in environmental nuisance.

Where appropriate the complainant will be notified of action taken. Complaints can be recorded on a Corrective Action Request Form as contained in Appendix B.

9.3 Record Keeping

Records will be kept of the following:

- Changes to the SRP.
- Minutes of meetings.
- Inspection reports.
- Environmental monitoring records and results (including calibration certificates).
- Non-conformances and complaints; and
- Approvals, certification and licences issued by statutory authorities.

All documents will be numbered to identify their revision status.

9.4 Review

A review process shall be carried out to verify compliance with and effectiveness of the SRP. The review will be managed by the SRP Manager who will:

- Undertake the reviews.
- Maintain records of the review; and
- Ensure corrective actions are promptly implemented.

The review should address the implementation and effectiveness of prescribed field procedures and documentation within the SRP.

An example Checklist Form is contained in Appendix C.

10 REFERENCES

EPA 969/12 – Landfill gas and development near landfills

Environment Protection Act 1993.

Environment Protection Regulations 2009.

EPA (2019) Environmental management of landfill facilities – solid waste

Land and Business (Sale and Conveyancing) Act 1994.

Land Services SA *Integrated Land Management System (SAILIS)* website: <https://sailis.lssa.com.au/home>.

Location SA Map Viewer: <http://location.sa.gov.au/viewer/>.

LWC (2022) Preliminary Site Investigation 10 – 20 Halls Road, Highbury SA. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees August 2022 – reference OO-01

LWC (2023) In Situ Ground Gas Assessment 10 – 20 Halls Road. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees, September 2023 OO-01 DR003

LWC (2024) Conceptualisation and Data Gap Review 10 – 20 Halls Road. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees, April 2024 OO-02 DR003

National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended in 2013).

NHMRC/NRMMC (2011) Australian Drinking Water Guidelines, version 3.7 (updated in January 2022).

NSW EPA (2020) Assessment and management of hazardous ground gases Contaminated Land Guideline

Parsons Brinckerhoff, 2010. Annual Water Monitoring Report, December 2009 – Former Highbury I Landfill Halls Road, Highbury SA. Prepared for SITA Environmental Solutions. 11 February 2010.

Planning, Development and Infrastructure Act 2016.

Planning, Development and Infrastructure (General) Regulations 2017.

REM (2007) Phase 1 Environmental Site Assessment – Halls Road Highbury Hallan Nominees Land.

SA EPA Site Contamination Index: https://www.epa.sa.gov.au/public_register/site_contamination_index.

SA EPA (1994) Environment Protection (Air Quality) Policy (updated in 2016).

SA EPA (2015) Environment Protection (Water Quality) Policy.

SA EPA (2019a) Guidelines for the Assessment and Remediation of Site Contamination.

SA EPA (2019b) Environmental Management of Landfill Facilities: Solid Waste Disposal.

SKM (2008a) Phase II Program - 10-14 and 16-20 Halls Road, Highbury. Report prepared for Hallan Nominees Pty Ltd, dated July 2008.

SKM (2008a) Development Plan Amendment, Environmental Investigations Executive Summary – Highbury Residential and Open Space Development. Report prepared for Dequetteville Pty Ltd, dated 7 July 2008.

SKM/ REM (2008). Final Report – Additional Environmental Investigations, Readymix Highbury. Prepared for Dequetteville Pty Ltd. 14 July 2008

SKM (2010a) *Additional Landfill Gas Monitoring and Soil Investigation Program - 10-14 and 16-20 Halls Road, Highbury*. Draft report prepared for Hallan Nominees Pty Ltd, dated 24 February 2010.

SKM (2010b) Voluntary Site Contamination Assessment Proposal – SITA Landfill Halls Road, South Australia Final Rev 2 21 May 2010

South Australian Property and Planning Atlas website: <https://sappa.plan.sa.gov.au/>.

State Planning Commission (2021) *Practice Direction 14 (Site Contamination Assessment 2021, as updated in June 2022)*.

US EPA (2005) *Ecological Soil Screening Levels for Antimony*, Interim Final OSWER Directive 9285.7-61.

FIGURES

Site Diagram

10-20 Halls Road, Highbury, SA 5089



Legend Site Boundary Internal Parcel Boundaries	Total Area: 18428m ² Total Perimeter: 560m	Scale:
	<small>Disclaimers:</small> Measurements are approximate only and may have been simplified or smaller lengths removed for readability. Parcels that make up a small percentage of the total site area have not been labelled for increased legibility.	Data Source Aerial Imagery: © Aerometrex Pty Ltd
		Date: 24 May 2022

**APPENDIX A PERSONAL PROTECTIVE
EQUIPMENT & EMERGENCY AND INCIDENT
RESPONSE PROCEDURES**

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE), which for the purposes of this report includes Respiratory Protective Equipment (RPE), should only be used when other desirable control methods are not feasible or residual risk requires further controls. All PPE that cannot be effectively decontaminated should be disposed of as asbestos waste.

The type of PPE required should be based on risk assessment. For instance a P1 disposable respirator may be appropriate for inspection purposes but a full face; positive pressure demand air-line respirator would be required for friable asbestos removal work in an enclosure. PPE requirements should be in accordance with the Code of Practice for the Safe Removal of Asbestos 2nd Edition [NOHSC:2002 (2005) Appendix C]. Table 4, pages 75 and 76 of the aforementioned code may be particularly useful.

In managing asbestos the following should be considered:

- **No smoking is to be permitted during site works.**
- **Workers handling asbestos or ACM should wash their hands thoroughly in warm soapy water before eating, drinking, smoking or using toilet facilities.**
- **If clothing is contaminated it should be removed and disposed as recommended.**

Respiratory Protective Devices

Where the above controls do not reduce atmospheric contaminants to acceptable levels, approved and suitable respiratory protective devices should be provided and used. As outlined in Australian Standard AS 1716, such suitable devices include air purifying respirators.

- **As a minimum an approved class P2 face mask or respirator should be worn when there is deemed to be a potential risk of exposure to asbestos fibres.**

Disposable Coveralls

Disposable coveralls with fitted hoods and cuffs may be worn and disposed of as asbestos waste. Fitted hoods should always be worn over respirator straps/hoods and eye wear.

In some circumstances where disposable protective clothing may not be appropriate i.e. fire hazard, re-useable types may be used if effective laundering can be established.

If undergarments or clothing is contaminated it should be removed and disposed as recommended unless there is a laundering facility available capable of laundering asbestos contaminated clothing.

Footwear and Gloves

Appropriate safety footwear such as steel-capped rubber-soled shoes or gumboots should be provided for all asbestos works. This footwear must remain in the asbestos work area for the duration of the asbestos works. On completion of the asbestos works the safety footwear must be either effectively decontaminated or disposed of as asbestos waste.

The use of protective gloves should be worn at all times when handling asbestos waste. On completion of the asbestos works, all gloves used should be disposed of as asbestos waste.

Minor Works

The following procedure must be implemented if there is a probability of disturbance to asbestos.

- **Disposable coveralls, including a hood shall be worn.**
- **An approved Class P2 facemask or respirator shall be worn during the works.**
- **There shall be no direct contact with any identified asbestos.**
- **Before leaving the work areas, with mask still in position, the surface of the coveralls and exposed body parts shall be decontaminated.**
- **Coveralls shall be removed (with mask still on) and placed in an asbestos waste bag which shall then be sealed and labelled.**

Decontamination

Decontamination of PPE used by personnel and equipment used during works shall occur before leaving the Site. Decontamination can be via a suitable vacuum cleaner or wet down method.

EMERGENCY AND INCIDENT CONTROL PROCEDURES

The protocols described below shall only be conducted where safe to do so.

Emergency Situations

Situations where life or property is considered to be at immediate risk, e.g. fire in asbestos contaminated area or strong wind event. The following protocols shall be implemented:

- **Evacuate all workers, residents and general public.**
- **Seal off or otherwise isolate the area and restrict access if possible.**
- **Advise the Site Owner (and auditor)**
- **Determine “clean up” or other remedial action.**
- **Conduct remedial action.**
- **Conduct clearance air monitoring, if required.**
- **Document the situation.**

Incident Situations

Situations not previously identified where there are potential for exposure to asbestos, e.g. ACM spill (from truck rollover), accidental uncovering of ACM fragments on-site shall be handled as per below:

- **Isolate the area and impose access restrictions.**
- **Consult the CEMP.**
- **Advise the Site Owner and Auditor.**
- **Determine “clean up” or other remedial action.**
- **Conduct remedial action.**
- **Conduct clearance air monitoring, if required.**
- **Document the situation.**

Note: Trucks engaged for remedial works should have their own emergency and incident response protocols and must be appropriately licenced.

APPENDIX B CORRECTIVE ACTION REQUEST FORM

CORRECTIVE ACTION REQUEST FORM

REPORT NO:

DATE:

<p>Report type (circle): Complaint WHS incident Environmental incident Other (describe):</p>
<p>Reported by: Name: Telephone: (W) Other Contact Details: Report taken by: Date: ... / ... / ... Time:</p>
<p>Description:..... Is the problem occurring now? Y / N Has it been lodged previously? Y /N</p>
<p>Immediate action taken (if any):</p>
<p>Investigation (describe cause of incident): Investigation by: Date: ... / ... / ...</p>
<p>Corrective/preventative action taken (if any): Taken by: Date:</p>
<p>Complainant response: Is a complainant response required? Y / N Completed ρ Date: ... / ... / ...</p>
<p>Review: Reviewed and Signed off by: Date:</p>

APPENDIX C SRP REVIEW CHECKLIST

Review No. Reviewer Date

Item No	Item to be Assessed	Complies (Y?N)	Evidence / Required Actions	Responsibility

Project Environmental Inspection Checklist

- This Inspection Checklist is to be completed by the CEMP Manager in conjunction with the Site Supervisor**

Project Name:		Project No:		
Project Manager:		Date:		
Contractor Name:		Contract Name:		Contract No:

✓ Satisfactory

✗ Not Satisfactory

Describe corrective action required:

N/A

	✓ Satisfactory	✗ Not Satisfactory	Describe corrective action required:	N/A
Environmental System				
Contractor's environmental policy displayed?				
Environmental Inspection records onsite?				
Tool box, prestart & project meeting records onsite?				
Housekeeping and Material Storage				
Stockpile location - not on vegetation, within driplines or drainage lines?				
No vegetation impacts?				
No fauna impacts?				
Mobile Plant and Equipment				
Plant and equipment clean prior to start onsite? E.g. free of weeds, soil & vegetation?				
Major plant & equipment services/maintained? E.g. no oil leaks, exhaust emissions OK, exhaust noise OK				
Hazardous Substances				
Spill kits, spill containment equipment onsite?				
Fuels & chemicals stored in bund, container, spill trays?				
Excavation and Trenching				
Spoil/topsoil appropriately stockpiled?				
Contaminated spoil separated and disposed to licensed facility?				
Aboriginal Heritage items identified?				
Fauna identified in trenches? Removed by NPWS/RSPCA?				
Imported fill confirmed as weed free?				
Asbestos Work				
Asbestos waste disposed to licensed facility?				
Asbestos removal being undertaken by suitably licenced contractor?				
Asbestos monitoring in place?				
Water				
No evidence of discharges to watercourses?				
Sediment & erosion controls in place?				
Controls in place when working over/adjacent to water?				

Amenities			
Waste separation/recycling bins in place?			
Other			
Compliance with other requirements not specified above (see site specific EMP)?			

SIGNATURE – CONTRACTOR

I confirm the Project Environmental Inspection Checklist has been completed. Where non compliance has been identified corrective action will be , or has been taken.			
Contractor Representative:			
Signature		Date:	

SIGNATURE – PROJECT MANAGER

I confirm the contractor’s implementation and maintenance of project specific controls has been inspected against “EMS-APPR-B Standard Preliminary Environmental Management Plan (Construction) – Minor Works” Where non compliance has been identified corrective action will be, or has been taken.			
Project Manager:			
Signature		Date:	

A completed copy of this form must be kept on file.

APPENDIX D SRP CONTENT CHECKLIST

Report Section and Information to be Included in an SRP where Relevant as Required in Appendix 5 of EPA 2019a	Included?
Executive Summary	
Background	<input checked="" type="checkbox"/>
Summary of Risk Conclusion	<input checked="" type="checkbox"/>
Scope of Work	<input checked="" type="checkbox"/>
Environmental Values	<input checked="" type="checkbox"/>
Determination of Harm to Human Health, Water of the Environment	<input checked="" type="checkbox"/>
Remediation Goals and Objectives	<input checked="" type="checkbox"/>
Summary of Remediation Conclusions and Recommendations	<input checked="" type="checkbox"/>
Site Information	
Site identification (address, allotments, plans, certificates of title, coordinates, maps)	<input checked="" type="checkbox"/>
Site owner / occupier	<input checked="" type="checkbox"/>
Site plan (layout, scale, north arrow, other site features)	<input checked="" type="checkbox"/>
Current and proposed site use and identification of site users	<input checked="" type="checkbox"/>
General Information	
Name of person requesting the work	<input checked="" type="checkbox"/>
Summary of previous works undertaken (include triggers for remediation, risk conclusions from DSI or SSRA)	<input checked="" type="checkbox"/>
Site contamination audit details	<input checked="" type="checkbox"/>
Remediation Options and Issues	

Report Section and Information to be Included in an SRP where Relevant as Required in Appendix 5 of EPA 2019a	Included?
Define remediation approaches (logistical, technical, financial, value, or water resource and ability to restore, threat to human health or environment)	Remedial options assessed. Excavation and removal of sources is considered best effective, noting the final development design is unknown. Adopted options could be altered under audit later in the process if required.
Discuss impracticability considerations	Impracticability of proposed remedial options is assessed. Excavation and removal of sources is considered straightforward and best effective (other than costs), noting the final development design is unknown. Adopted options could be altered under audit later in the process if required.
Evaluate available and viable remediation options to achieve goals	The current adopted remedial options are considered best effective, noting the final development design is unknown. Adopted options could be altered under audit later in the process if required.
Document rationale for selected remediation option	Refer Section 6.
Document management measures to prevent / reduce additional harm to human health, water or environment.	Refer Section 7
Determine the timeframe for remediation	6.10
Review by SA EPA or site contamination auditor	This document forms part of deliverable to be reviewed by the appointed site contamination auditor (refer Section 2 and also Table 3-1).
Stakeholder engagement	Refer Section 6.6
Reporting	
Signed copy of reports	Refer Document Control Page
Appendices may be provided in electronic format	<input checked="" type="checkbox"/>
Searchable PDF	<input checked="" type="checkbox"/>
Electronic files unlocked	<input checked="" type="checkbox"/>

APPENDIX E STATEMENT OF LIMITATIONS

STATEMENT OF LIMITATIONS & IMPORTANT INFORMATION REGARDING YOUR REPORT

INTRODUCTION

This report has been prepared by Land & Water Consulting for you, as Land & Water Consulting's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Land & Water Consulting may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Land & Water Consulting has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

No warranty or guarantee of the site conditions is intended.

This report was prepared for the sole use of you, the Client and may not contain sufficient information for purposes of other parties or for other uses. Any reliance on this report by third parties shall be at such parties sole risk. This report shall only be presented in full and may not be used to support any other objectives than those set out in the report, except where written approval with comments are provided by Land & Water Consulting.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

LIMITATIONS OF THE REPORT

The scope of works undertaken and the report prepared to complete the assessment was in accordance with the information provided by the client and the specifications for works required under the contract. As such, works undertaken and statements made are based on those specifications (such as levels of risks and significance of any contamination) and should be considered and interpreted within this context. The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

Your environmental report should not be used without reference to Land & Water Consulting in the first instance:

- When the nature of the proposed development is changed, for example if a residential development is proposed instead of a commercial one;
- When the size or configuration of the proposed development is altered;
- When the location or orientation of the proposed structures are modified;
- When there is a change in ownership;
- For application to an adjacent site.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statutes and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

ENVIRONMENTAL ASSESSMENT “FINDINGS” ARE PROFESSIONAL ESTIMATES

The information in this report is considered to be accurate with respect to conditions encountered at the site at the time of investigation and considering the inherent limitations associated with extrapolating information from a sample set. Note however that site assessment identifies actual subsurface conditions only at those specific points where samples are taken, when they are taken. Environmental data derived through sampling and analysis are interpreted by consultants who then render an opinion about overall subsurface conditions, the nature and extent of contamination and potential impacts on the use of the land. Actual conditions may differ from those inferred to exist as no professional and no subsurface assessment program can reveal every detail within the ground across a site. Subsurface conditions can vary across a particular site and no practical degree of sampling can ever eliminate the possibility that conditions may be present at a site that have not been represented through sampling.

SUBSURFACE CONDITIONS CAN CHANGE

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Land & Water Consulting should be kept apprised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions. Since subsurface conditions (including contamination concentrations) can change within a limited period of time and space, this inherent limitation to the representation of site conditions provided by this report should always be taken into consideration particularly if the report is used after a delay in time.

DATA SHOULD NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

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RESPONSIBILITY

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.



Conceptualisation & Data Gap Review

10-20 Halls Road, Highbury, South Australia

Future Urban/Hallan Nominees

July 2024

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
DR001	Draft	Dr James Fox	Dr James Fox	20 December 2023
DR003	Draft	Dr James Fox	Dr James Fox	1 May 2024
FR001	Final	Dr James Fox	Dr James Fox	11 July 2024

Project Details

Project Name	10-20 Halls Road, Highbury, South Australia
Client	Future Urban/Hallan Nominees
Client Project Manager	Ms Belinda Monier
LWC Project Manager	James Fox
LWC Project Director	Emily Picken
Authors	James Fox
File Reference	LWC OO 02 10-20 Halls Road CDG Review (FR001)

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EXECUTIVE SUMMARY

Land and Water Consulting (LWC) has been engaged by Future Urban/Hallan Nominees to prepare a conceptualisation and data gap review for 10-20 Halls Road, Highbury, South Australia (the Site).

The Site is situated within the Torrens River Catchment, approximately 14 km north-east of the Adelaide CBD, and comprises an area of approximately 1.85 hectares.

The northern portion of the Site (Allotment 11) is currently in use for residential purposes whereas the southern portion is vacant and undeveloped – with respect to Table 1 of *State Planning Commission Practice Direction 14 (Site Contamination Assessment 2022)* (“Practice Direction 14”), the current use of the northern portion is aligned with *Item 1: Residential Class 1 – Domestic Residential* (defined as a sensitive land use in the *Environment Protection Act 1993*).

Despite its current use, the land is zoned as Extractive Industry – it is understood that Future Urban plan to apply for residential rezoning of the Site.

LWC formulated a preliminary site investigation (PSI) for the Site in August 2022, which looked to build on earlier environmental assessment works undertaken by Resource Environmental Management (REM) and Sinclair Knight Merz (SKM) in 2008 – 2010.

The objective of the 2022 PSI was to identify potential sources of contamination and associated contaminants of potential concern arising from current and historical activities undertaken on the Site, and/or within its immediate vicinity, that may give rise to site contamination (as defined in Section 5B of the *Environment Protection 1993*) with respect to a proposed rezoning of the Site for residential land use – the objectives of this assessment accord with Practice Direction 14.

Contaminant Linkages

The PSI concluded that there are 16 potentially significant contaminant linkages (L) / exposure pathways associated with a sensitive land use that are unresolved since the previous Site assessment program undertaken in 2008-2010 – ten of these – L3, L4, L5, L6, L7, L8, L9, L10, L11, L12 were considered to be relatively insignificant. The other six linkages would need to be further assessed/ resolved prior to residential rezoning/development of the Site.

Linkage	Sources	Receptor	Pathway	Potential Significance
L1	S1 - Fill	Future residents (adults and children)	Dermal contact with impacted soils	<p>The 2008 soil investigation program involved an extensive grid-based and targeted sampling program across the Site, with only isolated/limited exceedances of Tier 1 health-based screening criteria for a low density residential land use. The detected impacts were surficial in nature and further delineated in 2009 as limited to the north-western portion of the Site. Although this issue should be addressed further, it is not considered to be significant in terms of limiting the rezoning and/or development of the Site for residential purposes.</p> <p>No PCAs appear to have occurred on the Site over the period since the 2008-09 soil investigations were undertaken.</p>
L2	S1 - Fill	Future residents (adults and children)	Ingestion of impacted soils	
L3	S1 - Fill	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	<p>This issue is not considered to be significant in terms of limiting the rezoning and/or development of the Site for residential purposes – although antimony concentrations in surficial soils exceeded the adopted Tier 1 ecological criterion in 2008, this appears to be limited to a relatively localised area and the adopted criterion may also have been overly-conservative.</p>
L4	S1 - Fill	Groundwater beneath the Site	Leaching from soil	<p>During the 2008-09 soil investigation programs, no chemical substance was reported at a concentration that would indicate the potential for leaching to groundwater.</p>
L5	S2 – Coke Works	Future residents (adults and children)	Dermal exposure to impacted soils	<p>The occurrence of this PCA has not been confirmed and the activity identified (on the basis of anecdotal information only) may actually have been the use of activated carbon for water filtration rather than a “coke works”.</p> <p>In addition, no evidence of impacts likely to have stemmed from such an activity were identified during the 2008-09 soil investigation programs.</p>
L6	S2 – Coke Works	Future residents (adults and children)	Ingestion of impacted soils	
L7	S2 – Coke Works	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	
L8	S2 – Coke Works	Groundwater beneath the Site	Leaching from soil	

Linkage	Sources	Receptor	Pathway	Potential Significance
L9	S3 – ASTs	Future residents (adults and children)	Dermal exposure to impacted soils	The 2008-09 soil investigation program included sampling locations that targeted the locations of the ASTs – no potential impacts were identified and it is noted (but not confirmed) that the 5,000 L AST and bowser were stated to have never been used whereas the 20,000 L AST is understood to have been used only as a water cart.
L10	S3 – ASTs	Future residents (adults and children)	Ingestion of impacted soils	
L11	S3 – ASTs	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	
L12	S3 – ASTs	Groundwater beneath the Site	Leaching from soil	
L13	S4 – landfill	Future residents (adults and children)	Migration of landfill gas to indoor air	<p>The 2010 landfill gas monitoring results for MW1_001, as well as Veolia's May 2022 results for the adjacent landfill, indicate that CO₂, and not CH₄, is the main gas now generated by the closed landfill. Although the May 2022 results indicate that the CO₂ concentrations were relatively low along the southern boundary of the Site (compared to other areas of the former landfill), one of the concentrations (2.5 %v/v at boundary location HBYPW009) exceeded the SA EPA (2019b) criterion of 1.5% v/v.</p> <p>Confirmatory monitoring would therefore be required to check the long term trends under various climate conditions/atmospheric pressures.</p>
L14	S4 – landfill	Future residents (adults and children)	Migration of vapour from impacted groundwater to indoor air	<p>The 2008-09 groundwater investigations involved a single well located on the southern Site boundary. With respect to the potentially relevant groundwater environmental values, the only impacts detected at that time were ammonia concentrations (during each sampling event) that exceed the current aesthetic criteria for potable and recreational water use. While it seems likely that this may be related to the adjoining landfill, the current state of groundwater beneath the Site is unknown and the limited 2008-09 testing program did not include potential volatile contaminants.</p> <p>Further monitoring is therefore recommended to assess the current state of groundwater and identify any potential associated risks.</p>
L15	S4 – landfill	Future residents (adults and children)	Ingestion of impacted groundwater	

Linkage	Sources	Receptor	Pathway	Potential Significance
L16	S1 – Fill	Fill – aesthetic impacts	Not aesthetically appropriate for residential development	Fill material that is aesthetically unsuitable for a sensitive land use could be recovered and sifted to remove bricks and oversize materials for disposal.

The most significant (i.e. potential ability for adverse outcome with highest magnitude of harm) of these potential linkages was Linkage 13 - migration of landfill gas from the former landfill located immediately south of the Site (currently owned by Veolia – landfill is a Class 1 activity pursuant to Schedule 1 of Practice Direction 14 and is located within 60 m of the Site). There are, in fact, two former landfills within 500 m of the Site, with the Highbury Landfill being located immediately south of the Veolia Landfill.

Accounting for the Class 1 activity immediately adjacent to the Site, it was considered that a site contamination audit would likely be required, in addition to the recommendations presented below.

1. Undertake further monitoring of the landfill gas regime to assess its current status beneath the Site and confirm that the regime will not change under seasonal conditions.
2. Undertake groundwater monitoring, particularly in the vicinity of the southern Site boundary, to assess the current state of the uppermost aquifer beneath the Site, the groundwater depth and flow direction and any potential seasonal variations (i.e. in depth, flow and/or chemical status).
3. Prepare a Site Remediation Plan (SRP) to render the site suitable for the proposed residential rezoning/development (i.e. with reference to the north-western area of elevated soil metal concentrations and the south-eastern area of aesthetically unacceptable fill).
4. Prepare a report to detail the additional assessment/remediation work and assess the potential risks to the environment and human health under a sensitive land use scenario.

Findings

A total of six linkages were considered to be potentially significant when considering a residential land use (notwithstanding the current land use is residential). The significance of these linkages to cause actual or potential harm to health, environment, or water) (in the opinion of LWC) following further field works in October 2023 and desk top work October – December 2023 is provided below:

Linkage	Sources	Receptor	Pathway	Potential Significance
L1	S1 - Fill	Future residents (adults and children)	Dermal contact with impacted soils	The 2008 soil investigation program involved an extensive grid-based and targeted sampling program across the Site, with only isolated/limited exceedances of Tier 1 health-based screening criteria for a low density residential land use.

Linkage	Sources	Receptor	Pathway	Potential Significance
L2	S1 - Fill	Future residents (adults and children)	Ingestion of impacted soils	<p>The detected impacts were surficial in nature and further delineated in 2009.</p> <p>No PCAs appear to have occurred on the Site over the period since the 2008-09 soil investigations were undertaken.</p> <p>Delineation works confirmed the metal impacts are confined to the northwest corner of the Site and likely associated with the metal shed that is present there.</p>
L13	S4 – landfill	Future residents (adults and children)	Migration of landfill gas to indoor air	<p>The 2010 landfill gas monitoring results for MW1_001, as well as Veolia's May 2022 results for the adjacent landfill, indicated that CO₂, and not CH₄, is the primary ground gas and this was confirmed via GasClam monitoring in January 2023.</p> <p>The depth of the onsite monitoring wells for gas are considered to be satisfactory with respect to the apparent thickness of the waste mass within the Veolia Landfill and no further monitoring or assessment is considered to be beneficial noting the current CS2 classification and the future propensity for the profile to change once landfill gas has ceased to be flared – thus although this linkage is potentially significant it can be managed via dwelling design/ control.</p>
L14	S4 – landfill	Future residents (adults and children)	Migration of vapour from impacted groundwater to indoor air	<p>Groundwater in the on-site well did not have sufficient head to be sampled in October 2023. Notwithstanding, groundwater flow direction beneath the landfill as consistently been reported by others to be to the southwest in the tertiary aquifer, i.e. down hydraulic gradient and away from Site.</p>
L15	S4 – landfill	Future residents (adults and children)	Ingestion of impacted groundwater	<p>Some organic compounds have been detected in the tertiary and basement groundwater though these are largely below potable criterion or marginally (i.e. 10%) above and the magnitude of such concentrations, coupled to direction of groundwater flow and the low C₆-C₉ loading in onsite groundwater does not indicate a potentially significant linkage (risk) to health, water or the environment pertaining to the Site when considering a sensitive land use.</p>

Linkage	Sources	Receptor	Pathway	Potential Significance
L16	S1 – Fill	Fill – aesthetic impacts	Not aesthetically appropriate for residential development	Fill material that is aesthetically unsuitable for a sensitive land use could be recovered and sifted to remove bricks and oversize materials for disposal or could be ‘hidden’ beneath dwelling footprints subject to proposed development design. This is unlikely to be a major challenge to rezoning or development.

Ground gas risk

Linkage 13 considered risk of migration of ground gas to indoor air of future sensitive land use. The objective of the January 2023 in situ ground gas assessment was to characterise the ground gas at the Site in association with varying atmospheric pressures. This was achieved using GasClam continuous ground gas loggers. The ground gas does show variability as a function of atmospheric pressure. The lowest pressure recorded was 981 mb – this is considered a suitably low pressure to represent a worst case ground gas regime.

The characteristic situation (CS) for ground gas beneath the Site is driven by carbon dioxide and is calculated as CS2 on the basis that carbon dioxide in the ground exceeds 5% vol/vol (maximum is 15.6%). The 2023 ground gas monitoring data plus previous 2008-2010 data and data obtained from Veolia for May 2022 regarding landfill monitoring bores (around the periphery of the landfill) indicates methane is not present – the gas generation stage of the landfill is not clear but is likely to be quite progressed given it was capped in ~1994.

As landfill gas flaring is currently undertaken, the post flaring gas scenario is unknown.

Passive venting and low calorie flaring are expected to continue for several years / indefinitely. It is expected that the EPA regulatory guidance (SA EPA 2019) would be in force which requires limitation of gas concentrations in monitoring bores at the boundary of the landfill facility or within structures located on or off site to less than 1% methane by volume or 1.5% carbon dioxide by volume. The latter is somewhat ambiguous to control given natural soil respiration / organic matter degradation can provide an elevated background CO₂ signature.

A theoretical calculation of the methane in the VL is provided in Appendix E-2 in lieu of direct information provided by the current apparent operator (Ennovo). Such calculation indicates that boundary methane at the boundary between the Site and the VL may be between 0.3 and 0.6 % assuming no extraction, which would fit the current profile of measurements on site and in northern perimeter bores, noting extraction is taking place; the benefits of extraction may not be truly seen in an ageing low calorie landfill at perimeter where highest content of methane is likely to be in the most dense / voluminous zones of the waste mass e.g. centrally.

LWC considers that there is no further benefit to additional monitoring of the landfill gas generation source nor on site ground gas profile, and that resources are best focused on developing building controls sympathetic to the future residential development mindful of a post flaring scenario. The CS2 classification may be reconsidered in light of future potential risk from offsite gas post cessation of landfill gas flaring, to provide an increased level of ground gas protection.

Groundwater risk

Some volatile organic compounds were identified in water in the tertiary unit in the northwest corner of the Veolia Landfill however the magnitude of concentration coupled to the depth to groundwater would likely significantly mitigate any risk of volatilisation to indoor air where a sensitive use is proposed. Notwithstanding this, the occurrence of where these compounds were reported is down hydraulic gradient of the Site with respect to both the tertiary and basement units.

Although not directly measured in water sampled from beneath the Site, VOC do not infer to have a significant loading based on the C₆-C₉ fraction reported in 2009. Based on data to date (including consistent groundwater flow pattern away from the Site) there is no indication that groundwater would impact receptors on and beneath the Site.

Soil risk

Lead in surface soil in and around the northwest shed reported at concentrations above the ASC NEPM Health Investigation Level A (300 mg/kg) in previous assessment and required further delineation (Linkage 1 and 2). This was achieved and the lead in soil here is adequately delineated to be below Health Investigation Level A. This soil can be dealt with during development via a Site Remediation Plan and can be disposed of offsite as Intermediate Waste Soil (IWS).

The aesthetic soil in the southeastern corner of the Site may also be removed from Site if not able to be placed beneath dwelling footprints or roadways and could be managed as Intermediate Waste Soils also given the chemical concentrations are less than the IWS criteria. The fill here is understood to be from a plant nursery owned by the Mercer family and this was supported as inclusions observed in recovered soil cores included plant labels typical of potted plants being sold at a plant nursery. Where such soil is 'covered' by the footprint of a dwelling then there would be no aesthetic limitations (though geotechnical issues may need to be discussed with a suitably qualified geotechnical engineer). This issue can be reviewed where a specific development plan is being contemplated.

Refer to the Statement of Limitations presented in Appendix J.

Definition of Acronyms

ACM	Asbestos Containing Material
AHD	Australian Height Datum
ARMCAZ	Agriculture and Resource Management Council of Australian and New Zealand
ASRIS	Australian Soil Resource Information System
AS	Australian Standard
ASS	Acid Sulfate Soil
ASC	Assessment of Site Contamination
BGL	below ground level
BTEX	benzene, toluene, ethylbenzene and xylenes (total)
CBD	Central Business District
COPC	Contaminants of Potential Concern
CH₄	Methane
CO	Carbon monoxide
CO₂	Carbon dioxide
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CT	Certificate of Title
DEW	Department of Environment and Water
DIT	Department of Infrastructure and Transport
DR	Draft Report
EPA	Environment Protection Authority
EP	Environment Protection
EPP	Environment Protection Policy
EPR	Environment Protection Regulations
FR	Final Report
GDA	Geocentric Datum of Australia
ha	hectares
IEI	Issue of Environmental Interest
km	kilometres
LWC	Land and Water Consulting
m	metres
m²	square metres
m³	square cubic metres
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
mg/L	milligrams per litre
µg/L	micrograms per litre
MAH	Monocyclic Aromatic Hydrocarbons
µg/m³	micrograms per cubic metre
NHMRC	National Health and Medical Research Council
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PACM	Potential Asbestos Containing Material
PASS	Potential Acid Sulfate Soil
PAH	Polycyclic Aromatic Hydrocarbons
PCA	Potentially Contaminating Activity
ppm	parts per million
PSI	Preliminary Site Investigation
SA EPA	South Australian Environment Protection Authority
SAQP	Sampling and Analysis Quality Plan
SAR	Site Assessment Report
SCAR	Site Contamination Audit Report
SVOC	Semi-volatile Organic Compound
SV	Soil Vapour
SWL	Standing Water Level
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UBD	Universal Business Directory
USC	Unified Soil Classification

UST	Underground Storage Tank
VOC	Volatile Organic Compound
WQEP	Environment Protection (Water Quality) Policy

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1 INTRODUCTION

1.1 Overview

Land and Water Consulting (LWC) was engaged by Future Urban/Hallan Nominees to undertake an in-situ ground gas assessment following the completion of a Preliminary Site Investigation (PSI ¹) of the property located at 10-20 Halls Road, Highbury, South Australia (the Site – refer to Table 1-1). A site plan is attached.

The Site is situated within the Torrens River Catchment, approximately 14 km north-east of the Adelaide CBD, and comprises an area of approximately 1.85 hectares.

Table 1-1 Site Details

Parcel Identifier	Certificate of Title	Property Number	Street Name	Suburb
D17357A11	CT 5768/114	10-14	Halls Road	Highbury
D17357A12	CT 5768/115	16-20	Halls Road	Highbury

It is understood that the northern portion of the Site (Allotment 11) is currently in use for residential purposes whereas the southern portion is vacant and undeveloped – with respect to Table 1 of *State Planning Commission Practice Direction 14 (Site Contamination Assessment 2022)* (“Practice Direction 14”), the current use of the northern portion is aligned with *Item 1: Residential Class 1 – Domestic Residential* (defined as a sensitive land use in Section 3-1 of the *Environment Protection Act 1993*).

Despite its current use, the land is zoned as Extractive Industry – it is understood that Future Urban plan to apply for residential rezoning of the Site.

A closed landfill owned and managed by Veolia is present on the immediate southern boundary of the Site and a further larger landfill owned and managed by the Highbury Landfill Authority (HLA) is present to the south of this.

The PSI identified potentially contaminating activities (PCA) associated with the Site – these were largely assessed in an extensive soil investigation/delineation program undertaken 2008 – 2010, as well as limited groundwater and landfill gas investigations at such time. However it has been ~12 years since this work was completed but both the aerial imagery and the recent site inspection observations indicate that no major changes have occurred with respect to the layout and use of the Site. The previous assessment programs did identify the following:

1. localised surficial heavy metal contamination in the north-western corner;
2. aesthetically impacted fill material in the south-eastern corner; and
3. the presence of a former landfill immediately adjacent to the southern Site boundary where the concentrations of CO₂ in landfill gas may present a risk with respect to a sensitive land use.

Although two groundwater monitoring events were undertaken in 2008-09 (with respect to a single well located on the southern Site boundary), and there was some indication of ammonia impacts potentially associated with the adjacent landfill, the current status of groundwater beneath the Site is unknown.

¹ in accordance with Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure* (1999 as amended 2013) – the ASC NEPM (1999)

1.2 Contaminant linkages

The (2022) PSI concluded that there are 16 potentially significant contaminant linkages/ exposure pathways associated with a sensitive land use that are unresolved since the previous Site assessment program undertaken in 2008-2010 – ten of these – L3, L4, L5, L6, L7, L8, L9, L10, L11, L12 were considered to be relatively insignificant. The other six linkages required further assessment to facilitate residential rezoning/development of the Site; these are summarised in Table 1-2. These are superseded by works undertaken in 2023 and 2024 (discussed herein).

Table 1-2 Summary of 2022 linkages (now superseded)

Linkage	Sources	Receptor	Pathway	Potential Significance
L1	S1 - Fill	Future residents (adults and children)	Dermal contact with impacted soils	<p>The 2008 soil investigation program involved an extensive grid-based and targeted sampling program across the Site, with only isolated/limited exceedances of Tier 1 health-based screening criteria for a low density residential land use. The detected impacts were surficial in nature and further delineated in 2009 as limited to the north-western portion of the Site. Although this issue should be addressed further, it is not considered to be significant in terms of limiting the re-zoning and/or development of the Site for residential purposes.</p> <p>No PCAs appear to have occurred on the Site over the period since the 2008-09 soil investigations were undertaken.</p>
L2	S1 - Fill	Future residents (adults and children)	Ingestion of impacted soils	
L3	S1 - Fill	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	This issue is not considered to be significant in terms of limiting the re-zoning and/or development of the Site for residential purposes – although antimony concentrations in surficial soils exceeded the adopted Tier 1 ecological criterion in 2008, this appears to be limited to a relatively localised area and the adopted criterion may also have been overly-conservative.
L4	S1 - Fill	Groundwater beneath the Site	Leaching from soil	During the 2008-09 soil investigation programs, no chemical substance was reported at a concentration that would indicate the potential for leaching to groundwater.
L5	S2 – Coke Works	Future residents (adults and children)	Dermal exposure to impacted soils	The occurrence of this PCA has not been confirmed and the activity identified (on

Linkage	Sources	Receptor	Pathway	Potential Significance
L6	S2 – Coke Works	Future residents (adults and children)	Ingestion of impacted soils	the basis of anecdotal information only) may actually have been the use of activated carbon for water filtration rather than a “coke works”. In addition, no evidence of impacts likely to have stemmed from such an activity were identified during the 2008-09 soil investigation programs.
L7	S2 – Coke Works	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	
L8	S2 – Coke Works	Groundwater beneath the Site	Leaching from soil	
L9	S3 – ASTs	Future residents (adults and children)	Dermal exposure to impacted soils	The 2008-09 soil investigation program included sampling locations that targeted the locations of the ASTs – no potential impacts were identified and it is noted (but not confirmed) that the 5,000 L AST and bowser were stated to have never been used whereas the 20,000 L AST is understood to have been used only as a water cart.
L10	S3 – ASTs	Future residents (adults and children)	Ingestion of impacted soils	
L11	S3 – ASTs	On-site terrestrial ecosystems – fauna and flora	Direct contact and translocation	
L12	S3 – ASTs	Groundwater beneath the Site	Leaching from soil	
L13	S4 – landfill	Future residents (adults and children)	Migration of landfill gas to indoor air	The 2010 landfill gas monitoring results for MW1_001, as well as Veolia’s May 2022 results for the adjacent landfill, indicate that CO ₂ , and not CH ₄ , is the main gas now generated by the closed landfill. Although the May 2022 results indicate that the CO ₂ concentrations were relatively low along the southern boundary of the Site (compared to other areas of the former landfill), one of the concentrations (2.5 %v/v at boundary location HBYPW009) exceeded the SA EPA (2019b) criterion of 1.5% v/v. Confirmatory monitoring would therefore be required to check the long term trends under various climate conditions/atmospheric pressures.
L14	S4 – landfill	Future residents (adults and children)	Migration of vapour from impacted groundwater to indoor air	The 2008-09 groundwater investigations involved a single well located on the southern Site boundary. With respect to the potentially relevant groundwater environmental values, the only impacts

Linkage	Sources	Receptor	Pathway	Potential Significance
L15	S4 – landfill	Future residents (adults and children)	Ingestion of impacted groundwater	<p>detected at that time were ammonia concentrations (during each sampling event) that exceed the current aesthetic criteria for potable and recreational water use. While it seems likely that this may be related to the adjoining landfill, the current state of groundwater beneath the Site is unknown and the limited 2008-09 testing program did not include potential volatile contaminants.</p> <p>Further monitoring is therefore recommended to assess the current state of groundwater and identify any potential associated risks.</p>
L16	S1 – Fill	Fill – aesthetic impacts	Not aesthetically appropriate for residential development	Fill material that is aesthetically unsuitable for a sensitive land use could be recovered and sifted to remove bricks and oversize materials for disposal.

The most significant (i.e. potential ability for adverse outcome with highest magnitude of harm) of these potential linkages was Linkage 13 - migration of landfill gas from the former landfill located immediately south of the Site (currently owned by Veolia – landfill is a Class 1 activity pursuant to Schedule 1 of Practice Direction 14 and is located within 60 m of the Site). There are, in fact, two former landfills within 500 m of the Site, with the Highbury Landfill being located immediately south of the Veolia Landfill.

Accounting for the Class 1 activity immediately adjacent to the Site, it was considered that a site contamination audit would likely be required, in addition to the recommendations presented below.

1. Undertake further monitoring of the landfill gas regime to assess its current status beneath the Site and confirm that the regime will not change under seasonal conditions.
2. Undertake groundwater monitoring, particularly in the vicinity of the southern Site boundary, to assess the current state of the uppermost aquifer beneath the Site, the groundwater depth and flow direction and any potential seasonal variations (i.e. in depth, flow and/or chemical status).
3. Prepare a Site Remediation Plan (SRP) to render the site suitable for the proposed residential rezoning/development (i.e. with reference to the north-western area of elevated soil metal concentrations and the south-eastern area of aesthetically unacceptable fill).
4. Prepare a report to detail the additional assessment/remediation work and assess the potential risks to the environment and human health under a sensitive land use scenario.

Tasks 1 has been completed though Task 2 is negated by groundwater level decrease. Task 3 has not been completed and will follow this task (Task 4). This document presents the additional assessment component of Task 4.

1.3 Objective

The objective of this document is to analyse the six potentially significant linkages and close these out or identify if they are data gaps how these may be resolved.

2 SITE DETAILS

2.1 Identification

A summary of Site particulars is presented as Table 2-1.

Table 2-1 Summary of Site Particulars

Site Location	10-14 and 16-20 Halls Road, Highbury, South Australia 5089
Property Description	The subject area of the Site is defined by the following Certificate of Titles: <ul style="list-style-type: none"> ▪ D17357AL11 Volume 5768 Folio 114 ▪ D17357AL12 Volume 5768 Folio 115 In the Area Named Highbury Hundred of Yatala Copies of the current CT are provided in Appendix B of the PSI.
Area of Site	Approximately 18,500 m ² (1.85 hectares)
Local Government Authority	City of Tea Tree Gully
Zoning	Resource Extraction (RE)
Current Site Usage	Northern portion – residential (sensitive land use) Southern portion – vacant
Ownership	<i>Hallan Nominees Pty Ltd</i>
Proposed Land Use	Re-zone to Residential

2.2 Site setting

The current surrounding land uses are detailed in Table 2-2. Generalised land use is shown in Appendix C.

Table 2-2 Surrounding Land Uses

Boundary	Description of Surrounding Land Use
North	Residential properties
East	Former quarry, across Halls Road
South	Former landfills to immediate south (SITA/Veolia) and approximately 230 m south (Highbury Landfill Authority)
West	Residential properties

2.3 Site description

The Site comprises two allotments and slopes from north to south, with a fall of ~ 20 m along an axis approximately 150 m long. Halls Road, to the east, provides access to the Site.

The northern Allotment 11 hosts the following infrastructure:

- a two storey dwelling with garden areas that include children's outdoor play equipment;
- sheds;
- general inert materials associated with farming or earthmoving;
- two aboveground storage tanks (ASTs) understood to have been used as water tanks for dust suppression etc.; and
- an old caravan.

The southern Allotment 12 has not been subjected to any development/ improvements and hosts heathy vegetation (grass, bushes, trees).

3 REGIONAL SETTING

3.1 Topography & hydrology

The survey marks dataset (detailed on The Atlas of South Australia database) indicates that the northern boundary of the Site is located at an elevation of approximately 180 m Australian Height Datum (AHD) and the southern boundary is approximately 160 m AHD – i.e. a 1 in 8 gradient, decreasing from north to south across the Site. The land to the west is generally of similar elevation whereas, to the east, the land surface falls away sharply due to the presence of a former quarry. Further to the east, the land elevation increases due to the Adelaide Hills. The land surface in general decreases to around 140 m AHD at the bottom of Halls Road.

The nearest fresh surface water body to the Site is an unnamed creek to the north which flows from east to west, down through Anstey Hill and parallel with Barracks Road. This creek would be located hydraulically up-gradient of the Site, given the reasonably sharp fall in elevation from north to south. The former quarry to the east and south-east of the Site contains various water bodies that have accumulated within the open pits.

The closest marine surface water body to the Site is Gulf St Vincent, located over 20 km to the west.

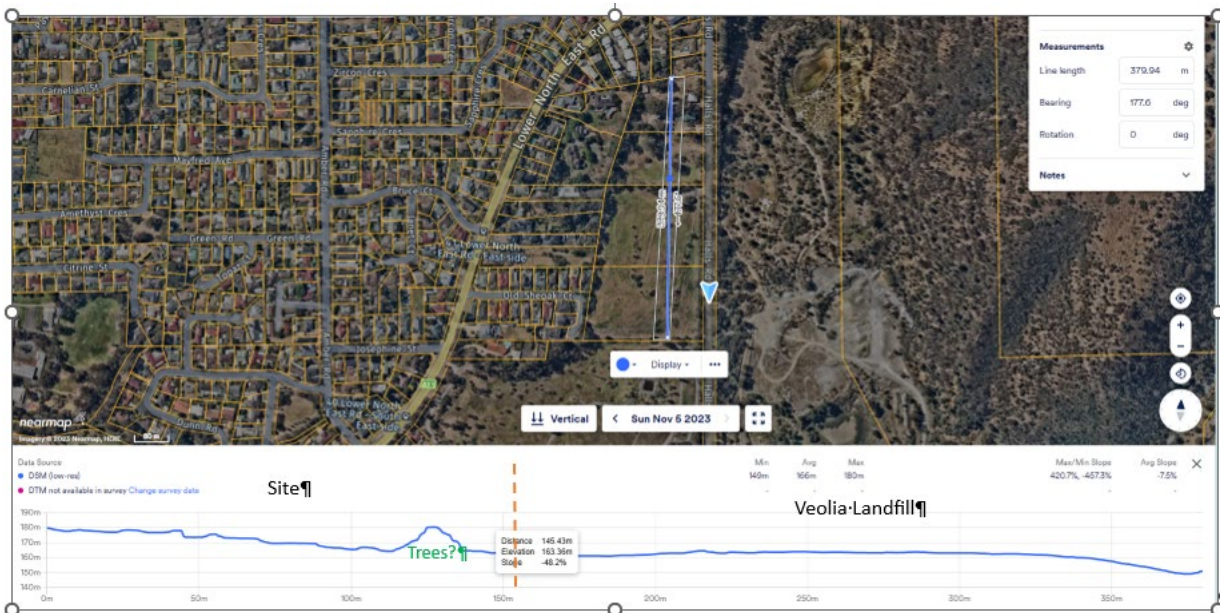


Figure 3-1 General elevation profile of the Site and the Veolia Landfill south of the Site

3.2 Geology

The Department of Environment, Water and Natural Resources (DEWNR) surface geological map (1:100,000), indicates that the Site is underlain by undifferentiated Tertiary rocks. The upper lithology is known to comprise sands that were excavated for a sand and gravel business along Halls Road, resulting in excavations which were then sold off for use as landfills.

The Atlas of Australian Soils classifies these sands as Tc1, being:

- Hilly to steep hilly, small valley plains: hard acidic yellow mottled soils (Dy3.61) with shallow grey-brown sandy soils (Uc6.11) and rock outcrops in association with variable areas of (Dy3.41 and Dy3.42), (Dy3.22), (Dr2.12 and Dr2.22) on hills and hill slopes, and minor areas of (Dy3.61) containing

ironstone gravel in the A horizons on some ridge tops; unclassified alluvial soils, peats (0), and acid swamp soils (0) in the wetter valleys.

The CSIRO Atlas of Australian Acid Sulfate Soils indicates that there is an extremely low probability (1-5%) of occurrence of acid sulfate soils.

Table 3-1 Geology of the Site and Surrounding Area

Name	Description	Parent Name	Province	Age	Distance (m)	Direction
Unnamed	Undifferentiated Tertiary rocks		Unknown	Tertiary	0	On-site
Stonyfell Quartzite	Quartzite, feldspathic, with shale interbeds; silty sandstone in part schistose and calcareous	Bungarider Subgroup	Adelaide Geosyncline	Neoproterozoic	306	East
Unnamed	Undifferentiated calcrete	Unnamed	Unknown	Pleistocene	769	West
Keswick Clay	Clay, smectite-rich, grey green, with red or yellow mottling and rare sand lenses	Unnamed	St Vincent Basin	Pleistocene	833	West
Woolshed Flat Shale	Shale, black; dolomitic siltstone; dolomite; grey laminated siltstone	Bungarider Subgroup	Adelaide Geosyncline	Neoproterozoic	901	East
Unnamed	Undifferentiated Quaternary rocks		Unknown	Pleistocene-Holocene	932	South-west

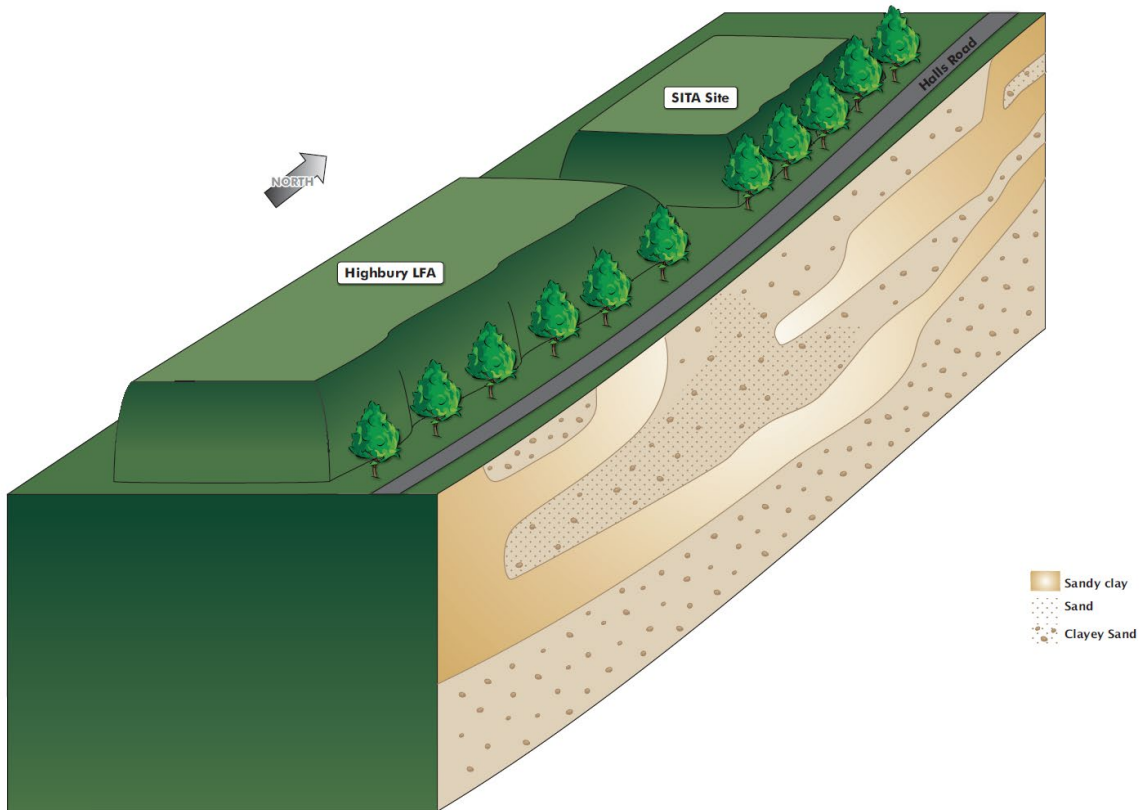


Figure 3-2 Conceptual Lithology (from SKM (2010)) – the Site is located to the immediate north of the “SITA site”

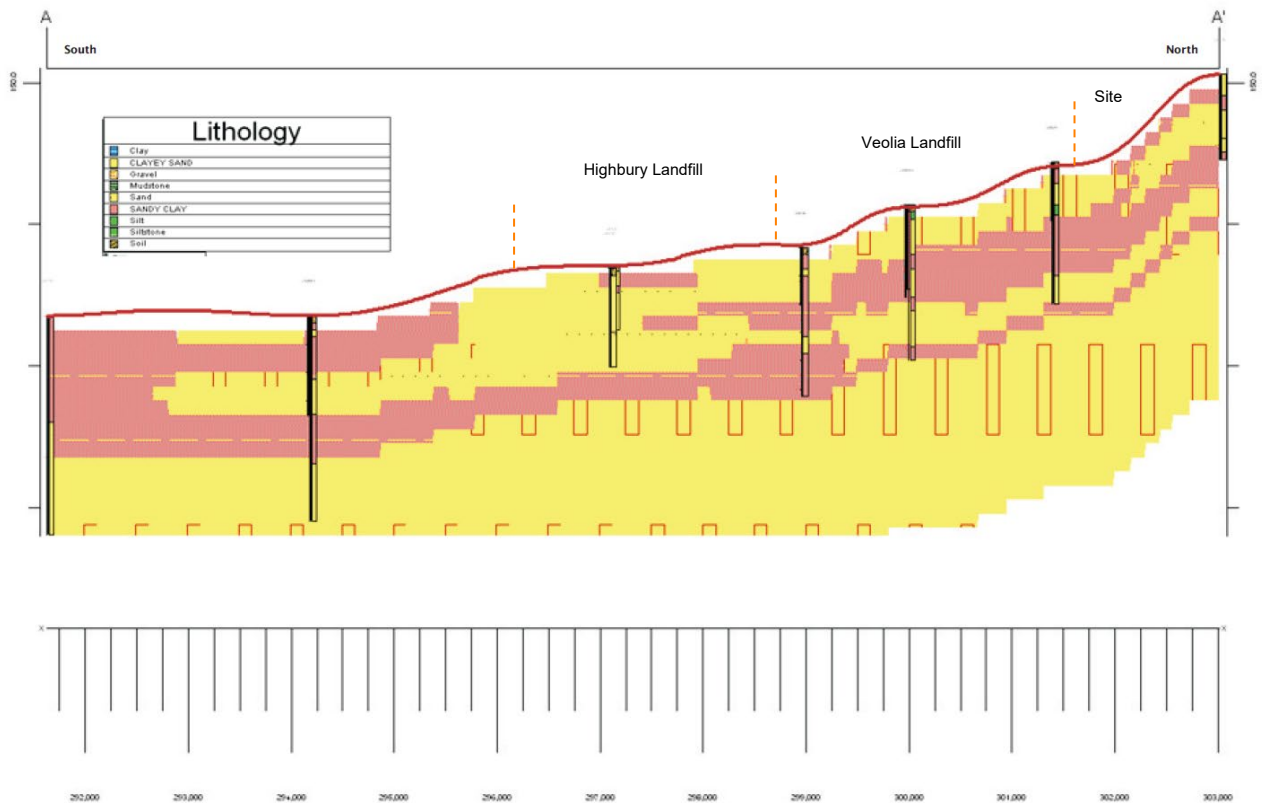


Figure 3-3 Geological Cross-Section from South to North (from SKM (2010)) – approximate boundaries added by LWC (2024)

3.3 Hydrogeology

The uppermost groundwater aquifer beneath the Site comprises sedimentary rock basins, including cavernous limestone, sandstone, sand, shale, and clay. Groundwater is expected to flow in a west to north-westerly direction, towards *Gulf St Vincent*, though there may be local complexities due to the quarrying activities in the area.

With reference to DEW (2022) *Water Connect* records, the depth to the uppermost aquifer within the vicinity of the Site is expected to be ≥ 20 m below ground level (BGL).

The DEW (2022) *Water Connect* database for a 2 km radius around the Site indicates that there are 227 registered bores, for which:

- recorded depths range from ~1 to 203.7 m BGL;
- standing water levels (SWLs) range from 1.2 to 103 m BGL;
- salinity values range from 171 to 7,479 mg/L total dissolved solids (TDS); and
- listed purposes (for groundwater bores) include:
 - domestic
 - domestic/stock
 - environmental, investigation, observation, and monitoring

- irrigation
- managed aquifer recharge;
- the closest domestic bore, listed as being 137 m south-west of the Site and installed to a depth of 50 m BGL in 1999, has a SWL of 38 m BGL and a salinity value of 1,434 mg/L TDS.

A report by SKM (2010) outlined that the natural lithology of the landfill and of the area immediately adjacent to the landfill is characterised by two potential zones of high permeability (sands, clayey sands). These zones of high permeability exist at depths of approximately 3 m below ground level (BGL) to 8 m BGL and 10 m BGL to 30 m BGL in the northwest of the site and approximately 3 m BGL to 5 m BGL and 8 m BGL to 12 m BGL in the southeast of the site, with the high permeability zones separated by an approximate 2 m thick 'bench' of lower permeability sandy clay.

The lithology gives rise to three groundwater systems:

- Perched cemented sand aquifer - The perched sand aquifer exists approximately 4-7 m below ground level (m BGL). PB reported that the lateral extent was unknown however was not a continuous unit. PB also reported that the perched system contained water in years of above average rainfall or after a single heavy rainfall event.
- Tertiary sand aquifer - The tertiary sand aquifer is a semi-confined system with a variable thickness clay base. PB reported that the water quality was moderate to good (salinity ranging between 1,000 to 1,500 $\mu\text{S}/\text{cm}$) with groundwater generally encountered between 14 and 33 m BGL.
- Fractured Rock Aquifer - The fractured rock basement has groundwater with a reported salinity of up to 4,500 $\mu\text{S}/\text{cm}$ with groundwater elevations similar to the tertiary aquifer system (standing water level generally reported around 30 m BGL).

A monitoring well (MW01_001) was installed in the 2008 environmental investigation.

With the exception of selenium and ammonia, the groundwater analyte concentrations within monitoring well MW1-001 did not exceed the (now superseded) *Environment Protection (Water Quality) Policy (2003)* criteria – the detected selenium and ammonia concentrations exceeded the adopted freshwater ecosystem protection values².

MW1_001 was further gauged and sampled on 18 November 2009. An interface water level probe, in addition to petroleum detection paste, was used to assess whether there was any measurable thickness of Light Non-Aqueous Phase Liquid (LNAPL) and this was not detected.

The monitoring well was purged and sampled using a dedicated disposable bailer and both intra-laboratory and inter-laboratory duplicate samples were also collected.

The standing water level (SWL) in MW1_001 on 17 November 2009 was 27.568 m below top of casing (BTC). Using data from the adjoining landfill site, groundwater was interpreted to be flowing in a south-westerly direction in the tertiary unit.

² Whereas the current (i.e. ANZG, 2018) freshwater ecosystem protection guideline for selenium (0.005 mg/L) has remained the same, the ammonia guideline has increased from 0.5 to 0.9 mg/L (as N) – as a result, none of the ammonia results obtained during the SKM (2008, 2010) groundwater monitoring events exceed the current guideline and it should also be noted that, as per Section 3.4, freshwater ecosystem protection has not been identified as a relevant groundwater environmental value for the Site. The ammonia results obtained in 2008 and 2009 (0.69 to 0.83 mg/L) do, however, exceed the NHMRC/NRMMC (2011) aesthetic guideline for potable (and recreational) water (0.41 mg/L as N).

Field parameters measured during the sampling of MW1_001 were as follows:

- pH was 6.8, compared to 7.8 in May 2008;
- EC was 2.46 mS/cm equating to 1,570 mg/L TDS), compared to 3.17 mS/cm in May 2008;
- redox potential was 103 mV, compared to 48.2 mV in May 2008; and
- temperature was 18.9° C, compared to 13.6° C in May 2008.

The ammonia concentration (0.8 mg/L) exceeded the (now superseded) *Environment Protection (Water Quality) Policy (2003)* freshwater ecosystem guideline of 0.5 mg/L. All remaining nutrient concentrations were below the laboratory LOR and/or the adopted guideline criteria.

A section 83A notification (61023) is listed for the Highbury Landfill located >200 m down hydraulic gradient. Three updates are associated with the record.

These records were requested and obtained from EPA in April 2024 (Appendix E-3):

- Highbury Landfill site. URS undertook 2 rounds of groundwater sampling at the Highbury Landfill site on behalf of Rodenburg Waste Solutions (RWS) during 2011 (in February and July). It has become apparent during the preparation of the 2011 Highbury Landfill Annual Monitoring
- Report that elevated **ammonia** concentrations have been reported in the two groundwater samples retrieved from the inferred up hydraulic gradient monitoring bore (MB07) during 2011 that necessitate EPA notification of suspected groundwater contamination (see ammonia graph attached).
- Elevated TKN concentrations (comprised predominantly of ammonia) has also been reported in MB07 during 2011 (see TKN graph attached).
- MB07 is located in the inferred up hydraulic gradient direction of the Highbury Landfill and is immediately down hydraulic gradient of the former Pacific Waste Management landfill site.
- The ammonia concentrations reported in MB07 during the 2011 groundwater sampling events of 75.4 mg/L and 60.8 mg/L exceed the adopted EPP guideline for aquatic freshwater ecosystems of 0.05 mg/L. The reported ammonia concentrations were higher than the range of historically reported results for MB07.
- The highest ammonia concentration previously reported in MB07 was 41.1 mg/L in May 2010, and the historical ammonia trend graph indicates an increasing trend is apparent in MB07 since the May 2005 monitoring event.
- Ultimately the last revision by URS in 2015 was recommending a scale down of monitoring/ analysis.

This Section 83A don't have any significant bearing on the Site.

4 ADDRESSING LINKAGES

The (2022) PSI concluded that there are 16 potentially significant contaminant linkages/ exposure pathways associated with a sensitive land use that are unresolved since the previous Site assessment program undertaken in 2008-2010 – ten of these – L3, L4, L5, L6, L7, L8, L9, L10, L11, L12 were considered to be relatively insignificant. The other six linkages (see Section 1.2) required further assessment to facilitate residential rezoning/development of the Site.

4.1 Linkage 1 & 2 – metals in fill

These linkages relate to exposure pathways associated with chemical substances in fill, within the northwest corner of the Site.

The 2008 soil investigation program involved an extensive grid-based and targeted sampling program across the Site, with only isolated/limited exceedances of Tier 1 health-based screening criteria for a low density residential land use. The detected impacts were surficial in nature and further delineated in 2009 as limited to the north-western portion of the Site.

Only three locations reported concentrations of metals (cobalt, lead, zinc and antimony) that exceeded one or more of the adopted health-based and/or ecological guidelines in 2008 (prior to revision of soil screening criteria in 2013 – the exceedances (as detailed in Table 4-1) were identified in the north-western corner of the Site (adjacent to a storage shed) and in the roadways adjacent to the shed.

The ASC NEPM (1999) Tier 1 soil screening levels were revised in 2013, resulting in the following reinterpretation of the results:

- Tier 1 criteria for cobalt and lead in a low density residential land use scenario was unchanged (i.e. 100 mg/kg and 300 mg/kg, respectively); identified exceedances remained.
 - Cobalt only marginally exceeds the tier 1 criteria and is relatively trivial
- Zinc would not exceed the current Tier 1 health investigation level (HIL) of 7,400 mg/kg for residential land use, the highest concentration (1,000 mg/kg) result may exceed a site-specific ecological criterion (which would need to be calculated based on site-specific soil parameters).

The concentrations of antimony were compared to a Tier 1 ecological screening criterion provided by the Netherlands Ministry of Housing, Spatial Planning, and the Environment (MHSPE) – i.e. the intervention value of 15 mg/kg, as opposed to the soil target value of 3 mg/kg. By comparison the United States Environment Protection Authority (US EPA, 2005) lists an ecological screening level of 78 mg/kg for soil invertebrates and 0.27 mg/kg for mammalian receptors, the latter being generally lower than laboratory detection limits (so its suitability is questionable).

Additionally, low pH soil was encountered in two locations. As the lowest pH (4.9) was reported at a depth of 1.6-1.9 m BGL, it would not be expected to have a significant impact on a future residential site use. The other low pH value, reported in a surficial soil sample, was the only evidence of low pH within the upper 1.6 m of the soil profile and was therefore not considered significant. In addition, a total of 13 of the 33 soil samples tested reported a soil pH greater than 8.5.



Figure 4-1 SKM (2008a) Investigation Locations

Table 4-1 Summary of Chemical Substances Exceeding a Soil Screening Level in the 2008 data (SKM, 2008a)

2008 Location	Antimony	Cobalt	Lead	Zinc
Guideline Criteria	15 ¹	100 ²	300 ²	200 ³
SB1_004	51	No exceedance	380	No exceedance
SB1_006	37	130	No exceedance	1000
SB1_007	110	130	530	560

As reported in SKM (2010), soil delineation works were undertaken in 2009, with respect to exceedances of the Tier 1 soil criteria reported in 2008 and the potential aesthetic issues associated with the fill material. This work comprised the drilling of 16 delineation soil bores (Figure 4-2).

Delineation soil bores DB01 to DB03 were drilled in the north-western corner of the Site to vertically delineate the heavy metal contamination identified in surficial samples (0.0-0.1 m BGL) obtained from soil bores SB01_004, SB01_006 and SB01_007 drilled by SKM in 2008 (Table 4-1).

Although DB01 and DB02 did not report any elevated concentrations of heavy metals throughout the entire soil profile, and therefore did not reflect the heavy metal concentrations reported by SKM (2008a), this may be attributable to the heterogeneity of the fill material located in the top 10 cm of the soil profile in this area.

Delineation soil bore DB03 reported a lead concentration of 980 mg/kg, in excess of current ASC NEPM (1999 revised 2013) HIL A of 300 mg/kg, in fill soil sample from depth 0-0.1 m BGL (surface). However, soil samples from 0.1-0.3 m BGL and 0.6-0.8 m BGL reported lead concentrations below adopted guideline values, thereby indicating that elevated lead concentrations are not present within the natural soil profile and are surficial (possibly attributable to flakes of lead paint from the shed or inherent to the fill material). All remaining heavy metal concentrations were reported below laboratory limits of reporting (LOR) and/ or adopted guidelines.

It was considered unlikely that elevated heavy metal concentrations are present within the natural soil profile.

Potential aesthetic issues were also identified in fill material, mainly located in the central and south-eastern portions of the Site, and associated with the presence of cement, bitumen, bricks and plastic – the extent of which was delineated by a combination of the initial 2008 and supplemental 2009 works (i.e. DB04-DB09 and DB12-DB16). Soils within the central portion of the Site generally consisted of brown sandy clay underlain by brown, orange, or cream sand/clayey sand – aesthetically impacted material (comprising bricks) was observed in soil bore DB10 only. However fill material consistent with that observed during the 2008 investigation was encountered in soil bores DB07 to DB12. The depth of fill material in these soil bores ranged between 1.4 m BGL (DB08) to 2.1 m BGL (DB07). The volume of aesthetically impacted fill material in the area outlined in Figure 4-4 was approximated at 4,700 m³.

Delineation soil bores DB10 and DB11 were installed in the vicinity of groundwater monitoring well MW1_001 to assess whether soil beneath the Site was acting as a source of ammonia to groundwater. The analytical results reported ammonia, nitrate, and nitrite concentrations below LOR in all of the soil samples analysed. Based on total Kjeldahl nitrogen (TKN) analysis (and noting that ammonia was below LOR), it was considered that the soil nitrogen was present as organic nitrogen. This form of nitrogen is a result of both fixation of N₂

from the atmosphere (hence highest concentrations in the surficial layer, which most likely represents the nitrogen component of the organic matter content of the soil) and the breakdown of amino acids and other organic nitrogen sources (e.g. proteins and urea). Based on the low TKN concentration at depth it was considered unlikely that the nitrogen identified in the surficial soil would impact groundwater quality beneath the Site.



Figure 4-2 Delineation bores and aesthetic fill extent (2009)

No potentially contaminating activities (PCAs) appear to have occurred on the Site over the period since the 2008-09 soil investigations were undertaken (LWC, 2022).

LWC undertook further soil bores in October 2023 to delineate the northwestern metals and tighten up the aesthetic fill estimation. Bores 23-1 to 23-10 were advanced to confirm and tighten up the aesthetic fill volume referred to as Linkage 16. Bores 23-11 to 23-13 were targeted to delineate lead in the northwest corner (Figure 4-3) as reported in SB01_004 and SB01_007 drilled by SKM in 2008 and in DB03 (SKM, 2010).



Figure 4-3 Delineation bores 2023

The soil bores were advanced using push tube techniques with plastic inserts (i.e. rinsate check blanks not required). Samples were collected from select bores for cross check (23-3) or where anthropogenic items were observed in the recovered cores (23-6):

Table 4-2 Sample analysis rationale

Sample	Analysis	Rationale
23-3 0.0-0.1	Metals and Total Recoverable Hydrocarbons (TRH)	Check sample for natural
23-3 0.4-0.5	Metals and Total Recoverable Hydrocarbons (TRH)	Check sample for natural
23-3 0.6-0.7	Metals and Total Recoverable Hydrocarbons (TRH)	Check sample for natural
23-6 1.9-2.1	Metals, TRH, pesticides, PAH, PCB, phenol	Anthropogenic items observed in the core: <ul style="list-style-type: none"> ▪ Trace plastic label (plant pot label) ▪ Metal fragment ▪ Hessian sack
23-11 / 0.0-0.1	arsenic cadmium chromium copper lead mercury nickel zinc	Delineation of previously identified lead (Pb)
23-12 / 0.0-0.1		
23-13 / 0.0-0.1		

No chemical substance was reported above either laboratory limit of reporting and/ or tier 1 soil screening criteria selected for screening for suitability for sensitive land use (i.e. human or ecological receptors) (refer Table 1 at rear). Lead was sufficiently delineated in the delineation bores not only laterally but also vertically, to within the top 10 cm of the soil. The maximum concentration of lead identified (2008 onwards) was 530 mg/kg therefore soil in this area (following the removal of the shed) can be skim stripped and disposed off-site as Intermediate Waste Soil (IWS; note the IWS criterion for lead is 1200 mg/kg).

The aesthetically impacted fill is not chemically onerous.

Soil bore logs are in Appendix B, Laboratory reports are in Appendix C and Quality assurance information is presented in Appendix D

4.2 Linkage 13 – landfill gas migration to indoor air

4.2.1 Source: Veolia Landfill

The landfill immediately south of the Site was recently (2022?) acquired by Veolia from SITA as part of a larger land/ property portfolio.

The land was historically owned by Ms Mercer’s family and was operated as a sand quarry consistent with the line of business of the Mercer family (see Figure 4-5). The land was sold to McMahon’s in 1975 and McMahaons then held an appropriate regulatory license for operation of a landfill facility. Review of available license document D0033 made out to Pacific Waste Management Pty Ltd for Halls Road Highbury dated 30 June 1991

indicates that the landfill was licensed to receive putrescible, non-putrescible and demolition wastes only from itself i.e. not municipal waste from the general public or councils.

The landfill ceased accepting waste and closed in or around 1994 and was capped – now the landfill is more or less fully vegetated with a domed appearance, covering approximately 3.7 hectares and has a surface elevation of around 163 m Australian Height Datum (AHD), crowning via a ridge at 166 m AHD in the approximate centre. The surface however generally follows the dip in landform from north to south as evident for land to the west, with the northern boundary having an approximate elevation of 161 m AHD and the southern boundary having an approximate elevation of 149 m AHD, therefore a general fall of around 12 m over ~228 m from north to south (gradient of 0.05).

The landfill was not lined, consistent with general practice at the time of commencement of filling. The depth of the landfill is contentious, and this has ramifications for the Site in terms of thickness of waste mass offsite that may give rise to generation of gases.

In 1994 Coffey produced a report on the Landfill (then owned by Pacific Waste Management and referred to as Highbury I Landfill) which indicated or reported that the base of the landfill was around 30-35 m from surface in the northwest grading to 20 m in the southeast (10 – 15 m difference which could match the general 12 m change in surface level assuming the landfill was developed as a 'wedge' with a flat and level base at around 129 m AHD). The basis for the depth given in the Coffey report is unknown; however this depth level was then picked up on by Parsons Brinckerhoff in subsequent environmental reporting prepared by the Site and ultimately the only indication or documentation of depth is given in a single conceptual cross section type figure included in a PB report prepared in 2007 (Figure 4-4).

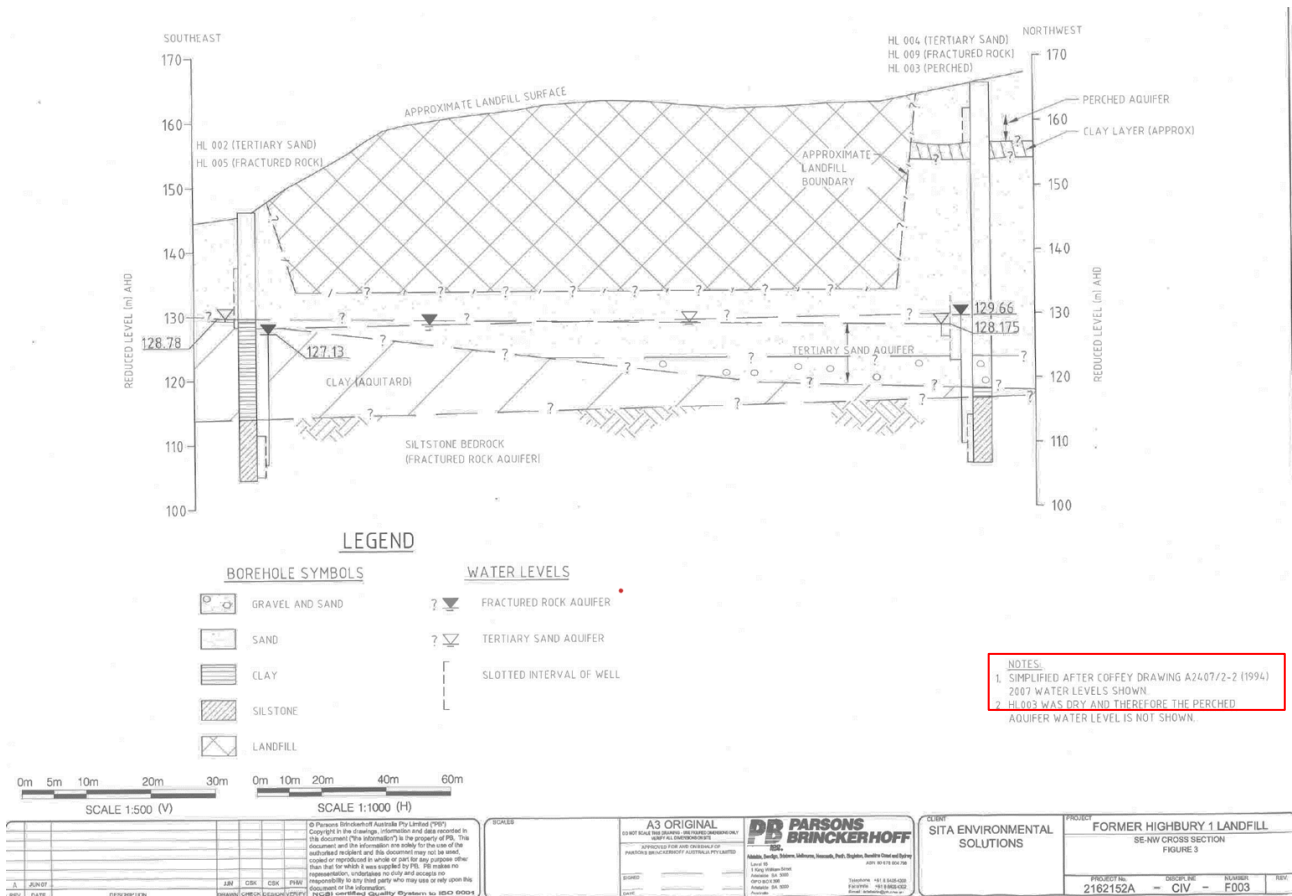


Figure 4-4 Southeast to northwest cross section taken from PB (2010) - red border highlights source of depth information

A general depth of 20 – 35 m from surface seems excessive (65 - 115 feet) and it would be reasonable to consider that such a depth would require significant batters and/ or shoring within the excavation to prevent collapse, noting the land was formerly a sand quarry and therefore lithology is likely to be reasonably unconsolidated.

Photographs of the sand quarry taken by the Mercer family in the early 1970s show the walls of the quarry to be around 5 – 6 m; this would then infer that McMahons excavated a further 30 m vertically between 1975 and 1994 and *then* accepted waste – this creation of capacity would delay waste acceptance (and income) and would not seem like a sound business idea. Further, for comparative purposes a figure is included that purports to show what a 21 m excavation looks like (Figure 4-7) – this seems significantly deep and it is difficult to reconcile such a depth being reached at the Veolia Landfill.



Figure 4-5 The Mercer sand quarry circa 1970 – see blue arrow for indication of wall height and depth to quarry floor



Figure 4-6 The Mercer sand quarry circa 1970 looking west – see blue arrow for indication of wall height and depth to quarry floor



Figure 4-7 70 feet deep (21 m) - Deep Excavation at Four Seasons Hotel – Geotechnical Photo Album (ucdavis.edu)

4.2.2 Gas extraction system

The Landfill currently has a landfill gas extraction system which was installed in 1991 and began extraction in 1995, managed by EDL. The gas extraction system on the site consists of 26 HDPR vertical wells with perforations along the length of the pipe (EDL, 2005) – see Appendix F.

The wells are located approximately 30 m apart and have a reported area of influence of 40 m. The installation pattern is designed to provide adequate overlap for efficient gas extraction. In 2010 the generated landfill gas was extracted by a positive displacement pump located at the power station. The pump generated a vacuum of between -15KPa and -20KPa to collect the landfill gas required to maintain the power station at its nominal 1MW output. The highest vacuum applied to any well in 2010 was -5KPa (well HIBPA016). The remainder had vacuums between -0.2KPa and -3.4KPa. The flow rate from individual wells was dictated by the composition of the extracted landfill gas as follows:

- Methane content;
- The CH₄/CO₂ ratio; and
- The oxygen content.

Landfill gas was flared during periods when generation was not possible. Gas extraction under these conditions was aided by the pump applying a vacuum to the field (if electricity is available) or by a passive flaring system (EDL, 2005).

In 2010 the approximate methane gas extraction parameters for the landfill were 32.5 % v/v for methane and 110 m³/hr flow rate (SKM, 2010).

At the time of the 2010 VSCAP, SKM reported that SITA were reviewing the requirement for additional landfill gas extraction wells with additional wells being considered along the eastern, western, and southeastern boundaries of the landfill.

According to information presented on McMahons website accessed 2023, date of information itself is unknown), due to decreasing gas volume and quality on the former EDL landfill power generation site, a flaring system was required by Highbury Landfill Authority to continue controlling migration of LFG for the long term, as the power generator was decommissioned.

The project involved controlling the LFG from the two landfill sites, termed the Highbury and SUEZ (now Veolia) landfills, as they are adjacent each other and linked by a common gas collection system. Essentially the gas collection system collects gas from both landfills and feeds the flare system.

McMahon Services commissioned a permanent flare provided by Biogas Systems Australia (now Ennova). Apparently, continual remedial works were undertaken on the gas collection system to allow effective operation of the flare system as well as to mitigate off-site gas migration. These works included draining flow lines, replacing broken or seized valves, repairing manifolds, and installing condensate pumps. The final design was a 600 m³/hr Lo-Cal™ HT flare, which is understood to be operating on the Highbury Landfill south of the Veolia Landfill.

This would infer that the gas is not actively extracted for power generation but is actively flared and therefore there is a current mechanism that reduces landfill gas pressure – a key question is therefore what the gas regime and potential for gas migration may look like once the calorific content of the gas decreases further, as it surely will, and becomes too thin for flaring.

Passive venting and low calorie flaring are expected to continue for several years / indefinitely. It is expected that the EPA regulatory guidance (SA EPA 2019) would be in force which requires limitation of gas concentrations in monitoring bores at the boundary of the landfill facility or within structures located on or off site to less than 1% methane by volume or 1.5% carbon dioxide by volume. The latter is somewhat ambiguous to control given natural soil respiration / organic matter degradation can provide an elevated background CO₂ signature.

A theoretical calculation of the methane in the VL is provided in Appendix E-2 in lieu of direct information provided by the current apparent operator (Ennova). Such calculation indicates that boundary methane at the boundary between the Site and the VL may be between 0.3 and 0.6 % assuming no extraction, which would fit the current profile of measurements on site and in northern perimeter bores, noting extraction is taking place; the benefits of extraction may not be truly seen in an ageing low calorie landfill at perimeter where highest content of methane is likely to be in the most dense / voluminous zones of the waste mass e.g. centrally.

4.2.3 Landfill gas perimeter monitoring

Landfill gas monitoring wells are installed on each boundary of the Landfill and are generally grouped as being shallow (installed to a depth of between 2.5 and 6.0 m), medium (6.5 – 10.0 m) and deep (28 – 32.5). The deeper monitoring wells support the 30-35 m BGL depth 'theory'.

The most recent data able to be procured by LWC is the May 2022 monitoring data, received from Veolia. Some historical data from 2009/2010 is available in SKM (2010).

The maximum methane detected in boundary monitoring wells in May 2022 was 4.8 %v/v in PW205, whilst maximum carbon dioxide was 22.3 %v/v. The location of PW205 is unknown (information requested by Veolia but LWC advised by Veolia that such information does not exist).

The monitoring wells known to be located on the adjoining boundary of the Landfill and the Site are PW008 and PW009. PW008 was installed to 31.5 m BGL and is screened between 3.0 and 31.5 m BGL and reports low methane (0.2 %v/v) in 2022 data and a marginal volume of carbon dioxide (2.5 %v/v). PW009 was installed to 32.5 m with a screened interval from 2.0 to 32.5 m BGL and reports zero methane and 0.1 %v/v CO₂.

Data from 2009 – 2010 shown in SKM (2010) shows methane to be low in both PW008 (<2.5 %v/v) and PW009 (effectively zero), with carbon dioxide being ~18%v/v in May 2009 (but then generally below 5%v/v for remainder of the monitoring data available and generally below 5%v/v in PW009).

Note that although listed as 'deep' wells, both wells monitors the depth interval 2.0 or 3.0 to 31.5 – 32.5 m BGL, therefore they are also effectively shallow and medium monitoring wells – ideally, they would have been collared to match the porous lithology at depth e.g. 14 – 30 m BGL (approximately) i.e. just targeting that zone.

Analysis of the May 2022 carbon dioxide data produces the following average CO₂ %v/v:

- Shallow wells – 8.5% v/v
- Middle (medium) wells – 10.25 %v/v
- Deep wells – 1.32 %v/v

Analysis of the May 2022 carbon dioxide data identify the following maximum CO₂ %v/v:

- Shallow wells – 22.3% v/v
- Middle (medium) wells – 17.8 %v/v
- Deep wells – 2.6 %v/v

Table 4-3 CO₂ in Veolia Landfill perimeter monitoring wells, May 2022

Depth Interval	Well	CO ₂ %v/v in May 2022	Average Depth Interval CO ₂ %v/v	Maximum Depth Interval CO ₂ %v/v
SHALLOW	PW101	11.9	8.5	22.3
SHALLOW	PW202	4.5		
SHALLOW	PW204	2		
SHALLOW	PW205	22.3		
SHALLOW	PW206	3.9		
SHALLOW	B13A	8.6		
SHALLOW	B12A	8.8		
SHALLOW	PW11A	9		
SHALLOW	B02A	4.5		
SHALLOW	B10A	4.5		
SHALLOW	B01A	13.5		
MIDDLE	PW002	6.4		
MIDDLE	PW001	5.4		
MIDDLE	PW003	10.6		
MIDDLE	PW004	4.1		
MIDDLE	PW005	2.8		
MIDDLE	PW106	7.5		
MIDDLE	B13B	8.3		
MIDDLE	B12B	17.8		
MIDDLE	PW11B	13		
MIDDLE	B02B	12.1		
MIDDLE	B10B	17		
MIDDLE	B01B	18		
DEEP	PW102	1.3	1.32	2.6
DEEP	PW009	0.1		
DEEP	PW008	2.5		
DEEP	PW104	2.6		
DEEP	PW006	0.1		

The distribution of carbon dioxide, which is heavier than air, suggest the primary / main response zones (depths from which most carbon dioxide is detected) are associated with shallow and middle depth monitoring wells, noting there is a lot of overlap between shallow and middle well upper screen depth such that they may essentially target the same zone.

The deepest middle depth monitoring well is listed as PW001 at 10.7 m BGL, screened 2.6 – 10.7 m. The deep monitoring wells do not contribute much CO₂, and it is possible that CO₂ enters the long screened deep wells at similar depths as the shallow/ middle wells but then ‘sinks’ to the lower reaches of the monitoring well (towards 30 m), being denser than air. Thus the deep wells may have the effect of dissipating CO₂.

The distribution of CO₂ in the depth based monitoring wells would suggest a waste mass aligned between 2 and <13.5 m based on well depth versus CO₂ readings as per Table 4-3, i.e. not an invert level of 30 m, and would align with the photographic evidence from the early 1970’s suggesting the depth of the landfill was around 5 – 6 m rather than 30 m.

4.2.4 Ground gas monitoring on the site

LWC were subsequently re-engaged to undertake further monitoring of ground gas beneath the Site that may be sourced from the Veolia Landfill. A total of six new ground gas monitoring wells (MW1 – MW6) were installed on the southern portion of the Site, closest to the Veolia Landfill, on 13 – 14 January 2023. These monitoring locations were advanced to a depth of 6 m below ground level (4 m screen) so as to screen the approximate depth of the waste mass in the Veolia Landfill. The distribution of these monitoring locations was based on a pyramid shape to provide a broad front to screen the landfill (MW04 – MW06) with depth into the Site (MW02, MW03, then MW01 at the point).

Three GasClam continuous gas logging monitors were installed in locations MW04, MW05 and MW06 i.e. running parallel along the southern boundary of the Site abutting the Veolia Landfill (LWC, 2023). Deployment commenced on 18 January 2023 and the units were recovered on 16 February 2023, i.e. a deployment duration of approximately 30 days.

The current on site ground gas regime is dominated by CO₂ (maximum of 15.6 %v/v, MW06) with some elevated carbon monoxide. Methane was not identified as being above machine limit of reporting except some marginal volume of 0.2 %v/v in one location on the Site. The gas composition accords with data obtained from the operator of the landfill (Veolia) in May 2022 for the average/ maximum CO₂ in shallow/ middle depth monitoring wells (see above).

The two gas monitoring wells positioned on the landfill side of the boundary with the Site (locations PW008 and PW009) reported much less carbon dioxide, but as noted, this could be to density related dissipation.

Based on the vertical distribution of gas in Veolia Landfill perimeter gas monitoring locations coupled to the onsite data collected by LWC in January 2023, LWC considers that the depth of the monitoring locations on the Site (6 m) are satisfactory for intercepting gas associated with the landfill, and likely screen a landfilled waste mass with an approximate thickness of around 6 m notwithstanding elevation differences due to the north – south gradient (refer Figure 4-8).

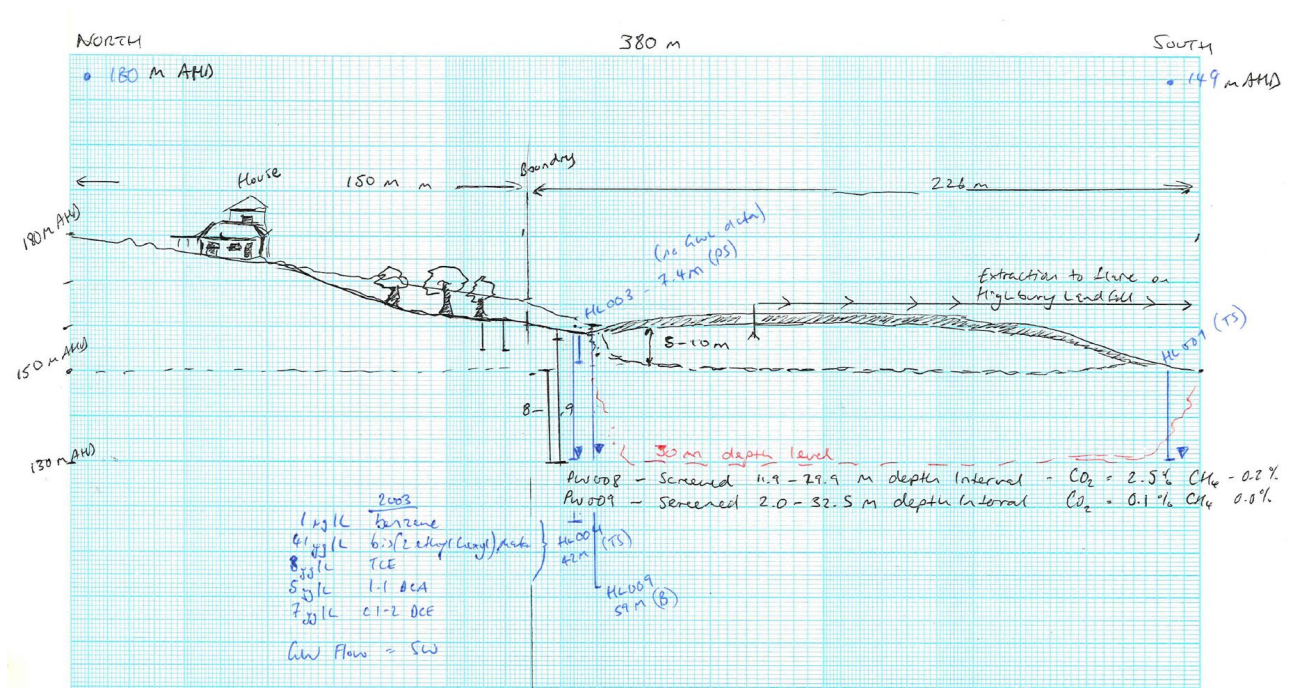


Figure 4-8 Conceptualisation looking east of the Site and the Veolia landfill

Field measurements were taken at the Site on 6, 19 and 22 February 2024 as per Appendix G3. A GFM430 unit sourced from Airmet was used, calibration records as Appendix G1. Ex-caps were present capping PVC at all monitoring locations such that no loss to atmosphere is expected to have occurred during field monitoring.



Figure 4-9 Onsite monitoring locations

Table 4-4 – Summary of field readings February 2024

Date	On Site Monitoring Locations	Off Site Monitoring Locations
6 February	4, 5, 6 (1, 2, 3 not located)	-
19 February	3, 4, 5 and 6 Used metal detector, located 3, (1, 2 not located)	LB01A/B, LB02A/B, PW011A/B
22 February	4, 5, 6 (1, 2 not located, 3 not tested by field staff (communication issue))	-

Offsite monitoring locations are gas monitoring wells located along Halls Road on the east side of the VL, installed as part of the VSCAP works for the VL (see Appendix G2).

Methane was not detected at any location (see Appendix G3). Carbon dioxide ranged between 0.4 %v/v and 6.0 %v/v in onsite wells across three dates. Results are considered to be generally consistent with previous results, noting the VL is under PGE. Flow was largely not detected at any location. Atmospheric pressure was a low of 990 mbar on 22 February 2024 and a high of 1004 mbar on 19 February 2024. Differential pressure was 0 Pa indicating:

If the differential pressure is zero in the context of landfill or ground gas monitoring, it means that the pressure inside the borehole is equal to the atmospheric pressure outside the borehole. This has several implications:

1. **No Driving Force for Gas Migration:** A zero differential pressure suggests that there is no pressure gradient to drive gas migration from the borehole to the surrounding environment. This means that the gas is not likely to be moving out of or into the borehole due to pressure differences.
2. **Stable Conditions:** The equilibrium between the borehole pressure and atmospheric pressure indicates stable conditions, where gas accumulation or release is not currently occurring due to pressure imbalances.
3. **Potential for Gas Build-up:** If differential pressure remains at zero over time, it may indicate that gas generation within the landfill or subsurface is not significant enough to create a pressure difference. Alternatively, it could also mean that any generated gas is being effectively vented or diffused naturally.
4. **Measurement Check:** Consistently zero differential pressure readings might warrant a check of the measurement equipment to ensure that the sensors are functioning correctly and providing accurate data (the machine was calibrated for specific use by the supplier and equipment was considered to be operating satisfactorily).

In summary, a zero differential pressure suggests a balance between internal and external pressures, indicating no current gas migration due to pressure differences.

Methane was not detected on the eastern boundary of the VL, through carbon dioxide was notably elevated in the location adjacent the southern boundary of the VL (LB01 location – unsure if A or B as need to dip and water in one of them (not tested would damage machine)).

Further, additional ground gas monitoring wells, new deeper ground gas monitoring wells and further rounds of ground gas monitoring on the Site are unlikely to yield any further benefit in terms of understanding ground gas risk profile, whilst flaring of landfill gas is still occurring. A key risk differentiator is the future cessation of flaring of landfill gas which could then facilitate outwards migration of gas away from the waste mass.

This risk would seem difficult to mitigate in the first instance as the gas gradient and driver for migration (pressure) within the waste mass is unknown. LWC consider a more proactive approach and indeed robust approach would be to focus less on future potential gas gradient and accept that a gradient could eventuate – this risk can then be mitigated using building controls, such as gas resistant membranes or under-slab depressurization or both, or more.

The audit team asked for opinion on a potential piston effect with groundwater potentially being in the on site ground gas monitoring wells.

In the context of ground gas concentrations, the "piston effect" refers to the phenomenon where changes in atmospheric pressure or the movement of groundwater can cause variations in gas concentrations within the subsurface environment or monitoring wells. This effect is named for its resemblance to the movement of a piston in a cylinder, where pressure changes can push gases in and out of the soil or monitoring wells.

1. **Pressure Fluctuations:**

- **Atmospheric Pressure Changes:** Fluctuations in atmospheric pressure can cause ground gases to be pushed into or pulled out of the soil or boreholes. When atmospheric pressure decreases, gases in the soil can expand and migrate upwards. Conversely, when atmospheric pressure increases, it can push gases deeper into the soil.
- **Groundwater Movement:** Rising or falling groundwater levels can displace soil gases. As groundwater rises, it can push gases upward (similar to a piston compressing a gas),

increasing gas concentrations in the vadose zone. When groundwater levels fall, it can create a vacuum that draws gases downwards.

2. Gas Concentration Changes:

- **Increase in Concentrations:** When atmospheric pressure drops or groundwater rises, the displacement of gases can lead to higher concentrations of gases like methane, carbon dioxide, and oxygen in the monitoring wells or soil gas probes.
- **Decrease in Concentrations:** When atmospheric pressure rises or groundwater falls, gases may be pushed deeper into the subsurface or dispersed, leading to lower concentrations at the monitoring points.

3. Impact on Gas Monitoring:

- **Temporal Variations:** Gas concentrations can vary significantly over time due to the piston effect. This means that measurements need to be taken over extended periods to accurately assess gas levels.
- **Data Interpretation:** Understanding the piston effect is crucial for interpreting gas concentration data correctly. It helps differentiate between genuine changes in gas production or migration and those caused by external pressure influences.

4. Mitigation and Management:

- **Monitoring Protocols:** Implementing consistent monitoring protocols that account for atmospheric pressure changes and groundwater levels can help mitigate the impact of the piston effect on data accuracy.
- **Design of Monitoring Systems:** Properly designed monitoring systems that consider the potential for pressure-induced gas migration can help in obtaining more reliable data. This might include the use of gas sampling equipment that minimizes the influence of pressure changes.

The "piston effect" in ground gas monitoring occurs when fluctuations in groundwater levels lead to changes in gas concentrations within the soil or monitoring wells. To understand what head of water is required to produce this effect, several factors need to be considered:

1. **Permeability of the Soil:** The soil's permeability affects how easily gases can move through it. More permeable soils (e.g., sandy soils) will allow gas to move more freely than less permeable soils (e.g., clay).
2. **Gas Permeability and Solubility:** Different gases have varying solubilities in water and permeabilities through soil. Methane, carbon dioxide, and oxygen each behave differently based on these properties.
3. **Magnitude of Groundwater Fluctuations:** Significant changes in groundwater levels are more likely to produce noticeable piston effects. Minor fluctuations may not have a substantial impact.
4. **Existing Gas Pressure and Concentrations:** The initial pressure and concentration of gases in the soil will influence how much they are displaced by changes in groundwater levels.

General Concept

To produce a noticeable piston effect, the head of water (i.e., the height of the water column) in the well must change enough to create a pressure differential that can push gases out of the soil pores or draw them in. The specific head required depends on the factors mentioned above, but here are some general guidelines:

- **Pressure Differential:** A change in water level creates a pressure differential. For example, a 1-meter rise in the water column in the well increases the pressure by approximately 9.8 kPa (1 meter of water column \approx 9.8 kPa pressure).

- **Gas Displacement:** For gas to be displaced, the pressure change needs to overcome the capillary forces and the resistance of the soil matrix. In highly permeable soils, a smaller change in head might be sufficient, whereas in less permeable soils, a more significant change may be required.

Assume a monitoring well in a sandy soil (high permeability):

- A 1-meter increase in groundwater level (head) might produce enough pressure to displace gases in the surrounding soil, leading to a measurable piston effect in the well.

In contrast, in a clayey soil (low permeability):

- A greater change in groundwater level, such as 2-3 meters, might be necessary to produce a similar piston effect because the soil's low permeability resists gas movement.

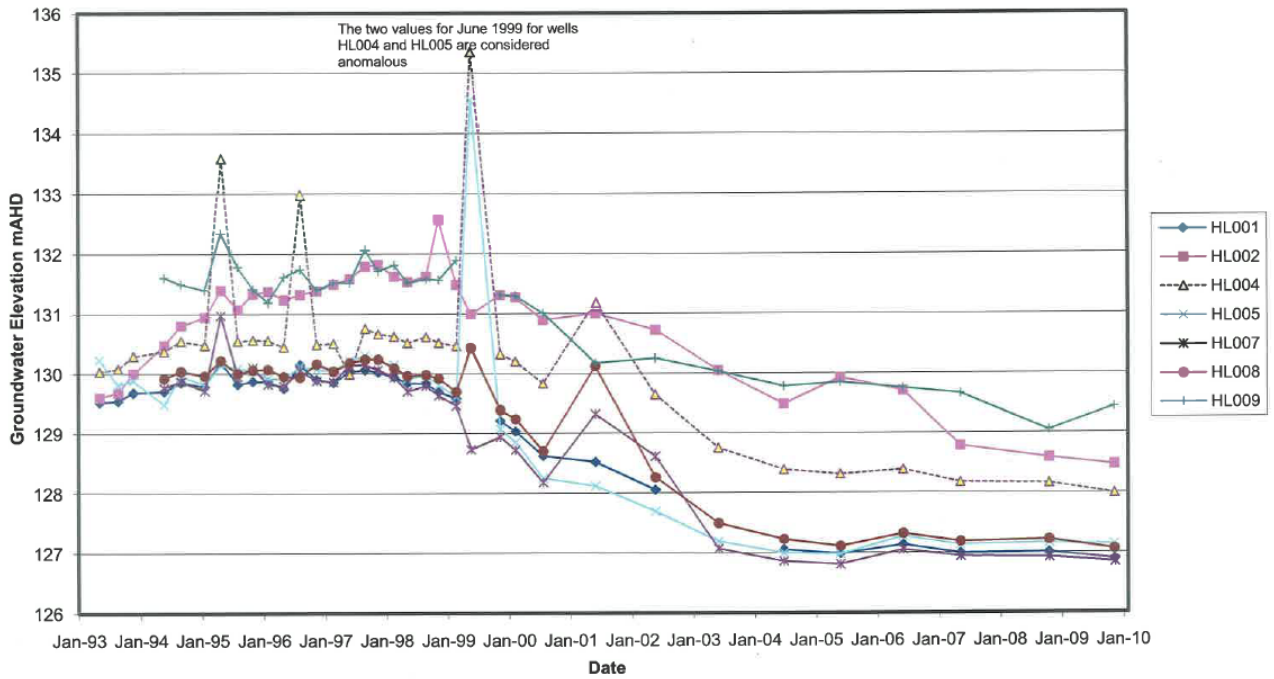
Quantitative Estimation

For a noticeable piston effect, change in pressure needs to be sufficient to overcome the soil's gas entry pressure, which depends on soil properties and gas characteristics. For practical purposes, changes in head on the order of 0.5 to 2 meters can often produce observable piston effects in typical landfill or ground gas monitoring scenarios, noting gas needs to exist also (methane not present in the on-site bores).

4.3 Linkage 14 – gas/ vapour from groundwater

The most recent groundwater monitoring report available to LWC pertaining to the landfill is dated 2010 (PB annual groundwater monitoring report). Groundwater in the tertiary sands was inferred to be flowing southwest, consistent with previous reporting/ events, whilst basement groundwater was reported to be flowing south.

Data was presented for tertiary wells HL001, HL002, HL004, HL008. Of these well HL004 is of interest, being in the northwest corner of the landfill adjacent the Site (Figure 4-5). Groundwater standing water levels are generally around 20 - 30 m below the surface where surface of landfill ranges 149 m in the south to 161 in the north (Figure 4-9). Well locations are shown in Figure 4-10. The inferred groundwater flow direction for the tertiary unit is shown in Figure 4-11.



2162152A
Highbury Landfill 1
December 2009 GME

Figure 4-10 Hydrograph for groundwater wells monitored at the Veolia Landfill December 2009 (reported 2010)

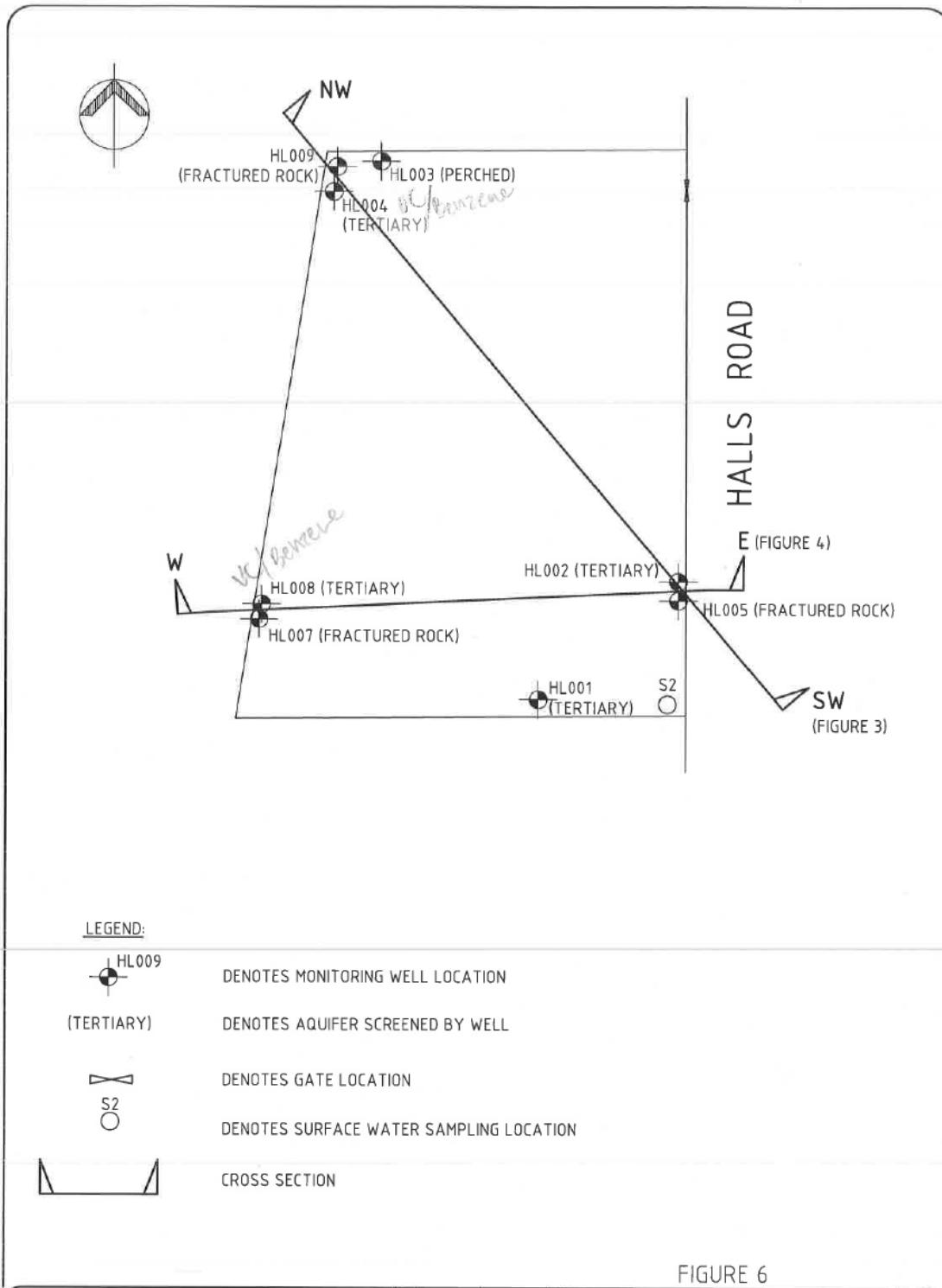


FIGURE 6

<p>PARSONS BRINCKERHOFF</p> <p>100 YEARS</p> <p>ABN 80 078 004 798</p> <p>PPK House, 101, Pirie Street, Adelaide, SA. 5000</p> <p>Telephone +61 8 8405 4300 Facsimile +61 8 8405 4302 Email: adelaide@pb.com.au</p>	Scale	NTS	Client	SITA ENVIRONMENTAL SOLUTIONS	Rev. Drawing No. 2121259A
	Drawn	JJN	Project	FORMER Highbury 1 Landfill	
	Drawn Date	JUN 07		HALLS RD HIGHBURY	
	Designed	CSK		SITE PLAN SHOWING WELL AND	
	Check	CSK		CROSS SECTION LOCATIONS	
Check Date	JUN 07				

Figure 4-11 Groundwater monitoring well locations and cross section axis (after PB, 2010)

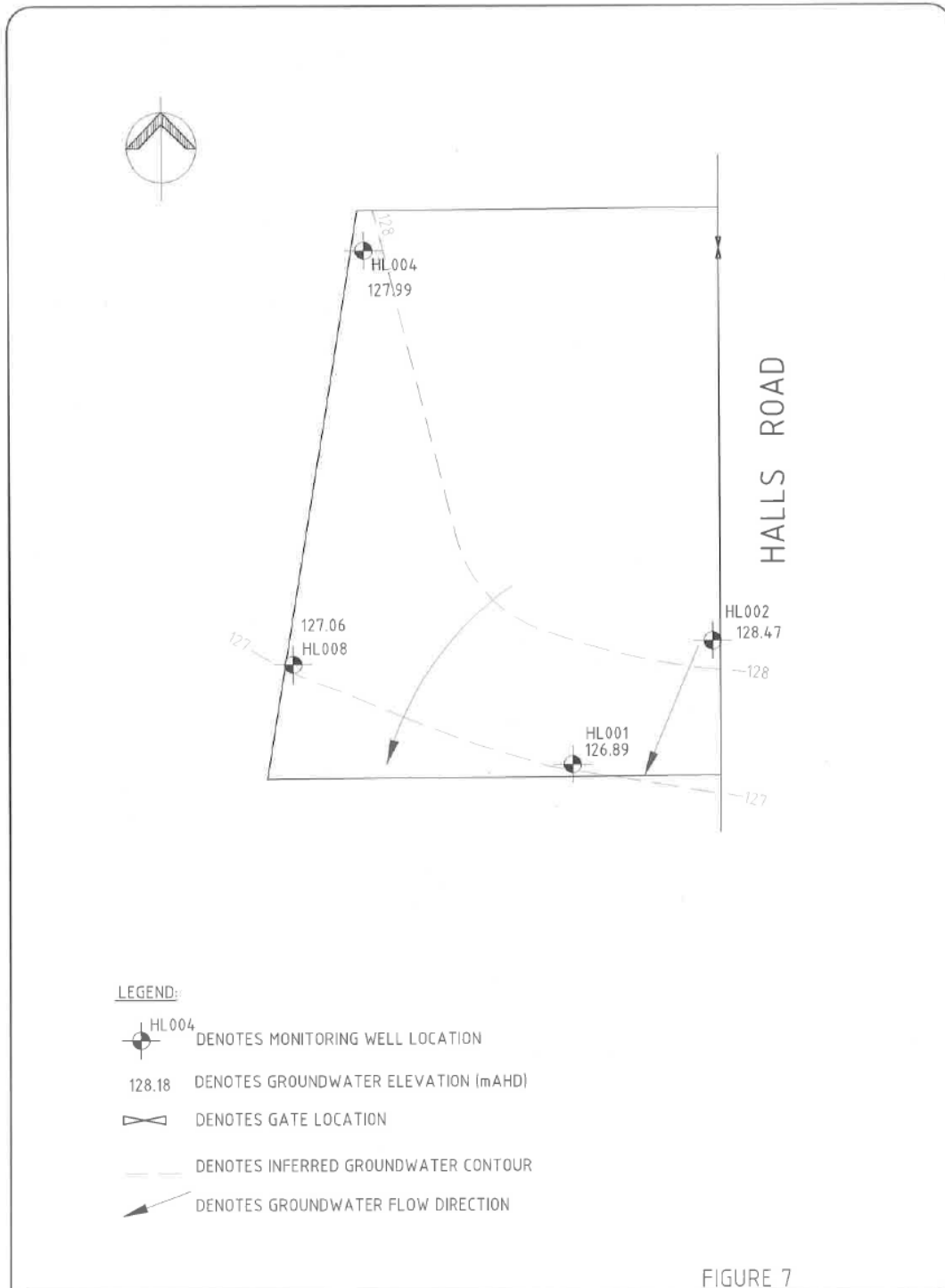


FIGURE 7

<p>PARSONS BRINCKERHOFF 100 YEARS ABN 80 078 004 798 Level 16, 1 King William St, Adelaide, SA. 5000 Telephone +61 8 8405 4300 Facsimile +61 8 8405 4302 Email: adelaide@pb.com.au</p>	Scale	NTS	Client	SITA ENVIRONMENTAL SOLUTIONS	Rev. 2162152A
	Drawn	JJN	Project	FORMER HIGHBURY 1 LANDFILL	
	Drawn Date	DEC 08	HALLS RD HIGHBURY		
	Designed	ECB	GROUNDWATER CONTOURS & FLOW DIRECTION		
	Check	ECB	(TERTIARY SAND AQUIFER) DECEMBER 2008		
Check Date	DEC 08				

Figure 4-12 Groundwater flow direction in the tertiary unit as reported in the PB 2010 annual groundwater monitoring report

The TDS (salinity) concentration of water sampled from H004 has been consistent since the start of the annual groundwater monitoring program. Trace barium, copper, iron, manganese, and zinc were detected in water from HL004 but didn't exceed potable criteria.

In terms of organics, water sampled from HL004 reported:

- benzene was reported at 1.2 µg/L (where potable criterion is 1 µg/L);
- trichloroethene (TCE) was reported at 8 µg/L (where potable criterion is 8 µg/L);
- cis-1,2 dichloroethene was reported at 9 µg/L (where potable criterion is 60 µg/L);
- vinyl chloride was reported at 13 µg/L (where potable criterion is 0.3 µg/L);
- 1-1-dichloroethane was reported at 3 µg/L (where potable criterion is unavailable);

Data was presented for fractured rock (basement) wells HL005, HL007, HL009). Of these well HL009 is of interest, being in the northwest corner of the landfill adjacent the Site.

Trace barium, copper, iron, manganese, and zinc were detected in water from HL004 but didn't exceed potable criteria other than iron (0.68 mg/L) which was above the aesthetic value of 0.3 mg/L.

In terms of organics, water sampled from HL009 reported:

- toluene was reported at 2 µg/L (where potable criterion is 800 µg/L);
- chloroform was reported at 5 µg/L (where previously applied potable criterion was 68 µg/L);
- the trihalomethanes bromoform, dibromochloromethane and bromodichloromethane were reported above laboratory detection limits – no guidelines are present.

Depth to groundwater would likely significantly mitigate any risk of volatilisation to indoor air where a sensitive use is proposed.

Groundwater monitoring well MW1_001 was installed in May 2008 and last gauged and sampled on 18 November 2009. No light non-aqueous phase liquid (LNAPL) was detected. The standing water level was 27.568 m below top of casing (BTOC).

Field parameters measured during the sampling of MW1_001 were as follows:

- pH was 6.8;
- EC was 2.46 mS/cm (equating to 1,570 mg/L total dissolved solids);
- redox potential was 103 mV; and
- temperature was 18.9° C.

Benzene was below detection and potable guideline (1 µg/L). Toluene was below detection (1 µg/L). The other organics reported in HL004 and HL009 water were not analysed for, though fraction C₆-C₉ can pick up these carbon fractions and such fraction was reported <20 µg/L, indicating a low loading of chlorinated hydrocarbons, if any.

Ammonia concentration (0.8 mg/L) exceeded the (now superseded) *Environment Protection (Water Quality) Policy (2003)* freshwater ecosystem guideline of 0.5 mg/L. All remaining nutrient concentrations were below the laboratory limit of reporting and/or the adopted guideline criteria. Ammonia in the groundwater beneath and down hydraulic gradient of the Veolia Landfill reported ammonia up to 11.8 mg/L (2010) – the difference

in magnitude of ammonia hints at the separation of groundwater beneath the landfill (down hydraulic gradient of the site) and the Site.

Gauging of this well in October 2023 indicated minimal head of water, largely insufficient for sampling, noting that this was a particularly dry period in South Australia. Given previous results and the consistent flow direction, Linkage 15 (ingestion of impacted groundwater) is not considered to be a significant linkage.

Transfer of landfill gas in groundwater as dissolved gases, to the Site, could occur, though is unlikely due to the pressure required to force gas into water and the equal pressure required to force gas out of water, i.e. this mechanism is more related to fractured rock environments where pressurisation may eventuate as a result of flow through fractured environments. Further, there is no indication of methane in the deep gas monitoring wells PW008 and PW009 on the landfill site nor in the six monitoring wells on Site, noting methane is lighter than air and would rise up through the soil column if present.

Considering the above, Linkage 14 (migration of vapour from impacted groundwater to indoor air) is not significant.

4.4 Linkage 15 – ingestion of impacted groundwater

Further to Section 4.3, gauging of the onsite well in October 2023 indicated minimal head of water, largely insufficient for sampling, noting that this was a particularly dry period in South Australia. However, given previous results and the consistent flow direction, Linkage 15 (ingestion of impacted groundwater) is not considered to be a significant linkage.

4.5 Linkage 16 – aesthetically impacted fill

Soil bores 23-1 to 23-10 were advanced in October 2023 and agreed with previous assessment / estimation of the extent of fill in the southern corner, and better delineated the pocket of fill in the central area (see 23-1, 23-2 and 23-3 in Figure 4-3). Estimation of fill previously made in 2009 (4,700 m³) appears to be reasonable as an upper maximum however a re-estimation based on the footprint shown and adopting an average depth of 1.0 m across the area (with deepest being around 23-6) would be 2,600 m³. Plans / allowance should cater for the upper figure of 4,700 m³. The fill might be placed beneath roadways etc. in any future development which would eliminate any aesthetic issues.

5 DISCUSSION AND CONCLUSIONS

5.1 Ground gas risk

Linkage 13 considered risk of migration of ground gas to indoor air of future sensitive land use. The objective of the January 2023 in situ ground gas assessment was to characterise the ground gas at the Site in association with varying atmospheric pressures. This was achieved using GasClam continuous ground gas loggers. The ground gas does show variability as a function of atmospheric pressure. The lowest pressure recorded was 981 mb – this is considered a suitably low pressure to represent a worst case ground gas regime.

The characteristic situation (CS) for ground gas beneath the Site is driven by carbon dioxide – the 2023 monitoring plus previous 2008-2010 data and data obtained from Veolia for May 2022 regarding landfill monitoring bores (around the periphery of the landfill) indicates methane is not present – it is not clear as to whether the landfill is in Phase II or has passed Phase IV based on carbon dioxide being dominant nor what a future migration flux may look like (if any) after cessation of landfill gas flaring.

The CS is driven by carbon dioxide and is calculated as CS2 on the basis that carbon dioxide in the ground exceeds 5% vol/vol (maximum is 15.6%). Offsite CO₂ was reported as 22.2% v/v but the specific location of such monitoring well is not known. The CO₂ is not dissimilar offsite / onsite prior to cessation of landfill gas flaring.

5.1.1 Depth of waste mass

LWC acknowledge that depth of waste material is a crucial parameter in terms of vertical extent of ground gas that may emanate from the Veolia Landfill (VL) both currently and post gas extraction (PGE).

The depth of the landfill will have an influence on the risk of landfill gas migration. associated with shallow landfills that are less than 5m deep compared to deeper landfill sites, especially those over 10m depth (Wilson, 2018). Gas will always take the easiest route to the surface and often this occurs at the boundary of the site (at the interface between waste and natural ground).

With a shallower landfill the pressure or diffusion gradient to the surface may be greater than that for lateral migration at depth and so the gas migrates to the surface in preference to moving off-site.

We have to decide whether the Veolia Landfill extended to around 30 m depth adjacent to the boundary of the Site, or extended to a much shorter depth, i.e. ~10 m, remembering that the 30 m value is almost a ‘throw away’ value recorded on one figure made by Coffey in 1994, and there is no other evidence to support this (and on the figure the depth of the landfill is denoted with “?” along the base and sides).

We are hampered by the significant lack of technical information pertaining to the design of the landfill and also, its operation, save for information already presented. We have requested information from the new owner of the landfill (Veolia) however the only information they have is one single piece of A4 showing the location of monitoring wells. LWC appear to hold more information on the landfill than Veolia does, which was sourced from the EPA and has previously been presented / discussed in its entirety.

Short of drilling holes into the landfill, which we suspect would not be allowed any time soon, we can only present desk top interpretation of available information.

We previously collated lines of evidence (or investigation) to determine the likely depth of the landfill.

The distribution of carbon dioxide (which is heavier than air) in VL monitoring wells, suggest the primary / main response zones (depths from which most carbon dioxide is detected) are associated with shallow and middle

depth monitoring wells, noting there is a lot of overlap between shallow and middle well upper screen depth such that they may essentially target the same zone.

The deepest middle depth monitoring well is listed as PW001 at 10.7 m BGL, screened 2.6 – 10.7 m. The deep monitoring wells (~30 m) do not report much CO₂, and it is possible that CO₂ enters these long screened deep wells at similar depths as the shallow/ middle wells (the deep wells have very long response zones of around 28 m) but then 'sinks' to the lower reaches of the monitoring well (towards 30 m), being denser than air. Thus the deep wells may have the effect of dissipating CO₂ entering in the upper part of their response zone.

The distribution of CO₂ across the varying depths of the monitoring wells would suggest a waste mass aligned between 2 and 10 m, with an invert level of around 10 m depth, not an invert level of 30 m, and would align with the photographic evidence from the early 1970's suggesting the depth of the quarry at such time (pre-landfill) was around 5 – 6 m rather than 30 m.

As indicated in the auditor's letter, the shallowest 'water table' is referred to as the perched unit which may be discontinuous – the depth of this table from surface is given as being between 3 – 8 m BGL which would seem to shallow to be limiting to landfill depth. The next water table would be the tertiary sand aquifer with groundwater generally encountered between 14 and 33 m BGL, and perhaps this is where the original 'ghost' 30 m depth came from by Coffey looking at the deeper end of this range. If assuming the upper depth of ~14 m BGL then this would be not too dissimilar to calculations made here and in LWC (2023).

We have had another look at available detail and would like to add the following:

- The works undertaken on the former Domain site south of Torrens Road (directly south the East Waste (EW) Landfill) concluded that the base of such landfill was ~127 m AHD – this information was included in the Interim Audit Advice for such site.
- The base of the EW Landfill was identified from a 1970 survey of the then sand quarry prior to sale to EW, corrected to AHD. Further, annual groundwater monitoring reports identified groundwater beneath the EW landfill is around 126 m AHD so the termination of excavation at or just above groundwater would make sense in terms of avoiding dewatering.
- The northern edge of the former quarry (EW landfill) shows values of 584 RL in the centre north, on the boundary with the Veolia Landfill – this equates to an AHD of 147.9 m (RL – 106.26 / 3.231). The elevation of Halls Road directly east of this point at such time based on such plan was 142.9 m AHD (Point A). Nearmaps (Figure 5-1) estimates the same point on Halls Road in 2024 to be roughly 143 m AHD – so we can say with reasonable fairness that the elevation of the road has not changed since 1970. The southern boundary area of the Veolia landfill is also around 147 m AHD in 2024 (according to Nearmaps).
- The 2024 elevation of Halls Road at a point directly east of the northern boundary area of the VL is ~158 m AHD (Point B) – let us say this represents true 'surface' level i.e. unchanged (as per Point A) since 1970.
- The VL was sold by the Mercer family to McMahons in 1975 and we assume that further quarrying and waste placement occurred from this time. In terms of aerial imagery, this gives us the years 1979, 1989, 1999 and then onwards, noting the 1999 aerial imagery shows the Veolia Landfill to be capped and covered in grass. So, really, we only have 1979 and 1989 imagery to work with.
- In the 1979 imagery we can see that the southern half of the VL 'appears' to be level with Halls Road and the boundary of the EW landfill, i.e. around 143 – 147 m AHD (ballpark). There are no obvious shadows associated with the southern boundary that may indicate notable excavation faces, unlike the shadows that can be seen on the western wall.

- Assuming the base of the quarry and landfill was level, and not sloping down towards the north (would a quarry introduce a reverse slope making it difficult for trucks?), we can estimate the northern depth by subtracting the elevation of the (non-excavated?) southern boundary (and Point A) from the elevation at Point B, which would be in the range then of 158 m AHD – 145 or 147 m AHD – ~13 or ~11 m depth.
- The orientation / presence of the shadows on the western wall would indicate this particular image was taken in the early to mid-afternoon as the sun has passed over to the west. There is one bench in the northwest corner of the landfill, with two vertical excavation faces (Face 1 and Face 2). The first face has a shadow length of ~3 m and the second face a shadow length of ~5 m.

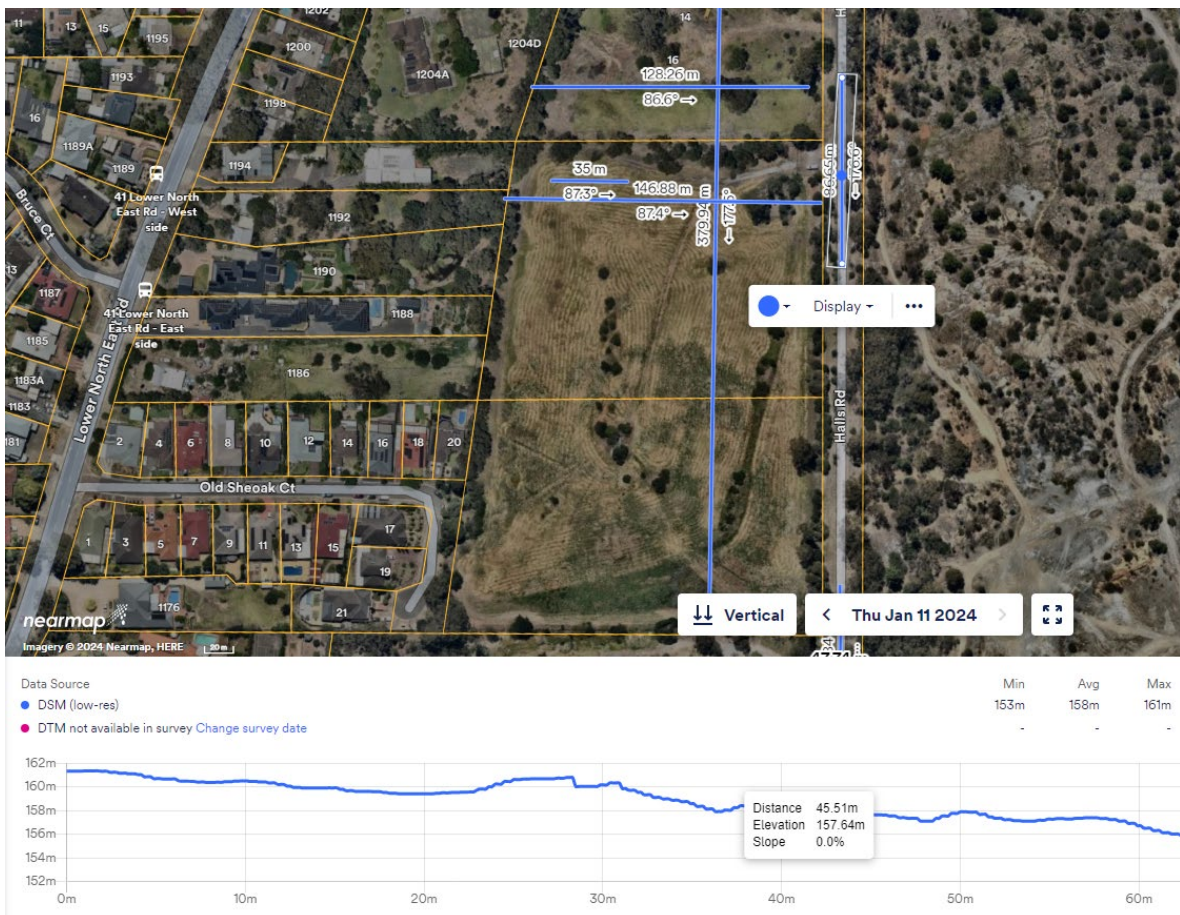


Figure 5-1 Nearmaps transects used for gauging elevation at various points

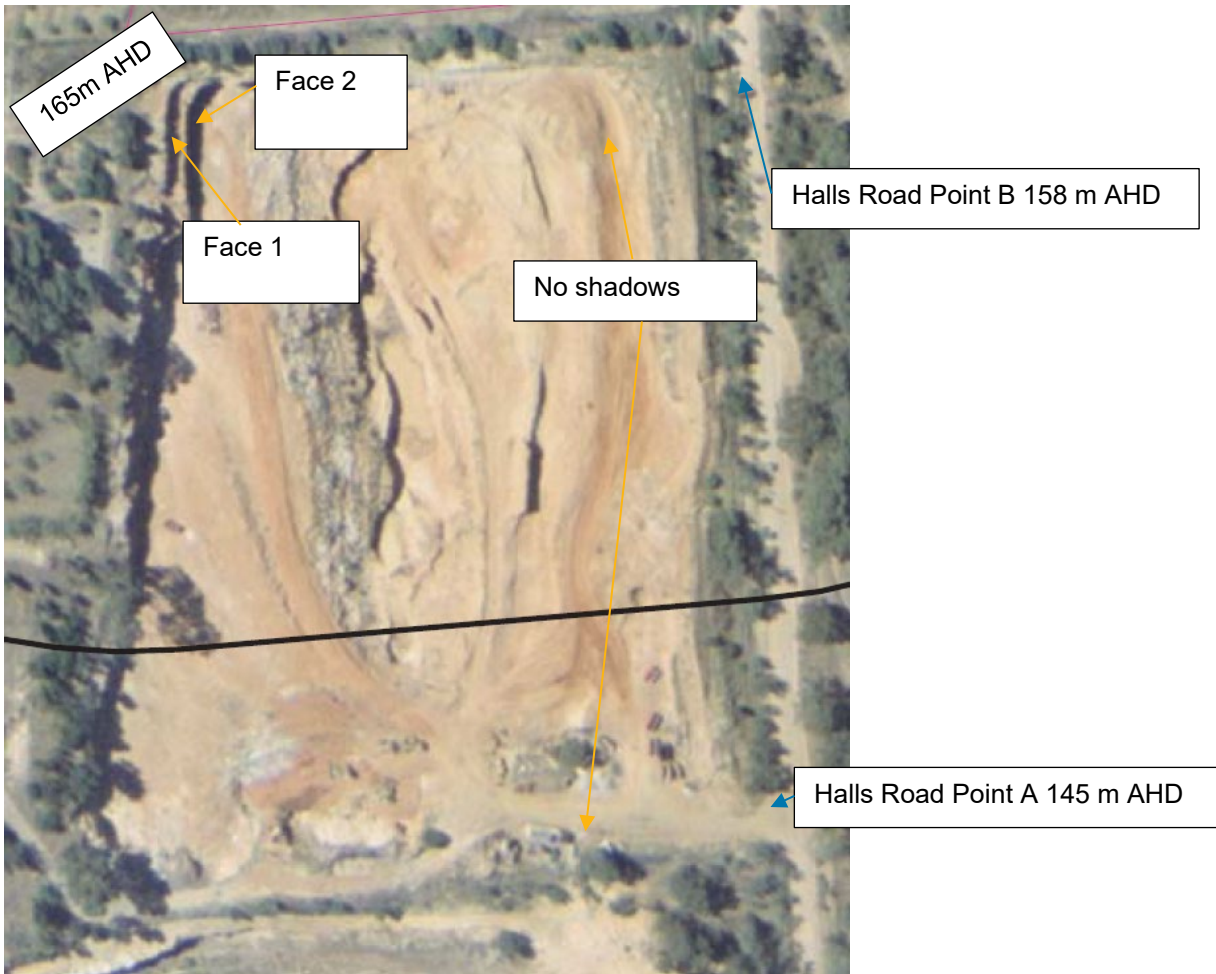


Figure 5-2 1979 image of the VL – see shadow length in northwest corner (see PSI report for original inc. scale bar)

Moving with the times we asked ChatGPT about estimating cliff faces using shadow length. Here is what we found for Face 2:

The method of determining the height of an object from its shadow using similar triangles can indeed be applied to **excavations, cliffs, or any vertical structures**. Let's explore how this works:

1. Similar Triangles Approach:

- The concept remains the same: We use similar triangles formed by the object, its shadow, and a known object (like a pole) with a known shadow length.
- The key assumption is that the sun's rays are parallel, the ground is flat, and the object is perpendicular to the ground.

2. Given Information:

- You have a shadow length of **5 meters** for the excavation or cliff.

3. Calculating the Height:

- Suppose you have a known object (like a pole) with a known shadow length (let's call it (EF)).
- Use the proportionality relationship: $[AB = \frac{\{DE \cdot BC\}}{\{EF\}}]$ where:
 - (AB) represents the height of the excavation or cliff.
 - (BC) represents the length of the shadow of the excavation or cliff.

- (DE) represents the height of the known object (pole).
- (EF) represents the length of the shadow of the known object.

4. Example:

- Suppose the known pole has a shadow length of 4 meters ((EF = 4)) and a height of 5 meters ((DE = 5)).
- If the shadow of the excavation or cliff is 5 meters ((BC = 5)), we can find the height of the excavation or cliff: $[AB = \frac{5 \cdot 5}{4} = 6.25]$ meters.

Therefore, the height of the excavation or cliff is approximately **6.25 meters**. Keep in mind that this method provides an estimate based on assumptions!

We ran the same query for Face 1 (3 m) and ChatGPT concluded a vertical face of 3.75 m (proportional approach) or 4 m (direct proportion). This would provide a cumulative depth of ~10 m and would be in broad agreement with the subtraction of southern boundary elevation from northern boundary elevation assuming a level base. Of course there is every possibility that further excavation took place after 1979, however we have no information of any type between 1979 and 1989, when the elevation looks to have increased not decreased (i.e. depth to base is shallower).

It is important to note that the land elevation increases from east (Halls Road) to west (west boundary of site/landfill) by around 7 m; the west boundary has an elevation of around 165 m AHD, so a depth of 10 m (based on shadow) would indicate a base elevation of 155 m AHD in the north west and becoming shallower to a depth of around 3 m in the north east aligning 3m lower than Halls Road at 158 m AHD.

The above lines of evidence indicate a potential depth of 10 – 13 m, not 30 m. The depth estimated aligns with the reported presence of CO₂ in the shallow and middle depth boundary monitoring wells (2 – 10 m) but not the deep wells (30 m).

By 1989 the VL appears to have received infilling of sand, with what appears to be a mound in the west central area, not extending to the boundaries. Given the darker line of material in the 1979 image in the same location/orientation, could this be the waste mass that is covered here, forming the central crown of the Site? Given extent of the excavation however, it is logical to fill waste up in available 'air-space' and noting the VL is 'crowned' as the cap rises significantly rather than following a flat elevation aligned with the natural surface (Figure 5-4).

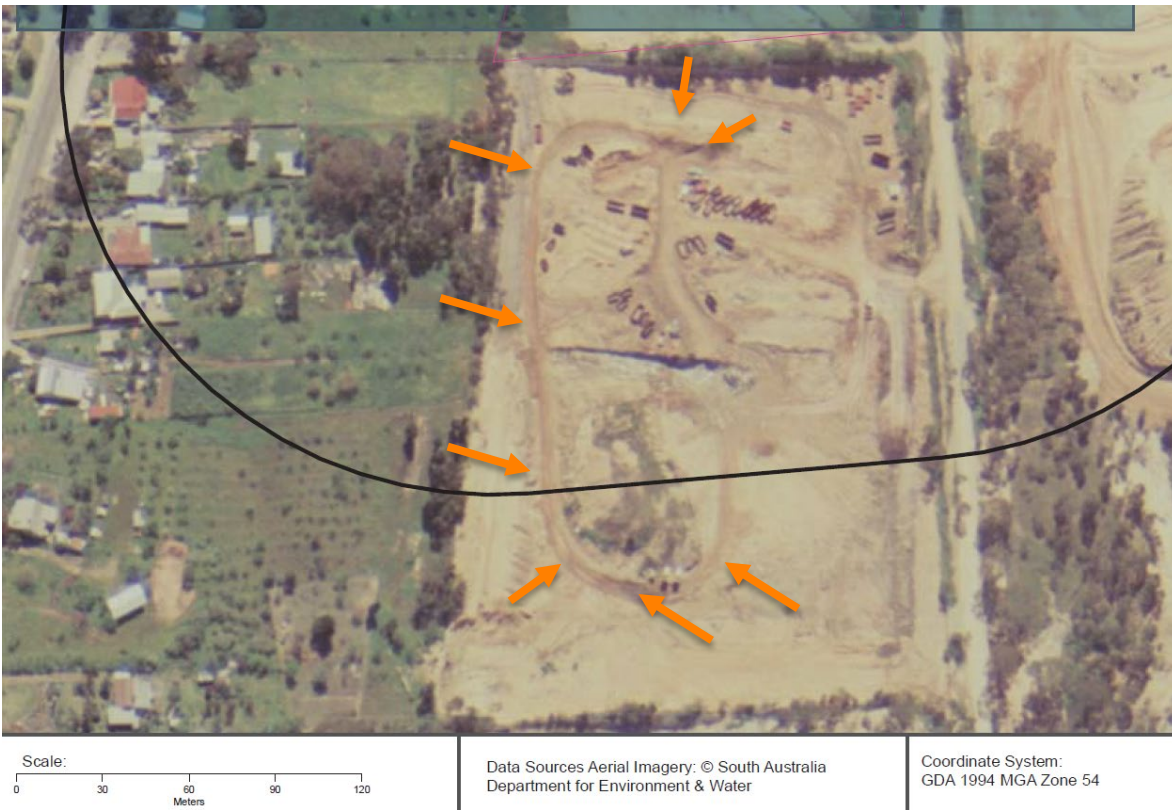


Figure 5-3 1989 image – see PSI

The response zone on the Site for MW01- MW06 is between 2 - 6 m depth with an average surface elevation of 162 m AHD – therefore screening to around 156 m AHD which would place the response zone of the wells in line with the bottom to middle of the waste mass where the elevation of the base in the northwest corner of the VL is estimated to be around 155 m AHD.



Figure 5-4 Southern edge of VL at boundary with East Waste landfill – note the slope of cap

The landfill is under passive extraction, with gas drained from the waste mass and transferred to the McMahons installed flare located in the East Waste Landfill, now operated by Ennovo.

The future ground gas regime not only at the Site but west of the Site may change considerably (or not) PGE. We can make some predictions/ assumptions regarding future ground gas regime (PGE) beneath the Site though we cannot measure (extent) what is not there. Modelling may attempt what could be there in the future however as we don't have significant gas in boundary bores to work from the natural background signal makes VL associated gas hard to identify, modelling would be hard to calibrate and define a diffusivity and retardation factor.

Hence, we are aware of the requirement for nature and extent determination but we can't inform the specific extent post PGE.

In lieu of specific modelling, how far can we expect CO₂ to travel when the source is a landfill / pressure gradient?

Nastev et al., (2003)³ developed a methane and CO₂ migration model based on quantitative landfill data. Methane plot is shown below (Figure 5-5 55% at 0 m) and they *report* that CO₂ shows same distribution starting with 45% at 0m (doesn't actually publish the CO₂). The plot shows 5% around 45 m at 8 m depth, hence say a 90% reduction over 45 m (this is in sand). With a start % of say 20 % as per VL data, then using same model logic the 45 m % could be 2% at 8 m depth or same value at around 34 m at depth 2 – 4 m (though this likely well within and below background soil CO₂?).

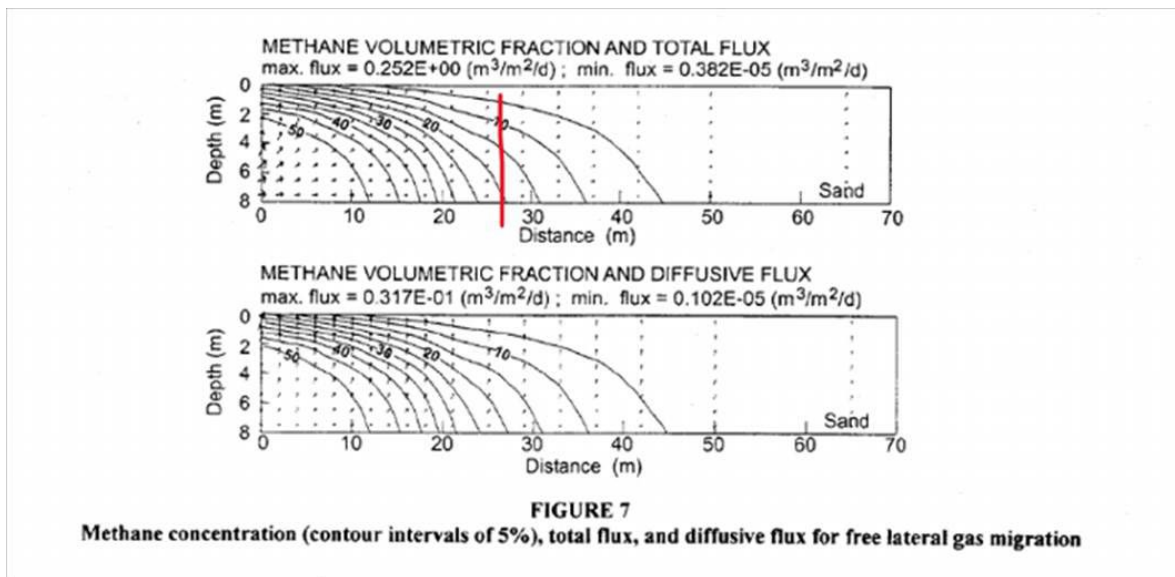


Figure 5-5 From Nastev et al., 2003

We consider that the off-site waste mass is appropriately vertically screened, such that new wells are not necessary:

- Available limited VL perimeter monitoring show no notable methane content but notable CO₂.
- CO₂ is denser than air and so will 'sink' rather than rise – bearing in mind gas analysers incorporate a pump to actively pump the CO₂ through the machine. Therefore CO₂ is more of a risk for deep basements, trenches etc than ingress to indoor air through surface emanation.
- The current wells are considered to screen the waste mass depth profile adequately enough noting the vertical configuration of CO₂ concentrations established in LWC (2023) and likely depth of the landfill based on available lines of evidence.
- Consideration / installation of deeper wells would likely return a similar CO₂ profile to the deep wells installed inside the VL boundary (PW008 and PW009) and would likely be an expensive exercise for

³ - Nastev, & Lefebvre, René & Therrien, René & Gélinas,. (2003). Numerical modeling of lateral landfill gas migration. Journal of Solid Waste Technology and Management. 29. 265-276.

little benefit in terms of further information noting the arguments above for the base of the VL in the north to be around 10 m deep and the PGE status of the landfill.

- Under current conditions, the characteristic situation is given as CS2, and this is unlikely to change on the back of any new wells as the current wells screening shallow depths create this characterisation (if CO₂ were to be migrating/ emanating vertically (it can't – unless pressured fractured environment) from deeper depths, it would be picked up in the current monitoring location configuration).
- What may change, is the post PGE ground gas regime, with higher concentrations of CO₂ potentially migrating off the VL site, at similar magnitude to the VL shallow and middle monitoring locations (i.e. closer to ~20% CO₂). We cannot estimate flow rate here PGE. Consequently this makes the current extent somewhat of a moot point and it would be better to agree on how we determine extent now, i.e. assume current VL shallow and middle depth well gas concentrations represent potential future concentrations and work out how to mitigate against these. It would be a lot simpler for everyone if the landfill was not under gas extraction, then we can design accordingly on an extent that would only decrease over time.
- In a similar vein, the potential PGE ground gas regime makes further in depth considerations of atmospheric pressure influence also somewhat of a redundant task.

5.1.2 Effect of atmospheric pressure

For Australian conditions, a worst-case meteorological scenario can be estimated from the fifth-percentile three-hour pressure decrease rate for the site, based on a two-year dataset for the nearest Bureau of Meteorology site with continuous pressure recording (NSW EPA, 2020).

Although NSW EPA (2020) states that the above approach should be used 'for Australian conditions', the same section of same report states:

"These guidelines are not intended to be prescriptive in this respect. Consistent with the general approach to contaminated land assessment adopted in NSW and nationally, professional judgement is required, based on a sound CSM and the sensitivity of the proposed site use. Such decisions must be fully justified in the relevant reports."

CL:AIRE TB17 Technical Bulletin provides guidance on the critical barometric pressure conditions that influence gas monitoring results and provides a clear framework to allow risk assessors to determine when they have sufficient gas monitoring data to evaluate and manage ground gas risk with confidence. The use of the approach set out in CL:AIRE TB17 is not explicitly ruled in or out of use in Australian Guidance (and noting the potential differences in weather systems present in NSW as covered by NSW EPA 2020 and South Australia (no specific guidance) and the "these guidelines are not meant to be prescriptive"...statement), we consider such process here as well as the NSW EPA (2020) approach.

5.1.2.1 UK Guidance

Current guidance on ground gas monitoring suggests that it should be carried out over a sufficient period to allow prediction of worst case conditions (BS8576: 2013). BS8576 also states that gas monitoring does not necessarily need to be carried out at worst-case conditions or at low or falling barometric pressure, although gas emission rates from the ground are likely to be at their highest when there are sharp falls in barometric pressure. BS8576 also states that gas monitoring should be continued until it is unlikely that any additional data will change the outcome of the risk assessment or mitigation design (see above comments on PGE ground gas regime).

Currently it is common practice in the UK to specify that gas monitoring covers a period of barometric pressure less than 1000mb and with periods of falling barometric pressure. This has been included in several earlier guidance documents (e.g. CIRIA Report C665 – CIRIA, 2007). However, in other parts of the world, it is not practical to restrict monitoring to times when barometric pressure is less than 1000mb.

According to TB17, The British Coal Technical Department (1990) defined barometric pressure drops as follows:

- Gradual fall – <4mb over 3 hours.
- Sharp fall – 4mb to 8mb over 3 hours; and
- Very sharp fall - >8mb over 3 hours.

According to TB17, some consultants in Victoria also require one or two results from a set to be obtained when the rate of atmospheric pressure fall prior to the monitoring is greater than or equal to 4mb in 3 hours.).

TB17 states that the change in surface emission rates in response to barometric pressure variations is usually quite small where gas flow is through the soil matrix and is limited by the permeability of the soil and the depth of the gas source. For example, with a 3m deep source at 20% methane concentration analysis shows that for any appreciable surface emissions to occur the pressure difference in the soil must be maintained at greater than 1mb and the permeability of the soil must be greater than about 1×10^{-5} m/s. Where soil has a greater permeability the soil atmosphere equalises quickly with any change in barometric pressure and any pressure differential is short lived.

In sites where the source is not generating large volumes of gas, the main transport mechanism is diffusion through soil (TB17). In this case the variation in methane concentration in a monitoring well that may be observed as barometric pressure changes is normally due to air ingress during high pressure diluting gas in the ground rather than increased surface emissions during low pressure – we don't think this is the case at the Site as high pressure generally correlated with low CO₂. Where there are open pathways such as in fractured rock or mine workings barometric pressure changes may result in higher air or gas flows – this is not the case at the Site.

TB17 discusses a study by Boltze and de Freitas (1996) into the changes in barometric pressure associated with dangerous ground gas emissions. They looked at the barometric pressure data for a period in London and concluded that the magnitude of the pressure drop was not the most important factor, and that the maximum velocity of gas exchange from the ground to air corresponds to the maximum slope of the graph of barometric pressure against time. They developed the “explosion risk threshold” concept. This considers the absolute value of the pressure drop and the time over which it occurs.

Boltze and de Freitas identified various zones of barometric pressure changes and concluded that the highest risk of gas emissions occurred in Zone 4. This is the area of the graph where very large pressure changes occur over a short period of time and potentially represents a risk of increased gas emissions from certain sites. The “danger threshold” was considered to be the boundary between Zone 4 and the zone of normal barometric pressure drops (defined as Zone 2). Although it was stated to be an arbitrary boundary that would move depending on factors such as soil permeability it is a useful starting point to define whether gas monitoring data has covered a sufficient period of barometric pressure variations.

Using this background, TB17 The analysis shows that it is the rate of fall in barometric pressure that is critical and the absolute value of pressure has little or no influence on the gas monitoring results. This indicates that contrary to common perception it may be better to ensure monitoring is undertaken when the rate of pressure drop is greater than 4mb pressure drop in 3 hours, but the absolute pressure range is above 1000mb, rather than having lots of results with a lower rate of drop but in a range less than 1000mb. The analysis also shows that pressure drops close to the boundary of Zone 3 can influence the peak GSVs and therefore it is another

consideration when assessing whether sufficient data has been collected. Zone 4 could be extended to cover larger pressure drops at longer durations as shown in Figure 5-6.

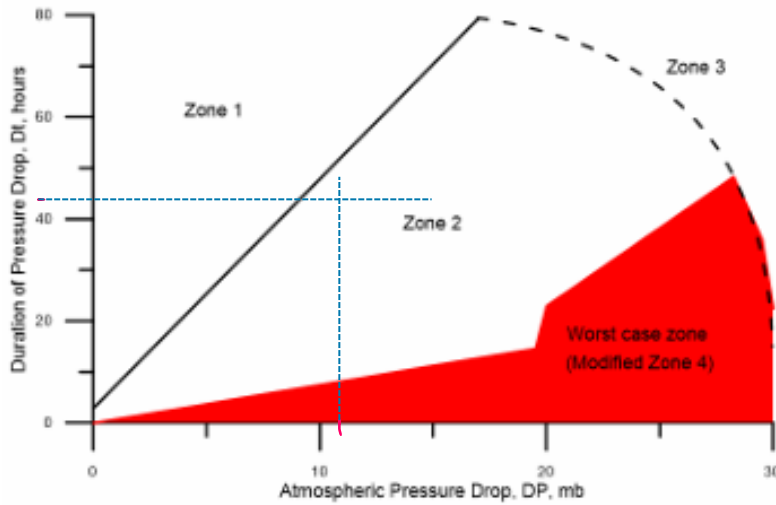


Figure 5-6 Worst-case zone for gas monitoring as per TB17 (blue lines – see notes below)

An aspect to bear in mind when considering the absolute pressure of 1000mb is that field readings (either with handheld or continuous analysers) are subject to both barometric variations and elevation (there is a decrease in pressure of approximately 1mb per 10m gained above sea level). This is another reason why the use of an arbitrary limit such as 1000mb is not appropriate.

We can see in Site data from February 2024 that machine pressure was 1004 mb yet Mean Sea Level Pressure (MSLP) reported at Adelaide West Tce (Official BoM Site) was 1021 mb on same day / time. The Site is at an elevation of around 162 m AHD with a 17 mb difference between BoM and Site values i.e. a difference of 9.53 mb per 10 m (very close to the value quoted in TB17).

Available pressure data for Adelaide from BoM is presented as 9 am and 3 pm data, i.e. a 6 hour difference in the same day, or 18 hour (3 pm to 9 am next day) or 24 hours. Data can be plotted to fulfil the 50 hour y axis shown in Figure 5-6 covering Zone 4.

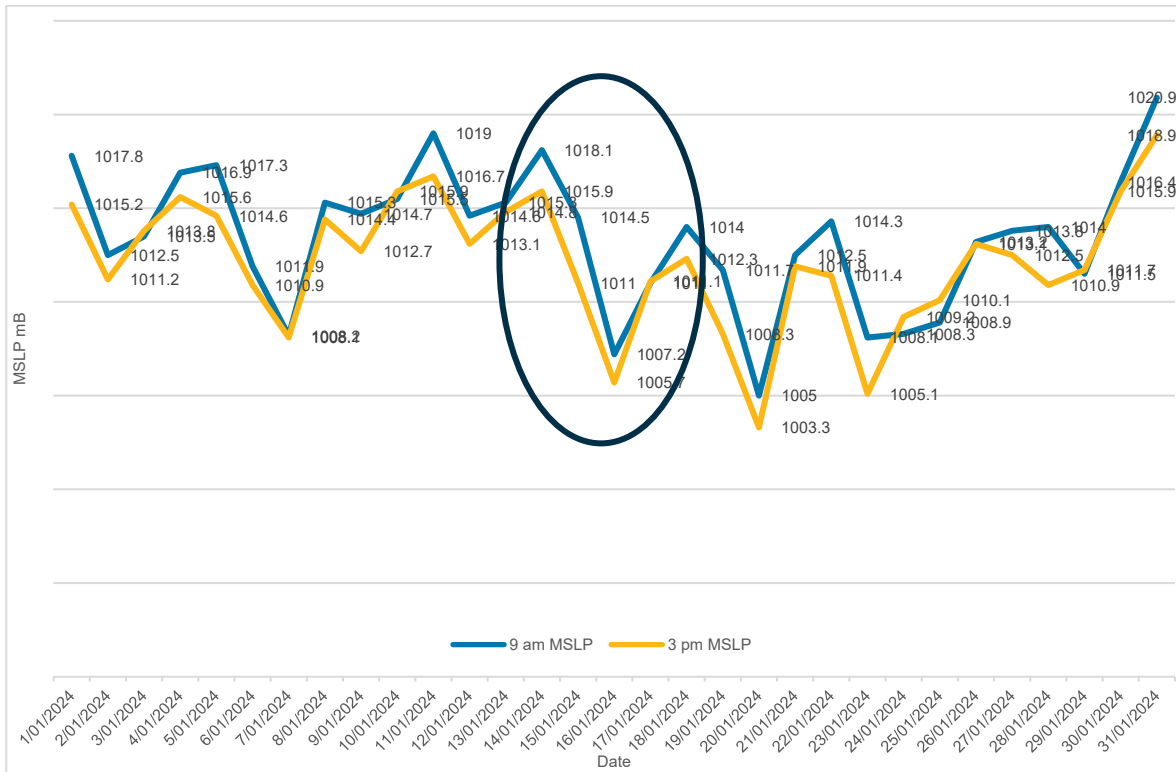


Figure 5-7 BoM data for Adelaide January 2024 0 circle = largest continual pressure drop

Using the last complete set of data from Adelaide West Tce (January 2024) we can see that the largest fall occurred between 14 and 16 January with a decrease from 1018 at 3 pm 14 January to 1005 at 9 am on the 16 January (42 hours, a fall of 13 mB). We have drawn blue lines on Figure 5-1 to show where this drop would sit – Zone 2, not in the danger zone.

We looked at the BoM data for when the GasClams were deployed in January 2023. Decreases of ~10 mB over 42 hours were evident on four occasions during this month, consistent with January 2023 worst fall. This shows worst fall at such time during continuous monitoring but doesn't show worst case on record (nor 5%ile). For that, we would need to review monthly data for X number of years to find if any fall fits within the danger zone remit.

However, a short cut may be at hand. Gergis et al., (2022) provide long term MSLP for Adelaide/ South Australia which shows an insignificant variation around the median over the year, based on data from 1841 to 2020 (Figure 5-8). The highest median (higher pressure) occurs in June. The inter quartile range (IQR) is smaller in December to March than the rest of the year (i.e. the pressures are more tightly grouped in the middle 50% of the measurements). This more variation in pressure readings are likely to occur April to November than December to March. Where there is more variation, this may infer a higher propensity for pressure drop (variability) over a short period.

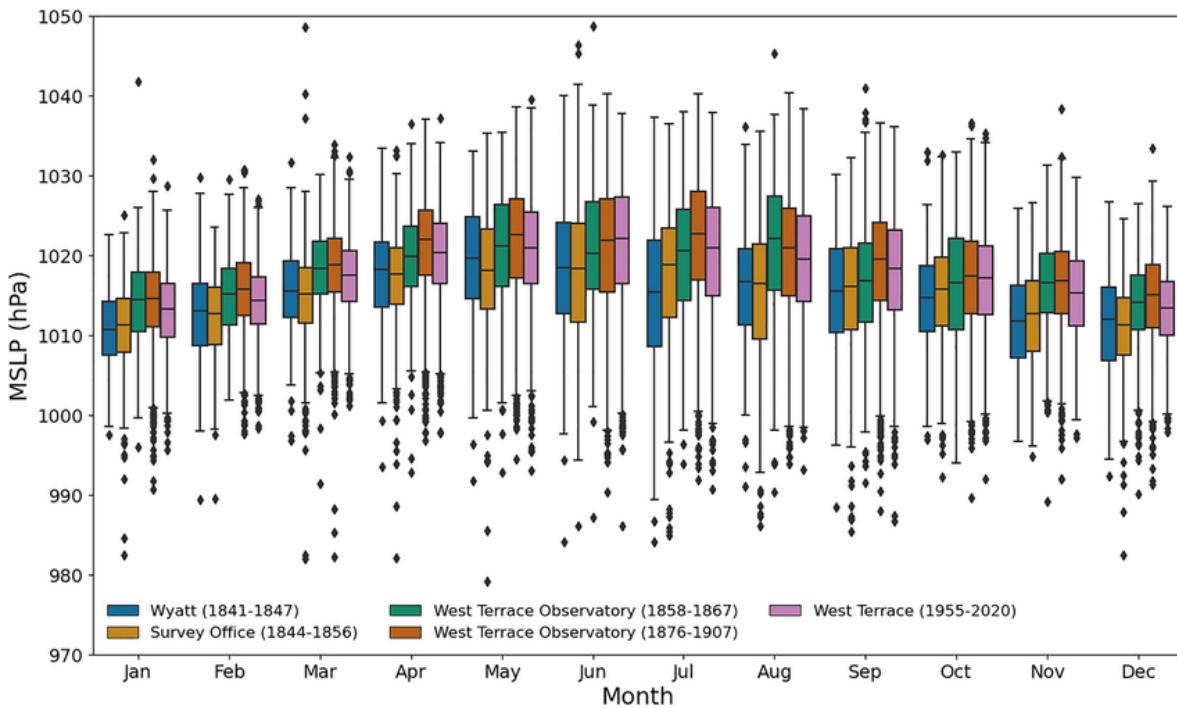


Figure 5-8 Daily mean sea level pressure (MSLP) grouped by month from the Wyatt, Survey Office and West Terrace Observatory datasets for Adelaide. Combined monthly means of MSLP from Bureau of Meteorology stations West Terrace (station number: 023000) and Kent Town (station number: 023090). Values are given in hectopascals (hPa). Outliers are defined as $1.5 \times$ interquartile range⁴

Noting the IQR for June MSLP we looked at the last available June MSLP for Adelaide West Terrace (2023) and found the greatest MSLP drop was 23 over 54 hours between 9.00 am 20 June and 3 pm 22 June (Figure 5-9). This also would equal Zone 2 (Figure 5-6).

⁴ Gergis, Joëlle & Baillie, Zak & Ashcroft, Linden & Trewin, Blair & Allan, Robert. (2022). Consolidating historical instrumental observations in southern Australia for assessing pre-industrial weather and climate variability. *Climate Dynamics*. 61. 10.1007/s00382-022-06573-x.

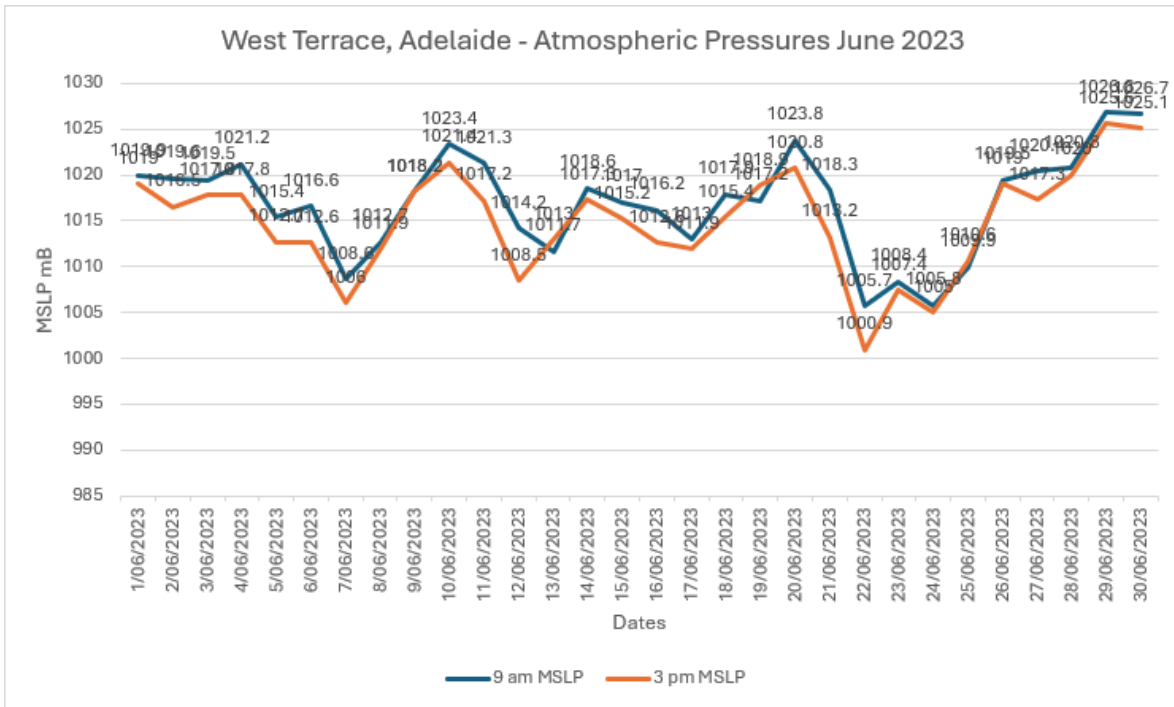


Figure 5-9 MSLP June 2023 Adelaide West Terrace BOM

Gergis et al recreated pressure situations for three significant storm events (1847, 1862 and 1900 – Figure 5-10) and this gives us long term clues as to the potential magnitude of extreme pressure differential over ~48 hours in South Australia. From these plots we can see the anomalies are up to 150 Pa (not exactly always over Adelaide). Note that 1 Pascal = 0.01 millibar therefore an anomaly of 150 Pa would equate to 1.5 mB difference.

What this tells us indirectly is that extreme pressure anomalies are not common in South Australia, with three notable low pressure anomalies / events identified (by Gergis) since 1841.

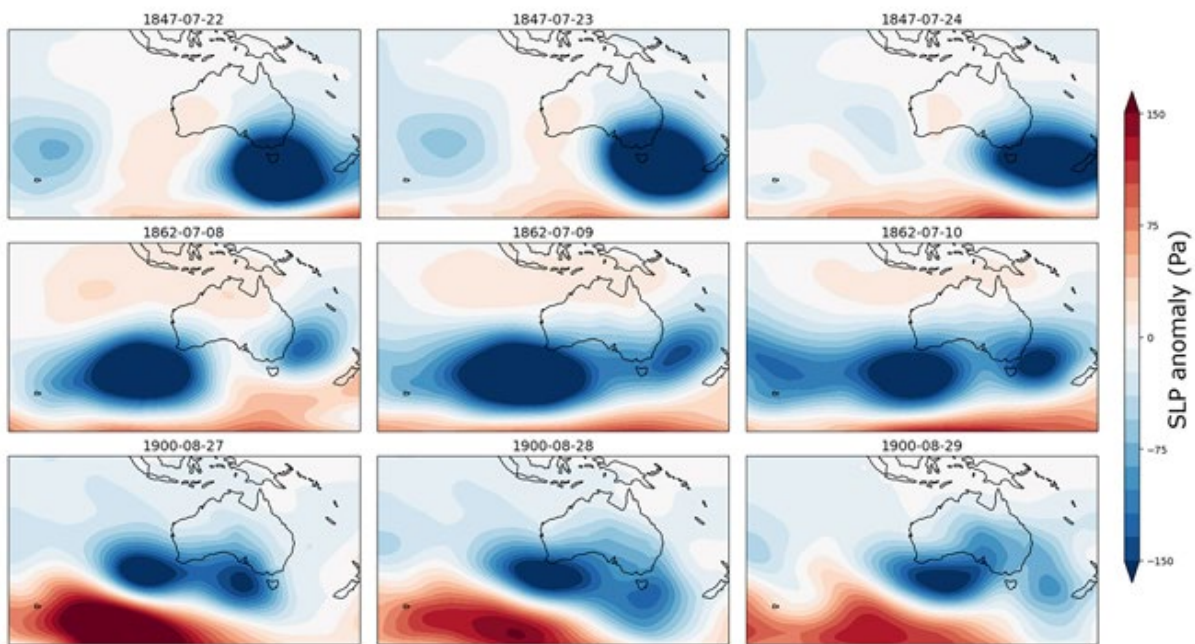


Fig. 10 Mean sea level pressure anomalies of selected weather systems that occurred during the stormy months of July 1847 (top), July 1862 (middle) and August 1900 (bottom) from the ensemble mean of 20CRv3. Anomalies are calculated relative to a 1981–2010 reference period to clearly isolate the synoptic signal

Figure 5-10 Recreated pressure situations for three significant storm events in South Australia (1847, 1862 and 1900) (Gergis et al., 2022)

5.1.2.1 NSW EPA (2020) Guidance

As noted, for Australian conditions, a worst-case meteorological scenario can be estimated from the fifth-percentile three-hour pressure decrease rate for the site, based on a two-year dataset for the nearest Bureau of Meteorology site with continuous pressure recording (NSW EPA, 2020).

Daily atmospheric data was sourced (1 January 1955 – 12 November 2021) for the West Terrace, Adelaide SA Bureau of Meteorology station. The 95th percentile of three hour pressure drop measurements for such period is -2.6 hPa with a maximum of -22.4 hPa (1959).

Table 5-1 Statistics of 3 hour pressure drops 1955 – 2021 West Tce, Adelaide

95th percentile	Max	Min	Mean	SD
-2.6	-22.4	-0.1	-1.12	0.85

The 95th percentile of three hour pressure drops would not appear to be significant with respect to notable pressure differentials occurring rapidly to an extent that a sudden decrease in atmospheric pressure would facilitate a flux (release/ burst) of ground gas.

Barometric conditions encountered in ground gas monitoring did not necessarily meet worst case scenario however equally it would be difficult to meet worst case scenario specifically for SA and in any case the worst case scenario is not likely to be significant in terms of gas flux.

5.1.3 Nature and extent of ground gas

When considering the key facets of site contamination nature and extent in relation to ground gas, we have to consider the many variables that can affect the potential extent of gas at any given moment, as ground gas is a much more dynamic type of contamination to assess and manage than say metals in soil. The field readings and gasclam readings taken whilst the VL is under PGE are one cohort of readings; these readings may look different post PGE. We can look to assess the variables of ground gas now, i.e. atmospheric pressure, soil porosity, temperature, waste depth, groundwater level, though in addition we have ongoing source degradation, and variances in and ultimately cessation of, PGE.

The nature is clear: carbon dioxide in soils within the Site.

However notwithstanding the above listed variables, the measurements are compounded by naturally occurring carbon dioxide within the soils from soil respiratory actions/ processes (or degradation of organic material). It is not uncommon to find carbon dioxide in the region of 4 – 5 %v/v from uncontaminated non-landfill affected soils. The Site readings are within this magnitude. This then adds a layer of difficulty to the determination of extent of carbon dioxide in soils on the site from the offsite source, noting the reasonably unremarkable carbon dioxide readings from the landfill monitoring bores located on the northern edge of the VL.

Due to naturally occurring carbon dioxide and the variables listed not least the role of the current PGE operation, the extent of carbon dioxide on the Site may be a question unlikely to find a specific answer, and a lot of resources may be expended in order to find an answer to a question that has no specific answer. We feel it would be very unlikely for anyone to definitively say, X % of the carbon dioxide measured is from the landfill and the carbon dioxide from the landfill will extend X m into the Site. There are just too many variables and too much background noise to be so definitive.

5.1.4 Risk framework for landfill gas migration

Wilson ⁽⁵⁾ presents a risk based framework that can be used to screen the landfill gas migration risk around old landfills. It was developed for a Scottish Local Authority to help them reduce the size of planning consultation zones and has also been applied successfully on a number of sites in England to identify whether gas extraction systems in old landfills are still required. It uses basic data that is normally readily available (site history, approximate volume of waste, geology, topography etc) and allows sites to be screened to see if there is likely to be any significant risk associated with landfill gas migration.

This method of screening landfill sites has been developed using international guidance such as that provided by New Zealand Ministry for the Environment (2004⁶) and Environment Canada (1996⁷) as an initial guide. The approach requires an assessment of the level of risk associated with three components of landfill gas migration:

- Hazard component (i.e. the source);
- Pathway component; and
- Receptor component.

The hazard component relates to the source of landfill gas (i.e. the landfill itself) and has four parameters to be considered:

⁵ Ground Gas Information Sheet No3 Screening approach for landfill gas migration around landfill sites - [ggis-no-3-paper-s-wilson-hard-copy-v2.pdf \(epg-ltd.co.uk\)](#)

⁶ New Zealand Ministry for the Environment (2004). Risk Screening System, Contaminated Land Management Guidelines No3.

⁷ Environment Canada (1996). Guidance Document for Landfill Gas Management.

- The type of landfill waste accepted and its biodegradable content;
- The age of the landfill (time since filling was completed);
- The volume of material placed in the landfill and whether it is a wet or dry landfill; and
- The presence of engineering measures that could reduce the risk of gas migration (liners, gas extraction) or increase the risk (engineered capping layer).

Type of Waste

On this basis the risk associated with the nature of the material can be estimated as follows:

- Domestic/Sanitary landfill – High – Score = 1.
- Commercial/Industrial – Moderate – Score = 0.6.
- Inert landfill – Low – Score = 0.1.

Age of Waste

On the basis of a typical gas generation profile the impact of age on the level of risk can be judged as follows:

- 0 to 20 years – High – Score = 1.
- 20 to 40 years – Moderate – Score = 0.6.
- >40 years – Low – Score = 0.1.

Volume of material and depth of landfill

The greater the volume of waste material the greater the volume of gas that can be generated (for a given type of material). Landfills with a higher moisture content will also generate much more gas than one that is dry (biodegradation needs moisture to occur). Figure 3 (per Wilson, reproduced from Environment Canada, 1996) is used in Wilson to help estimate the risk associated with the volume of landfill material in a wet landfill. The numbers on the body of the graph indicate a gradation of production within each risk category (1 is lower and 3 is higher). The graph characterises a site as low medium or high gas production, which for the purpose of this assessment method is considered equivalent to low, medium, and high risk. The adjusted capacity on the y-axis can be amended to take account of the proportion of inert, industrial, and commercial and domestic waste. However, for the purposes of a preliminary assessment using this method the unadjusted volume of the waste is used, irrespective of type.

Only a worst case approximation of the volume is required, based on estimates of the plan area of the landfill and the likely maximum depth. The plan area can be estimated from old OS maps and the likely depth is based on side slopes marked on maps and any other available information (e.g. geological maps and strata that are known to have been quarried). The risk score can be assessed as follows using Figure 3:

- High risk – Score = 1.
- Medium risk – Score = 0.6.
- Low risk – Score = 0.1.

Engineering measures

The potential for significant landfill gas migration will be substantially reduced if the site has a landfill liner and/or a gas extraction system. Conversely if the site is unlined and has no internal management system then the risk

of gas migration will increase. The presence of gas vent trenches and wells around the perimeter of a landfill site will also reduce the risk of landfill gas migration.

The presence of an engineered impermeable cap will increase the risk of gas migration as will impermeable layers of soil within the waste (for example daily cover) if there is no effective gas extraction system. The level of risk can be assessed as follows:

- High risk – No liner or gas management system and an impermeable capping layer – Score = 1.
- Moderate risk – Unlined and uncapped - Score = 0.6.
- Low risk – Fully engineered landfill – Score = 0.1.

There are two parts to the pathway component. The first is the nature of the soils/rock surrounding the landfill and the likely permeability.

This is determined from geological maps (solid and drift geology). Soils with lower permeability (e.g. clayey soils) will limit the risk of gas migration and soils/rocks with a higher permeability (e.g. highly fractured rock or sand and gravel deposits) will increase the risk.

Groundwater conditions will also influence the risk of gas migration (lateral gas migration through saturated soils is limited).

The other consideration is the likely presence of preferential pathways such as faults or large services. The level of risk can be assessed as follows:

- High risk – Open or high permeability pathway – Score = 1.
- Moderate risk – Permeable soils such as sand and gravel - Score = 0.6.
- Low risk – Low permeability soils or rock – Score = 0.1.

Overall Risk

The overall risk of gas migration from a site is determined by multiplying the individual scores together. The overall level of risk is based on the following assumptions:

- Low risk – Individual scores comprise 4 low, 2 moderate and 2 high
- Low/ moderate risk - Individual scores comprise 3 low, 4 moderate and 1 high ($0.13 \times 0.64 \times 1 = <1.3 \times 10^{-4}$)
- Moderate risk – Individual scores comprise 8 moderate ($0.68 = <0.017$)
- High risk - > 0.017

It is important to note that this method of assessment and these values were developed as a guide to help judgement and make assessments of different sites consistent and should not be seen as absolute boundaries. A risk screening of the VL is given in Table 7-1. The risk screening indicates a low/ moderate risk though this assumes any future dwellings have no protection.

Table 5-2 Risk screening using Wilson (2018) process

Factor	Details	Risk Rating	Score
Type of landfill	Largely construction waste with some municipal type waste	Moderate	0.6
Age of landfill	Closed and capped by 1999. Therefore at least 25 years old with first waste likely accepted around 1975 – 48 years (?)	Moderate	0.6
Volume of landfill	3.7 ha (37,000 m ²) x 10 m depth = 370,000 m ³ = 1 tonne / m ³ = 370,000 tonne ⁸	Low	0.1
Engineering measures	<p>(assumed) 1 m thick clay cap – not sure of indication of groundwater within waste mass – assume not as quarrying likely ceased on or before water table.</p> <p>Unknown daily cover that was engineered – aerals suggest some cover but unsure of compaction etc.</p> <p>Current PGE system in operation.</p>	Moderate	0.6
Pathway Component			
Geology	Generally sand (area used for sand quarrying)	Moderate	0.6
Preferential Pathways	No preferential pathways – future dwellings would likely	Low	0

⁸ [Physical Characteristics of Solid Waste - Density, Moisture, Size \(aboutcivil.org\)](http://aboutcivil.org)

Factor	Details	Risk Rating	Score
	have services enter from the Street.		
Receptor component			
Receptor	One current house and proposed future housing	High	1
Evidence of gas migration	No significant results as CO ₂ is within natural range.	Low (especially whilst PG is operation)	0.1
Overall risk			1.3 x 10 ⁴ Low to moderate risk

Pragmatically, there is a potential future risk to dwellings from ground gas; some of this risk is technically not able to be quantified right now due to the ongoing PGE nature of the landfill.

Therefore we can determine that the extent of the contamination is the entire Site and the entire Site requires dwelling protection. This is also logical as if changing the nature of the surface of the Site by building dwellings, those closer to the VL may have an effect of downwards shielding / pressure therefore extending the lateral movement of the gas, in the same way that a landfill cap produces the same effect.

LWC considers that there is no further benefit to additional monitoring of the landfill gas generation source nor on site ground gas profile, and that resources are best focused on developing building controls sympathetic to the future residential development. The CS2 classification may be reconsidered in light of future potential risk from offsite gas post cessation of landfill gas flaring, to provide an increased level of ground gas protection.

5.2 Groundwater risk

SKM (2010) outlined that the natural lithology of the landfill and of the area immediately adjacent to the landfill is characterised by two potential zones of high permeability (sands, clayey sands). These zones of high permeability exist at depths of approximately 3 m below ground level (BGL) to 8 m BGL and 10 m BGL to 30 m BGL in the northwest of the site and approximately 3 m BGL to 5 m BGL and 8 m BGL to 12 m BGL in the southeast of the site, with the high permeability zones separated by an approximate 2 m thick 'bench' of lower permeability sandy clay.

The lithology gives rise to three groundwater systems:

- Perched cemented sand aquifer - The perched sand aquifer exists approximately 4-7 m below ground level (m BGL). PB reported that the lateral extent was unknown however was not a continuous unit. PB also reported that the perched system contained water in years of above average rainfall or after a single heavy rainfall event.
- Tertiary sand aquifer - The tertiary sand aquifer is a semi-confined system with a variable thickness clay base. PB reported that the water quality was moderate to good (salinity ranging between 1,000 to 1,500 µS/cm) with groundwater generally encountered between 14 and 33 m BGL.

- Fractured Rock Aquifer - The fractured rock basement has groundwater with a reported salinity of up to 4,500 $\mu\text{S}/\text{cm}$ with groundwater elevations similar to the tertiary aquifer system (standing water level generally reported around 30 m BGL).

A monitoring well (MW01_001) was installed in the 2008 environmental investigation.

With the exception of selenium and ammonia, the groundwater analyte concentrations within monitoring well MW1-001 did not exceed the (now superseded) Environment Protection (Water Quality) Policy (2003) criteria – the detected selenium and ammonia concentrations exceeded the adopted freshwater ecosystem protection values .

MW1_001 was further gauged and sampled on 18 November 2009. An interface water level probe, in addition to petroleum detection paste, was used to assess whether there was any measurable thickness of Light Non-Aqueous Phase Liquid (LNAPL) and this was not detected.

The monitoring well was purged and sampled using a dedicated disposable bailer and both intra-laboratory and inter-laboratory duplicate samples were also collected.

The standing water level (SWL) in MW1_001 on 17 November 2009 was 27.568 m below top of casing (BTC). Using data from the adjoining landfill site, groundwater was interpreted to be flowing in a south-westerly direction in the tertiary unit.

Installation of onsite monitoring wells to host the gas clams involved drilling to 6 m depth and groundwater was not encountered, noting the perched unit was not evident and is possibly a discontinuous water table (inferred in VL data/ reports also).

The tertiary sand aquifer is a semi-confined system with a variable thickness clay base. With water generally encountered between 14 and 33 m BGL.

If we consider this as the primary water table then the depth to the water table would seem considerable in terms of being able to provide a significant piston effect over that range of vadose zone, noting lateral migration is more considerable than vertical migration (CL:AIRE Technical Bulletin TB18⁹).

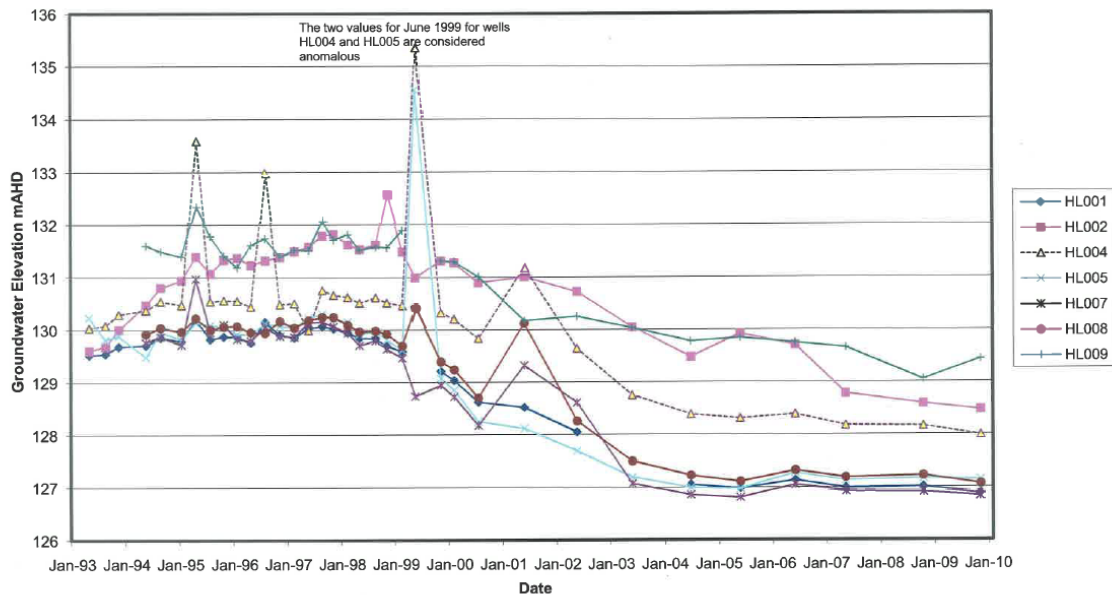
While there isn't a specific maximum depth universally agreed upon, in most cases, depths greater than 10 meters are considered unlikely to experience significant piston effects from groundwater fluctuations alone¹⁰.

Significant groundwater fluctuations are not evident from the historical record and are not indicated much above 133 m AHD (Figure 4-1).

⁹ Continuous Ground-Gas Monitoring and the Lines of Evidence Approach to Risk Assessment, TB18, Jan 2019 [TB18 - ContinuousGGMonitoring-web \(3\).pdf](#)

¹⁰ Using principles set out in Braja M. Das and Khaled Sobhan, Principles of Geotechnical Engineering. 9th Edition, Cengage Learning, February 1, 2018

Figure 9: Groundwater Elevations (hydrographs)



2162152A
 Highbury Landfill 1
 December 2009 GME

Figure 4-11 Hydrographs for VL wells Jan 1993 – January 2010 (PB, 2010)¹¹

Some volatile organic compounds were identified in water in the tertiary unit in the northwest corner of the Veolia Landfill (southwest of Site) however the magnitude of concentration coupled to the depth to groundwater would likely significantly mitigate any risk of volatilisation to indoor air where a sensitive use is proposed. Notwithstanding this, the occurrence of where these compounds were reported is down hydraulic gradient of the Site with respect to both the tertiary and basement units.

Although not directly measured in water sampled from beneath the Site, VOC do not infer to have a significant loading based on the C₆-C₉ fraction reported in 2009. Based on data to date (including consistent groundwater flow pattern away from the Site) there is no indication that groundwater would impact receptors on and beneath the Site.

Groundwater is considered to flow southwest such that the Site is largely up hydraulic gradient of the Veolia Landfill (VL). Large scale migration of chemical substances (emerging or otherwise) in groundwater form beneath the landfill (a potential source of contaminants, emerging or otherwise) is therefore considered to be of a low likelihood. Theoretically it is possible for some minor diffuse migration against the hydraulic gradient to occur though is unlikely to significantly represent a large scale migration of chemicals affecting more than a few metres into the Site.

The Site itself shows no indication as to why it may offer to be a source of chemical substances (emerging or otherwise) in groundwater, based on identified PCA – none of which suggest harm to groundwater.

As per the PSI, there are no apparent PCA up hydraulic gradient of the Site, nor any lodged regulatory notifications (e.g. Section 83A) within a distance that may influence the Site. The land use up hydraulic gradient

¹¹ Annual Water Monitoring Report – December 2009 – Former Highbury I Landfill, Halls Road, Highbury, SA – 11 February 2010 – Prepared by PB for SITA

of the Site is largely sensitive (residential), the extreme northern portion of the quarry to the northeast (open hole on the ground being recharged by rainfall) and then the Hills interface. There is no reason to infer any specific groundwater impact from an up hydraulic gradient source.

LWC acknowledges that changes in the depth to the groundwater table can affect the ground-gases in the unsaturated zone. If groundwater rises the ground-gases can be compressed and pressurised while if the groundwater falls the ground-gases may be put under suction. This behaviour is known as the '**piston effect**' (Boyle and Witherington, 2007¹²).

The piston effect typically occurs when there are significant fluctuations in the water table level, particularly in areas with high permeability soils or where there are pathways for gas migration. However, it's less common for the piston effect to occur at great depths, as the pressure differentials required to drive gas migration become less significant with increasing depth.

5.3 Soil risk

Lead in surface soil in and around the northwest shed reported at concentrations above the ASC NEPM Health Investigation Level A (300 mg/kg) in previous assessment and required further delineation (Linkage 1 and 2). This was achieved and the lead in soil here is adequately delineated to be below Health Investigation Level A.

This soil can be dealt with during development via a Site Remediation Plan and can be disposed of offsite as Intermediate Waste Soil (IWS).

Supplementary sampling to analyse soil ecological parameters (CEC, pH and % clay) was undertaken on 6 February 2024. Clay was not tested for as the Site is relatively sandy, and the clay function is fairly limited in the EIL formulation for the relevant metals.

In this case lead (Pb) is of interest being the focus of northwest delineation sampling. Concentrations of lead did not initially breach the Ecological Investigation Level (exceeded ASC NEPM Health Investigation Level A). The Ecological Investigation Level derivation is not technically needed for lead as a "book value" is provided in Schedule B1 (which requires ABC for completion).

The EIL sheet for lead is presented in Attachment A-1 along with the supporting laboratory certificates (A-2) and tabulated data including the EIL for Pb is presented in A-3.

The aesthetic soil in the southeastern corner of the Site may also be removed from Site if not able to be placed beneath dwelling footprints or roadways and could be managed as Intermediate Waste Soils also given the chemical concentrations are less than the IWS criteria. The fill here is understood to be from a plant nursery owned by the Mercer family and this was supported as inclusions observed in recovered soil cores included plant labels typical of potted plants being sold at a plant nursery. Where such soil is 'covered' by the footprint of a dwelling then there would be no aesthetic limitations (though geotechnical issues may need to be discussed with a suitably qualified geotechnical engineer). This issue can be reviewed where a specific development plan is being contemplated.

A grid-based walkover was completed by LWC on 6 February 2024 using the grid arrangement shown in Attachment B. This was repeated in the lower (southern portion) of the Site on 19 February 2024 by LWC noting that there had been a little bit of vegetation disturbance between the two dates by way of a "bushy" fire.

¹² Boyle R. and Witherington P. 2007. Guidance on evaluation of development proposals in sites where methane and carbon dioxide are present. Report Edition No.04. March 2007, National House Building Council, Amersham, UK.

The survey/ walkover was conducted in accordance with relevant National and Interstate guidance by an experienced practitioner who has completed asbestos materials training. No ACM was identified during either walkover.

Taking into account the DSI work around 2008 – 2009 (notable number of test pits), the drilling for gas clam locations, the data gap soil bores undertaken in 2023 and the two walkovers completed in February 2024, there has never been any incidence or observation of asbestos containing material (ACM) on the Site nor in the Site and there is no reason to suspect why there would be – there are two access points to the Site: one you would have to drive past the house (which always seems occupied) and two, there is a locked gate further down the road leading into the southern ‘paddock’ area, This arrangement does not support the likelihood of random fly tipping of ACM to be reasonably likely.

5.4 Limitations

Please refer to the statement of limitations as Appendix J.

6 REFERENCES

EPA 969/12 – Landfill gas and development near landfills

Environment Protection Act 1993.

Environment Protection Regulations 2009.

EPA (2019) Environmental management of landfill facilities – solid waste

Land and Business (Sale and Conveyancing) Act 1994.

Land Services SA *Integrated Land Management System (SAILIS) website:* <https://sailis.lssa.com.au/home>.

Location SA Map Viewer: <http://location.sa.gov.au/viewer/>.

LWC (2022) Preliminary Site Investigation 10 – 20 Halls Road, Highbury SA. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees August 2022 – reference OO-01

LWC (2023) In Situ Ground Gas Assessment 10 – 20 Halls Road. Prepared by Land & Water Consulting for Future Urban/ Hallan Nominees, September 2023 OO-01 DR003

National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended in 2013).

NHMRC/NRMMC (2011) Australian Drinking Water Guidelines, version 3.7 (updated in January 2022).

NSW EPA (2020) Assessment and management of hazardous ground gases Contaminated Land Guideline

Parsons Brinckerhoff, 2010. Annual Water Monitoring Report, December 2009 – Former Highbury I Landfill Halls Road, Highbury SA. Prepared for SITA Environmental Solutions. 11 February 2010.

Planning, Development and Infrastructure Act 2016.

Planning, Development and Infrastructure (General) Regulations 2017.

REM (2007) Phase 1 Environmental Site Assessment – Halls Road Highbury Hallan Nominees Land.

SA EPA Site Contamination Index: https://www.epa.sa.gov.au/public_register/site_contamination_index.

SA EPA (1994) Environment Protection (Air Quality) Policy (updated in 2016).

SA EPA (2015) Environment Protection (Water Quality) Policy.

SA EPA (2019a) Guidelines for the Assessment and Remediation of Site Contamination.

SA EPA (2019b) Environmental Management of Landfill Facilities: Solid Waste Disposal.

SKM (2008a) Phase II Program - 10-14 and 16-20 Halls Road, Highbury. Report prepared for Hallan Nominees Pty Ltd, dated July 2008.

SKM (2008a) Development Plan Amendment, Environmental Investigations Executive Summary – Highbury Residential and Open Space Development. Report prepared for Dequetteville Pty Ltd, dated 7 July 2008.

SKM/ REM (2008). Final Report – Additional Environmental Investigations, Readymix Highbury. Prepared for Dequetteville Pty Ltd. 14 July 2008

SKM (2010a) *Additional Landfill Gas Monitoring and Soil Investigation Program - 10-14 and 16-20 Halls Road, Highbury*. Draft report prepared for Hallan Nominees Pty Ltd, dated 24 February 2010.

SKM (2010b) Voluntary Site Contamination Assessment Proposal – SITA Landfill Halls Road, South Australia Final Rev 2 21 May 2010

South Australian Property and Planning Atlas website: <https://sappa.plan.sa.gov.au/>.

State Planning Commission (2021) *Practice Direction 14 (Site Contamination Assessment 2021, as updated in June 2022)*.

US EPA (2005) *Ecological Soil Screening Levels for Antimony*, Interim Final OSWER Directive 9285.7-61.

TABLE

SITE PLAN

Site Diagram

10-20 Halls Road, Highbury, SA 5089



Legend Site Boundary Internal Parcel Boundaries	Total Area: 18428m ² Total Perimeter: 560m	Scale:
	Disclaimers: Measurements are approximate only and may have been simplified or smaller lengths removed for readability. Parcels that make up a small percentage of the total site area have not been labelled for increased legibility.	Coordinate System: GDA 1994 MGA Zone 54

APPENDIX A

LICENSE D0033



SOUTH AUSTRALIAN WASTE MANAGEMENT COMMISSION

Waste Management Act, 1987



WASTE DEPOT LICENCE

The person named hereunder is licensed to operate a waste depot under Division I of the Waste Management Act

LICENSEE: PACIFIC WASTE MANAGEMENT PTY LTD

LICENCE NUMBER: D0033

DEPOT ADDRESS: Halls Road Highbury

TYPE(S) OF DEPOT: SOLID WASTE LANDFILL

M. D. MADIGAN
DIRECTOR

PACIFIC WASTE MANAGEMENT PTY LTD
Prospect Road Extension
Gepps Cross 5094



SOUTH AUSTRALIAN WASTE MANAGEMENT COMMISSION

G.P.O. BOX 2607 ADELAIDE 5001

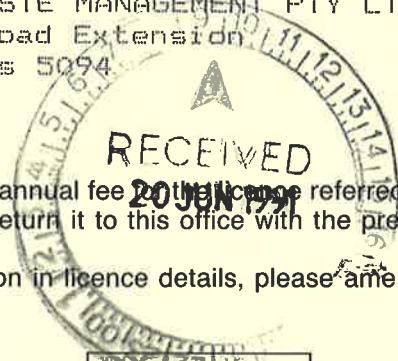


APPLICATION/ANNUAL RETURN FOR A WASTE DEPOT LICENCE

OFFICE USE ONLY

CHEQUE \$	(\$100.00)
RECEIVED	1.7.91
TECH. OFF.	
SECT. 90	

PACIFIC WASTE MANAGEMENT PTY LTD
Prospect Road Extension
Gepps Cross 5094



I wish to advise that the annual fee of the licence referred to above is now due. Please complete and sign the form and return it to this office with the prescribed fee.

In the event of a variation in licence details, please amend the form before it is returned.

LICENCE NUMBER
(OFFICE USE ONLY)

00055

PAYMENT OF FEE DUE BY

30/06/91

LICENSEE

PACIFIC WASTE MANAGEMENT PTY LTD

PERSON TO BE CONTACTED
FOR ENQUIRIES

NAME

TEL. NO.

NAME OF OWNER
(IF DIFFERENT TO LICENSEE)

Pacific Waste Management P/L

POSTAL ADDRESS OF OWNER

Lot 7 Newton Road Wetherly NSW 2164

TYPE(S) OF DEPOT

SOLID WASTE LANDFILL

LOCATION OF DEPOT
(LOT/SECTION/HUNDRED)

Part Section B21, Hundred of Yatala

ADDRESS OF DEPOT

Halls Road Highbury

CERTIFICATE(S) OF TITLE
REFERENCE

CT 4249 942CT 839 182

INIT. CHECKED	
PRICE	<input checked="" type="checkbox"/>
QTY.	<input checked="" type="checkbox"/>
DESC.	<input checked="" type="checkbox"/>
CLERICAL	<input checked="" type="checkbox"/>
P.O. COMP	<input type="checkbox"/>
P.O. APPR.	<input type="checkbox"/>
CONT.	<input type="checkbox"/>

PRESCRIBED FEE

\$

60

B.P. Bloomfield

SIGNATURE

B.P. BLOOMFIELD

NAME

DATE 20.06.91

M.D. Madigan
M. D. MADIGAN
DIRECTOR



SOUTH AUSTRALIAN WASTE MANAGEMENT COMMISSION

South Australian Waste Management Commission Act, 1979

DEPOT LICENCE

Pacific Waste Management Pty Ltd.
McMAHON WASTE DISPOSAL
Prospect Road Extension
Gepps Cross 5094

The Depot described hereunder has been licensed under the provisions of Part III of the South Australian Waste Management Commission Act 1979. This licence remains in force for a period of one year from the date of grant subject to the occupier's compliance with the provisions of the Act, regulations and conditions of licence.

1. The General Conditions applicable to this licence are attached.



You are asked to read the Conditions of Licence carefully and are required to comply with them throughout the term of the licence.

LICENCE NUMBER:

D0033

EXPIRY DATE:

16/06/89

LICENSEE:

McMAHON WASTE DISPOSAL

DEPOT LOCATION:

Part Section 821, Hundred of Yatala

CERTIFICATE(S) OF TITLE:

Volume 4028 Folio 351; Volume 839 Folio 192

TYPE OF DEPOT:

SOLID WASTE LANDFILL

R. H. MADDOCKS
DIRECTOR

SOUTH AUSTRALIAN WASTE MANAGEMENT COMMISSION.

South Australian Waste Management Commission Act, 1979/80

(Sections 26 (1) (a) and 27(3) (a))

SOUTH AUSTRALIAN WASTE MANAGEMENT COMMISSION

APPLICATION FOR LICENCE/RENEWAL OF LICENCE FOR A DEPOT

(A separate application must be completed for each depot for which a licence is required.)

RECD. 13 APR 1983

TO: The Director,
South Australian Waste Management Commission,
GPO Box 2607

Adelaide 5001

REFERRED TO: *Clyde Lee*
\$120.00 P.O.

I hereby apply for (renewal of) a licence in respect of a depot, details of which appear below.

FULL NAME OF OCCUPIER (block letters please)		McMAHON WASTE DISPOSAL	
POSTAL ADDRESS OF OCCUPIER		P.O. BOX 309 BLACK ATHOL SA	Postcode 5084
OWNER'S NAME	PACIFIC WASTE MANAGEMENT PTY LIMITED		
OWNER'S ADDRESS	LOT 7 NEWTON ROAD WETHERSILL PARK NEW		Postcode 2164
PERSON TO BE CONTACTED FOR ENQUIRIES	Name: B. BLOOMFIELD Address: 15 CHURCH ST FRESHLING SA	Telephone Numbers Bus: 2626033 A.H. 085252297	
CURRENT LICENCE NUMBER (if applicable)	D0033	DUE DATE FOR RENEWAL (if applicable) 16/6/83	
THE APPLICATION IS IN RESPECT OF	An Existing Depot <input checked="" type="checkbox"/> (Please tick appropriate box) A Proposed Depot <input type="checkbox"/>		
LOCATION **	LOT.	SECTION	HUNDRED
	ADDRESS		
CERTIFICATE OF TITLE REFERENCE		Volume No. 4028	839
		Folio No. 351	192

- * Delete if not applicable
- ** A site plan of the depot must be attached to this application. The site plan must indicate clearly the point of access to the depot.

PARTICULARS OF DEPOT

TYPE OF DEPOT (Please tick appropriate boxes)	Transfer Station Depot (final disposal) <input checked="" type="checkbox"/>	Landfill <input checked="" type="checkbox"/>
	Resource Recovery <input type="checkbox"/>	Compaction <input type="checkbox"/>
Other (please specify) <input type="checkbox"/>		Baling <input type="checkbox"/>
DEPOT OPERATION (please tick appropriate boxes)	Depot will accept waste from:	
	General public <input type="checkbox"/>	Residents of specified council areas <input type="checkbox"/>
	Councils <input type="checkbox"/>	Private contractors <input type="checkbox"/>
	Other (please specify) <input checked="" type="checkbox"/>	OWN USE
State days and hours depot open.		

PARTICULARS OF WASTE TO BE ACCEPTED

TYPE OF WASTE (please tick appropriate box)	Putrescible <input checked="" type="checkbox"/>	Non-Putrescible (other than demolition) <input checked="" type="checkbox"/>	Demolition <input checked="" type="checkbox"/>
	Sludge <input type="checkbox"/>	Liquid <input type="checkbox"/>	
PRESCRIBED WASTE (please declare—refer to the Seventh Schedule)			

Please answer the following questions by placing a tick in the appropriate box.

Is the depot located within the area of a council or other places listed in the Eighth Schedule? YES NO

Is the depot within the area of a council not listed in the Eighth Schedule? YES NO

Have applications been submitted in the name of the occupier in respect of licences for other depots within the same Council area as this application? YES NO

Licence Fee of \$60 is enclosed.

I hereby certify that to the best of my knowledge the information provided in this application is correct.

B. P. Bloomfield
Signature of Occupier or his Agent
Date 11/4/83

Please print name and address B. P. BLOOMFIELD
15 CHURCH ST FRESHLING SA 5372

Pacific Waste Management Pty Ltd

RECORDS CHECKED 18/5/88

S.A.W.M.C.

COPY

ENVIRONMENT PROTECTION AUTHORITY
South Australia

EPA Licence No. : 000765
Licence Co-ordinator : Dean Macmullen
Telephone : 8204 2035
Page : 1

Environmental Authorisation under Part 6 of the Environment Protection Act, 1993

Name: Pacific Waste Management Pty Ltd
Postal Address: PO Box 309
BLAIR ATHOL 5084

is hereby issued a

Licence to undertake a prescribed activity of environmental significance under
Section 36 of the Environment Protection Act, 1993

Pacific Waste Management Pty Ltd (the Licensee) is authorised to undertake the following activities of environmental significance referred to under Schedule 1 of the Environment Protection Act, 1993 (the Act), subject to the conditions below and the Act.

3(3) Waste Depot for storage and treatment of waste

carried on at

Halls Rd, HIGHBURY (the Premises)

This licence will commence on : 01-March-1997
It will expire on : 28-February-1999

This licence shall remain in force until the expiry date unless sooner suspended, cancelled or surrendered. It is subject to conditions which must be complied with no later than the date of commencement of this licence unless provided for on the right hand side of the condition in the column marked compliance date.

Definitions

For the purpose of this licence:

"Solid Waste Depot" includes the area authorised to operate as the depot and is hereafter referred to as the depot.

"Clean Fill" Material consisting of clean excavated natural material including clay, soil, crushed rock, rubble and like inert mineral matter up to a maximum of 200 mm in size. The filling material shall not contain any organic material such as timber or vegetable matter or any other waste material.

ENVIRONMENT PROTECTION AUTHORITY
South Australia

EPA Licence No. : 000765
Licence Co-ordinator : Dean Macmullen
Telephone : 8204 2035
Page : 2

The Licensee is permitted to operate a waste depot on the premises subject to the following conditions:

Conditions:

**Compliance
Date:**

1. If the Licensee changes its name or postal address then the Licensee must inform the EPA in writing within 1 month of such a change.
- 2.1 The last date for an application for renewal of the authorisation is 60 days before expiry date.
- 2 The last date for payment of the authorisation fee for renewed licence period is 30 days before expiry.
- 3.1 The Licensee must display a copy of this authorisation on a notice board or other equivalent place named as a site on which the activities authorised are to be undertaken.
- 3.2 The Licensee must ensure that every employee, agent or contractor responsible for carrying out responsibilities controlled by this licence, is properly instructed as to the requirements of this authorisation and the general environmental duty under Section 25 of the Act and the means by which such requirements and the general duty are to be fulfilled in relation to the authorised activities.
- 3.3 The Licensee must maintain a written record of all complaints concerning the premises.
- 3.4 In the event that the Licensee issues to its officers or employees an environmental policy relating to reporting of incidents, handling public complaints or requirements for environment protection practices relating to pollution and waste, the Licensee must provide a copy of the policy to the Environment Protection Authority within one(1) month of being issued unless the Authority agrees that the policy is not required to be issued.
- 4.1 The Licensee, unless otherwise approved in writing by the Environment Protection Authority, shall not permit:
 - a) the receipt or disposal of waste at the site.
 - b) the exposure or removal of previously deposited waste at the depot.
 - c) the construction of physical structures or stockpiles at the depot that results in or is likely to result in a nuisance or offensive condition, damage to the environment, or a risk to health or safety.
- 4.2 The Licensee, unless otherwise approved in writing by the Environment Protection Authority, shall not permit:
 - a) the escape of landfill gas or leachate from the depot.
 - b) the escape of dust or mud from the depot.
 - c) the escape of odours from the depot.
 - d) vermin to congregate or breed at the depot.
 - e) discharge of liquids, including contaminated surface water, from the depot not conforming to quality parameters approved by the Environment Protection Authority.

ENVIRONMENT PROTECTION AUTHORITY
South Australia

EPA Licence No. : 000765
Licence Co-ordinator : Dean Macmullen
Telephone : 8204 2035
Page : 3

Conditions: (cont.)

- f) the lighting of fires and/or the escape of fire from the depot.

4.3 The Licensee shall:

- a) take all reasonable and immediate steps to extinguish any unauthorised fire at the depot.

4.4 The Licensee shall:

- a) identify any potential hazard to the health and safety of persons entering the waste depot (eg deep ponds, steep slopes, unstable soil conditions) and fence, mark, or otherwise define these hazards within the depot and maintain adequate boundary fencing and gates to prevent access to the depot by unauthorised persons.
- b) carry out all depot operations, and maintain the land within the depot so as to avoid compromising the stability of land, buildings and structures in or adjacent to the depot.

Approval of Certain Works

5.1 Subject to obtaining any necessary approval during the term of this licence the Licensee shall not carry out works for the construction or alteration of a building or structure or the installation or alteration of plant or equipment for use for an activity the subject of this authorisation, where such works or alterations are likely to result in:

- a) an alteration of the process by which the pollution or waste arising from the activity occurs;
- or
- b) an increased level of, or change in the nature of the pollution or waste arising from the activity;
- or
- c) a relocation of the point of discharge of pollution or waste at the site the subject of this authorisation; without application for, and subsequent approval from, the Environment Protection Authority unless the works requires development authorisation under the Development Act, 1993.

5.2 Upon application to the Environment Protection Authority for the construction, installation or alteration of works the Licensee must provide details to the satisfaction of the Environment Protection Authority, to enable an appropriate assessment of the environmental impact of the proposed works to be made.

Imposition and Variation of Conditions

6.1 The Environment Protection Authority may impose or vary conditions during the term of this authorisation:

- a) where monitoring or other assessment of the activity has shown that the activity has caused or is causing (whether by itself or in combination with other activities) significantly greater harm or risk of such

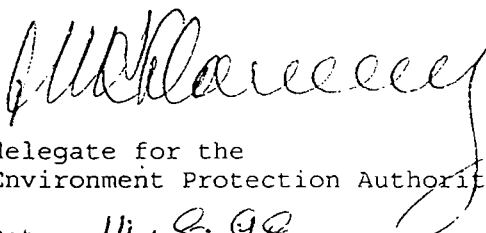
ENVIRONMENT PROTECTION AUTHORITY
South Australia

EPA Licence No. : 000765
Licence Co-ordinator : Dean Macmullen
Telephone : 8204 2035
Page : 4

Conditions: (cont.)

- harm than anticipated at the time of granting or renewal of the authorisation.
- b) which relate to provision or information relating to the holder of the authorisation; or any agent or contractor operating on behalf of the holder.
- c) which relate to provision of information relating to the activity subject to the authorisation including the levels of inputs and outputs and the amounts of pollutants or waste generated by the activity.

This license is not valid unless signed below.

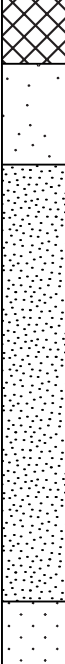

delegate for the
Environment Protection Authority
Date : 14.8.98

APPENDIX B SOIL BORE LOGS

PROJECT NUMBER OO-01
PROJECT NAME Soil Investigation
CLIENT Future Urban
ADDRESS 10-20 Halls Road, Highbury, South Australia

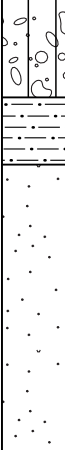
DRILLING DATE 23/10/2023
DRILLING COMPANY A&S Drilling
DRILLING METHOD Pushtube
TOTAL DEPTH 2.0 m

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		FILL: Gravelly SILT black/grey, gravels up to 10 mm in diameter, no odour or staining.		D	L		
			FILL: Calcerous CHERT, thin layer 30 - 40 cm beneath the surface, no odour or staining.		D	L		
			SAND, brown/grey becoming brown/yellow, fine grain, no odour or staining.		D	L		
			SAND, brown/yellow/red, medium to coarse grain, hard cemented, no odour or staining.		D	VD		
2			SANDSTONE, yellow, medium to coarse grain, pulverised consistency, no odour or staining.		D	VD		
2			REFUSAL at 2.0 m BGL					
2.5								
3								
3.5								
4								


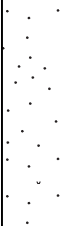
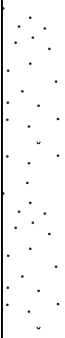
PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 2.1 m
---	--

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		Sandy SILT, brown, fine to medium grain sand, some gravels up to 40 mm in diameter, no odour or staining.		D	L		
			Sandy LOAM, dark brown, fine grain sand, trace roots, some charcoal clumps up to 40 mm in diameter, no odour or staining.		D	L		
			SAND, light yellow, fine to medium grain, trace roots, no odour or staining.		D	L		
			SAND, orange, medium to coarse grain, no odour or staining.		D	VD		
1								
1.5			SAND, orange, coarse grain, no odour or staining.		D	D		
2								
2.5			REFUSAL at 2.1 m BGL					
3								
3.5								
4								


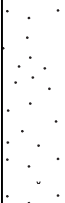
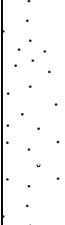

PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 2.3 m
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LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		Gravelly SAND, brown/grey, medium to coarse grain, gravells up to 20 mm in diameter, trace roots, slight organic/hydrocarbon odour, no staining.	23-3_0-0.1	D	L		
				23-3_0.4-0.5				
				SAND, light yellow, fine to medium grain, trace quartz up to 15 mm in diameter, no odour or staining.	23-3_0.6-0.7	D		
1			SAND, yellow/red, fine to medium grain, cemented, no odour or staining.		D	VD		
1.5			SAND, red/orange, medium to coarse grain, cemented, no odour or staining.		D	D		
2								
2.5			EOH at 2.3 m BGL					
3								
3.5								
4								

PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 2.4 m
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LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		Gravelly Silty SAND, brown/grey, medium grain, gravells up to 10 mm in diameter, trace roots, no odour or staining.		D	L		
1			SAND, red/grey, medium to coarse grain, trace rocks up to 50 mm in diameter, no odour or staining.		D	L		
1.5			SAND, red/grey, medium to coarse grain, cemented, some gravells up to 30 mm in diameter, no odour or staining.		D	VD		
2			SAND, red/grey, medium to coarse grain, trace roots, no odour or staining.		D	D		
2.5			EOH at 2.4 m BGL					
3								
3.5								
4								

PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 2.5 m
---	--

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		FILL: SAND, dark grey, fine to medium grain, trace bricks and roots, some gravels up to 20 mm in diameter, no odour or staining.		D	D		
1			SAND, light grey, fine to medium grain, trace cobbles up to 20 mm in diameter, no odour or staining.		D	L		
1.5			SAND, red/grey, medium grain, trace quartz up to 15 mm in diameter, no odour or staining.		D	D		
2								
2.5			EOH at 2.5 m BGL					
3								
3.5								
4								

PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube & Auger TOTAL DEPTH 4.5 m
---	--

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT	[Cross-hatch pattern]	FILL: SAND, grey/brown, medium to coarse grain, trace wood and plastic, no odour or staining.	23-6_0-0.1	D	D		
				23-6_0.5-0.6				
1			FILL: SAND, grey/brown, fine to medium grain, trace plastic, no odour or staining.	23-6_0.8-0.9	D	L		
1.5			FILL: SAND, brown/yellow, fine to medium grain, trace plastic, metal, hessian and roots, some gravels up to 50 mm in diameter with depth, no odour or staining.	23-6_1.4-1.8	D	L		
2				23-6_1.9-2.1 DUPA				
2.5								
3								
3.5	AUGER							
4		[Diagonal lines pattern]	Sandy CLAY, moderate plasticity, brown/orange, medium grain sand, no odour or staining.	23-6_2.9-4.1	D	F		
4.5			EOH at 4.5 m BGL					







PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 3.0 m
---	--

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
		[Cross-hatch pattern]	FILL: Gravelly SAND, brown, fine to medium grain, gravels up to 10 mm in diameter, no odour or staining.		D	L		
0.5		[Dotted pattern]	SAND, brown, fine grain, no odour or staining.		D	L		
1		[Dotted pattern]	SAND, brown, medium grain, no odour or staining.		D	L		
1.5	PT	[Dotted pattern]	SAND, yellow/orange, fine grain, no odour or staining.		D	L		
2		[Dotted pattern]						
2.5		[Dotted pattern]	Slightly Clayey SAND, no plasticity, yellow/orange, fine grain, no odour or staining.		D	D/DV		
3		[Dotted pattern]						
			EOH at 3.0 m BGL					
3.5								
4								

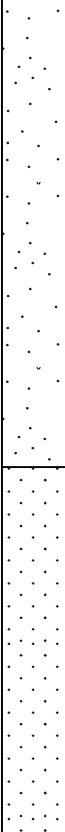
<p>PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia</p>	<p>DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 2.0 m</p>
--	---

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		FILL: SAND, grey/brown, medium grain, no odour or staining.		D	L		
			SAND, dark grey, medium grain, no odour or staining.		D	D		
			SAND, grey, medium grain, no odour or staining.		D	L		
			SAND, yellow, medium grain, no odour or staining.		D	L		
			SAND, orange/brown, cemented, no odour or staining.		D	D		
1								
1.5								
2			SANDSTONE, orange, coarse grain, no odour or staining.		D	VD		
2			EOH at 2.0 m BGL					
2.5								
3								
3.5								
4								

<p>PROJECT NUMBER OO-01</p> <p>PROJECT NAME Soil Investigation</p> <p>CLIENT Future Urban</p> <p>ADDRESS 10-20 Halls Road, Highbury, South Australia</p>	<p>DRILLING DATE 23/10/2023</p> <p>DRILLING COMPANY A&S Drilling</p> <p>DRILLING METHOD Pushtube</p> <p>TOTAL DEPTH 2.5 m</p>
--	---

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		SAND, brown/orange, medium grain, no odour or staining.		D	D		
1			SAND, brown, medium grain, no odour or staining.		D	L		
1.5			SAND, black/dark brown/orange, medium grain, no odour or staining.		D	D		
2			SAND, orange/brown, medium grain, cemented, no odour or staining.		D	D		
2.5			EOH at 2.5 m BGL					
3								
3.5								
4								

PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 2.8 m
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LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		FILL: Clayey SAND, grey, medium to coarse grain, low plasticity, trace roots, no odour or staining.		D	L		
1								
1.5			FILL: Sandy CLAY, low plasticity, brown, fine to medium grain, trace roots, no odour or staining.		D	L		
2			SAND, orange, fine to medium grain, no odour or staining.		D	F		
2.5					D	L		
3			EOH at 2.8 m BGL					
3.5								
4								





PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 1 m
---	--

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT	[Cross-hatch pattern]	FILL: Sandy GRAVEL, grey, medium to coarse grain, gravels up to 10 mm in diameter, no odour or staining.	23-11_0-0.1	D	L		
		[Cross-hatch pattern]	FILL: Gravelly SAND, red, medium to coarse grain, gravels up to 60 mm in diameter, no odour or staining.	23-11_0.2-0.3	D	L		
		[Dotted pattern]	SAND, red/orange, medium to coarse grain, trace roots, trace cobbles up to 60 mm in diameter, no odour or staining.	23-11_0.4-0.5	D	D/VD		
		[Dotted pattern]		23-11_0.7-0.8				
[Dotted pattern]	23-11_0.9-1.0							
1			EOH at 1.0 m BGL					
1.5								
2								
2.5								
3								
3.5								
4								





PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 1 m
---	--

LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		Silty SAND, brown, fine to medium grain, no odour or staining.	23-12_0-0.1	D	L		
			SAND, red/brown, medium to coarse grain, trace roots, no odour or staining.	23-12_0.2-0.3	D	L		
			SAND, brown, medium to coarse grain, no odour or staining.	23-12_0.4-0.5	D	L		
			Sandy CLAY, moderate plasticity, brown, fine to medium grain sand, no odour or staining.		D	L		
1			EOH at 1.0 m BGL					
1.5								
2								
2.5								
3								
3.5								
4								

PROJECT NUMBER OO-01 PROJECT NAME Soil Investigation CLIENT Future Urban ADDRESS 10-20 Halls Road, Highbury, South Australia	DRILLING DATE 23/10/2023 DRILLING COMPANY A&S Drilling DRILLING METHOD Pushtube TOTAL DEPTH 1 m
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LOGGED BY J Fox & K Bergin

Depth (m)	Method	Graphic Log	Material Description	Samples	Moisture	Consistency	PID	Additional Observations
0.5	PT		Gravelly SAND, grey/brown, medium to coarse grain, trace roots, gravels up to 15 mm in diameter, no odour or staining.	23-13_0-0.1 DUPB	D	L		
			SAND, brown, fine to medium grain, trace roots, some gravels up to 20 mm in diameter, no odour or staining.	23-13_0.3-0.4	D	L		
			SAND, red/orange, medium to coarse grain, no odour or staining.	23-13_0.6-0.7	D	L		
			Sandy CLAY, moderate plasticity, orange/red, fine to medium grain sand, no odour or staining.	23-13_0.8-0.9 23-13_0.9-1.0	D	VD		
1			EOH at 1.0 m BGL					
1.5								
2								
2.5								
3								
3.5								
4								

APPENDIX C LABORATORY REPORTS FOR OCTOBER 2023 SOILS

CHAIN OF CUSTODY FORM

From : Land & Water Consulting Pty Ltd
 Suite 3, 4-8 Goodwood Road, WAYVILLE, SA, 5034
 ph: (08) 8271 5255 fax: (08) 8357 1307



Sample Analysis *Quartz*

LAB Quote Number:
 LWC Project No: *00-01*
 LWC Contact Information:
 Contact Name: *James Fox*
 Project Manager: *James Fox*
 Contact Email: *laboratoryresults@lwconsulting.com.au*
 Date Samples Sent: *23-10-23*
 Phone Number: *08 8271 5255*
 COC Checked by:

<i>MB</i>	<i>TRM</i>	<i>HILA</i>	<i>TRM</i>	<i>1</i>
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Lab ID	Date	Matrix	Sample ID	No. Bottles	Tick required analytes	
<i>23-10-23</i>	<i>23-10-23</i>	<i>Soil</i>	<i>23-3 0.0-0.1</i>	<i>1</i>	<i>X</i>	<i>X</i>
			<i>" 0.4-0.5</i>	<i>1</i>	<i>X</i>	<i>X</i>
			<i>" 0.6-0.7</i>	<i>1</i>		<i>X</i>
			<i>23-6 0.2-0.1</i>	<i>1</i>		
			<i>" 0.5-0.6</i>			
			<i>" 0.8-0.9</i>			
			<i>" 1.4-1.8</i>			
			<i>" 1.9-2.1</i>			<i>X</i>
			<i>" 2.8-3.0</i>			
			<i>" 3.5-3.6</i>			
			<i>" 3.9-4.1</i>			
			<i>23-13 0.0-0.1</i>		<i>X</i>	
			<i>" 0.5-0.4</i>			
			<i>" 0.6-0.7</i>			
			<i>" 0.8-0.9</i>			
			<i>" 0.9-1.0</i>			
			<i>23-12 0.0-0.1</i>		<i>X</i>	
			<i>0.2-0.3</i>			
			<i>0.4-0.5</i>			
			<i>0.9-1.0</i>			
			<i>23-11 0.0-0.1</i>		<i>X</i>	
			<i>0.2-0.3</i>			
			<i>0.4-0.5</i>			
			<i>0.7-0.8</i>			
			<i>0.9-1.0</i>			
			<i>DUP A</i>			
			<i>DUP B</i>		<i>X</i>	<i>X</i>
			<i>TBI</i>			
TOTAL						

#1037544
[Signature]
24/10/23

ADDITIONAL COMMENTS:

Received by
Paternal
23/10 1:45 PM
16.9°C
-0.3°C
16.6°C on IR

Eurofins Environment Testing Australia Pty Ltd

ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road Dandenong South VIC 3175 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	19/8 Lewalan Street Grovedale VIC 3216 Tel: +61 3 8564 5000 NATA# 1261 Site# 25403	179 Magowar Road Girraween NSW 2145 Tel: +61 2 9900 8400 NATA# 1261 Site# 18217	Unit 1,2 Dacre Street Mitchell ACT 2911 Tel: +61 2 6113 8091 NATA# 1261 Site# 25466	1/21 Smallwood Place Murarrie QLD 4172 Tel: +61 7 3902 4600 NATA# 1261 Site# 20794	1/2 Frost Drive Mayfield West NSW 2304 Tel: +61 2 4968 8448 NATA# 1261 Site# 25079 & 25289

Eurofins ARL Pty Ltd

ABN: 91 05 0159 898

Perth
46-48 Banksia Road Welshpool WA 6106 Tel: +61 8 6253 4444 NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

Auckland	Christchurch	Tauranga
35 O'Rorke Road Penrose, Auckland 1061 Tel: +64 9 526 4551 IANZ# 1327	43 Detroit Drive Rolleston, Christchurch 7675 Tel: +64 3 343 5201 IANZ# 1290	1277 Cameron Road, Gate Pa, Tauranga 3112 Tel: +64 9 525 0568 IANZ# 1402

Sample Receipt Advice

Company name:	LWC Management Pty Ltd
Contact name:	James Fox
Project name:	Not provided
Project ID:	OO-01
Turnaround time:	5 Day
Date/Time received	Oct 23, 2023 1:45 PM
Eurofins reference	1037549

Sample Information

- ✓ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ✗ All samples have been received as described on the above COC.
- ✓ COC has been completed correctly.
- ✓ Attempt to chill was evident.
- ✓ Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- ✓ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ✓ Appropriate sample containers have been used.
- ✓ Sample containers for volatile analysis received with zero headspace.
- ✗ Split sample sent to requested external lab.
- ✗ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Notes

SAMPLE 23-6_3.5-3.6 AND DUP A WERE NOT RECEIVED. SAMPLE 23-6_1.9-2.1 RECEIVED WITH 2 JARS

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Amy Meunier on phone : or by email: AmyMeunier@eurofins.com

Results will be delivered electronically via email to James Fox - jfox@lwconsulting.com.au.



Melbourne
6 Monterey Road
Dandenong South
VIC 3175
Tel: +61 3 8564 5000
NATA# 1261
Site# 1254

Geelong
19/8 Lewalan Street
Grovedale
VIC 3216
Tel: +61 3 8564 5000
NATA# 1261
Site# 25403

Sydney
179 Magowar Road
Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261
Site# 18217

Canberra
Unit 1,2 Dacre Street
Mitchell
ACT 2911
Tel: +61 2 6113 8091
NATA# 1261
Site# 25466

Brisbane
1/21 Smallwood Place
Murarrie
QLD 4172
Tel: +61 7 3902 4600
NATA# 1261
Site# 20794

Newcastle
1/2 Frost Drive
Mayfield West NSW 2304
Tel: +61 2 4968 8448
NATA# 1261
Site# 25079 & 25289

Perth
46-48 Banksia Road
Welshpool
WA 6106
Tel: +61 8 6253 4444
NATA# 2377
Site# 2370

Auckland
35 O'Rorke Road
Penrose,
Auckland 1061
Tel: +64 9 526 4551
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: +64 3 343 5201
IANZ# 1290

Tauranga
1277 Cameron Road,
Gate Pa,
Tauranga 3112
Tel: +64 9 525 0568
IANZ# 1402

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Company Name: LWC Management Pty Ltd
Address: Suite 3/ 4-8 Goodwood Road
Wayville
SA 5034

Order No.:
Report #: 1037549
Phone: 08 8271 5255
Fax:

Received: Oct 23, 2023 1:45 PM
Due: Oct 30, 2023
Priority: 5 Day
Contact Name: James Fox

Project Name:
Project ID: OO-01

Eurofins Analytical Services Manager : Amy Meunier

Sample Detail						HOLD	Metals M8	Moisture Set	NEPM Screen Table 1(A) HLL's for Soil Contaminants - Basic Suite - Excluding	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
External Laboratory										
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID					
1	23-3_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054538		X	X		X
2	23-3_0.4-0.5	Oct 23, 2023		Soil	M23-Oc0054539		X	X		X
3	23-3_0.6-0.7	Oct 23, 2023		Soil	M23-Oc0054540			X		X
4	23-6_1.9-2.1	Oct 23, 2023		Soil	M23-Oc0054541			X	X	
5	23-13_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054542		X	X		
6	23-12_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054543		X	X		
7	23-11_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054544		X	X		
8	DUP B	Oct 23, 2023		Soil	M23-Oc0054545		X	X		
9	23-6_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054546	X				
10	23-6_0.5-0.6	Oct 23, 2023		Soil	M23-Oc0054547	X				
11	23-6_0.8-0.9	Oct 23, 2023		Soil	M23-Oc0054548	X				
12	23-6_1.4-1.8	Oct 23, 2023		Soil	M23-Oc0054549	X				
13	23-6_2.8-3.0	Oct 23, 2023		Soil	M23-Oc0054550	X				



web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Melbourne 6 Monterey Road Dandenong South VIC 3175 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	Geelong 19/8 Lewalan Street Grovedale VIC 3216 Tel: +61 3 8564 5000 NATA# 1261 Site# 25403	Sydney 179 Magowar Road Girraween NSW 2145 Tel: +61 2 9900 8400 NATA# 1261 Site# 18217	Canberra Unit 1,2 Dacre Street Mitchell ACT 2911 Tel: +61 2 6113 8091 NATA# 1261 Site# 25466	Brisbane 1/21 Smallwood Place Murarrie QLD 4172 Tel: +61 7 3902 4600 NATA# 1261 Site# 20794	Newcastle 1/2 Frost Drive Mayfield West NSW 2304 Tel: +61 2 4968 8448 NATA# 1261 Site# 25079 & 25289
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Perth 46-48 Banksia Road Welshpool WA 6106 Tel: +61 8 6253 4444 NATA# 2377 Site# 2370
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Auckland 35 O'Rorke Road Penrose, Auckland 1061 Tel: +64 9 526 4551 IANZ# 1327	Christchurch 43 Detroit Drive Rolleston, Christchurch 7675 Tel: +64 3 343 5201 IANZ# 1290	Tauranga 1277 Cameron Road, Gate Pa, Tauranga 3112 Tel: +64 9 525 0568 IANZ# 1402
--	---	---

Company Name:	LWC Management Pty Ltd	Order No.:		Received:	Oct 23, 2023 1:45 PM
Address:	Suite 3/ 4-8 Goodwood Road Wayville SA 5034	Report #:	1037549	Due:	Oct 30, 2023
		Phone:	08 8271 5255	Priority:	5 Day
		Fax:		Contact Name:	James Fox
Project Name:					
Project ID:	OO-01				

Eurofins Analytical Services Manager : Amy Meunier

Sample Detail						HOLD	Metals M8	Moisture Set	NEPM Screen Table 1(A) HLL's for Soil Contaminants - Basic Suite - Excluding	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
14	23-6_3.9-4.1	Oct 23, 2023		Soil	M23-Oc0054551	X				
15	23-13_0.3-0.4	Oct 23, 2023		Soil	M23-Oc0054552	X				
16	23-13_0.6-0.7	Oct 23, 2023		Soil	M23-Oc0054553	X				
17	23-13_0.8-0.9	Oct 23, 2023		Soil	M23-Oc0054554	X				
18	23-13_0.9-1.0	Oct 23, 2023		Soil	M23-Oc0054555	X				
19	23-12_0.2-0.3	Oct 23, 2023		Soil	M23-Oc0054556	X				
20	23-12_0.4-0.5	Oct 23, 2023		Soil	M23-Oc0054557	X				
21	23-12_0.9-1.0	Oct 23, 2023		Soil	M23-Oc0054558	X				
22	23-11_0.2-0.3	Oct 23, 2023		Soil	M23-Oc0054559	X				
23	23-11_0.4-0.5	Oct 23, 2023		Soil	M23-Oc0054560	X				
24	23-11_0.7-0.8	Oct 23, 2023		Soil	M23-Oc0054561	X				
25	23-11_0.9-1.0	Oct 23, 2023		Soil	M23-Oc0054562	X				
26	TB1	Oct 23, 2023		Water	M23-Oc0054563	X				
Test Counts						18	6	8	1	3

LWC Management Pty Ltd
 Suite 3/ 4-8 Goodwood Road
 Wayville
 SA 5034



NATA Accredited
 Accreditation Number 1261
 Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
 NATA is a signatory to the ILAC Mutual Recognition
 Arrangement for the mutual recognition of the
 equivalence of testing, medical testing, calibration,
 inspection, proficiency testing scheme providers and
 reference materials producers reports and certificates.

Attention: **James Fox**

Report **1037549-S**

Project name

Project ID **OO-01**

Received Date **Oct 23, 2023**

Client Sample ID			23-3_0.0-0.1	23-3_0.4-0.5	23-3_0.6-0.7	23-6_1.9-2.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M23- Oc0054538	M23- Oc0054539	M23- Oc0054540	M23- Oc0054541
Date Sampled			Oct 23, 2023	Oct 23, 2023	Oct 23, 2023	Oct 23, 2023
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1) ^{N04}	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2) ^{N01}	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene ^{N02}	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Heavy Metals						
Arsenic	2	mg/kg	3.5	4.1	-	4.7
Beryllium	2	mg/kg	-	-	-	< 2
Boron	10	mg/kg	-	-	-	< 10
Cadmium	0.4	mg/kg	< 0.4	< 0.4	-	< 0.4
Chromium	5	mg/kg	17	10	-	15
Cobalt	5	mg/kg	-	-	-	< 5
Copper	5	mg/kg	9.5	6.3	-	8.4
Lead	5	mg/kg	11	12	-	14
Manganese	5	mg/kg	-	-	-	58
Mercury	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Nickel	5	mg/kg	7.8	< 5	-	< 5
Selenium	2	mg/kg	-	-	-	< 2
Zinc	5	mg/kg	26	16	-	37
Sample Properties						
% Moisture	1	%	3.0	4.5	2.0	5.3

Client Sample ID			23-3_0.0-0.1	23-3_0.4-0.5	23-3_0.6-0.7	23-6_1.9-2.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M23- Oc0054538	M23- Oc0054539	M23- Oc0054540	M23- Oc0054541
Date Sampled			Oct 23, 2023	Oct 23, 2023	Oct 23, 2023	Oct 23, 2023
Test/Reference	LOR	Unit				
BTEX						
Benzene	0.1	mg/kg	-	-	-	< 0.1
Toluene	0.1	mg/kg	-	-	-	< 0.1
Ethylbenzene	0.1	mg/kg	-	-	-	< 0.1
m&p-Xylenes	0.2	mg/kg	-	-	-	< 0.2
o-Xylene	0.1	mg/kg	-	-	-	< 0.1
Xylenes - Total*	0.3	mg/kg	-	-	-	< 0.3
4-Bromofluorobenzene (surr.)	1	%	-	-	-	69
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	-	-	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	-	-	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	-	-	1.2
Acenaphthene	0.5	mg/kg	-	-	-	< 0.5
Acenaphthylene	0.5	mg/kg	-	-	-	< 0.5
Anthracene	0.5	mg/kg	-	-	-	< 0.5
Benz(a)anthracene	0.5	mg/kg	-	-	-	< 0.5
Benzo(a)pyrene	0.5	mg/kg	-	-	-	< 0.5
Benzo(b&j)fluoranthene ^{N07}	0.5	mg/kg	-	-	-	< 0.5
Benzo(g,h,i)perylene	0.5	mg/kg	-	-	-	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	-	-	-	< 0.5
Chrysene	0.5	mg/kg	-	-	-	< 0.5
Dibenz(a,h)anthracene	0.5	mg/kg	-	-	-	< 0.5
Fluoranthene	0.5	mg/kg	-	-	-	< 0.5
Fluorene	0.5	mg/kg	-	-	-	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	-	-	< 0.5
Naphthalene	0.5	mg/kg	-	-	-	< 0.5
Phenanthrene	0.5	mg/kg	-	-	-	< 0.5
Pyrene	0.5	mg/kg	-	-	-	< 0.5
Total PAH*	0.5	mg/kg	-	-	-	< 0.5
2-Fluorobiphenyl (surr.)	1	%	-	-	-	50
p-Terphenyl-d14 (surr.)	1	%	-	-	-	53
Organochlorine Pesticides						
Bifenthrin	0.05	mg/kg	-	-	-	< 0.05
Organophosphorus Pesticides						
Chlorpyrifos	0.2	mg/kg	-	-	-	< 0.2
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1221	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1232	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1242	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1248	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1254	0.1	mg/kg	-	-	-	< 0.1
Aroclor-1260	0.1	mg/kg	-	-	-	< 0.1
Total PCB*	0.1	mg/kg	-	-	-	< 0.1
Dibutylchloroendate (surr.)	1	%	-	-	-	66
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	54
Triazines						
Atrazine	0.2	mg/kg	-	-	-	< 0.2

Client Sample ID			23-3_0.0-0.1	23-3_0.4-0.5	23-3_0.6-0.7	23-6_1.9-2.1
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M23- Oc0054538	M23- Oc0054539	M23- Oc0054540	M23- Oc0054541
Date Sampled			Oct 23, 2023	Oct 23, 2023	Oct 23, 2023	Oct 23, 2023
Test/Reference	LOR	Unit				
NEPM 2013 Acid Herbicides						
Picloram	0.5	mg/kg	-	-	-	< 0.5
2,4-D	0.5	mg/kg	-	-	-	< 0.5
2,4,5-T	0.5	mg/kg	-	-	-	< 0.5
MCPA	0.5	mg/kg	-	-	-	< 0.5
MCPB	0.5	mg/kg	-	-	-	< 0.5
Mecoprop	0.5	mg/kg	-	-	-	< 0.5
Warfarin (surr.)	1	%	-	-	-	56
NEPM 2013 Organochlorine Pesticides						
Endosulfan sulphate	0.05	mg/kg	-	-	-	< 0.05
Mirex	0.05	mg/kg	-	-	-	< 0.05
4,4'-DDD	0.05	mg/kg	-	-	-	< 0.05
4,4'-DDE	0.05	mg/kg	-	-	-	< 0.05
4,4'-DDT	0.05	mg/kg	-	-	-	< 0.05
Aldrin	0.05	mg/kg	-	-	-	< 0.05
Chlordanes - Total	0.1	mg/kg	-	-	-	< 0.1
Dieldrin	0.05	mg/kg	-	-	-	< 0.05
Endosulfan I	0.05	mg/kg	-	-	-	< 0.05
Endosulfan II	0.05	mg/kg	-	-	-	< 0.05
Endrin	0.05	mg/kg	-	-	-	< 0.05
Heptachlor	0.05	mg/kg	-	-	-	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	-	-	< 0.05
Methoxychlor	0.05	mg/kg	-	-	-	< 0.05
Toxaphene	0.5	mg/kg	-	-	-	< 0.5
Dibutylchloroendate (surr.)	1	%	-	-	-	66
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	54
Aldrin and Dieldrin (Total)*	0.05	mg/kg	-	-	-	< 0.05
DDT + DDE + DDD (Total)*	0.05	mg/kg	-	-	-	< 0.05
NEPM 2013 Phenols						
2-Methylphenol (o-Cresol)	0.2	mg/kg	-	-	-	< 0.2
3&4-Methylphenol (m&p-Cresol)	0.4	mg/kg	-	-	-	< 0.4
Pentachlorophenol	1	mg/kg	-	-	-	< 1
Phenol	0.5	mg/kg	-	-	-	< 0.5
Phenol-d6 (surr.)	1	%	-	-	-	72
Other Parameters						
Chromium (hexavalent)	1	mg/kg	-	-	-	< 1
Cyanide (free)	5	mg/kg	-	-	-	< 5

Client Sample ID			23-13_0.0-0.1	23-12_0.0-0.1	23-11_0.0-0.1	DUP B
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			M23- Oc0054542	M23- Oc0054543	M23- Oc0054544	M23- Oc0054545
Date Sampled			Oct 23, 2023	Oct 23, 2023	Oct 23, 2023	Oct 23, 2023
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	6.7	5.2	15	5.3
Cadmium	0.4	mg/kg	0.8	0.5	< 0.4	0.4
Chromium	5	mg/kg	12	9.8	18	12
Copper	5	mg/kg	20	15	140	16
Lead	5	mg/kg	81	55	48	48
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	5.8	6.0	5.2	< 5
Zinc	5	mg/kg	53	66	140	48
Sample Properties						
% Moisture	1	%	2.9	3.4	12	2.2

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Melbourne	Oct 25, 2023	14 Days
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Melbourne	Oct 25, 2023	14 Days
Total Recoverable Hydrocarbons - 2013 NEPM Fractions - Method: LTM-ORG-2010 TRH C6-C40	Melbourne	Oct 25, 2023	14 Days
Metals M8 - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Melbourne	Oct 26, 2023	28 Days
NEPM Screen Table 1(A) HIL's for Soil Contaminants - Basic Suite - Excluding Methyl Mercury/PBDE			
NEPM 2013 Metals : Metals M12 - Method: LTM-MET-3030 by ICP-OES (hydride ICP-OES for Mercury)	Melbourne	Oct 25, 2023	28 Days
Heavy Metals - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS	Melbourne	Oct 25, 2023	28 Days
BTEX - Method: LTM-ORG-2010 BTEX and Volatile TRH	Melbourne	Oct 25, 2023	14 Days
Polycyclic Aromatic Hydrocarbons - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Melbourne	Oct 25, 2023	14 Days
Organochlorine Pesticides - Method: LTM-ORG-2220 OCP & PCB in Soil and Water (USEPA 8270)	Melbourne	Oct 25, 2023	14 Days
Organophosphorus Pesticides - Method: LTM-ORG-2200 Organophosphorus Pesticides by GC-MS (USEPA 8270)	Melbourne	Oct 25, 2023	14 Days
Polychlorinated Biphenyls - Method: LTM-ORG-2220 OCP & PCB in Soil and Water (USEPA 8082)	Melbourne	Oct 25, 2023	28 Days
Triazines - Method: LTM-ORG-2210 Triazine Herbicides in Soil and Water by GC-MS/MS	Melbourne	Oct 25, 2023	14 Days
NEPM 2013 Acid Herbicides - Method: MGT 530	Melbourne	Oct 25, 2023	14 Days
NEPM 2013 Organochlorine Pesticides - Method: USEPA 8081 Organochlorine Pesticides	Melbourne	Oct 25, 2023	14 Days
NEPM 2013 Phenols - Method: LTM-ORG-2130 PAH and Phenols in Soil and Water	Melbourne	Oct 25, 2023	14 Days
Chromium (hexavalent) - Method: LTM-INO-4100 Hexavalent Chromium by Spectrometric detection	Melbourne	Oct 25, 2023	28 Days
Cyanide (free) - Method: LTM-INO-4020 Total Free WAD Cyanide by CFA	Melbourne	Oct 25, 2023	14 Days
% Moisture - Method: LTM-GEN-7080 Moisture	Melbourne	Oct 24, 2023	14 Days

Melbourne 6 Monterey Road Dandenong South VIC 3175 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	Geelong 19/8 Lewalan Street Grovedale VIC 3216 Tel: +61 3 8564 5000 NATA# 1261 Site# 25403	Sydney 179 Magowar Road Girraween NSW 2145 Tel: +61 2 9900 8400 NATA# 1261 Site# 18217	Canberra Unit 1,2 Dacre Street Mitchell ACT 2911 Tel: +61 2 6113 8091 NATA# 1261 Site# 25466	Brisbane 1/21 Smallwood Place Murarrie QLD 4172 Tel: +61 7 3902 4600 NATA# 1261 Site# 20794	Newcastle 1/2 Frost Drive Mayfield West NSW 2304 Tel: +61 2 4968 8448 NATA# 1261 Site# 25079 & 25289
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Perth 46-48 Banksia Road Welshpool WA 6106 Tel: +61 8 6253 4444 NATA# 2377 Site# 2370
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Company Name: LWC Management Pty Ltd	Order No.:	Received: Oct 23, 2023 1:45 PM
Address: Suite 3/ 4-8 Goodwood Road Wayville SA 5034	Report #: 1037549	Due: Oct 30, 2023
	Phone: 08 8271 5255	Priority: 5 Day
	Fax:	Contact Name: James Fox
Project Name:		
Project ID: OO-01		

Eurofins Analytical Services Manager : Amy Meunier

Sample Detail						HOLD	Metals M8	Moisture Set	NEPM Screen Table 1(A) HLL's for Soil Contaminants - Basic Suite - Excluding	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
External Laboratory										
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID					
1	23-3_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054538		X	X		X
2	23-3_0.4-0.5	Oct 23, 2023		Soil	M23-Oc0054539		X	X		X
3	23-3_0.6-0.7	Oct 23, 2023		Soil	M23-Oc0054540			X		X
4	23-6_1.9-2.1	Oct 23, 2023		Soil	M23-Oc0054541			X	X	
5	23-13_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054542		X	X		
6	23-12_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054543		X	X		
7	23-11_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054544		X	X		
8	DUP B	Oct 23, 2023		Soil	M23-Oc0054545		X	X		
9	23-6_0.0-0.1	Oct 23, 2023		Soil	M23-Oc0054546	X				
10	23-6_0.5-0.6	Oct 23, 2023		Soil	M23-Oc0054547	X				
11	23-6_0.8-0.9	Oct 23, 2023		Soil	M23-Oc0054548	X				
12	23-6_1.4-1.8	Oct 23, 2023		Soil	M23-Oc0054549	X				
13	23-6_2.8-3.0	Oct 23, 2023		Soil	M23-Oc0054550	X				

Melbourne 6 Monterey Road Dandenong South VIC 3175 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	Geelong 19/8 Lewalan Street Grovedale VIC 3216 Tel: +61 3 8564 5000 NATA# 1261 Site# 25403	Sydney 179 Magowar Road Girraween NSW 2145 Tel: +61 2 9900 8400 NATA# 1261 Site# 18217	Canberra Unit 1,2 Dacre Street Mitchell ACT 2911 Tel: +61 2 6113 8091 NATA# 1261 Site# 25466	Brisbane 1/21 Smallwood Place Murarrie QLD 4172 Tel: +61 7 3902 4600 NATA# 1261 Site# 20794	Newcastle 1/2 Frost Drive Mayfield West NSW 2304 Tel: +61 2 4968 8448 NATA# 1261 Site# 25079 & 25289
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Perth 46-48 Banksia Road Welshpool WA 6106 Tel: +61 8 6253 4444 NATA# 2377 Site# 2370
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Auckland 35 O'Rorke Road Penrose, Auckland 1061 Tel: +64 9 526 4551 IANZ# 1327	Christchurch 43 Detroit Drive Rolleston, Christchurch 7675 Tel: +64 3 343 5201 IANZ# 1290	Tauranga 1277 Cameron Road, Gate Pa, Tauranga 3112 Tel: +64 9 525 0568 IANZ# 1402
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Company Name: LWC Management Pty Ltd	Order No.:	Received: Oct 23, 2023 1:45 PM
Address: Suite 3/ 4-8 Goodwood Road Wayville SA 5034	Report #: 1037549	Due: Oct 30, 2023
	Phone: 08 8271 5255	Priority: 5 Day
	Fax:	Contact Name: James Fox
Project Name:		
Project ID: OO-01		

Eurofins Analytical Services Manager : Amy Meunier

Sample Detail						HOLD	Metals M8	Moisture Set	NEPM Screen Table 1(A) HLL's for Soil Contaminants - Basic Suite - Excluding	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X
14	23-6_3.9-4.1	Oct 23, 2023		Soil	M23-Oc0054551	X				
15	23-13_0.3-0.4	Oct 23, 2023		Soil	M23-Oc0054552	X				
16	23-13_0.6-0.7	Oct 23, 2023		Soil	M23-Oc0054553	X				
17	23-13_0.8-0.9	Oct 23, 2023		Soil	M23-Oc0054554	X				
18	23-13_0.9-1.0	Oct 23, 2023		Soil	M23-Oc0054555	X				
19	23-12_0.2-0.3	Oct 23, 2023		Soil	M23-Oc0054556	X				
20	23-12_0.4-0.5	Oct 23, 2023		Soil	M23-Oc0054557	X				
21	23-12_0.9-1.0	Oct 23, 2023		Soil	M23-Oc0054558	X				
22	23-11_0.2-0.3	Oct 23, 2023		Soil	M23-Oc0054559	X				
23	23-11_0.4-0.5	Oct 23, 2023		Soil	M23-Oc0054560	X				
24	23-11_0.7-0.8	Oct 23, 2023		Soil	M23-Oc0054561	X				
25	23-11_0.9-1.0	Oct 23, 2023		Soil	M23-Oc0054562	X				
26	TB1	Oct 23, 2023		Water	M23-Oc0054563	X				
Test Counts						18	6	8	1	3

Internal Quality Control Review and Glossary
General

- Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follow guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013. They are included in this QC report where applicable. Additional QC data may be available on request.
- All soil/sediment/solid results are reported on a dry weight basis unless otherwise stated.
- All biota/food results are reported on a wet weight basis on the edible portion unless otherwise stated.
- For CEC results where the sample's origin is unknown or environmentally contaminated, the results should be used advisedly.
- Actual LORs are matrix dependent. Quoted LORs may be raised where sample extracts are diluted due to interferences.
- Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
- SVOC analysis on waters is performed on homogenised, unfiltered samples unless noted otherwise.
- Samples were analysed on an 'as received' basis.
- Information identified in this report with blue colour indicates data provided by customers that may have an impact on the results.
- This report replaces any interim results previously issued.

Holding Times

Please refer to the 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours before sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and despite any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling; therefore, compliance with these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether, the holding time is 7 days; however, for all other VOCs, such as BTEX or C6-10 TRH, the holding time is 14 days.

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

µg/L: micrograms per litre

ppm: parts per million

ppb: parts per billion

%: Percentage

org/100 mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100 mL: Most Probable Number of organisms per 100 millilitres

CFU: Colony forming unit

Terms

APHA	American Public Health Association
CEC	Cation Exchange Capacity
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where moisture has been determined on a solid sample, the result is expressed on a dry weight basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples, these are performed on laboratory-certified clean sands and in the case of water samples, these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC represents the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (<i>bis</i> -tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment; however free tributyltin was measured, and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPa, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site-specific Sampling Analysis and Quality Plan (SAQP) have been implemented.

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30%; however the following acceptance guidelines are equally

applicable: Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range, not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%

PFAS field samples that contain surrogate recoveries above the QC limit designated in QSM 5.4, where no positive PFAS results have been reported, have been reviewed, and no data was affected.

QC Data General Comments

- Where a result is reported as less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown are not data from your samples.
- pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
- Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery, the term "INT" appears against that analyte.
- For Matrix Spikes and LCS results, a dash "-" in the report means that the specific analyte was not added to the QC sample.
- Duplicate RPDs are calculated from raw analytical data; thus, it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Beryllium	mg/kg	< 2			2	Pass	
Boron	mg/kg	< 10			10	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Cobalt	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	
Manganese	mg/kg	< 5			5	Pass	
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Selenium	mg/kg	< 2			2	Pass	
Zinc	mg/kg	< 5			5	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total*	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g,h,i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a,h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Organochlorine Pesticides							
Bifenthrin	mg/kg	< 0.05			0.05	Pass	
Method Blank							
Organophosphorus Pesticides							
Chlorpyrifos	mg/kg	< 0.2			0.2	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.1			0.1	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.1			0.1	Pass	
Aroclor-1242	mg/kg	< 0.1			0.1	Pass	
Aroclor-1248	mg/kg	< 0.1			0.1	Pass	
Aroclor-1254	mg/kg	< 0.1			0.1	Pass	
Aroclor-1260	mg/kg	< 0.1			0.1	Pass	
Total PCB*	mg/kg	< 0.1			0.1	Pass	
Method Blank							
Triazines							
Atrazine	mg/kg	< 0.2			0.2	Pass	
Method Blank							
NEPM 2013 Acid Herbicides							
Picloram	mg/kg	< 0.5			0.5	Pass	
2,4-D	mg/kg	< 0.5			0.5	Pass	
2,4,5-T	mg/kg	< 0.5			0.5	Pass	
MCPA	mg/kg	< 0.5			0.5	Pass	
MCPB	mg/kg	< 0.5			0.5	Pass	
Mecoprop	mg/kg	< 0.5			0.5	Pass	
Method Blank							
NEPM 2013 Organochlorine Pesticides							
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Mirex	mg/kg	< 0.05			0.05	Pass	
4,4'-DDD	mg/kg	< 0.05			0.05	Pass	
4,4'-DDE	mg/kg	< 0.05			0.05	Pass	
4,4'-DDT	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.05			0.05	Pass	
Toxaphene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
NEPM 2013 Phenols							
2-Methylphenol (o-Cresol)	mg/kg	< 0.2			0.2	Pass	
3&4-Methylphenol (m&p-Cresol)	mg/kg	< 0.4			0.4	Pass	
Pentachlorophenol	mg/kg	< 1			1	Pass	
Phenol	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Chromium (hexavalent)	mg/kg	< 1			1	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery							
Total Recoverable Hydrocarbons							
TRH C6-C9	%	98			70-130	Pass	
TRH C10-C14	%	90			70-130	Pass	
TRH C6-C10	%	96			70-130	Pass	
TRH >C10-C16	%	91			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	87			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	97			80-120	Pass	
Beryllium	%	100			80-120	Pass	
Boron	%	102			80-120	Pass	
Cadmium	%	94			80-120	Pass	
Chromium	%	102			80-120	Pass	
Cobalt	%	102			80-120	Pass	
Copper	%	100			80-120	Pass	
Lead	%	107			80-120	Pass	
Manganese	%	100			80-120	Pass	
Mercury	%	100			80-120	Pass	
Nickel	%	97			80-120	Pass	
Selenium	%	96			80-120	Pass	
Zinc	%	100			80-120	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	75			70-130	Pass	
Toluene	%	78			70-130	Pass	
Ethylbenzene	%	81			70-130	Pass	
m&p-Xylenes	%	81			70-130	Pass	
Xylenes - Total*	%	80			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	129			70-130	Pass	
Acenaphthylene	%	129			70-130	Pass	
Anthracene	%	78			70-130	Pass	
Benz(a)anthracene	%	93			70-130	Pass	
Benzo(a)pyrene	%	100			70-130	Pass	
Benzo(b&j)fluoranthene	%	79			70-130	Pass	
Benzo(g,h,i)perylene	%	96			70-130	Pass	
Benzo(k)fluoranthene	%	100			70-130	Pass	
Chrysene	%	104			70-130	Pass	
Dibenz(a,h)anthracene	%	98			70-130	Pass	
Fluoranthene	%	98			70-130	Pass	
Fluorene	%	101			70-130	Pass	
Indeno(1,2,3-cd)pyrene	%	78			70-130	Pass	
Naphthalene	%	103			70-130	Pass	
Phenanthrene	%	121			70-130	Pass	
Pyrene	%	126			70-130	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
Bifenthrin	%	103			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code	
Aroclor-1260	%	99			70-130	Pass		
LCS - % Recovery								
NEPM 2013 Acid Herbicides								
Picloram	%	90			70-130	Pass		
2,4-D	%	81			70-130	Pass		
2,4,5-T	%	93			70-130	Pass		
MCPA	%	86			70-130	Pass		
MCPB	%	83			70-130	Pass		
Mecoprop	%	90			70-130	Pass		
LCS - % Recovery								
NEPM 2013 Organochlorine Pesticides								
Endosulfan sulphate	%	106			70-130	Pass		
Mirex	%	97			70-130	Pass		
4,4'-DDD	%	129			70-130	Pass		
4,4'-DDE	%	93			70-130	Pass		
4,4'-DDT	%	112			70-130	Pass		
Aldrin	%	79			70-130	Pass		
Chlordanes - Total	%	86			70-130	Pass		
Dieldrin	%	109			70-130	Pass		
Endosulfan I	%	101			70-130	Pass		
Endosulfan II	%	75			70-130	Pass		
Endrin	%	111			70-130	Pass		
Heptachlor	%	102			70-130	Pass		
Hexachlorobenzene	%	80			70-130	Pass		
Methoxychlor	%	108			70-130	Pass		
LCS - % Recovery								
NEPM 2013 Phenols								
2-Methylphenol (o-Cresol)	%	100			25-140	Pass		
3&4-Methylphenol (m&p-Cresol)	%	120			25-140	Pass		
Pentachlorophenol	%	57			25-140	Pass		
Phenol	%	116			25-140	Pass		
LCS - % Recovery								
Chromium (hexavalent)	%	89			70-130	Pass		
Test	Lab Sample ID	QA Source	Units	Result 1		Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery								
Total Recoverable Hydrocarbons				Result 1				
TRH C6-C9	M23-Oc0058057	NCP	%	88		70-130	Pass	
TRH C10-C14	M23-Oc0048967	NCP	%	96		70-130	Pass	
TRH C6-C10	M23-Oc0058057	NCP	%	85		70-130	Pass	
TRH >C10-C16	M23-Oc0048967	NCP	%	97		70-130	Pass	
Spike - % Recovery								
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1				
Naphthalene	M23-Oc0058057	NCP	%	92		70-130	Pass	
Spike - % Recovery								
Heavy Metals				Result 1				
Arsenic	M23-Oc0054539	CP	%	86		75-125	Pass	
Beryllium	M23-Oc0054539	CP	%	82		75-125	Pass	
Boron	M23-Oc0054539	CP	%	86		75-125	Pass	
Cadmium	M23-Oc0054539	CP	%	88		75-125	Pass	
Chromium	M23-Oc0054539	CP	%	92		75-125	Pass	
Cobalt	M23-Oc0054539	CP	%	91		75-125	Pass	
Copper	M23-Oc0054539	CP	%	88		75-125	Pass	
Lead	M23-Oc0054539	CP	%	92		75-125	Pass	
Mercury	M23-Oc0054539	CP	%	102		75-125	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1		Acceptance Limits	Pass Limits	Qualifying Code
Nickel	M23-Oc0054539	CP	%	86		75-125	Pass	
Selenium	M23-Oc0054539	CP	%	87		75-125	Pass	
Zinc	M23-Oc0054539	CP	%	79		75-125	Pass	
Spike - % Recovery								
BTEX				Result 1				
Benzene	M23-Oc0058057	NCP	%	86		70-130	Pass	
Toluene	M23-Oc0058057	NCP	%	92		70-130	Pass	
Ethylbenzene	M23-Oc0058057	NCP	%	98		70-130	Pass	
m&p-Xylenes	M23-Oc0058057	NCP	%	71		70-130	Pass	
o-Xylene	M23-Oc0058057	NCP	%	98		70-130	Pass	
Xylenes - Total*	M23-Oc0058057	NCP	%	80		70-130	Pass	
Spike - % Recovery								
Polycyclic Aromatic Hydrocarbons				Result 1				
Acenaphthene	M23-Oc0048902	NCP	%	122		70-130	Pass	
Acenaphthylene	M23-Oc0048902	NCP	%	127		70-130	Pass	
Anthracene	M23-Oc0048902	NCP	%	84		70-130	Pass	
Benz(a)anthracene	M23-Oc0048902	NCP	%	96		70-130	Pass	
Benzo(a)pyrene	M23-Oc0048902	NCP	%	99		70-130	Pass	
Benzo(b&j)fluoranthene	M23-Oc0048902	NCP	%	85		70-130	Pass	
Benzo(g,h,i)perylene	M23-Oc0048902	NCP	%	74		70-130	Pass	
Benzo(k)fluoranthene	M23-Oc0048902	NCP	%	123		70-130	Pass	
Chrysene	M23-Oc0048902	NCP	%	117		70-130	Pass	
Dibenz(a,h)anthracene	M23-Oc0048902	NCP	%	84		70-130	Pass	
Fluoranthene	M23-Oc0048902	NCP	%	109		70-130	Pass	
Fluorene	M23-Oc0048902	NCP	%	122		70-130	Pass	
Indeno(1,2,3-cd)pyrene	M23-Oc0048902	NCP	%	116		70-130	Pass	
Naphthalene	M23-Oc0048902	NCP	%	86		70-130	Pass	
Phenanthrene	M23-Oc0048902	NCP	%	116		70-130	Pass	
Pyrene	M23-Oc0048902	NCP	%	112		70-130	Pass	
Spike - % Recovery								
Organochlorine Pesticides				Result 1				
Bifenthrin	M23-Oc0052387	NCP	%	113		70-130	Pass	
Spike - % Recovery								
Polychlorinated Biphenyls				Result 1				
Aroclor-1016	M23-Oc0037988	NCP	%	95		70-130	Pass	
Aroclor-1260	M23-Oc0037988	NCP	%	91		70-130	Pass	
Spike - % Recovery								
NEPM 2013 Acid Herbicides				Result 1				
Picloram	M23-Oc0058056	NCP	%	76		70-130	Pass	
2,4-D	M23-Oc0058056	NCP	%	70		70-130	Pass	
MCPA	M23-Oc0058056	NCP	%	74		70-130	Pass	
MCPB	M23-Oc0058056	NCP	%	71		70-130	Pass	
Spike - % Recovery								
NEPM 2013 Organochlorine Pesticides				Result 1				
Endosulfan sulphate	M23-Oc0052387	NCP	%	110		70-130	Pass	
Mirex	M23-Oc0052387	NCP	%	103		70-130	Pass	
4,4'-DDD	M23-Oc0052387	NCP	%	79		70-130	Pass	
4,4'-DDE	M23-Oc0052387	NCP	%	104		70-130	Pass	
4,4'-DDT	M23-Oc0052387	NCP	%	86		70-130	Pass	
Aldrin	M23-Oc0052387	NCP	%	109		70-130	Pass	
Chlordanes - Total	M23-Oc0052387	NCP	%	110		70-130	Pass	
Dieldrin	M23-Oc0052387	NCP	%	103		70-130	Pass	
Endosulfan I	M23-Oc0041806	NCP	%	114		70-130	Pass	
Endosulfan II	M23-Oc0052387	NCP	%	98		70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endrin	M23-Oc0052387	NCP	%	103			70-130	Pass	
Heptachlor	M23-Oc0052387	NCP	%	128			70-130	Pass	
Hexachlorobenzene	M23-Oc0052387	NCP	%	116			70-130	Pass	
Methoxychlor	M23-Oc0052387	NCP	%	79			70-130	Pass	
Spike - % Recovery									
NEPM 2013 Phenols				Result 1					
2-Methylphenol (o-Cresol)	M23-Oc0048902	NCP	%	53			30-130	Pass	
3&4-Methylphenol (m&p-Cresol)	M23-Oc0048902	NCP	%	64			30-130	Pass	
Pentachlorophenol	M23-Oc0050045	NCP	%	84			30-130	Pass	
Phenol	M23-Oc0048902	NCP	%	61			30-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	M23-Oc0054545	CP	%	100			75-125	Pass	
Beryllium	M23-Oc0054545	CP	%	95			75-125	Pass	
Boron	M23-Oc0054545	CP	%	94			75-125	Pass	
Cadmium	M23-Oc0054545	CP	%	93			75-125	Pass	
Chromium	M23-Oc0054545	CP	%	95			75-125	Pass	
Cobalt	M23-Oc0054545	CP	%	94			75-125	Pass	
Copper	M23-Oc0054545	CP	%	97			75-125	Pass	
Lead	M23-Oc0054545	CP	%	108			75-125	Pass	
Mercury	M23-Oc0054545	CP	%	96			75-125	Pass	
Nickel	M23-Oc0054545	CP	%	93			75-125	Pass	
Selenium	M23-Oc0054545	CP	%	92			75-125	Pass	
Zinc	M23-Oc0054545	CP	%	114			75-125	Pass	
Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Total Recoverable Hydrocarbons				Result 1	Result 2	RPD			
TRH C6-C9	M23-Oc0058051	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C10-C14	M23-Oc0048966	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	M23-Oc0048966	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	M23-Oc0048966	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C6-C10	M23-Oc0058051	NCP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH >C10-C16	M23-Oc0048966	NCP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	M23-Oc0048966	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	M23-Oc0048966	NCP	mg/kg	< 100	< 100	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	M23-Oc0058051	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	M23-Oc0054538	CP	mg/kg	3.5	3.2	10	30%	Pass	
Beryllium	M23-Oc0054538	CP	mg/kg	< 2	< 2	<1	30%	Pass	
Boron	M23-Oc0054538	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Cadmium	M23-Oc0054538	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M23-Oc0054538	CP	mg/kg	17	15	13	30%	Pass	
Cobalt	M23-Oc0054538	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Copper	M23-Oc0054538	CP	mg/kg	9.5	8.8	7.8	30%	Pass	
Lead	M23-Oc0054538	CP	mg/kg	11	9.1	21	30%	Pass	
Manganese	M23-Oc0054538	CP	mg/kg	120	140	14	30%	Pass	
Mercury	M23-Oc0054538	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M23-Oc0054538	CP	mg/kg	7.8	6.2	22	30%	Pass	
Selenium	M23-Oc0054538	CP	mg/kg	< 2	< 2	<1	30%	Pass	
Zinc	M23-Oc0054538	CP	mg/kg	26	31	20	30%	Pass	

Duplicate								
Heavy Metals				Result 1	Result 2	RPD		
Arsenic	M23-Oc0054539	CP	mg/kg	4.1	4.1	<1	30%	Pass
Beryllium	M23-Oc0054539	CP	mg/kg	< 2	< 2	<1	30%	Pass
Boron	M23-Oc0054539	CP	mg/kg	< 10	< 10	<1	30%	Pass
Cadmium	M23-Oc0054539	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass
Chromium	M23-Oc0054539	CP	mg/kg	10	10	1.2	30%	Pass
Cobalt	M23-Oc0054539	CP	mg/kg	< 5	< 5	<1	30%	Pass
Copper	M23-Oc0054539	CP	mg/kg	6.3	6.4	<1	30%	Pass
Lead	M23-Oc0054539	CP	mg/kg	12	12	3.2	30%	Pass
Manganese	M23-Oc0054539	CP	mg/kg	110	110	2.6	30%	Pass
Mercury	M23-Oc0054539	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Nickel	M23-Oc0054539	CP	mg/kg	< 5	< 5	<1	30%	Pass
Selenium	M23-Oc0054539	CP	mg/kg	< 2	< 2	<1	30%	Pass
Zinc	M23-Oc0054539	CP	mg/kg	16	16	<1	30%	Pass
Duplicate								
Heavy Metals				Result 1	Result 2	RPD		
Arsenic	M23-Oc0054541	CP	mg/kg	4.7	5.4	14	30%	Pass
Beryllium	M23-Oc0054541	CP	mg/kg	< 2	< 2	<1	30%	Pass
Boron	M23-Oc0054541	CP	mg/kg	< 10	< 10	<1	30%	Pass
Cadmium	M23-Oc0054541	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass
Chromium	M23-Oc0054541	CP	mg/kg	15	19	23	30%	Pass
Cobalt	M23-Oc0054541	CP	mg/kg	< 5	< 5	<1	30%	Pass
Copper	M23-Oc0054541	CP	mg/kg	8.4	10	19	30%	Pass
Lead	M23-Oc0054541	CP	mg/kg	14	17	18	30%	Pass
Manganese	M23-Oc0054541	CP	mg/kg	58	61	5.5	30%	Pass
Mercury	M23-Oc0054541	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Nickel	M23-Oc0054541	CP	mg/kg	< 5	< 5	<1	30%	Pass
Selenium	M23-Oc0054541	CP	mg/kg	< 2	< 2	<1	30%	Pass
Zinc	M23-Oc0054541	CP	mg/kg	37	46	22	30%	Pass
Duplicate								
BTEX				Result 1	Result 2	RPD		
Benzene	M23-Oc0058055	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Toluene	M23-Oc0058055	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Ethylbenzene	M23-Oc0058055	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
m&p-Xylenes	M23-Oc0058055	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass
o-Xylene	M23-Oc0058055	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Xylenes - Total*	M23-Oc0058055	NCP	mg/kg	< 0.3	< 0.3	<1	30%	Pass
Duplicate								
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD		
Acenaphthene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Acenaphthylene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Anthracene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Benz(a)anthracene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Benzo(a)pyrene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Benzo(b&j)fluoranthene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Benzo(g,h,i)perylene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Benzo(k)fluoranthene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Chrysene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Dibenz(a,h)anthracene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Fluoranthene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Fluorene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Indeno(1.2.3-cd)pyrene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Naphthalene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Phenanthrene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Pyrene	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass

Duplicate								
Organochlorine Pesticides				Result 1	Result 2	RPD		
Bifenthrin	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Duplicate								
Organophosphorus Pesticides				Result 1	Result 2	RPD		
Chlorpyrifos	M23-Oc0048300	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass
Duplicate								
Polychlorinated Biphenyls				Result 1	Result 2	RPD		
Aroclor-1016	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Aroclor-1221	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Aroclor-1232	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Aroclor-1242	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Aroclor-1248	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Aroclor-1254	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Aroclor-1260	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Total PCB*	M23-Oc0058887	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Duplicate								
Triazines				Result 1	Result 2	RPD		
Atrazine	M23-Oc0048300	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass
Duplicate								
NEPM 2013 Acid Herbicides				Result 1	Result 2	RPD		
Picloram	M23-Oc0052525	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
2,4-D	M23-Oc0052525	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
2,4,5-T	M23-Oc0052525	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
MCPA	M23-Oc0052525	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
MCPB	M23-Oc0052525	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Mecoprop	M23-Oc0052525	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Duplicate								
NEPM 2013 Organochlorine Pesticides				Result 1	Result 2	RPD		
Endosulfan sulphate	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Mirex	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
4,4'-DDD	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
4,4'-DDE	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
4,4'-DDT	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Aldrin	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Chlordanes - Total	M23-Oc0048300	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Dieldrin	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Endosulfan I	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Endosulfan II	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Endrin	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Heptachlor	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Hexachlorobenzene	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Methoxychlor	M23-Oc0048300	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass
Toxaphene	M23-Oc0058887	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Duplicate								
NEPM 2013 Phenols				Result 1	Result 2	RPD		
2-Methylphenol (o-Cresol)	M23-Oc0048300	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass
3&4-Methylphenol (m&p-Cresol)	M23-Oc0048300	NCP	mg/kg	< 0.4	< 0.4	<1	30%	Pass
Pentachlorophenol	M23-Oc0048300	NCP	mg/kg	< 1	< 1	<1	30%	Pass
Phenol	M23-Oc0048300	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass
Duplicate								
				Result 1	Result 2	RPD		
Chromium (hexavalent)	M23-Oc0052009	NCP	mg/kg	< 1	< 1	<1	30%	Pass
Duplicate								
Sample Properties				Result 1	Result 2	RPD		
% Moisture	M23-Oc0054543	CP	%	3.4	3.6	4.6	30%	Pass

Duplicate								
Heavy Metals				Result 1	Result 2	RPD		
Arsenic	M23-Oc0054544	CP	mg/kg	15	17	16	30%	Pass
Beryllium	M23-Oc0054544	CP	mg/kg	< 2	< 2	<1	30%	Pass
Boron	M23-Oc0054544	CP	mg/kg	< 10	< 10	<1	30%	Pass
Cadmium	M23-Oc0054544	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass
Chromium	M23-Oc0054544	CP	mg/kg	18	19	3.0	30%	Pass
Cobalt	M23-Oc0054544	CP	mg/kg	< 5	< 5	<1	30%	Pass
Copper	M23-Oc0054544	CP	mg/kg	140	160	11	30%	Pass
Lead	M23-Oc0054544	CP	mg/kg	48	47	2.1	30%	Pass
Manganese	M23-Oc0054544	CP	mg/kg	230	240	2.6	30%	Pass
Mercury	M23-Oc0054544	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Nickel	M23-Oc0054544	CP	mg/kg	5.2	5.6	8.3	30%	Pass
Selenium	M23-Oc0054544	CP	mg/kg	< 2	< 2	<1	30%	Pass
Zinc	M23-Oc0054544	CP	mg/kg	140	160	9.0	30%	Pass
Duplicate								
Heavy Metals				Result 1	Result 2	RPD		
Arsenic	M23-Oc0054545	CP	mg/kg	5.3	5.3	<1	30%	Pass
Beryllium	M23-Oc0054545	CP	mg/kg	< 2	< 2	<1	30%	Pass
Boron	M23-Oc0054545	CP	mg/kg	< 10	< 10	<1	30%	Pass
Cadmium	M23-Oc0054545	CP	mg/kg	0.4	0.4	3.7	30%	Pass
Chromium	M23-Oc0054545	CP	mg/kg	12	13	2.3	30%	Pass
Cobalt	M23-Oc0054545	CP	mg/kg	< 5	< 5	<1	30%	Pass
Copper	M23-Oc0054545	CP	mg/kg	16	16	<1	30%	Pass
Lead	M23-Oc0054545	CP	mg/kg	48	48	<1	30%	Pass
Manganese	M23-Oc0054545	CP	mg/kg	180	180	2.4	30%	Pass
Mercury	M23-Oc0054545	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass
Nickel	M23-Oc0054545	CP	mg/kg	< 5	< 5	<1	30%	Pass
Selenium	M23-Oc0054545	CP	mg/kg	< 2	< 2	<1	30%	Pass
Zinc	M23-Oc0054545	CP	mg/kg	48	49	1.1	30%	Pass

Comments
Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q08	The matrix spike recovery is outside of the recommended acceptance criteria. An acceptable recovery was obtained for the laboratory control sample indicating a sample matrix interference.

Authorised by:

Michael Morrison	Analytical Services Manager
Caitlin Breeze	Senior Analyst-Inorganic
Joseph Edouard	Senior Analyst-Volatile
Mary Makarios	Senior Analyst-Metal
Mary Makarios	Senior Analyst-Inorganic
Joseph Edouard	Senior Analyst-Organic
Mary Makarios	Senior Analyst-Sample Properties
Edward Lee	Senior Analyst-Organic
Harry Bacalis	Senior Analyst-Volatile
Emily Rosenberg	Senior Analyst-Metal



Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please [click here](#).

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APPENDIX D QUALITY ASSURANCE REVIEW

DATA QUALITY SUMMARY REPORT - SOILS

Project No: OO-01-03
 Site: 10 - 20 Halls Road Highbury
 Matrix: SOILS
 Primary Laboratory: Eurofins 1037549
 Secondary Laboratory: Not Applied

No. of Tests Requested/ Reported:
 Frequency of QA/QC undertaken: Min 1 in 20 samples duplicated
 Frequency of QA/QC Required: 1 in 20 samples is required to be duplicated

Data Quality Issue Assessed	Issue Reviewed	Results Acceptable	Comments
Sampling Technique	✓	Y	
Sample Holding Times	✓	Y	
Analytical Procedures	✓	Y	
Laboratory Limits of Reporting (below relevant guideline value)	✓	Y	
Field Duplicate Agreement (RPD%)	✓	Y	See Note 1
Blank Sample Analysis			
Method Blank			
Rinsate Blank	NA	-	See Note 2
Trip Blank	NA	-	See Note 3
Laboratory Duplicate Agreement (RPD%)	✓	Y	
Matrix Spikes/Matrix Spike Duplicates			
Recovery Percentages	✓	Y	
Duplicate Agreement (RPD%)	✓	Y	
Surrogate Recoveries	✓	Y	
Other Issues/Items	✓	Y	

Other Observations:

Note 1: An intra duplicate was analysed. Inter was not analysed as previous data (assessments) on this site had sufficient quality assurance ratio. Elevated RPD was evident for cadmium and lead although all results were within same order of magnitude and were well under tier 1 criteria.
 Elevated RPDs are not considered to affect the suitability of the primary for site contamination interpretation purposes as (1) generally the absolute difference between primary and duplicate samples was minor and (2) all heavy metal concentrations were reported below adopted guidelines.

Note 2: Rinsate not used as driller used plastic sleeves to avoid contamination

Note 3: Trip blanks not required as metals analysed primarily although SA EPA broad screen was adopted the volatile content was below limit of reporting - therefore no incidence of volatile cross contamination.

Note 6: The primary field team member was Mr Thomas McCarthy who has over 6 years relevant experience

Summary Comments:

Analytical data can be used as a basis of interpretation, subject to the limitations outlined above.

Recommended Corrective Action:

Non

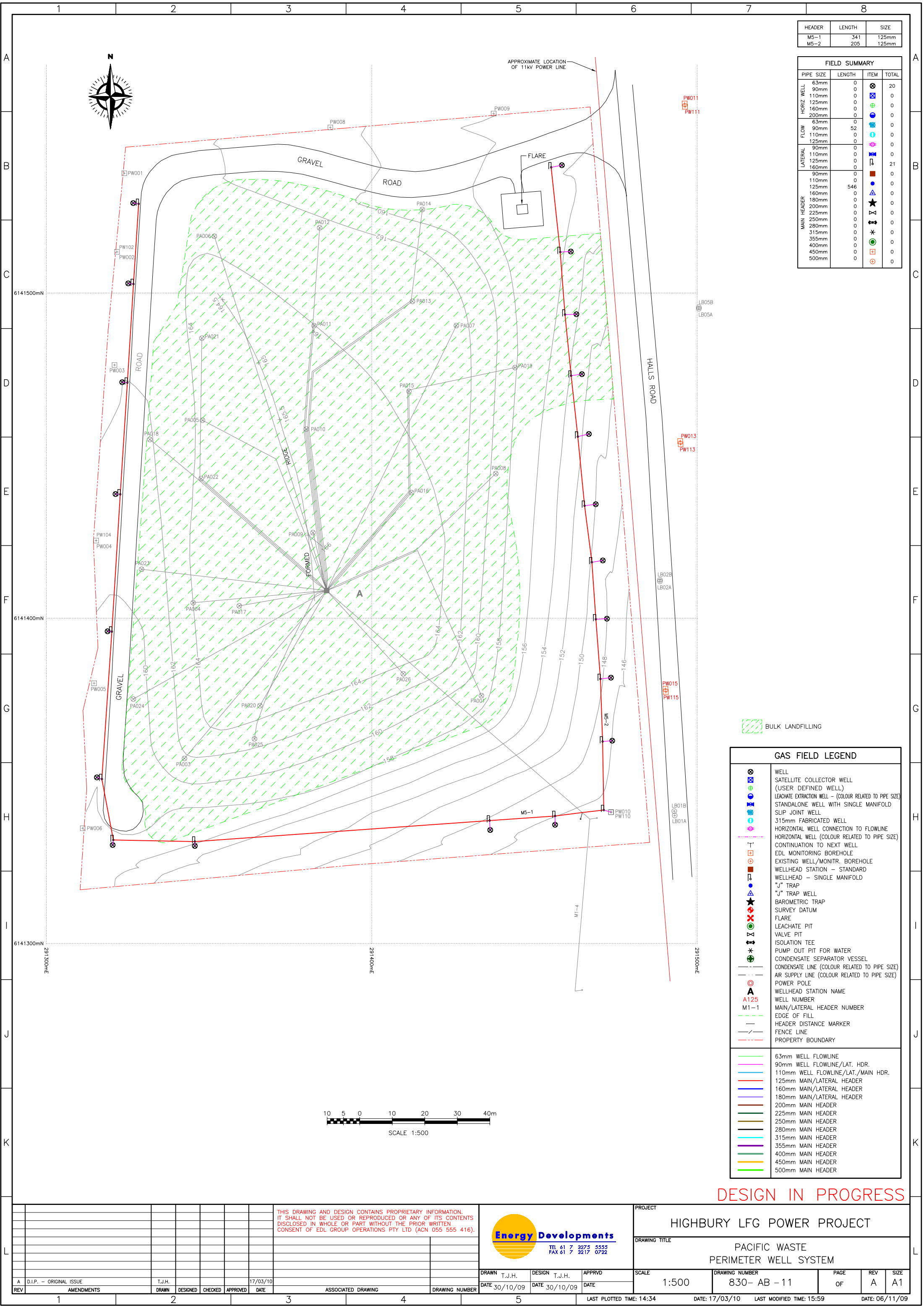
APPENDIX E VEOLIA GAS DATA MAY 2022

E-1 GAS DATA

Highbury Landfill - SUEZ Landfill Gas Monitoring Wells

Date: 24/05/2022

LOCATION ID	CH ₄ Criteria % v/v	CH ₄ % v/v	CO ₂ % v/v	O ₂ % v/v	CO ppm	H ₂ S ppm	BALANCE %	Magnehelic Kilopascals	Testo mb	REL.PRESSURE mb	DATE	Depth Class	Actual Depth (m)	Screened Interval (m)	Comment
HBYPW002	5.0	0.0	6.4	14.6	0	0	78.9	0.00	0.00	-0.13	24/05/2022	Middle	9.3	2.1 - 9.3	
HBYPW102	5.0	0.0	1.3	19.0	0	0	79.5	0.10	-1.29	-1.20	24/05/2022	Deep	29.9	11.9 - 29.9	
HBYPW009	5.0	0.0	0.1	20.1	0	0	79.7	0.00	0.00	-0.15	24/05/2022	Deep	32.5	2.0 - 32.5	
HBYPW008	5.0	0.2	2.5	17.7	0	1	79.5	0.00	0.10	-0.08	24/05/2022	Deep	31.5	3.0 - 31.5	
HBYPW101	2.5	0.0	11.9	7.8	0	0	80.3	0.00	-0.07	-0.15	24/05/2022	Shallow	3.8	1.8 - 3.8	
HBYPW001	5.0	0.0	5.4	14.7	0	0	79.5	0.00	-0.08	-0.14	24/05/2022	Middle	10.3	2.6 - 10.7	
HBYPW202	2.5	0.0	4.5	15.7	0	0	79.7	0.00	-0.11	-0.12	24/05/2022	Shallow	4.2	2.7 - 4.2	
HBYPW003	5.0	0.0	10.6	7.9	0	0	81.3	0.00	0.00	-0.09	24/05/2022	Middle	9.4	2.6 - 9.4	
HBYPW104	5.0	0.8	2.6	17.8	0	0	78.9	-0.08	-1.06	-1.22	24/05/2022	Deep	27.8	11.8 - 27.8	
HBYPW004	5.0	0.0	4.1	16.7	0	0	79.2	0.00	-0.04	-0.10	24/05/2022	Middle	9.2	2.0 - 9.2	
HBYPW204	2.5	0.0	2.0	18.3	0	0	79.6	0.00	0.00	-0.01	24/05/2022	Shallow	4.0	2.8 - 4.0	
HBYPW005	5.0	0.0	2.8	16.9	0	0	80.2	0.00	0.00	-0.20	24/05/2022	Middle	8.0	2.6 - 8.0	
HBYPW205	5.0	4.8	22.3	2.8	0	0	70.0	0.00	0.00	-0.07	24/05/2022	Shallow	2.5	1.4 - 2.5	
HBYPW206	2.5	0.4	3.9	13.7	0	0	82.0	0.00	-0.03	-0.05	24/05/2022	Shallow	3.0	1.4 - 3.0	
HBYPW106	5.0	0.0	7.5	12.4	0	0	80.0	0.00	0.04	-0.11	24/05/2022	Middle	6.5	3.5 - 6.5	
HBYPW006	5.0	0.0	0.1	20.4	0	0	79.4	0.02	-0.15	-0.15	24/05/2022	Deep	28	9.0 - 28.0	
HBYLB13A	2.5	0.0	8.6	11.5	0	0	79.8	0.00	0.00	-0.08	24/05/2022	Shallow	5.0	2.5 - 5.0	
HBYLB13B	5.0	0.0	8.3	12.4	0	0	79.2	0.00	0.00	-0.11	24/05/2022	Middle	8.5	6.0 - 8.5	
HBYLB12A	2.5	0.0	8.8	13.2	0	0	77.8	0.00	-0.10	-0.02	24/05/2022	Shallow	4.5	2.5 - 4.5	
HBYLB12B	5.0	0.0	17.8	5.2	0	0	76.9	0.00	0.16	-0.04	24/05/2022	Middle	9.5	6.5 - 9.5	
HBYPW11A	2.5	0.0	9.0	12.9	0	0	78.0	0.00	0.00	0.08	24/05/2022	Shallow	5.0	3.0 - 5.0	
HBYPW11B	5.0	0.0	13.0	8.8	0	0	78.1	0.00	0.15	-0.03	24/05/2022	Middle	9.7	8.0 - 9.7	
HBYLB02A	2.5	0.0	4.5	16.5	0	0	78.8	0.00	0.04	0.08	24/05/2022	Shallow	4.1	1.6 - 4.1	
HBYLB02B	5.0	0.0	12.1	9.9	0	0	78.0	0.00	-0.03	-0.08	24/05/2022	Middle	10.0	6.5 - 10.0	
HBYLB10A	2.5	0.0	4.5	16.5	0	0	78.9	0.00	0.08	-0.03	24/05/2022	Shallow	3.8	1.4 - 3.8	
HBYLB10B	5.0	0.0	17.0	5.0	0	0	78.0	0.00	0.02	-0.15	24/05/2022	Middle	10.0	6.5 - 10.0	
HBYLB01A	2.5	0.0	13.5	7.5	0	0	78.9	0.00	0.00	-0.11	24/05/2022	Shallow	6.0	3.5 - 6.0	
HBYLB01B	5.0	0.0	18.0	1.5	0	0	80.5	0.00	-0.40	-0.14	24/05/2022	Middle	10.0	7.5 - 10.0	



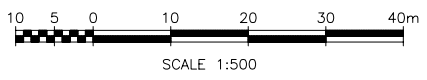
HEADER	LENGTH	SIZE
M5-1	341	125mm
M5-2	205	125mm

FIELD SUMMARY			
PIPE SIZE	LENGTH	ITEM	TOTAL
63mm	0	⊗	20
90mm	0	⊗	0
110mm	0	⊗	0
125mm	0	⊗	0
160mm	0	⊗	0
200mm	0	⊗	0
63mm	0	⊗	0
90mm	52	⊗	0
110mm	0	⊗	0
125mm	0	⊗	0
160mm	0	⊗	21
200mm	0	⊗	0
225mm	546	⊗	0
250mm	0	⊗	0
280mm	0	⊗	0
315mm	0	⊗	0
355mm	0	⊗	0
400mm	0	⊗	0
450mm	0	⊗	0
500mm	0	⊗	0

BULK LANDFILLING

GAS FIELD LEGEND	
	WELL
	SATELLITE COLLECTOR WELL (USER DEFINED WELL)
	LEACHATE EXTRACTION WELL - (COLOUR RELATED TO PIPE SIZE)
	STANDALONE WELL WITH SINGLE MANIFOLD
	SLIP JOINT WELL
	315mm FABRICATED WELL
	HORIZONTAL WELL CONNECTION TO FLOWLINE
	HORIZONTAL WELL (COLOUR RELATED TO PIPE SIZE)
	CONTINUATION TO NEXT WELL
	EDL MONITORING BOREHOLE
	EXISTING WELL/MONITR. BOREHOLE
	WELLHEAD STATION - STANDARD
	WELLHEAD - SINGLE MANIFOLD
	"J" TRAP
	"U" TRAP WELL
	BAROMETRIC TRAP
	SURVEY DATUM
	FLARE
	LEACHATE PIT
	VALVE PIT
	ISOLATION TEE
	PUMP OUT PIT FOR WATER
	CONDENSATE SEPARATOR VESSEL
	CONDENSATE LINE (COLOUR RELATED TO PIPE SIZE)
	AIR SUPPLY LINE (COLOUR RELATED TO PIPE SIZE)
	POWER POLE
	WELLHEAD STATION NAME
	WELL NUMBER
	MAIN/LATERAL HEADER NUMBER
	EDGE OF FILL
	HEADER DISTANCE MARKER
	FENCE LINE
	PROPERTY BOUNDARY

	63mm WELL FLOWLINE
	90mm WELL FLOWLINE/LAT. HDR.
	110mm WELL FLOWLINE/LAT./MAIN HDR.
	125mm MAIN/LATERAL HEADER
	160mm MAIN/LATERAL HEADER
	180mm MAIN/LATERAL HEADER
	200mm MAIN HEADER
	225mm MAIN HEADER
	250mm MAIN HEADER
	280mm MAIN HEADER
	315mm MAIN HEADER
	355mm MAIN HEADER
	400mm MAIN HEADER
	450mm MAIN HEADER
	500mm MAIN HEADER



DESIGN IN PROGRESS

<p>THIS DRAWING AND DESIGN CONTAINS PROPRIETARY INFORMATION. IT SHALL NOT BE USED OR REPRODUCED OR ANY OF ITS CONTENTS DISCLOSED IN WHOLE OR PART WITHOUT THE PRIOR WRITTEN CONSENT OF EDL GROUP OPERATIONS PTY LTD (ACN 055 555 416).</p>			<p>TBL 41 7 3225 5555 FAX 61 7 3217 0722</p>		<p>PROJECT HIGHBURY LFG POWER PROJECT</p>	
<p>DRAWN T.J.H. DESIGN T.J.H. APRVD [blank]</p>			<p>SCALE 1:500</p>		<p>DRAWING TITLE PACIFIC WASTE PERIMETER WELL SYSTEM</p>	
<p>DATE 30/10/09 DATE 30/10/09 DATE [blank]</p>			<p>DRAWING NUMBER 830- AB - 11</p>		<p>PAGE OF A 1</p>	
<p>DATE 17/03/10</p>			<p>LAST PLOTTED TIME: 14:34</p>		<p>DATE: 17/03/10 LAST MODIFIED TIME: 15:59</p>	
<p>DATE 06/11/09</p>			<p>DATE: 06/11/09</p>		<p>DATE: 06/11/09</p>	

E-2 THEORETICAL GAS (METHANE) CALCULATIONS

To calculate the potential current generation rate of methane from the landfill, we first need to determine the amount of methane being emitted per hour. We can do this by multiplying the flow rate of methane by its concentration in the landfill. To express the potential generation rate in terms of volume percent, we need to convert the mass of methane emitted per hour to volume.

The flare serves two landfills, therefore we need to account for flare flow and volume representing total waste mass, and then find the proportion relevant to the VL.

Assumptions

- Tonnes of waste in VL is 370,000
- Tonnes of waste in Highbury Landfill is 698,000
- Total tonnes of waste is 1,068,000
- Flow rate is consistently the maximum feed at flare: 600 m³/hour
- Volume of methane is 32.5 % volume as per 2010 data (expected to have decreased)

Given that the density of methane at standard conditions is approximately 0.716 kg/m³, we can use this value to convert the mass of methane emitted per hour to volume.

Calculate the volume of methane emitted per hour:

$$\text{Volume of methane emitted per hour} = 600 \text{ m}^3/\text{hour} \times 0.325$$

$$\text{Volume of methane emitted per hour} = 600 \text{ m}^3/\text{hour} \times 0.325$$

$$\text{Volume of methane emitted per hour} = 195 \text{ m}^3/\text{hour}$$

Convert the volume of methane to mass:

$$\text{Mass of methane emitted per hour} = 195 \text{ m}^3/\text{hour} \times 0.716 \text{ kg/m}^3$$

$$\text{Mass of methane emitted per hour} = 139.77 \text{ kg/hour}$$

Generation Rate (Highbury and VL combined)

For 1,068,000 tonne of waste:

$$\begin{aligned} \text{Potential CH}_4 \text{ generation rate} &= 139.77 \text{ kg CH}_4 / \text{hour} / 1,068,000,000 \text{ kg waste} \\ &= 1.309 \times 10^{-7} \text{ kg CH}_4 / \text{kg waste} \end{aligned}$$

Potential Generation Rate for VL only:

$$1.309 \times 10^{-7} \text{ kg CH}_4 / \text{kg waste} \times 370,000,000 \text{ kg waste} = 48 \text{ kg CH}_4$$

Potential Migration Rate for VL assuming no extraction

$$\text{Area of VL} = 37,000 \text{ m}^2$$

$$\text{Density of CH}_4 = 48 \text{ kg} / 37,000 \text{ m}^2 = 0.0013 \text{ kg/m}^2$$

$$\text{Boundary interface area (BIA) (length of boundary} \times \text{depth of waste)} = \sim 130 \text{ m} \times 10 \text{ m} = 1300 \text{ m}^2$$

$$\text{CH}_4 \text{ for BIA} = 0.0013 \text{ kg/m}^2 \times 1300 \text{ m}^2 = 1.7 \text{ kg}$$

$$\text{Volume} = \text{mass} / \text{density}$$

OO-01 10-20 Halls Road

$$= 1.7 \text{ kg} / 0.716 \text{ kg/m}^3$$

$$2.4 \text{ m}^3$$

Mix with boundary volume ($1300 \text{ m}^2 \times 1 \text{ m}$) = 1300 m^3

Porosity (V_{air}) = assume 0.3 so $0.7 \times 1300 \text{ m}^3$ then $V_{\text{air}} = 910 \text{ m}^3$

Volume methane = 0.3 % (volume)

Porosity (V_{air}) = assume 0.7 so $0.3 \times 1300 \text{ m}^3$ then $V_{\text{air}} = 390 \text{ m}^3$

Volume methane = 0.3 % (volume) = 390 m^3

So at porosity 0.3 $\text{CH}_4 = 0.3\%$

So at porosity 0.7 $\text{CH}_4 = 0.62\%$

This assumes no removal; of methane from the landfill.

This would match current boundary readings, thus the effect of passive / LoCal flaring is difficult to determine, but may be less obvious at edges of waste mass.

E-3 SECTION 83A RECORDS FOR HIGHBURY LANDFILL

Fernando, Su (EPA)

From: Bradford, Emma (EPA)
Sent: Friday, 30 November 2012 11:10 AM
To: Smith, Kathy (EPA)
Subject: FW: Notification of suspected groundwater contamination at Highbury Landfill
Attachments: Highbury Landfill Ammonia historical trend graph.pdf; 42657618-002-FIGURE 3.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Kath,

Here is smoe more information regarding the same S83A.

Em

From: Boyce, Wendy (EPA)
Sent: Tuesday, 9 October 2012 2:29 PM
To: Bradford, Emma (EPA)
Subject: FW: Notification of suspected groundwater contamination at Highbury Landfill

Hello Emma

Partner email to a previous one just sent through

Kind regards
wb

Wendy Boyce

Principal Adviser, Site Contamination (Audit)
Site Contamination Branch
wendy.boyce@epa.sa.gov.au
Tel: (08) 8204 2033 | F: (08) 8124 4673

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Think before you print

From: Evans, Andrew (EPA)
Sent: Wednesday, 12 September 2012 3:27 PM
To: Boyce, Wendy (EPA)
Subject: FW: Notification of suspected groundwater contamination at Highbury Landfill

From: Paparella, Tony [<mailto:tony.paparella@urs.com>]
Sent: Wednesday, 14 December 2011 1:56 PM
To: Evans, Andrew (EPA)

Cc: Morris, Melinda; rob@rodenburg.com.au

Subject: Notification of suspected groundwater contamination at Highbury Landfill

Hi Andy

Just writing to confirm our earlier conversation about the Highbury Landfill site. URS have undertaken 2 rounds of groundwater sampling at the Highbury Landfill site on behalf of Rodenburg Waste Solutions (RWS) during 2011 (in February and July). It has become apparent during the preparation of the 2011 Highbury Landfill Annual Monitoring Report that elevated ammonia concentrations have been reported in the two groundwater samples retrieved from the inferred up hydraulic gradient monitoring bore (MB07) during 2011 that necessitate EPA notification of suspected groundwater contamination (see ammonia graph attached). Elevated TKN concentrations (comprised predominantly of ammonia) were also been reported in MB07 during 2011 (see TKN graph attached). I have also attached a plan showing the locations of the groundwater monitoring bores at the site. As shown on the site plan, MB07 is located in the inferred up hydraulic gradient direction of the site, and is immediately down hydraulic gradient of the former Pacific Waste Management landfill site.

URS understand that the EPA are familiar with the historical groundwater results for the Highbury Landfill. URS has prepared the annual monitoring reports for the site since 2005 and assume these reports have been forwarded onto the EPA. It is understood that the EPA received the 2011 Highbury Landfill Annual Monitoring Report earlier today.

The ammonia concentrations reported in MB07 during the 2011 groundwater sampling events of 75.4 mg/L and 60.8 mg/L exceed the adopted EPP guideline for aquatic freshwater ecosystems of 0.05 mg/L. The reported ammonia concentrations are higher than the range of historically reported results for MB07 (see ammonia trend graph attached). The highest ammonia concentration previously reported in MB07 was 41.1 mg/L in May 2010, and the historical ammonia trend graph indicates an increasing trend is apparent in MB07 since the May 2005 monitoring event.

Please accept this email as evidence of notification to the SA EPA of suspected groundwater contamination in the inferred up hydraulic gradient monitoring bore (MB07) at the Highbury Landfill site.

Regards,

Tony Paparella
Senior Environmental Engineer

URS Australia Pty Ltd
Level 4, 70 Light Square, Adelaide SA 5000, Australia
Phone: +61 8 8366 1000
Direct: +61 8 8366 1086
Fax: +61 8 8366 1001
Mobile: +61 450 734 647
email: tony.paparella@urs.com
visit our website at www.urs.com.au

please note the change in email address and update your address book

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NOTE:

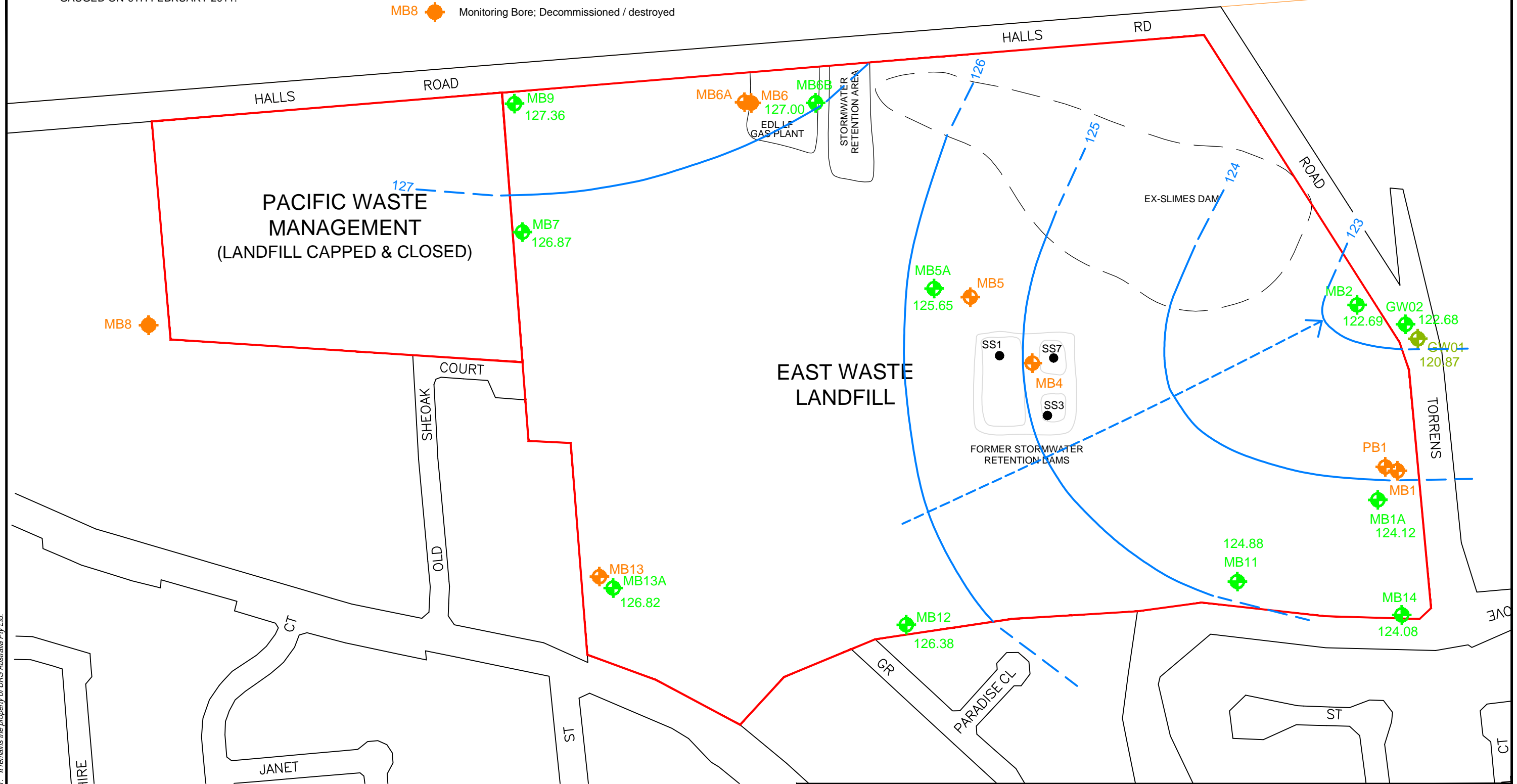
NO SURFACE WATER SAMPLE COLLECTED DURING THIS GROUNDWATER MONITORING EVENT .

GROUNDWATER ELEVATION DATA FOR GW01 OMITTED FROM CONTOURS. THIS DATA REPRESENTS A DEEPER AQUIFER.

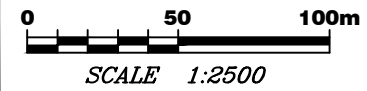
ALL GROUNDWATER MONITORING WELLS WERE GAUGED ON 9TH FEBRUARY 2011.


LEGEND

-  **MB7** 126.95 Active Water Table Aquifer Monitoring Bore and Reduced Groundwater Level (mAHD)
-  Interpreted Groundwater Contour
-  Inferred Groundwater Flow Direction
-  **GW01** Monitoring Bore Deeper Proterozoic Aquifer
-  **MB8** Monitoring Bore; Decommissioned / destroyed

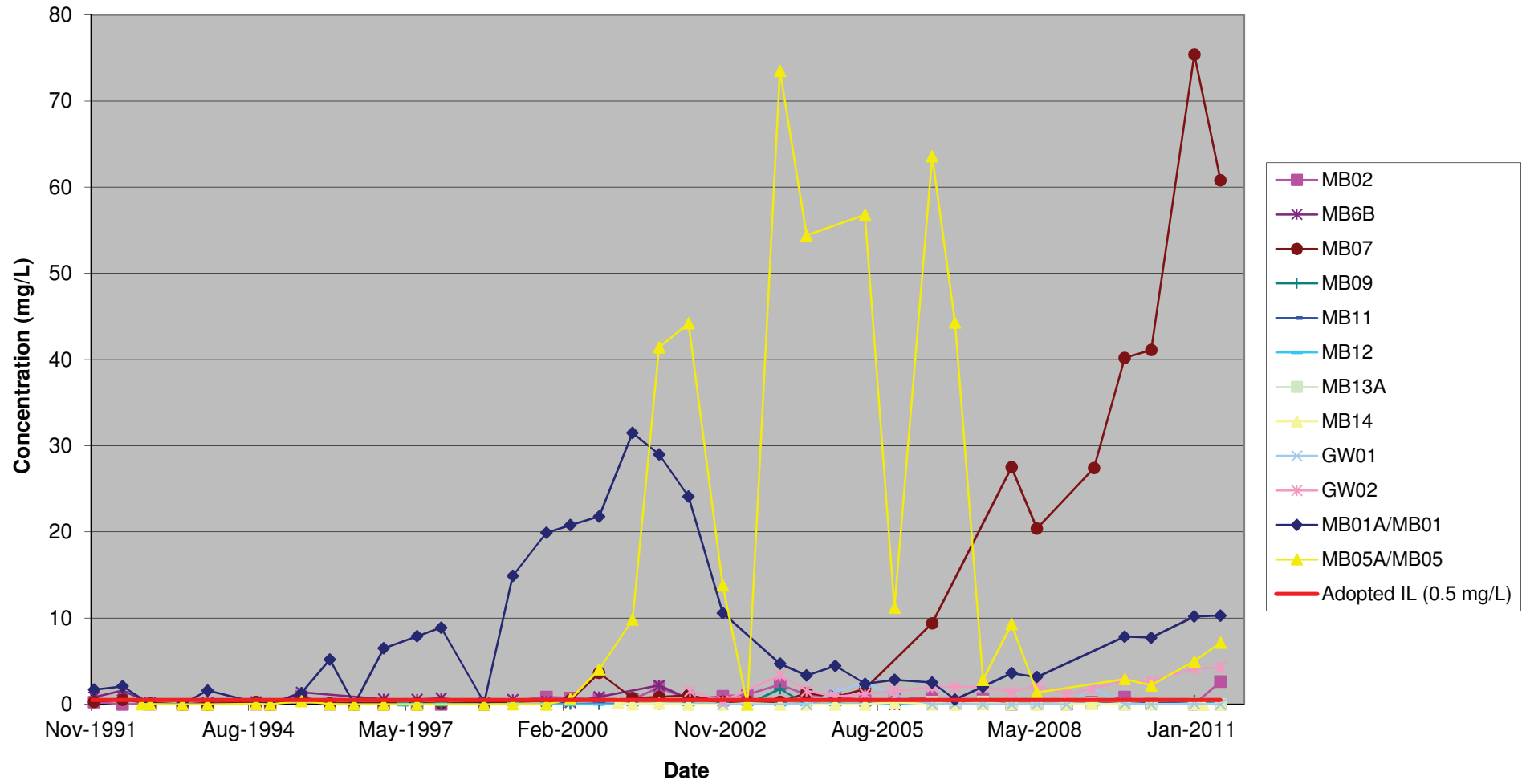


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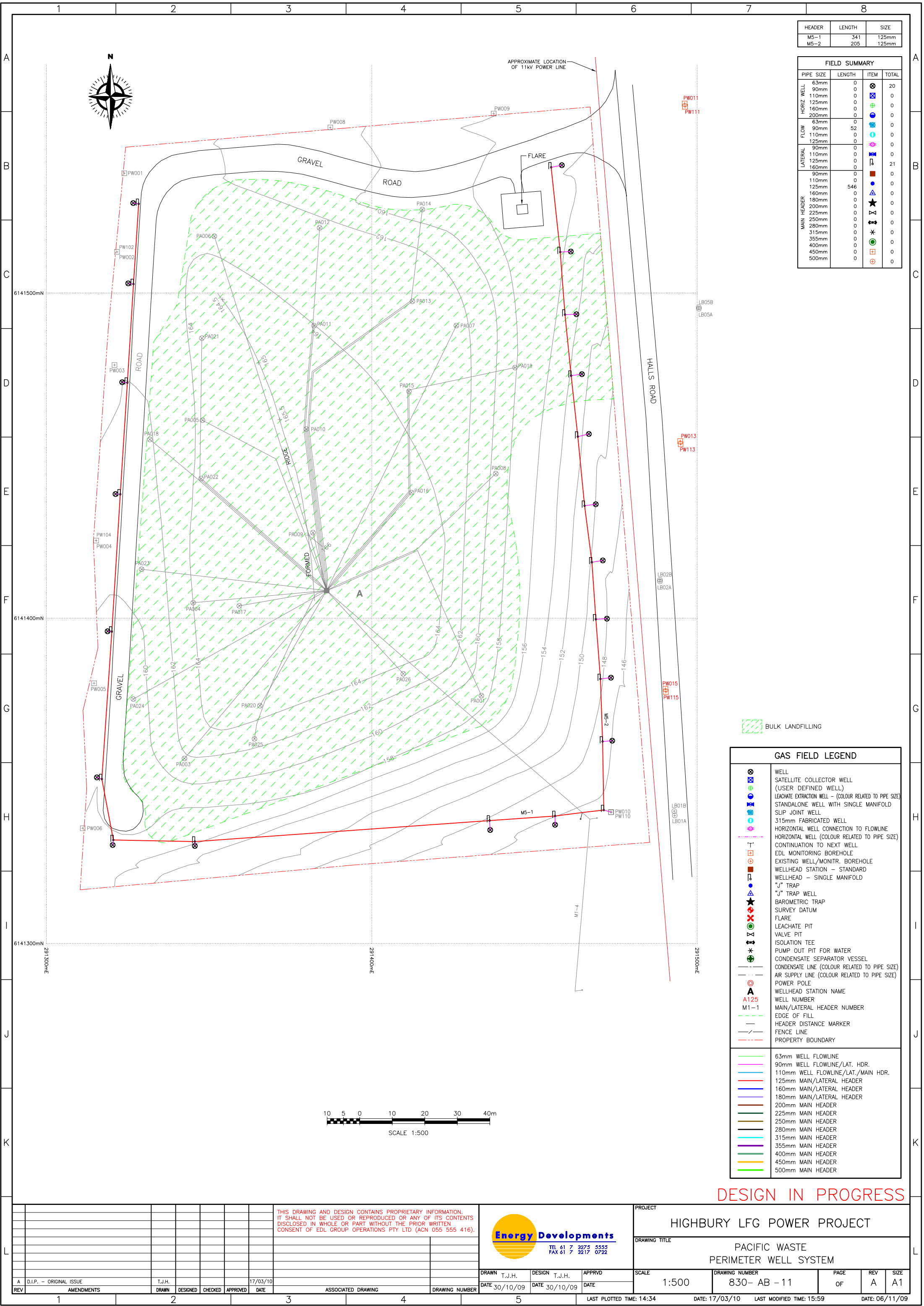


CLIENT RODENBURG WASTE SOLUTIONS		PROJECT HIGHBURY LANDFILL GROUNDWATER MONITORING 2011				TITLE SITE PLAN, LOCATIONS AND INTERPRETED GROUNDWATER CONTOURS JULY 2011	
		DESIGNED: EC	DRAWN: KWB	CHECKED: TP	APPROVED: MM		
		PROJECT No.: 42657618			DATE: OCT. 2011		Rev. A
		FILE No.: 42657618-002-01				FIGURE: 3	
						A3	

Ammonia as N



APPENDIX F VEOLIA GAS MONITORING LOCATIONS

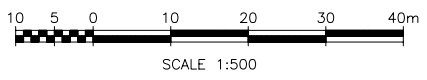


HEADER	LENGTH	SIZE
M5-1	341	125mm
M5-2	205	125mm

FIELD SUMMARY			
PIPE SIZE	LENGTH	ITEM	TOTAL
63mm	0	⊗	20
90mm	0	⊗	0
110mm	0	⊗	0
125mm	0	⊗	0
160mm	0	⊗	0
200mm	0	⊗	0
63mm	0	⊗	0
90mm	52	⊗	0
110mm	0	⊗	0
125mm	0	⊗	0
160mm	0	⊗	21
200mm	0	⊗	0
225mm	546	⊗	0
250mm	0	⊗	0
280mm	0	⊗	0
315mm	0	⊗	0
355mm	0	⊗	0
400mm	0	⊗	0
450mm	0	⊗	0
500mm	0	⊗	0

BULK LANDFILLING

GAS FIELD LEGEND	
	WELL
	SATELLITE COLLECTOR WELL (USER DEFINED WELL)
	LEACHATE EXTRACTION WELL - (COLOUR RELATED TO PIPE SIZE)
	STANDALONE WELL WITH SINGLE MANIFOLD
	SLIP JOINT WELL
	315mm FABRICATED WELL
	HORIZONTAL WELL CONNECTION TO FLOWLINE
	HORIZONTAL WELL (COLOUR RELATED TO PIPE SIZE)
	CONTINUATION TO NEXT WELL
	EDL MONITORING BOREHOLE
	EXISTING WELL/MONITR. BOREHOLE
	WELLHEAD STATION - STANDARD
	WELLHEAD - SINGLE MANIFOLD
	"J" TRAP
	"U" TRAP WELL
	BAROMETRIC TRAP
	SURVEY DATUM
	FLARE
	LEACHATE PIT
	VALVE PIT
	ISOLATION TEE
	PUMP OUT PIT FOR WATER
	CONDENSATE SEPARATOR VESSEL
	CONDENSATE LINE (COLOUR RELATED TO PIPE SIZE)
	AIR SUPPLY LINE (COLOUR RELATED TO PIPE SIZE)
	POWER POLE
	WELLHEAD STATION NAME
	WELL NUMBER
	MAIN/LATERAL HEADER NUMBER
	EDGE OF FILL
	HEADER DISTANCE MARKER
	FENCE LINE
	PROPERTY BOUNDARY
	63mm WELL FLOWLINE
	90mm WELL FLOWLINE/LAT. HDR.
	110mm WELL FLOWLINE/LAT./MAIN HDR.
	125mm MAIN/LATERAL HEADER
	160mm MAIN/LATERAL HEADER
	180mm MAIN/LATERAL HEADER
	200mm MAIN HEADER
	225mm MAIN HEADER
	250mm MAIN HEADER
	280mm MAIN HEADER
	315mm MAIN HEADER
	355mm MAIN HEADER
	400mm MAIN HEADER
	450mm MAIN HEADER
	500mm MAIN HEADER



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DATE	APPROVED	CHECKED	DESIGNED	DRAWN
17/03/10				T.J.H.
AMENDMENTS				
1				

Energy Developments
 TEL 61 7 3275 5555
 FAX 61 7 3217 0722

DRAWN T.J.H. DESIGN T.J.H. APRVD
 DATE 30/10/09 DATE 30/10/09 DATE

PROJECT HIGHBURY LFG POWER PROJECT				
DRAWING TITLE PACIFIC WASTE PERIMETER WELL SYSTEM				
SCALE 1:500	DRAWING NUMBER 830- AB - 11	PAGE OF	REV A	SIZE A1
LAST PLOTTED TIME: 14:34 DATE: 17/03/10 LAST MODIFIED TIME: 15:59 DATE: 06/11/09				

APPENDIX G GROUND GAS MONITORING 2024

G-1 CALIBRATION

Gas Calibration Certificate



Instrument **GFM430**
 Serial No. **11259**
 Sensors **CH₄, CO₂, O₂**

Air-Met Scientific Pty Ltd
 1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
Pump	Operation	✓	
	Filter	✓	
	Flow	✓	
	Valves, Diaphragm	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	CH ₄	✓	
	CO ₂	✓	
	O ₂	✓	
	H ₂ S	✓	
	LEL	✓	
	CO	✓	
Alarms	Beeper	✓	
	Settings	✓	
Software	Version		
Datalogger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No	Instrument Reading
O ₂		20.9% Vol O ₂		Fresh Air	20.9%
CO ₂		40% Vol CO ₂	NATA	SA047	40.0%
CH ₄		60% Vol CH ₄	NATA	SA047	60.0%

Calibrated by: _____

Matthew Wright

Calibration date: 30/01/2024

Next calibration due: 29/04/2024

collected 6-2-24
 Used 6-2-24
 Returned 6-2-24
 J.



Air-Met Scientific Pty Ltd
1300 137 067

Gas Calibration Certificate

Instrument **GFM430**
Serial No. **11259**
Sensors **CH₄, CO₂, O₂**

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
Pump	Operation	✓	
	Filter	✓	
	Flow	✓	
	Valves, Diaphragm	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	CH ₄	✓	
	CO ₂	✓	
	O ₂	✓	
	H ₂ S	✓	
	LEL	✓	
	CO	✓	
Alarms	Beeper	✓	
	Settings	✓	
Software	Version		
Datalogger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Calibration gas and concentration	Certified	Gas bottle No	Instrument Reading
O ₂		20.9% Vol O ₂		Fresh Air	20.9%
CO ₂		40% Vol CO ₂	NATA	SA047	40.0%
CH ₄		60% Vol CH ₄	NATA	SA047	60.0%

Calibrated by:

Matthew Wright

Calibration date:

7/02/2024

Next calibration due:

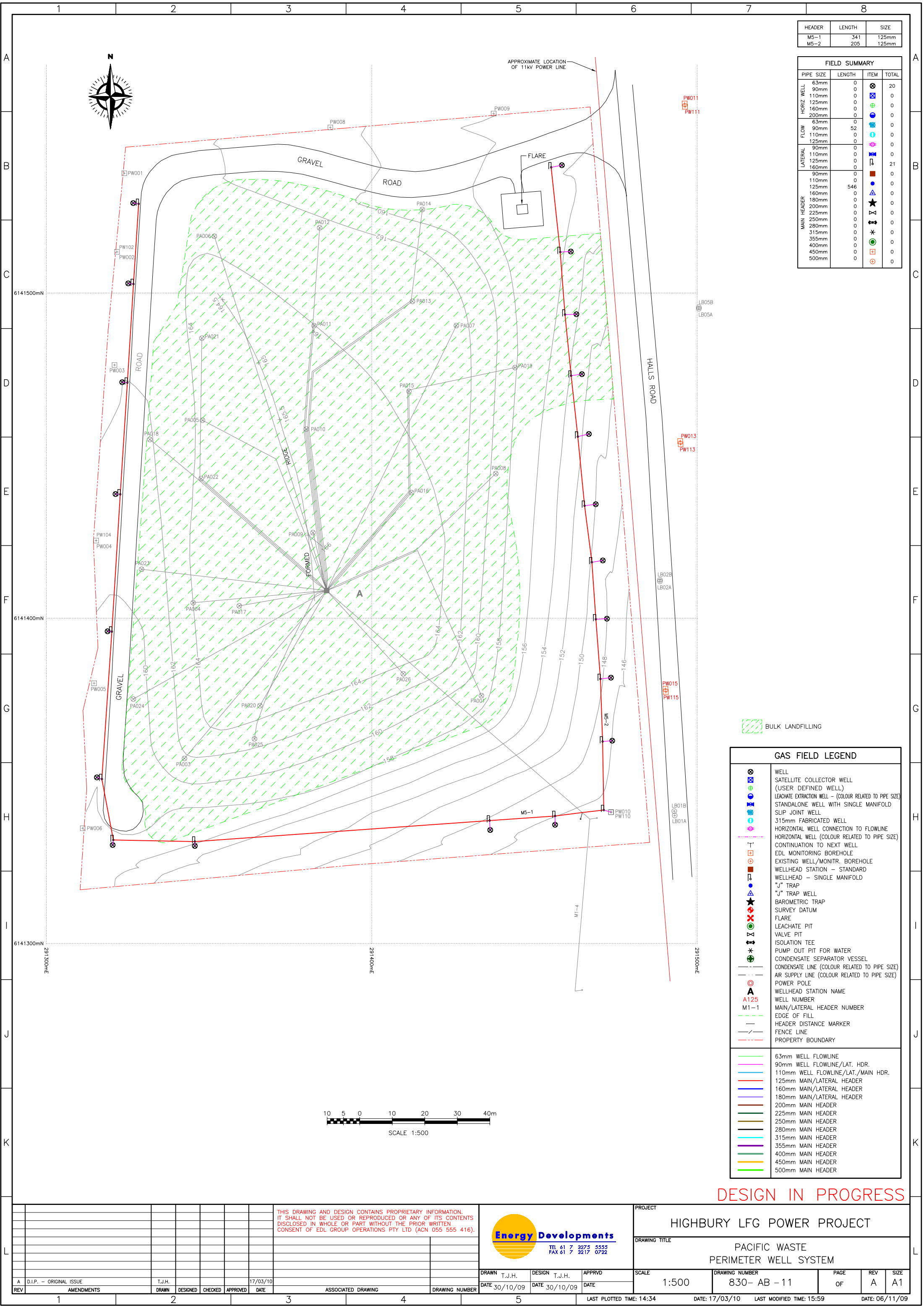
7/05/2024

used 19-2-24
22-2-24

00-01 + 00-05

[Signature]

G-2 OFFSITE LOCATIONS



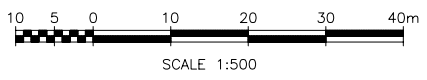
HEADER	LENGTH	SIZE
M5-1	341	125mm
M5-2	205	125mm

FIELD SUMMARY			
PIPE SIZE	LENGTH	ITEM	TOTAL
63mm	0	⊗	20
90mm	0	⊗	0
110mm	0	⊗	0
125mm	0	⊗	0
160mm	0	⊗	0
200mm	0	⊗	0
63mm	0	⊗	0
90mm	52	⊗	0
110mm	0	⊗	0
125mm	0	⊗	0
160mm	0	⊗	0
200mm	0	⊗	0
225mm	546	⊗	0
250mm	0	⊗	0
280mm	0	⊗	0
315mm	0	⊗	0
355mm	0	⊗	0
400mm	0	⊗	0
450mm	0	⊗	0
500mm	0	⊗	0

BULK LANDFILLING

GAS FIELD LEGEND	
	WELL
	SATELLITE COLLECTOR WELL (USER DEFINED WELL)
	LEACHATE EXTRACTION WELL - (COLOUR RELATED TO PIPE SIZE)
	STANDALONE WELL WITH SINGLE MANIFOLD
	SLIP JOINT WELL
	315mm FABRICATED WELL
	HORIZONTAL WELL CONNECTION TO FLOWLINE
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	CONTINUATION TO NEXT WELL
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	EXISTING WELL/MONITR. BOREHOLE
	WELLHEAD STATION - STANDARD
	WELLHEAD - SINGLE MANIFOLD
	"J" TRAP
	"U" TRAP WELL
	BAROMETRIC TRAP
	SURVEY DATUM
	FLARE
	LEACHATE PIT
	VALVE PIT
	ISOLATION TEE
	PUMP OUT PIT FOR WATER
	CONDENSATE SEPARATOR VESSEL
	CONDENSATE LINE (COLOUR RELATED TO PIPE SIZE)
	AIR SUPPLY LINE (COLOUR RELATED TO PIPE SIZE)
	POWER POLE
	WELLHEAD STATION NAME
	WELL NUMBER
	MAIN/LATERAL HEADER NUMBER
	EDGE OF FILL
	HEADER DISTANCE MARKER
	FENCE LINE
	PROPERTY BOUNDARY

	63mm WELL FLOWLINE
	90mm WELL FLOWLINE/LAT. HDR.
	110mm WELL FLOWLINE/LAT./MAIN HDR.
	125mm MAIN/LATERAL HEADER
	160mm MAIN/LATERAL HEADER
	180mm MAIN/LATERAL HEADER
	200mm MAIN HEADER
	225mm MAIN HEADER
	250mm MAIN HEADER
	280mm MAIN HEADER
	315mm MAIN HEADER
	355mm MAIN HEADER
	400mm MAIN HEADER
	450mm MAIN HEADER
	500mm MAIN HEADER



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<p>DRAWN T.J.H. DESIGN T.J.H. APPRVD DATE 30/10/09 DATE 30/10/09 DATE</p>			<p>DRAWING TITLE PACIFIC WASTE PERIMETER WELL SYSTEM</p>		<p>SCALE 1:500</p>	
<p>AMENDMENTS</p>			<p>DRAWING NUMBER 830- AB - 11</p>		<p>PAGE OF</p>	
<p>1</p>			<p>2</p>		<p>3</p>	
<p>4</p>			<p>5</p>		<p>LAST PLOTTED TIME: 14:34 DATE: 17/03/10 LAST MODIFIED TIME: 15:59 DATE: 06/11/09</p>	

G-3 TABLE

Ground Gas Field Measurements February 2024

				Onsite						Offsite - East Boundary of Landfill						
				Residence	Mid Site		South - adjacent Landfill			South		Middle		North		
				MW01	MW02	MW03	MW04	MW05	MW06	LB01A	LB01B	LB02A	LB02B	PW11A	PW11B	
				6	6	6	6	6	6	6	10	4.1	10	5	9.7	
				Depth (m BGL)												
				SA EPA Landfill Guidelines												
				Unit	EQL											
6-Feb-24																
methane	%v/v	-	1				0.0	0.0	0.0							
lower explosive limit	%v/v	-	100				0.0	0.0	0.0							
carbon dioxide	%v/v	-	1.5				1.4	2.8	6.0							
oxygen	%v/v	-	-				19.3	18.2	15.1							
balance of gases	%v/v	-	-				20.7	21.0	21.1							
atmospheric pressure	mbar	-	-				998	998	998							
differential pressure	Pa	-	-				0.0	0.0	0.0							
flow rate	L/sec	-	-				0.0	-0.2	0.0							
19-Feb-24																
methane	%v/v	-	1			0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
lower explosive limit	%v/v	-	100			0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
carbon dioxide	%v/v	-	1.5			3.2	0.6	0.4	5.3		15.7	9.2	9.9	12.8	0.8	
oxygen	%v/v	-	-			18.1	20.5	20.8	16.8		4.3	13.1	10.1	7.6	20.1	
balance of gases	%v/v	-	-			21.3	21.1	21.2	22.1		20.0	22.3	20.0	20.4	20.9	
atmospheric pressure	mbar	-	-			1004	1001	1001	1001		1004	1004	1004	1004	1004	
differential pressure	Pa	-	-			0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
flow rate	L/hr	-	-			0.0	0.0	0.0	0.0		0.1	0.0	0.0	0.1	0	
22-Feb-24																
methane	%v/v	-	1				0.0	0.0	0.0							
lower explosive limit	%v/v	-	100				0.0	0.0	0.0							
carbon dioxide	%v/v	-	1.5				3	1.8	1.0							
oxygen	%v/v	-	-				18.0	19.2	19.6							
balance of gases	%v/v	-	-				21.0	21.0	20.6							
atmospheric pressure	mbar	-	-				990	990	990							
differential pressure	Pa	-	-				0.0	0.0	0.0							
flow rate	L/hr	-	-				0.2	-0.2	0.1							

APPENDIX H ECOLOGICAL INVESTIGATION LEVEL/ SOILS

H-1 EIL SHEET

Inputs	
Select contaminant from list below	
Cr_III	
Below needed to calculate fresh and aged ACLs	
Enter % clay (values from 0 to 100%)	
10	
Below needed to calculate fresh and aged ABCs	
Measured background concentration (mg/kg). Leave blank if no measured value	
or for fresh ABCs only	
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background concentration	
0.4	
or for aged ABCs only	
Enter State (or closest State)	
SA	
Enter traffic volume (high or low)	
low	

Outputs		
Land use	Cr III soil-specific EILs	
	(mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	60	140
Urban residential and open public spaces	170	410
Commercial and industrial	270	680

Inputs	
Select contaminant from list below	
Cu	
Below needed to calculate fresh and aged ACLs	
Enter cation exchange capacity (silver thiourea method) (values from 0 to 100 cmolc/kg dwt)	
12.3	
Enter soil pH (calcium chloride method) (values from 1 to 14)	
6	
Enter organic carbon content (%OC) (values from 0 to 50%)	
3.6	
Below needed to calculate fresh and aged ABCs	
Measured background concentration (mg/kg). Leave blank if no measured value	
or for fresh ABCs only	
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background concentration	
0.4	
or for aged ABCs only	
Enter State (or closest State)	
SA	
Enter traffic volume (high or low)	
low	

Outputs		
Land use	Cu soil-specific EILs	
	(mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	50	80
Urban residential and open public spaces	100	210
Commercial and industrial	150	300

Inputs	
Select contaminant from list below	
Ni	
Below needed to calculate fresh and aged ACLs	
Enter cation exchange capacity (silver thiourea method) (values from 0 to 100 cmolc/kg dwt)	
12.3	
Below needed to calculate fresh and aged ABCs	
Measured background concentration (mg/kg). Leave blank if no measured value	
or for fresh ABCs only	
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background concentration	
0.4	
or for aged ABCs only	
Enter State (or closest State)	
SA	
Enter traffic volume (high or low)	
low	

Outputs		
Land use	Ni soil-specific EILs	
	(mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	10	40
Urban residential and open public spaces	65	200
Commercial and industrial	120	330

Inputs	
Select contaminant from list below	Zn
Below needed to calculate fresh and aged ACLs	
Enter cation exchange capacity (silver thiourea method) (values from 0 to 100 cmolc/kg dwt)	12.3
Enter soil pH (calcium chloride method) (values from 1 to 14)	6
Below needed to calculate fresh and aged ABCs	
Measured background concentration (mg/kg). Leave blank if no measured value	
or for fresh ABCs only	
Enter iron content (aqua regia method) (values from 0 to 50%) to obtain estimate of background concentration	0.4
or for aged ABCs only	
Enter State (or closest State)	SA
Enter traffic volume (high or low)	low

Outputs		
Land use	Zn soil-specific EILs	
	(mg contaminant/kg dry soil)	
	Fresh	Aged
National parks and areas of high conservation value	45	150
Urban residential and open public spaces	160	460
Commercial and industrial	250	680

H-2 SOIL RESULTS



CERTIFICATE OF ANALYSIS

Work Order : EM2401774
Client : LWC MANAGEMENT PTY LTD
Contact : MR JAMES FOX
Address : SUITE 3 4-8 GOODWOOD ROAD
WAYVILLE SOUTH AUSTRALIA 5034
Telephone : ----
Project : 00-01
Order number : 00-01
C-O-C number : ----
Sampler : JAMES FOX
Site : ----
Quote number : EN/111
No. of samples received : 3
No. of samples analysed : 1

Page : 1 of 3
Laboratory : Environmental Division Melbourne
Contact : Kieren Burns
Address : 4 Westall Rd Springvale VIC Australia 3171
Telephone : +61881625130
Date Samples Received : 07-Feb-2024 12:25
Date Analysis Commenced : 08-Feb-2024
Issue Date : 16-Feb-2024 10:54



Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H⁺ + Al³⁺).



Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Sample ID		NW EIL 1 0.0-0.1	----	----	----	----
		Sampling date / time		06-Feb-2024 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EM2401774-001	-----	-----	-----	-----
				Result	---	---	---	---
EA001: pH in soil using 0.01M CaCl extract								
pH (CaCl2)	----	0.1	pH Unit	6.0	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.3	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	232	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.0	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	9.1	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	2.9	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.2	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	12.3	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	0.3	----	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	3.1	----	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	16.8	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Iron	7439-89-6	0.005	%	0.365	----	----	----	----
EP004: Organic Matter								
Organic Matter	----	0.5	%	6.3	----	----	----	----
Total Organic Carbon	----	0.5	%	3.6	----	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) ED007: Exchangeable Cations

(SOIL) ED008: Exchangeable Cations

(SOIL) ED006: Exchangeable Cations on Alkaline Soils

(SOIL) ED005: Exchange Acidity

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry) 14913 (Biology).

(SOIL) EP004: Organic Matter



QUALITY CONTROL REPORT

Work Order	: EM2401774	Page	: 1 of 3
Client	: LWC MANAGEMENT PTY LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR JAMES FOX	Contact	: Kieren Burns
Address	: SUITE 3 4-8 GOODWOOD ROAD WAYVILLE SOUTH AUSTRALIA 5034	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: ----	Telephone	: +61881625130
Project	: 00-01	Date Samples Received	: 07-Feb-2024
Order number	: 00-01	Date Analysis Commenced	: 08-Feb-2024
C-O-C number	: ----	Issue Date	: 16-Feb-2024
Sampler	: JAMES FOX		
Site	: ----		
Quote number	: EN/111		
No. of samples received	: 3		
No. of samples analysed	: 1		



This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC
 * = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: SOIL				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5591341)									
EM2401787-001	Anonymous	EG005T: Iron	7439-89-6	50	mg/kg	2.10 %	20900	0.5	0% - 20%
EM2401787-010	Anonymous	EG005T: Iron	7439-89-6	50	mg/kg	14900	15100	1.3	0% - 20%
EA001: pH in soil using 0.01M CaCl extract (QC Lot: 5591109)									
EM2401773-001	Anonymous	EA001: pH (CaCl2)	----	0.1	pH Unit	5.0	5.0	0.0	0% - 20%
EM2401773-008	Anonymous	EA001: pH (CaCl2)	----	0.1	pH Unit	5.5	5.4	3.3	0% - 20%
EA002: pH 1:5 (Soils) (QC Lot: 5591104)									
EM2401587-002	Anonymous	EA002: pH Value	----	0.1	pH Unit	5.3	5.4	0.0	0% - 20%
EA010: Conductivity (1:5) (QC Lot: 5591105)									
EM2401587-002	Anonymous	EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	12	12	0.0	0% - 50%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5591409)									
EM2401787-001	Anonymous	EA055: Moisture Content	----	0.1 (1.0)*	%	3.7	2.4	42.4	No Limit
EM2401787-010	Anonymous	EA055: Moisture Content	----	0.1 (1.0)*	%	6.1	5.7	6.1	No Limit
ED007: Exchangeable Cations (QC Lot: 5602736)									
EB2403609-001	Anonymous	ED007: Exchangeable Calcium	----	0.1	meq/100g	11.7	10.3	12.9	0% - 20%
		ED007: Exchangeable Magnesium	----	0.1	meq/100g	2.4	2.2	9.2	0% - 20%
		ED007: Exchangeable Potassium	----	0.1	meq/100g	0.2	0.2	0.0	No Limit
		ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	0.0	No Limit
EP004: Organic Matter (QC Lot: 5598026)									
EM2401722-001	Anonymous	EP004: Organic Matter	----	0.5	%	4.3	4.3	0.0	No Limit
		EP004: Total Organic Carbon	----	0.5	%	2.5	2.5	0.0	No Limit



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Result	Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%)
Method: Compound	CAS Number	LOR	Unit	Low				High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5591341)								
EG005T: Iron	7439-89-6	50	mg/kg	<50	33227 mg/kg	103	70.0	130
EA001: pH in soil using 0.01M CaCl extract (QCLot: 5591109)								
EA001: pH (CaCl2)	----	----	pH Unit	----	4 pH Unit	100	98.8	101
					7 pH Unit			
EA002: pH 1:5 (Soils) (QCLot: 5591104)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	100	98.8	101
					7 pH Unit			
EA010: Conductivity (1:5) (QCLot: 5591105)								
EA010: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	1413 µS/cm	100	94.5	105
ED007: Exchangeable Cations (QCLot: 5602736)								
ED007: Exchangeable Calcium	----	0.1	meq/100g	<0.1	8.9 meq/100g	95.7	79.0	113
ED007: Exchangeable Magnesium	----	0.1	meq/100g	<0.1	9.52 meq/100g	89.4	85.0	115
ED007: Exchangeable Potassium	----	0.1	meq/100g	<0.1	1.49 meq/100g	90.6	70.0	122
ED007: Exchangeable Sodium	----	0.1	meq/100g	<0.1	1.3726 meq/100g	89.3	76.0	112
ED007: Cation Exchange Capacity	----	0.1	meq/100g	<0.1	21.283 meq/100g	92.1	82.0	112
EP004: Organic Matter (QCLot: 5598026)								
EP004: Organic Matter	----	0.5	%	<0.5	2.53 %	86.2	82.0	98.0
EP004: Total Organic Carbon	----	0.5	%	<0.5	1.46 %	86.3	81.0	99.0

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery (%) MS	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number			Low	High
EP004: Organic Matter (QCLot: 5598026)							
EM2401722-001	Anonymous	EP004: Organic Matter	----	0.95 %	# Not Determined	70.0	130
		EP004: Total Organic Carbon	----	0.55 %	# Not Determined	70.0	130



QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EM2401774	Page	: 1 of 6
Client	: LWC MANAGEMENT PTY LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR JAMES FOX	Telephone	: +61881625130
Project	: 00-01	Date Samples Received	: 07-Feb-2024
Site	: ----	Issue Date	: 16-Feb-2024
Sampler	: JAMES FOX	No. of samples received	: 3
Order number	: 00-01	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers exist - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP004: Organic Matter	EM2401722--001	Anonymous	Organic Matter	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP004: Organic Matter	EM2401722--001	Anonymous	Total Organic Carbon	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method	Extraction / Preparation			Analysis			
	Container / Client Sample ID(s)	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved NW EIL 1 0.0-0.1	----	----	----		12-Feb-2024	09-Feb-2024	3
EA002: pH 1:5 (Soils)							
Soil Glass Jar - Unpreserved NW EIL 1 0.0-0.1	----	----	----		13-Feb-2024	09-Feb-2024	4

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type	Method	Count		Rate (%)		Quality Control Specification
		QC	Regular	Actual	Expected	
Matrix Spikes (MS)						
Total Metals by ICP-AES	EG005T	0	3	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
		Container / Client Sample ID(s)	Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis
EA001: pH in soil using 0.01M CaCl extract							
Soil Glass Jar - Unpreserved (EA001) NW EIL 1 0.0-0.1	06-Feb-2024	09-Feb-2024	13-Feb-2024	✓	12-Feb-2024	09-Feb-2024	*



Matrix: SOIL

Evaluation: ✘ = Holding time breach ; ✔ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002: pH 1:5 (Soils)							
Soil Glass Jar - Unpreserved (EA002) NW EIL 1 0.0-0.1	06-Feb-2024	09-Feb-2024	13-Feb-2024	✔	13-Feb-2024	09-Feb-2024	✘
EA010: Conductivity (1:5)							
Soil Glass Jar - Unpreserved (EA010) NW EIL 1 0.0-0.1	06-Feb-2024	09-Feb-2024	13-Feb-2024	✔	13-Feb-2024	08-Mar-2024	✔
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) NW EIL 1 0.0-0.1	06-Feb-2024	----	----	----	09-Feb-2024	20-Feb-2024	✔
ED005: Exchange Acidity							
Soil Glass Jar - Unpreserved (ED005) NW EIL 1 0.0-0.1	06-Feb-2024	15-Feb-2024	05-Mar-2024	✔	15-Feb-2024	05-Mar-2024	✔
ED006: Exchangeable Cations on Alkaline Soils							
Soil Glass Jar - Unpreserved (ED006) NW EIL 1 0.0-0.1	06-Feb-2024	16-Feb-2024	05-Mar-2024	✔	16-Feb-2024	05-Mar-2024	✔
ED007: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED007) NW EIL 1 0.0-0.1	06-Feb-2024	15-Feb-2024	05-Mar-2024	✔	15-Feb-2024	05-Mar-2024	✔
ED008: Exchangeable Cations							
Soil Glass Jar - Unpreserved (ED008) NW EIL 1 0.0-0.1	06-Feb-2024	15-Feb-2024	05-Mar-2024	✔	15-Feb-2024	05-Mar-2024	✔
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) NW EIL 1 0.0-0.1	06-Feb-2024	09-Feb-2024	04-Aug-2024	✔	09-Feb-2024	04-Aug-2024	✔
EP004: Organic Matter							
Soil Glass Jar - Unpreserved (EP004) NW EIL 1 0.0-0.1	06-Feb-2024	13-Feb-2024	05-Mar-2024	✔	13-Feb-2024	05-Mar-2024	✔



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
Analytical Methods							
Laboratory Duplicates (DUP)							
Electrical Conductivity (1:5)	EA010	1	9	11.11	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	3	33.33	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	8	12.50	10.00	✔	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	1	5	20.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	3	66.67	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Electrical Conductivity (1:5)	EA010	1	9	11.11	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	3	33.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	5	40.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
pH in soil using a 0.01M CaCl2 extract	EA001	2	20	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	3	33.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Electrical Conductivity (1:5)	EA010	1	9	11.11	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Exchangeable Cations	ED007	1	3	33.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Organic Matter	EP004	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	3	33.33	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Organic Matter	EP004	1	8	12.50	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	0	3	0.00	5.00	✖	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl ₂ extract	EA001	SOIL	In house: Referenced to Rayment and Lyons 4B3 (mod.) or 4B4 (mod.) 10 g of soil is mixed with 50 mL of 0.01M CaCl ₂ and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Electrical Conductivity (1:5)	EA010	SOIL	In house: Referenced to Rayment and Lyons 3A1 and APHA 2510. Conductivity is determined on soil samples using a 1:5 soil/water leach. This method is compliant with NEPM Schedule B(3).
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Exchange Acidity by 1M Potassium Chloride	* ED005	SOIL	In house: referenced to Rayment and Lyons, method 15G1. This method is unsuitable for near neutral and alkaline soils. NATA accreditation does not cover performance of this service.
Exchangeable Cations on Alkaline Soils	* ED006	SOIL	In house: Referenced to Soil Survey Test Method C5. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with alcoholic ammonium chloride at pH 8.5. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil.
Exchangeable Cations	ED007	SOIL	In house: Referenced to Rayment & Lyons Method 15A1. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations with pre-treatment	ED008	SOIL	In house: Referenced to Rayment & Lyons Method 15A2. Soluble salts are removed from the sample prior to analysis. Cations are exchanged from the sample by contact with Ammonium Chloride. They are then quantitated in the final solution by ICPAES and reported as meq/100g of original soil. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Organic Matter	EP004	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
pH in soil using a 0.01M CaCl ₂ extract	EA001-PR	SOIL	In house: Referenced to Rayment and Lyons 4B1, 10 g of soil is mixed with 50 mL of 0.01M CaCl ₂ and tumbled end over end for 1 hour. pH is measured from the continuous suspension. This method is compliant with NEPM Schedule B(3).
Exchangeable Cations Preparation Method (Alkaline Soils)	* ED006PR	SOIL	In house: Referenced to Rayment and Lyons method 15C1.
Exchangeable Cations Preparation Method	ED007PR	SOIL	In house: Referenced to Rayment & Lyons method 15A1. A 1M NH ₄ Cl extraction by end over end tumbling at a ratio of 1:20. There is no pretreatment for soluble salts. Extracts can be run by ICP for cations.



<i>Preparation Methods</i>	<i>Method</i>	<i>Matrix</i>	<i>Method Descriptions</i>
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
1:5 solid / water leach following drying at 40°C	EN34-AD	SOIL	10 g of 40°C dried soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Organic Matter	EP004-PR	SOIL	In house: Referenced to AS1289.4.1.1. Dichromate oxidation method after Walkley and Black. This method is compliant with NEPM Schedule B(3).



SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EM2401774**

Client	: LWC MANAGEMENT PTY LTD	Laboratory	: Environmental Division Melbourne
Contact	: MR JAMES FOX	Contact	: Kieren Burns
Address	: SUITE 3 4-8 GOODWOOD ROAD WAYVILLE SOUTH AUSTRALIA 5034	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: jfox@lwconsulting.com.au	E-mail	: kieren.burns@alsglobal.com
Telephone	: ----	Telephone	: +61881625130
Facsimile	: ----	Facsimile	: +61-3-8549 9626
Project	: 00-01	Page	: 1 of 2
Order number	: 00-01	Quote number	: EM2023LANWAT0009 (EN/111)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: JAMES FOX		

Dates

Date Samples Received	: 07-Feb-2024 12:25	Issue Date	: 07-Feb-2024
Client Requested Due Date	: 16-Feb-2024	Scheduled Reporting Date	: 16-Feb-2024

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 8.2°C - Ice present
Receipt Detail	:	No. of samples received / analysed	: 3 / 1

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Proactive Holding Time Report
 - Requested Deliverables
- **Please direct any queries related to sample condition / numbering / breakages to Client Services.**
- Sample Disposal - Aqueous (3 weeks), Solid (2 months) from receipt of samples.
- **Analytical work for this work order will be conducted at ALS Springvale, ALS Sydney and ALS Brisbane.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.



Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	Sampling date / time	Sample ID	(On Hold) SOIL No analysis requested	SOIL - AG-1 EB Only Agricultural Soil Suite 1 EB Only	SOIL - EA055-103 Moisture Content	SOIL - P-22 (Meib) minus PSD Soil Characterisation Suite (minus PSD)
EM2401774-001	06-Feb-2024 00:00	NW EIL 1 0.0-0.1		✓	✓	✓
EM2401774-002	06-Feb-2024 00:00	NW EIL 2 0.0-0.1	✓			
EM2401774-003	06-Feb-2024 00:00	NW EIL 3 0.0-0.1	✓			

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

INVOICES ADDRESS

- A4 - AU Tax Invoice (INV)

Email admin@lwconsulting.com.au

JAMES FOX

- *AU Certificate of Analysis - NATA (COA)
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)
- A4 - AU Tax Invoice (INV)
- Chain of Custody (CoC) (COC)
- EDI Format - ESDAT (ESDAT)
- EDI Format - XTab (XTAB)

Email jfox@lwconsulting.com.au
 Email jfox@lwconsulting.com.au
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 Email jfox@lwconsulting.com.au
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 Email jfox@lwconsulting.com.au

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) ED007: Exchangeable Cations

(SOIL) ED008: Exchangeable Cations

(SOIL) ED006: Exchangeable Cations on Alkaline Soils

(SOIL) ED005: Exchange Acidity

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry) 14913 (Biology).

(SOIL) EP004: Organic Matter



CHAIN OF CUSTODY

ALS Laboratory: please tick →

Sydney: 277 Woodpark Rd, Smithfield NSW 2176
Ph: 02 8784 8555 E: samples.sydney@alsenviro.com

Brisbane: 32 Shand St, Stafford QLD 4053
Ph: 07 3243 7222 E: samples.brisbane@alsenviro.com

Melbourne: 2-4 Westall Rd, Springvale VIC 3171
Ph: 03 8549 9600 E: samples.melbourne@alsenviro.com

Perth: 10 Hod Way, Malaga WA 6090
Ph: 08 9209 7655 E: samples.perth@alsenviro.com

Newcastle: 5 Rosegum Rd, Warabrook NSW 2304
Ph: 02 4968 9433 E: samples.newcastle@alsenviro.com

Townsville: 14-15 Desma Ct, Bohle QLD 4818
Ph: 07 4796 0600 E: townsville.environmental@alsenviro.com

Adelaide: 2-1 Burma Rd, Pooraka SA 5095
Ph: 08 8359 0890 E: adelaide@alsenviro.com

Launceston: 27 Wellington St, Launceston TAS 7250
Ph: 03 6331 2158 E: launceston@alsenviro.com

CLIENT: LWC	TURNAROUND REQUIREMENTS : <input type="checkbox"/> Standard TAT (List due date):		FOR LABORATORY USE ONLY (Circle)	
OFFICE: ADL	(Standard TAT may be longer for some tests e.g. Ultra Trace Organics)		Custody Seal Intact? Yes No N/A	
PROJECT: 00-01	<input type="checkbox"/> Non Standard or urgent TAT (List due date):		Free ice / frozen ice bricks present upon receipt? Yes No N/A	
ORDER NUMBER:	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle)		Random Sample Temperature on Receipt: 24.2 °C
PROJECT MANAGER: JAMES FOX	CONTACT PH: 00 8271 5255	COC: 1 2 3 4 5 6 7	OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER:	SAMPLER MOBILE:	RELINQUISHED BY: James Du-	RECEIVED BY:	RELINQUISHED BY:
COC emailed to ALS? (YES / (NO))	EDD FORMAT (or default):	DATE/TIME: 6.2.24 12.45	DATE/TIME: 6.2.25 12.45	DATE/TIME: 6.2.24 15.00
Email Reports to: jfox@lwcconsulting.com.au				RECEIVED BY: [Signature]
Email Invoice to:				DATE/TIME: 7/2 12.45

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: n/a

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)		CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).				Additional information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES				Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	NW EIL 1 0.0-0.1	6.2.24	S		1	X			
2	" " 2 "	"	"		1		X		
3	" " 3 "	"	"		1		X		
					TOTAL	3	1	2	

Environmental Division
Melbourne
Work Order Reference
EM2401774

Telephone : + 61-3-8549 9600

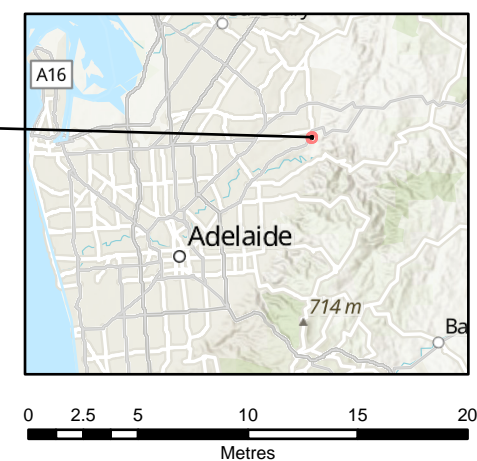
Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag.

H-3 TABULATION

APPENDIX I ACM GRID WALKOVER



- Legend**
- Site Boundary
 - Cadastre
 - ACM Grid



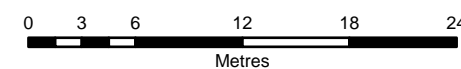
LWC
Land & Water Consulting
Email: enquiries@lwcconsulting.com.au
Web: www.lwcconsulting.com.au

Project: 10-20 Halls Road, Highbury	
Figure Title: ACM Grid - 4m X 4m Northern Portion	
Date: February 2024	Projection: GDA 2020 - MGA 54
Scale: See Plan	Figure in Set: 2 of 2
Site Address: 10-20 Halls Road, Highbury, SA 5089	<p>Figure 2 Revision A</p>
Drawing Reference OO-01	



Legend

- Site Boundary
- Cadastre
- ACM Grid



LWC
Land & Water Consulting
Email: enquiries@lwcconsulting.com.au
Web: www.lwcconsulting.com.au

Project:
10-20 Halls Road, Highbury

Figure Title:
ACM Grid - 4m X 4m
Southern Portion

Date: February 2024	Projection: GDA 2020 - MGA 54
Scale: See Plan	Figure in Set: 1 of 2

Site Address: 10-20 Halls Road, Highbury, SA 5089	<p>Figure 1 Revision A</p>
---	---

Drawing Reference OO-01

APPENDIX J STATEMENT OF LIMITATIONS

STATEMENT OF LIMITATIONS & IMPORTANT INFORMATION REGARDING YOUR REPORT

INTRODUCTION

This report has been prepared by Land & Water Consulting for you, as Land & Water Consulting's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Land & Water Consulting may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Land & Water Consulting has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

No warranty or guarantee of the site conditions is intended.

This report was prepared for the sole use of you, the Client and may not contain sufficient information for purposes of other parties or for other uses. Any reliance on this report by third parties shall be at such parties sole risk. This report shall only be presented in full and may not be used to support any other objectives than those set out in the report, except where written approval with comments are provided by Land & Water Consulting.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

LIMITATIONS OF THE REPORT

The scope of works undertaken and the report prepared to complete the assessment was in accordance with the information provided by the client and the specifications for works required under the contract. As such, works undertaken and statements made are based on those specifications (such as levels of risks and significance of any contamination) and should be considered and interpreted within this context. The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

Your environmental report should not be used without reference to Land & Water Consulting in the first instance:

- When the nature of the proposed development is changed, for example if a residential development is proposed instead of a commercial one;
- When the size or configuration of the proposed development is altered;
- When the location or orientation of the proposed structures are modified;
- When there is a change in ownership;
- For application to an adjacent site.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statutes and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

ENVIRONMENTAL ASSESSMENT “FINDINGS” ARE PROFESSIONAL ESTIMATES

The information in this report is considered to be accurate with respect to conditions encountered at the site at the time of investigation and considering the inherent limitations associated with extrapolating information from a sample set. Note however that site assessment identifies actual subsurface conditions only at those specific points where samples are taken, when they are taken. Environmental data derived through sampling and analysis are interpreted by consultants who then render an opinion about overall subsurface conditions, the nature and extent of contamination and potential impacts on the use of the land. Actual conditions may differ from those inferred to exist as no professional and no subsurface assessment program can reveal every detail within the ground across a site. Subsurface conditions can vary across a particular site and no practical degree of sampling can ever eliminate the possibility that conditions may be present at a site that have not been represented through sampling.

SUBSURFACE CONDITIONS CAN CHANGE

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Land & Water Consulting should be kept apprised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions. Since subsurface conditions (including contamination concentrations) can change within a limited period of time and space, this inherent limitation to the representation of site conditions provided by this report should always be taken into consideration particularly if the report is used after a delay in time.

DATA SHOULD NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

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RESPONSIBILITY

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.




In Situ Ground Gas Assessment

10-20 Halls Road, Highbury, South Australia

Future Urban/Hallan Nominees

September 2023

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
DR001	Draft	Dr James Fox	Dr James Fox	10 March 2023
				
DR003	Draft	Dr James Fox	Dr James Fox	7 September 2023

Project Details

Project Name	10-20 Halls Road, Highbury, South Australia
Client	Future Urban/Hallan Nominees
Client Project Manager	Ms Belinda Monier
LWC Project Manager	James Fox
LWC Project Director	Emily Picken
Authors	Alistair Vaughan
File Reference	LWC OO 01 ISGG Assessment DR003

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EXECUTIVE SUMMARY

Land and Water Consulting (LWC) was previously engaged by Future Urban/Hallan Nominees to undertake a Preliminary Site Investigation (PSI) of the property located at 10-20 Halls Road, Highbury, South Australia (the Site).

The Site is situated within the Torrens River Catchment, approximately 14 km north-east of the Adelaide CBD, and comprises an area of approximately 1.85 hectares.

The northern portion of the Site (Allotment 11) is currently in use for residential purposes whereas the southern portion is vacant and undeveloped – with respect to Table 1 of *State Planning Commission Practice Direction 14 (Site Contamination Assessment 2022)* (“Practice Direction 14”), the current use of the northern portion is aligned with *Item 1: Residential Class 1 – Domestic Residential* (defined as a sensitive land use in the *Environment Protection Act 1993*).

Despite its current use, the land is zoned as Extractive Industry – it is understood that Future Urban plan to apply for residential rezoning of the Site.

The objective of the PSI was to identify potential sources of contamination and associated contaminants of potential concern arising from current and historical activities undertaken on the Site, and/or within its immediate vicinity, that may give rise to site contamination (as defined in Section 5B of the *Environment Protection 1993*) with respect to a proposed rezoning of the Site for residential land use – the objectives of this assessment accord with Practice Direction 14.

The PSI concluded that there are six potentially significant contaminant linkages/ exposure pathways associated with a sensitive land use that are unresolved since the previous Site assessment program undertaken in 2008-2010 – these would need to be further assessed/ resolved prior to residential rezoning/development of the Site. The most significant of these is the proximity of the Site to a former landfill (a Class 1 activity undertaken within 60 m) but there are, in fact, two former landfills within 500 m of the Site. It was therefore considered that a site contamination audit would likely be required, in addition to the recommendations presented below.

1. Undertake further monitoring of the landfill gas regime to assess its current status beneath the Site and confirm that the regime will not change under seasonal conditions.
2. Undertake groundwater monitoring, particularly in the vicinity of the southern Site boundary, to assess the current state of the uppermost aquifer beneath the Site, the groundwater depth and flow direction and any potential seasonal variations (i.e. in depth, flow and/or chemical status).
3. Prepare a Site Remediation Plan (SRP) to render the site suitable for the proposed residential rezoning/development (i.e. with reference to the north-western area of elevated soil metal concentrations and the south-eastern area of aesthetically unacceptable fill).
4. Prepare a report to detail the additional assessment/remediation work and assess the potential risks to the environment and human health under a sensitive land use scenario.

LWC were subsequently re-engaged to Undertake further monitoring of the landfill gas regime to assess its current status beneath the Site and assess potential regime changes under varying atmospheric conditions.

The current ground gas regime is dominated by carbon dioxide with some elevated carbon monoxide. Methane was not identified as being above machine limit of reporting except some marginal volume of 0.2 %v/v in one location. This accords with data obtained from the operator of the landfill (Veolia) in May 2022 which recorded high carbon dioxide (22.3 %v/v) but no methane.

It is not clear as to whether the landfill has entered or exhausted the methane generation phase, and so there is some possibility that methane may be generated in the future.

The Characteristic Situation (CS) is driven by carbon dioxide and is calculated as CS2 on the basis that carbon dioxide in the ground exceeds 5% vol/vol (maximum is 15.6%).

Given the ambiguous gas profile associated with the landfill regarding current and future gas composition and the CS2 determination on site, further risk assessment is likely required coupled with possible ground gas protection measures when considering a residential development.

As per EPA guidance note EPA 969/12, a site contamination auditor would need to be engaged to audit further assessment and design and implementation of management measures.

Refer also to the Statement of Limitations presented in Appendix S.

Definition of Acronyms

ACM	Asbestos Containing Material
AHD	Australian Height Datum
ARMCAZ	Agriculture and Resource Management Council of Australian and New Zealand
ASRIS	Australian Soil Resource Information System
AS	Australian Standard
ASS	Acid Sulfate Soil
ASC	Assessment of Site Contamination
BGL	below ground level
BTEX	benzene, toluene, ethylbenzene and xylenes (total)
CBD	Central Business District
COPC	Contaminants of Potential Concern
CH₄	Methane
CO	Carbon monoxide
CO₂	Carbon dioxide
CRC CARE	Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CT	Certificate of Title
DEW	Department of Environment and Water
DIT	Department of Infrastructure and Transport
DR	Draft Report
EPA	Environment Protection Authority
EP	Environment Protection
EPP	Environment Protection Policy
EPR	Environment Protection Regulations
FR	Final Report
GDA	Geocentric Datum of Australia
ha	hectares
IEI	Issue of Environmental Interest
km	kilometres
LWC	Land and Water Consulting
m	metres
m²	square metres
m³	square cubic metres
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
mg/L	milligrams per litre
µg/L	micrograms per litre
MAH	Monocyclic Aromatic Hydrocarbons
µg/m³	micrograms per cubic metre
NHMRC	National Health and Medical Research Council
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
OCP	Organochlorine Pesticide
OPP	Organophosphorus Pesticide
PACM	Potential Asbestos Containing Material
PASS	Potential Acid Sulfate Soil
PAH	Polycyclic Aromatic Hydrocarbons
PCA	Potentially Contaminating Activity
ppm	parts per million
PSI	Preliminary Site Investigation
SA EPA	South Australian Environment Protection Authority
SAQP	Sampling and Analysis Quality Plan
SAR	Site Assessment Report
SCAR	Site Contamination Audit Report
SVOC	Semi-volatile Organic Compound
SV	Soil Vapour
SWL	Standing Water Level
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
UBD	Universal Business Directory
USC	Unified Soil Classification

UST	Underground Storage Tank
VOC	Volatile Organic Compound
WQEP	Environment Protection (Water Quality) Policy

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1 INTRODUCTION

1.1 OVERVIEW

Land and Water Consulting (LWC) was engaged by Future Urban/Hallan Nominees to undertake an in-situ ground gas assessment following the completion of a Preliminary Site Investigation (PSI ¹) of the property located at 10-20 Halls Road, Highbury, South Australia (the Site – refer to Table 1-1). A site plan is attached.

The Site is situated within the Torrens River Catchment, approximately 14 km north-east of the Adelaide CBD, and comprises an area of approximately 1.85 hectares.

Table 1-1 Site Details

Parcel Identifier	Certificate of Title	Property Number	Street Name	Suburb
D17357A11	CT 5768/114	10-14	Halls Road	Highbury
D17357A12	CT 5768/115	16-20	Halls Road	Highbury

It is understood that the northern portion of the Site (Allotment 11) is currently in use for residential purposes whereas the southern portion is vacant and undeveloped – with respect to Table 1 of *State Planning Commission Practice Direction 14 (Site Contamination Assessment 2022)* (“Practice Direction 14”), the current use of the northern portion is aligned with *Item 1: Residential Class 1 – Domestic Residential* (defined as a sensitive land use in Section 3-1 of the *Environment Protection Act 1993*).

Despite its current use, the land is zoned as Extractive Industry – it is understood that Future Urban plan to apply for residential rezoning of the Site.

A closed landfill owned and managed by Veolia is present on the immediate southern boundary of the Site and a further larger landfill owned and managed by the Highbury Landfill Authority (HLA) is present to the south of this.

The PSI identified potentially contaminating activities (PCA) associated with the Site – these were largely assessed in a extensive soil investigation/delineation program undertaken 2008 – 2010, as well as limited groundwater and landfill gas investigations at such time. However it has been ~12 years since this work was completed but both the aerial imagery and the recent site inspection observations indicate that no major changes have occurred with respect to the layout and use of the Site. The previous assessment programs did identify the following:

1. localised surficial heavy metal contamination in the north-western corner;
2. aesthetically impacted fill material in the south-eastern corner; and
3. the presence of a former landfill immediately adjacent to the southern Site boundary where the concentrations of CO₂ in landfill gas may present a risk with respect to a sensitive land use.

Although two groundwater monitoring events were undertaken in 2008-09 (with respect to a single well located on the southern Site boundary), and there was some indication of ammonia impacts potentially associated with the adjacent landfill, the current status of groundwater beneath the Site is unknown.

¹ in accordance with Schedule B2 of the *National Environment Protection (Assessment of Site Contamination) Measure* (1999 as amended 2013) – the ASC NEPM (1999)

The most potentially limiting environmental factor on any future development is likely to be the gas associated with landfilling activities to the south of the Site.

1.2 OBJECTIVE

The objective of the assessment was to assess the ground gas regime on the Site in relation to the landfilling activities undertaken south of the Site with respect to a potential future sensitive use of the Site (residential development).

1.3 SCOPE OF WORKS

The in-situ ground gas assessment was prepared with reference to:

- *Card G, Wilson S & Mortimer S 2012, 'A Pragmatic Approach to Ground Gas Risk Assessment', CL:AIRE Research Bulletin, RB17, CL:AIRE, London, UK, www.claire.co.uk/component/phocadownload/category/11-research-bulletins?download=312:research-bulletin-17.*
- *CIRIA 1995, R152, Methane and Associated Hazards to Construction: Risk Assessment for Methane and Other Gases from the Ground, CIRIA, London, UK.*
- *CIRIA 2007, C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings, CIRIA, London, UK.*
- *NSW EPA (2020) Assessment and management of hazardous ground gases Contaminated Land Guideline*
- *Schedule B(2) – 'Guidelines on Site Characterisation' outlined in the National Environment Protection (Assessment of Site Contamination) Measure 1999;*
- *SA EPA (2019a) – Guidelines for the Assessment and Remediation of Site Contamination; and*

The scope of works was as follows:

1. Advance
2. Install three GasCLam 2 ('GasClam) constant gas logging units along the southern boundary i.e. screening the waste mass in the Veolia landfill (and the HLA landfill located further south). Monitoring for 30 days.
3. Check parameters on installation and recovering of GasClams (flow, gases, atmospheric pressure).

2 SITE DETAILS

2.1 IDENTIFICATION

A summary of Site particulars is presented as Table 2-1.

Table 2-1 Summary of Site Particulars

Site Location	10-14 and 16-20 Halls Road, Highbury, South Australia 5089
Property Description	The subject area of the Site is defined by the following Certificate of Titles: <ul style="list-style-type: none"> ▪ D17357AL11 Volume 5768 Folio 114 ▪ D17357AL12 Volume 5768 Folio 115 In the Area Named Highbury Hundred of Yatala Copies of the current CT are provided in Appendix B of the PSI.
Area of Site	Approximately 18,500 m ² (1.85 hectares)
Local Government Authority	City of Tea Tree Gully
Zoning	Resource Extraction (RE)
Current Site Usage	Northern portion – residential (sensitive land use) Southern portion – vacant
Ownership	<i>Hallan Nominees Pty Ltd</i>
Proposed Land Use	Re-zone to Residential

2.2 SITE SETTING

The current surrounding land uses are detailed in Table 2-2. Generalised land use is shown in Appendix C.

Table 2-2 Surrounding Land Uses

Boundary	Description of Surrounding Land Use
North	Residential properties
East	Former quarry, across Halls Road
South	Former landfills to immediate south (SITA/Veolia) and approximately 230 m south (Highbury Landfill Authority)
West	Residential properties

2.3 SITE DESCRIPTION

The Site comprises two allotments and slopes towards the south. Halls Road, to the east, provides access to the Site and is quite steep (refer also to Section 3.1).

Northern Allotment 11 hosts the following infrastructure:

- a two storey dwelling with garden areas that include children's outdoor play equipment;
- sheds;
- general inert materials associated with farming or earthmoving;
- two aboveground storage tanks (ASTs) understood to have been used as water tanks for dust suppression etc.; and
- an old caravan.

Southern Allotment 12 has not been subjected to any development/improvements and hosts healthy vegetation (grass, bushes, trees).

3 REGIONAL SETTING

3.1 TOPOGRAPHY & HYDROLOGY

As shown on the plans in Appendix D, the survey marks dataset (detailed on The Atlas of South Australia database) indicates that the northern boundary of the Site is located at an elevation of approximately 190 m Australian Height Datum (AHD) and the southern boundary is approximately 170 m AHD – i.e. a 1 in 8 gradient, decreasing from north to south across the Site. The land to the west is generally of similar elevation whereas, to the east, the land surface falls away sharply due to the presence of a former quarry. Further to the east, the land elevation increases due to the Adelaide Hills. The land surface in general decreases to around 140 m AHD at the bottom of Halls Road.

The nearest fresh surface water body to the Site is an unnamed creek to the north which flows from east to west, down through Anstey Hill and parallel with Barracks Road. This creek would be located hydraulically up-gradient of the Site, given the reasonably sharp fall in elevation from north to south. The former quarry to the east and south-east of the Site contains various water bodies that have accumulated within the open pits.

The closest marine surface water body to the Site is Gulf St Vincent, located over 20 km to the west.

3.2 GEOLOGY

The Department of Environment, Water and Natural Resources (DEWNR) surface geological map (1:100,000), indicates that the Site is underlain by undifferentiated Tertiary rocks (refer to Appendix E and Table 3-1). The upper lithology is known to comprise sands (refer to Figures 3-1 and 3-2) that were excavated for a sand and gravel business along Halls Road, resulting in excavations which were then sold off for use as landfills.

The Atlas of Australian Soils classifies these sands as Tc1, being:

- Hilly to steep hilly, small valley plains: hard acidic yellow mottled soils (Dy3.61) with shallow grey-brown sandy soils (Uc6.11) and rock outcrops in association with variable areas of (Dy3.41 and Dy3.42), (Dy3.22), (Dr2.12 and Dr2.22) on hills and hill slopes, and minor areas of (Dy3.61) containing ironstone gravel in the A horizons on some ridge tops; unclassified alluvial soils, peats (0), and acid swamp soils (0) in the wetter valleys.

As also included in Appendix E, the CSIRO Atlas of Australian Acid Sulfate Soils indicates that there is an extremely low probability (1-5%) of occurrence of acid sulfate soils.

Table 3-1 Geology of the Site and Surrounding Area

Name	Description	Parent Name	Province	Age	Distance (m)	Direction
Unnamed	Undifferentiated Tertiary rocks		Unknown	Tertiary	0	On-site
Stonyfell Quartzite	Quartzite, feldspathic, with shale interbeds; silty sandstone in part schistose and calcareous	Bungarider Subgroup	Adelaide Geosyncline	Neoproterozoic	306	East
Unnamed	Undifferentiated calcrete	Unnamed	Unknown	Pleistocene	769	West
Keswick Clay	Clay, smectite-rich, grey-green, with red or yellow mottling and rare sand lenses	Unnamed	St Vincent Basin	Pleistocene	833	West

Name	Description	Parent Name	Province	Age	Distance (m)	Direction
Woolshed Flat Shale	Shale, black; dolomitic siltstone; dolomite; grey laminated siltstone	Bungarider Subgroup	Adelaide Geosyncline	Neoproterozoic	901	East
Unnamed	Undifferentiated Quaternary rocks		Unknown	Pleistocene-Holocene	932	South-west

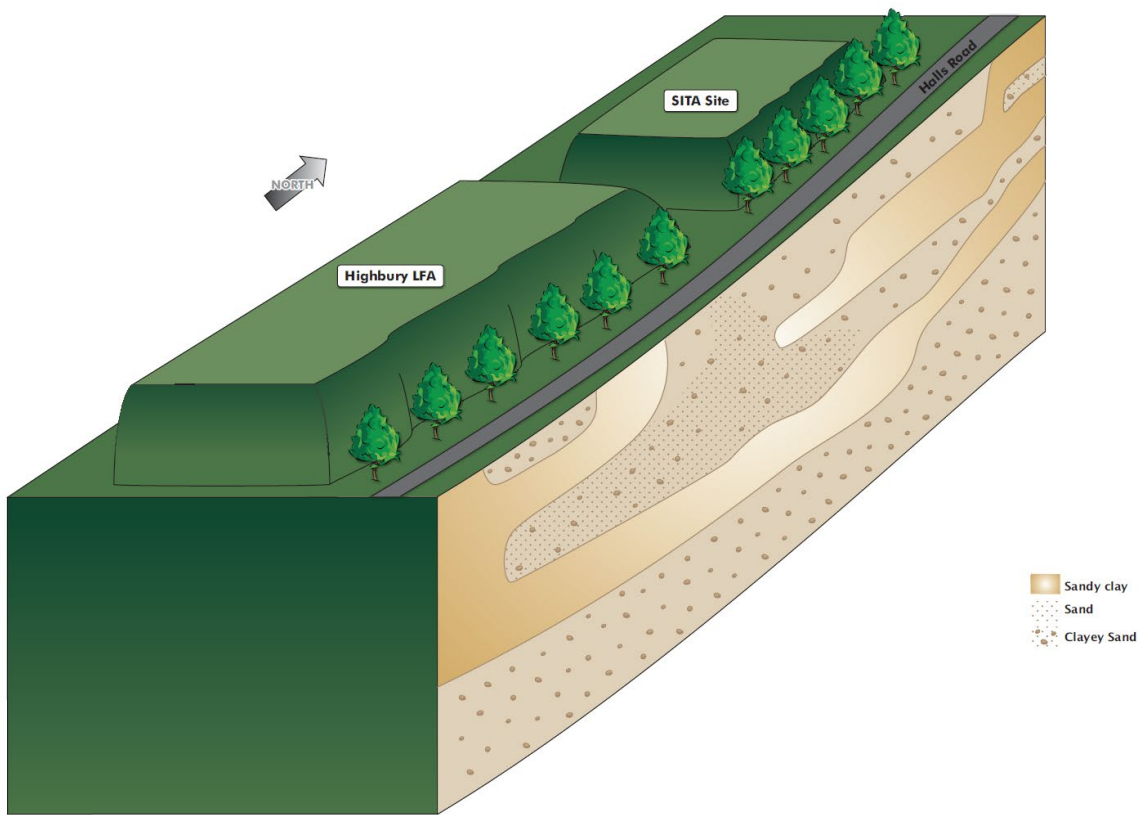


Figure 3-1 Conceptual Lithology (from SKM (2010)) – the Site is located to the immediate north of the “SITA site” (refer also to Figure 4-2)

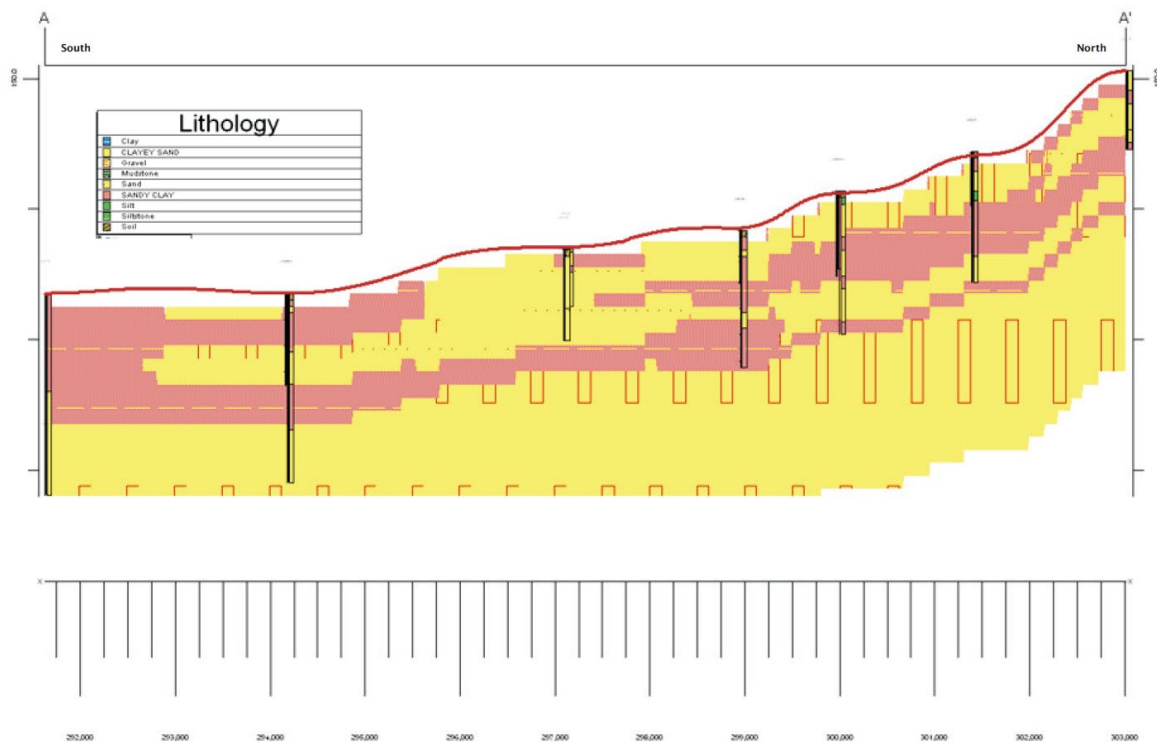


Figure 3-2 Geological Cross-Section from South to North (from SKM (2010))

3.3 HYDROGEOLOGY

The uppermost groundwater aquifer beneath the site comprises sedimentary rock basins, including cavernous limestone, sandstone, sand, shale and clay. Groundwater is expected to flow in a west to north-westerly direction, towards *Gulf St Vincent*, though there may be local complexities due to the quarrying activities in the area.

With reference to the DEW (2022) *WaterConnect* records (refer to Appendix F), the depth to the uppermost aquifer within the vicinity of the Site is expected to be ≥ 20 m below ground level (BGL). On-site monitoring well MW1_001 reported a depth to water of 27.568 m below the top of the PVC casing (BTOC – corresponding to 132.159 m AHD) in May 2008 and 27.625 m BTOC (132.102 m AHD) in November 2009.

The DEW (2022) *WaterConnect* database for a 2 km radius around the Site indicates that there are 227 registered bores, for which:

- recorded depths range from ~1 to 203.7 m BGL;
- standing water levels (SWLs) range from 1.2 to 103 m BGL;
- salinity values range from 171 to 7,479 mg/L total dissolved solids (TDS); and
- listed purposes (for groundwater bores) include:
 - domestic
 - domestic/stock
 - environmental, investigation, observation and monitoring
 - irrigation

- managed aquifer recharge;
- the closest domestic bore, listed as being 137 m south-west of the Site and installed to a depth of 50 m BGL in 1999, has a SWL of 38 m BGL and a salinity value of 1,434 mg/L TDS.

In addition to the above, there is one on-site monitoring well (MW01_001), drilled as part of a 2008 environmental investigation (refer to Section 4.6.2), that does not appear to be included in the *WaterConnect* database.

4 METHODOLOGY

4.1 MONITORING WELLS

A total of six new ground gas monitoring wells (MW1 – MW6, Figure 4-1) were installed on 13 – 14 January 2023, to a depth of 6 m BGL on Site (4 m screen) so as to screen the approximate depth of the waste mass in the Veolia landfill. The distribution of wells was based on broad front to screen the landfill (MW04 – MW06) with depth into the Site (MW01).



Figure 4-1 Well locations

Construction logs are held on file. Wells were capped with metal gatic lids (Figure 4-2).



Figure 4-2 MW02 post install

Three GasClam continuous gas monitors were installed in locations MW04, MW05 and MW06 along the southern boundary of the Site screening the Veolia landfill. Calibration certificates for these units are presented in Appendix B.

Deployment commenced on 18 January 2023 and recovered on 16 February 2023, i.e. a deployment duration of approximately 30 days.

The GasClams obtained the following parameters per hour over the deployment period:

- Gas concentrations – Methane (CH₄), Carbon Dioxide (CO₂), Oxygen (O₂), Hydrogen Sulphide (H₂S), Carbon Monoxide (CO).
- Borehole pressure.
- Atmospheric pressure.

- Temperature.

For data quality assurance measures ensuring calibration to the environment, recording of these parameters was undertaken separately using a supplier calibrated GA5000 Landfill Gas unit at deployment and recovery of the GasClam i.e., to “book end” the recording period. Readings were taken on deployment on 18 January 2023 and mid cycle on 27 January 2023.

The parameters recorded were as follows:

- Weather conditions at the Site, including atmospheric barometric pressure, were recorded at the start and end of monitoring.
- Concentrations of methane, carbon dioxide and oxygen (%v/v) reported by the gas analysers were recorded at 3 minutes of pumping until parameters were steady. Any higher gas concentrations observed during the 3-minute period were noted for reporting the maximum values observed.
- Data was recorded consistently in the following order of measurement in accordance with BS8576:2013:
 - Pressure in and gas flow from the well.
 - Ambient gas concentrations ('zeroed').
 - Gas concentrations – Methane (CH₄), Carbon Dioxide (CO₂), Oxygen (O₂), Hydrogen Sulphide (H₂S), Carbon Monoxide (CO).
 - Ambient temperature.
 - Atmospheric pressure.

4.2 ASSESSMENT CRITERIA

The trigger levels for landfill gas in monitoring bores at the boundary of a landfill facility or within the structures located on or off the Site are defined by the EPA as greater than 1% methane (v/v) and greater than 1.5% carbon dioxide (v/v) (EPA 2007 (updated 2019)). However this assessment was not designed or required to assess or address gas potentially associated with the landfill relative to EPA 2007 (updated 2019).

The following guidance was consulted and adopted:

- Wilson, S; Oliver, S; Mallett, H; Hutchings, H; Card, G (2007) Assessing risks posed by hazardous ground gases to buildings CIRIA C665, London, UK
- British Standard BS 8485:2015+A1:2019 (outlines a process for ground gas characterisation and hazard assessment that is substantially derived from CIRIA C665. While there are differences in emphasis (for example, with respect to using Data Quality Objectives (DQOs) and the centrality of a risk-based approach) these guidelines and BS8485:2015+A1:2019 are consistent in all significant areas).
- NSW EPA (2020) Assessment and management of hazardous ground gases - Contaminated Land Guideline

5 RESULTS

5.1 GROUND CONDITIONS

The ground conditions observed on 18 January 2023 are listed in Table 5-1. No indication of landfilled waste (putrescible) was encountered in any locations.

Table 5-1 Ground conditions encountered on boreholes for well installations

Location	Fill	Natural
MW01	Light brown gravelly silt to 0.5 m BGL	Gravelly sand/ sand grading from light brown to orange/ yellowish. White silt at 5 m BGL
MW02	Dark brown sand/ light brown gravelly silt with quartz fragments to 1.5 m BGL.	Sand, grading between yellow/ orange/ grey and white at depth. White silt at 5 m BGL
MW03	N/A	Cream sand/ gravelly sand. Brown, low plasticity clay at 2.0 m BGL with silty sand/ clayey sand at depth.
MW04	N/A	Fine to medium grain sand, grading from cream to brown/ orange. Brown/ orange silt at 3.5 m BGL becoming clayey sand at 4.0 m BGL.
MW05	Grey/ light brown gravelly silt to 3.0 m BGL.	Clay/ gravelly clay from 3.0 m BGL, becoming orange silt at 4.0 m BGL. Brown/ orange clayey sand/ sand at depth.
MW06	Cream/ blue gravel down to 1.0 m BGL. Becoming gravelly sandy clay with low to moderate plasticity down to 2.5 m BGL.	Gravelly sand/ sand clay/ clayey gravelly sand natural soils.

5.2 STATIC MONITORING

A calibrated GA5000 gas monitoring unit was used to record gas parameters on installation and mid cycle when checking GasClam batteries (Table 5-2). The results report no significant methane though carbon dioxide is prevalent, notably in two locations adjacent the landfill (MW05 and MW06) and also MW02; the

latter possibly being associated with buried fill on the Site rather than landfill, as MW02 is located back up the hill away from the landfill.

Maximum reported flow rate was 0.4 L/ hour.

Table 5-2 GA5000 check on MW01-MW06

Parameter	MW01	MW02	MW03	MW04	MW05	MW06
Install Atmospheric Pressure (mbar)	1000	1000	1000	1000	1000	1000
Battery Check Pressure	993	993	993	993	993	993
Retrieval Atmospheric Pressures (mbar)						
Install CH ₄ (%vol.vol)	0.0	0.0	0.0	0.0	0.0	0.0
Battery Check (%vol.vol)	0.0	0.0	0.0	0.0	0.0	0.0
Retrieval CH ₄ (%vol.vol)						
Install CO ₂ (%vol.vol)	2.6	12.1	3.0	1.7	9.0	6.2
Battery Check CO ₂ (%vol.vol)	4.6	12.3	6.6	2.9	10	9.2
Retrieval CO ₂ (%vol.vol)						
Install O ₂ (%vol.vol)	7.7	10.1	18.5	19.6	12.8	16.1
Battery Check O ₂ (%vol.vol)	6.7	8.2	13.6	16.6	9.9	10.5
Retrieval O ₂ (%vol.vol)						
Install H ₂ S (%vol.vol)	1	0	0	0	6	0

Parameter	MW01	MW02	MW03	MW04	MW05	MW06
Battery Check H ₂ S (%vol.vol)	1	1	2	1	0	0
Retrieval H ₂ S (%vol.vol)						
Maximum Flow (L/hr)	0.2	0.2	0.2	0.2	0.4	0.3

5.3 GASCLAM LOGGING DATA

A summary of the GasClam results is presented as Table 5-3.

Table 5-3 GasClam parameters and maximum/ minimum values

Parameter	MW04	MW05	MW06
Installation Date	18 January 2023	18 January 2023	18 January 2023
Retrieval Date	16 February 2023	16 February 2023	16 February 2023
Deployment Duration			
No. of Data Points	961	961	961
Calibrated by Supplier (Airmet)	Yes	Yes	Yes
Maximum Atmospheric Pressure (mbar)	1001	1001	1001
Average Atmospheric Pressure (mbar)	991.5	991.5	991.5
Lowest Atmospheric Pressures (mbar)	981	981	981
Maximum CH ₄ (%vol.vol)	0.1	0.0	0.2
Lowest CH ₄ (%vol.vol)	0.0	0.0	0.0
Maximum CO ₂ (%vol.vol)	6.0	13.7	15.6
Lowest CO ₂ (%vol.vol)	0.0	0.0	0.1
Maximum O ₂ (%vol.vol)	20.4	20.8	20.3
Lowest O ₂ (%vol.vol)	15.3	0.0	0.0
Maximum H ₂ S (ppm)	0.0	0.9	0.3
Lowest H ₂ S (ppm)	0.0	0.0	0.0
Maximum CO (ppm)	0.0	43.3	4.8
Lowest CO (ppm)	0.0	0.0	0.0

Parameter	MW04	MW05	MW06
Maximum Temperature °C	28		
Lowest Temperature °C	19.3		

Graphical representation of the GasClam data is presented in Figures 5-1 to 5-3. The data from MW04 (Figure 5-1) shows a distinct inverse relationship between carbon dioxide and atmospheric pressure: when the pressure increases, the CO₂ decreases and vice versa. This phenomenon is often observed in gases associated with landfill sources. When the atmospheric pressure is high the gas is pushed back or closer into the ground/ source, and when the pressure reduces the gas moves up or away from source.

A similar association is evident in MW06 (Figure 5-3) though less so in MW05 (Figure 5-2).

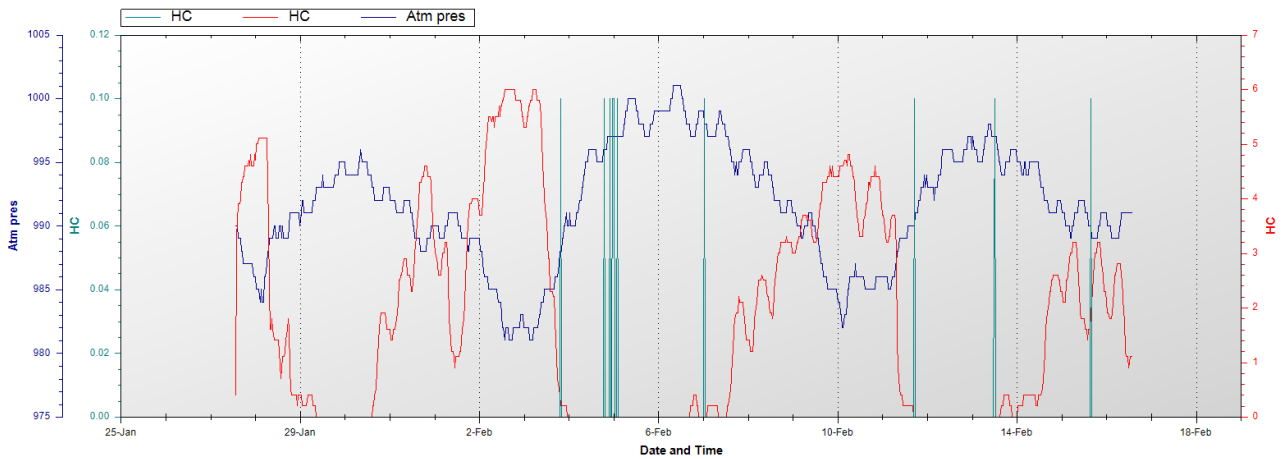


Figure 5-1 MW04 (HC Red = Carbon Dioxide, HC Green = Methane, Atm Blue = Atmospheric Pressure):

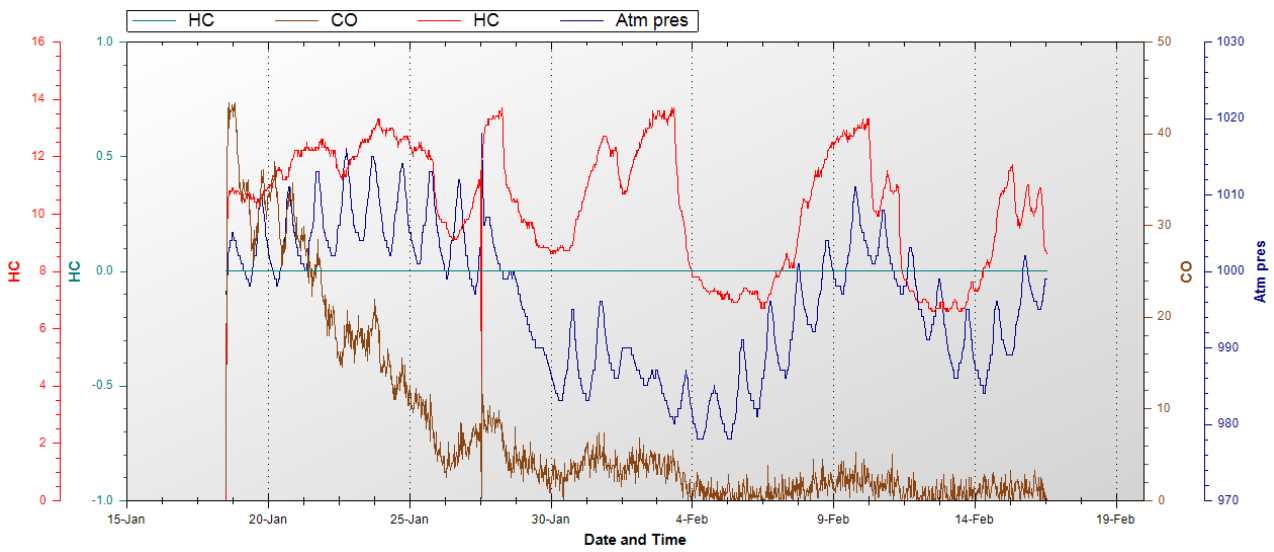


Figure 5-2 MW05 (HC Red = Carbon Dioxide, HC Green = Methane, CO Brown = Carbon monoxide, Atm Blue = Atmospheric Pressure)

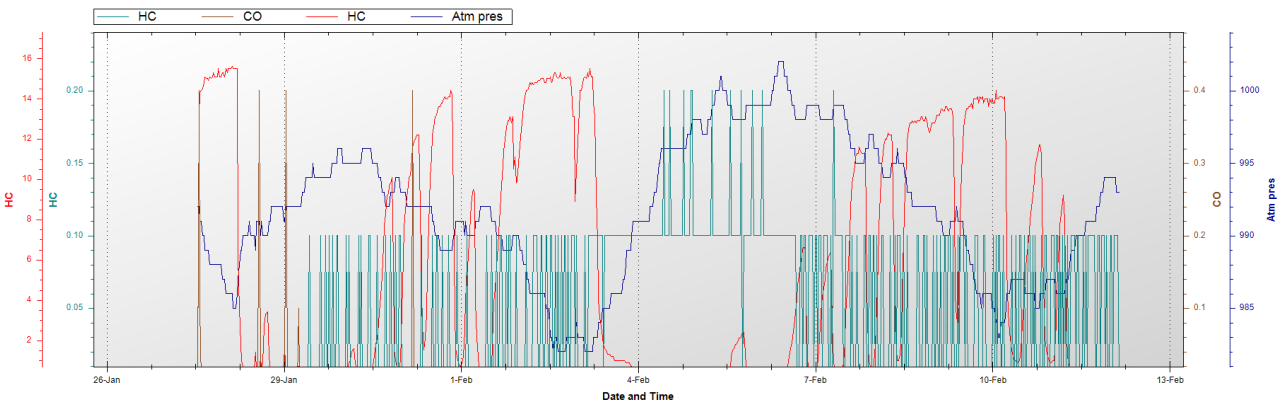


Figure 5-3 MW06 (HC Red = Carbon Dioxide, HC Green = Methane, CO Brown = Carbon monoxide, Atm Blue = Atmospheric Pressure):

6 LANDFILL DATA

Landfill gas data for the landfill immediately south was obtained from Veolia for May 2022 (Appendix C). The results are spot checks using a GA5000 or similar. The results for May 2022 do not show any methane, though carbon dioxide is significant and reported up to 22.3 %v/v around the periphery of the landfill.

Flow rate was not reported. Atmospheric pressure was not reported.

7 RISK ASSESSMENT

7.1 REVIEW OF NATURE OF DEVELOPMENT

Presumed proposed occupied spaces would be residential in nature.

Schedule B7 of the National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM) describes four generic land-use scenarios (Health Investigation Level (HILs) A, B, C and D) that form the basis for the HILs and Health Screening Levels (HSLs) developed for soil and soil vapour contamination. These are:

HIL A – residential with a garden or accessible soil; childcare centres and primary schools

HIL B – residential with minimal opportunities for soil access; secondary schools

HIL C – public open spaces and recreation areas

HIL D – commercial and industrial premises.

HILs A, B and D are generally relevant to buildings, with construction of buildings (such as clubhouses and toilets) within an HIL C scenario being a special case. The risks associated with direct exposure to contaminated soil were a primary consideration in the definition of the HIL scenarios; there is a partial but not full correlation with the risks due to exposure to ground gases. BS 8485:2015+A1:2019 describes four building types (types A, B, C and D) that form the basis for selecting ground gas protection measures in the UK. These are:

Type A building – private ownership with no building management controls on alterations to the internal structure, the use of rooms, the ventilation of rooms or the structural fabric of the building; some small rooms present.

Type B building – private or commercial properties with central building management control of any alterations to the building or its uses but limited or no central building management control of building maintenance, including the gas protection measures; multiple occupancy; small- to medium-sized rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas.

Type C building – commercial buildings with central building management control of any alterations to the building or its uses and central building management control of building maintenance, including the gas protection measures; single occupancy of ground floor and basement areas; small- to large-sized rooms with active ventilation or good passive ventilation of all rooms and other internal spaces throughout ground floor and basement areas.

Type D building – industrial-style buildings having large volume internal space(s) that are well ventilated; corporate ownership with building management controls on alterations to the ground floor and basement areas of the building and on maintenance of ground gas protective measures.

Australia has developed styles of building construction, occupancy and use that accord with the local climate and lifestyles, which differ in some respects from those common in the UK. For the purpose of the NSW EPA (2020) guidelines, five types of building have been defined. These are:

Low-density residential – usually but not exclusively single-storey dwellings on a separate land title (commonly Torrens title) with single occupancy; no building management and no post-occupancy controls on room use, ventilation or alterations to the internal structure; limited controls on building design and construction due to exempt and complying development provisions in NSW; construction for new buildings is predominantly slab-on-ground, but also suspended floors with crawl space and partial or full basements, particularly on

sloping sites; correlates closely with residential component of HIL A and with BS 8485:2015+A1:2019 Type A, but the median size (footprint area) of new houses in Australia is significantly larger than in the UK.

medium- and high-density residential – multiple-occupancy low-, medium- or high-rise townhouses and apartments; usually on a strata title and subject to by-laws, with maintenance of the external structure of the building and common areas managed and controlled by an owner’s corporation; includes some public housing and some mixed-occupancy developments, and developments with commercial occupancy of the ground floor; frequently includes basement or undercroft car parking; may involve ground-bearing or piled foundations; usually air-conditioned, with active ventilation of basement car parking; correlates reasonably well with HIL B and partially with BS 8485:2015+A1:2019 Type B.

public buildings, schools, hospitals and shopping centres – similar in many respects to standard commercial buildings; generally low- to medium-rise rather than high-rise; particular constraints regarding building evacuation in an emergency; frequently includes basement or undercroft car parking; may involve ground-bearing or piled foundations; almost always air-conditioned, with active ventilation throughout (does not apply to many existing schools); correlates generally with HIL D but includes primary schools and childcare centres, which are HIL A; correlates partially with BS 8485:2015+A1:2019 Type C.

standard commercial buildings – includes offices and some shops, industrial subdivisions and smaller showrooms; building management control of any alterations to the building or its uses and central building management control of building maintenance, including gas protection measures; single or multiple occupancy of ground floor and basement areas; frequently includes basement or undercroft car parking; may involve ground-bearing or piled foundations; small to large-sized rooms with active ventilation or air-conditioning in all buildings, except those on industrial subdivisions, which will have good passive ventilation; correlates generally with HIL D and BS 8485:2015+A1:2019 Type C.

large commercial and industrial buildings – includes warehouses, most factories, big-box retail stores, large showrooms, and hardware or garden centres; characterised by large, open, high-volume buildings; often single-storey; may have basement, roof, or exterior parking; corporate ownership, owner-occupied or leased; generally easy evacuation; may involve ground-bearing or piled foundations; correlates well with HIL D and BS 8485:2015+A1:2019 Type D.

For the purposes of this assessment, we consider that future development would comprise BS 8485:2015+A1:2019 Type A (**low density residential in NSW EPA 2020**).

7.2 DETERMINING THE GAS SCREENING VALUE

For bulk ground gases, the approach to Level 2 risk assessment is based on the method proposed by Wilson and Card (1999) and outlined in CIRIA C665 and BS 8485:2015+A1:2019. The objective is to assess risks to buildings (and their occupants) constructed, or intended to be constructed, on the site; the approach applies regardless of the gas source, but the results must be interpreted in the context of the CSM.

The Wilson and Card method uses both gas concentrations and borehole flow rates to define a characteristic situation (CS) for a site based on the limiting borehole gas volumetric flow for methane and carbon dioxide, as measured in the gas monitoring boreholes on the site. The measured borehole flow rates represent gas flow through the surface of the site, forming the basis for this approach. The gas flow from a 50-mm borehole is, very conservatively, assumed to represent the upward flow of gas through soil across a site surface area of 10 square metres (m²) (Pecksen 1986).

CIRIA C665 and BS 8485:2015+A1:2019 use the term ‘gas screening value’ (GSV) for the site representative value assessed from the set of limiting borehole gas volumetric flow measurements. GSV is also used in these guidelines. GSV uses units of litres of gas per hour (L/hr).

$$\text{GSV} = \text{maximum borehole flow rate (L/hr)} \times (\text{maximum gas concentration (\% v/v)/100})$$

For example, if data from site monitoring indicated a maximum flow rate of 3.5 L/hr and a maximum methane concentration of 20% v/v, the site would have a methane GSV of 0.7 L/hr ($20/100 \times 3.5$).

The GSV is an overall site value, not an individual borehole value or an event value. As is the case for other aspects of contaminated land assessment and management, a large site may be stratified (subdivided) where it is appropriate to do so and the rationale underpinning the stratification is explained. A GSV may then be calculated for each subdivision. The rationale must reflect the gas regime and engineering considerations.

The calculation is carried out for both methane and carbon dioxide, and the worst-case value is adopted.

The assumption of equivalence between methane and carbon dioxide is made on the basis that the LEL for methane in air is similar to the concentration at which carbon dioxide becomes acutely toxic in air (5% v/v). Because ground gas with a high carbon dioxide content is denser than air and may remain segregated at low points, particularly in basements and other in-ground structures, this is a reasonable precautionary approach. However, experience in NSW has indicated that it may sometimes produce over-conservative outcomes, as has been the case elsewhere. It is, therefore, appropriate to review the outcome of a Level 2 risk assessment against the CSM, taking into account source and pathways factors, and the details of the current or proposed development.

7.3 DETERMINING THE CHARACTERISTIC SITUATION (CS)

The CS classification was derived by Wilson and Card and is determined directly from the GSV – it is used in NSW EPA (2020) (Table 10-4).

Where the CS is 1, no further action is required.

Where the CS is 2 or 3, gas protection measures are required. Appropriate gas protection measures for the site should be selected as outlined in Section 5 of these guidelines.

Where the CS is 4, gas protection measures are required, and the need for a Level 3 risk assessment should be considered. If a Level 3 risk assessment is not considered necessary, the reasons for this decision should be documented, and appropriate gas protection measures for the site should be selected, as outlined in Section 5 of these guidelines.

Where the CS is 5 or 6, gas protection measures are required, and a Level 3 risk assessment must be carried out to assess the maximal risk, inform the design of gas protection measures and determine the residual risk following implementation of those measures.

If it is considered appropriate to modify the CS based on a weight-of-evidence approach, an initial CS should be determined in the usual way. That value should then be adjusted based on the evidence presented, ensuring the adjustment is fully justified. It is not expected that the CS would be adjusted up or down by more than one unit (NSW EPA, 2020).

Table 7-1 Copy of Table 7 from NSW EPA (2020)

Table 7 Modified Wilson and Card classification

GSV threshold (L/hr)	CS	Risk classification	Additional factors	Typical sources
<0.07	1	Very low risk	Typically, methane <1% v/v and/or carbon dioxide <5% v/v; otherwise consider increase to CS 2	Natural soils with low organic content Typical fill
<0.7	2	Low risk	Borehole flow rate not to exceed 70 L/hr; otherwise consider increase to CS 3	Natural soils with high organic content Recent deep fill
<3.5	3	Moderate risk		Old inert waste landfill Flooded mine workings
<15	4	Moderate to high risk	Consider need for Level 3 risk assessment	Mine workings susceptible to flooding Closed putrescible waste landfill
<70	5	High risk	Level 3 risk assessment required	Shallow, unflooded abandoned mine workings
>70	6	Very high risk		Recently used putrescible waste landfill

1. Site characterisation should be based on monitoring of gas concentrations and borehole flow rates for the minimum periods defined in Section 3.4.
2. The CSM must identify the source of gas and its generation potential.
3. Soil gas investigations should be conducted in accordance with the guidance provided in Section 3.4.
4. Where there is no detectable flow, the lower measurement limit of the instrument should be used.
5. To determine a GSV of <0.07, instruments capable of accurately measuring concentration to 0.5% v/v and flow to 0.1 L/hr are recommended.

The onsite ground gas comprises carbon dioxide at a maximum volume of 15.6 % v/v with a maximum flow rate of 0.4 L/hr. This provides a GSV of 0.06. This equals CS1 however as CO₂ exceeds 5 %v/v then CS2 is applicable.

Methane was reported at a maximum of 0.2% and so carbon dioxide takes precedent in the GSV calculations.

Offsite the CO₂ was reported at 22.3% v/v but no flow rate was reported so a CS cannot be calculated.

7.4 GAS PROTECTION VALUES

The CS obtained on site (CS2), and the maximum CO₂ reported offsite and the nature of the existing buildings or proposed development on the site can be used to obtain an appropriate gas protection guidance value from Table 8 of NSW EPA (2020) (reproduced as Table 7-2 below).

Table 7-2 Copy of Table 8 from NSW EPA (2020)

Table 8 Guidance values for gas protection

CS	Required gas protection guidance 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

^(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.

Assuming CS2, and low density residential building categorisation, the gas protection guidance value is 3.

7.4.1 PROTECTION MEASURES

When a guidance value has been obtained from Table 8 of NSW EPA (2020), proposed gas protection measures, and combinations of measures, may be evaluated using the scores listed in Table 9 of NSW EPA (2020). A combination of two or more protection measures (no more than one of each type) that are appropriate for the site conditions must be selected so that the combined score equals or exceeds the required guidance value.

NSW EPA (2020) notes that at a minimum, it is good practice to install ventilation in all foundation systems to relieve pressure. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain performance.

A range of protection measures can be considered if required.

Table 7-3 Copy of Table 9 from NSW EPA (2020) – scores for protection measures

Measure or system element	Score	Comment
Venting or dilution measures		
Passive sub-floor ventilation with very good performance – the steady-state concentration of methane over 100% of the ventilation layer remains below 1% v/v at a wind speed of 0.3 metres per second (m/s) ^(a)	2.5	The design of the venting layer (i.e. granular medium with inlet/outlet pipes versus open-void or modular drainage system)(b) must be considered when modelling steady-state concentrations
Passive sub-floor ventilation with good performance – the steady-state concentration of methane over 100% of the ventilation layer remains below 1% v/v at a wind speed of 1 m/s and below 2.5% v/v at a wind speed of 0.3 m/s) ^(a)	1.5	If post-installation testing of passive ventilation indicates that it cannot meet this requirement, inlets and outlets must be upgraded. If this is unsuccessful, it will be necessary to retrofit an active system
Sub-floor ventilation with active abstraction or pressurisation	2.5	Not appropriate for NEPM HIL A residential settings because robust management systems, including alarms, must be in place to ensure long-term operation and maintenance. Achieving the full score requires a design with adequate redundancy and full coverage of the building footprint.
Ventilated car park (basement or undercroft)	4.0 (d)	Assumes that the car park is vented to deal with exhaust fumes in accordance with BCA ^(c) requirements. The design of a car-park and the specifications of its ventilation system need to be considered in assigning an appropriate score of up to four.
Horizontal soil barriers beneath building footprint		
Horizontal clay or amended soil barriers designed to achieve defined permeability and diffusivity of the gases of concern placed, compacted and tested under appropriate engineering supervision	(d)	Requires appropriate engineering input and integration with the building design from the earliest possible stage. This must consider the effects of any proposed piling on the gas regime
Floor Slabs		
Reinforced concrete ground-bearing floor slab or waffle pod slab	0.5	At a minimum, it is good practice to install ventilation in all foundation

Measure or system element	Score	Comment
Reinforced concrete ground-bearing foundation raft slab with limited service penetrations cast into slab	1.0	systems to relieve pressure. Breaches in floor slabs, such as joints, have to be effectively sealed against gas ingress to maintain performance.
Reinforced concrete cast in situ or post-tensioned suspended slab with minimal service penetrations and water bars around all penetrations and at joints	1.5	
Fully tanked basement	2.0	The design of a basement and the specifications of its ventilation system need to be considered in assigning an appropriate score. Fully tanked means designed to be waterproof under the range of groundwater conditions likely at the site, to the extent that supplementary internal drainage is not required.
Membranes		
Proprietary gas-resistant membrane with a gas transmission rate for the gases of concern on the site that is certified and appropriate to the overall design of the gas protection system. It should be installed by a specialist to an appropriate level of workmanship with documented internal CQC, including integrity testing (e.g. tracer gas or smoke testing), under independent CQA carried out by a certified specialist(e) or appropriately qualified and experienced professional with independent verification of the entire process ^(f)	2.0	Membrane performance depends on the membrane material and thickness specified, design and quality of the installation, protection from and resistance to damage after installation, and the integrity of joints in membranes that require joints. Materials that offer some degree of self-sealing and repair are preferred. Long term performance depends on the durability of the material, including its resistance to chemical degradation in the environment in which it is installed.
Monitoring and detection		
Intermittent monitoring using hand-held equipment	0.5	Monitoring and alarm systems are only valid as part of a combined gas protection system. Where fitted, permanent systems should be installed in the underfloor venting system but can also be provided in the occupied space as a back-up
Permanent monitoring system installed in the occupied space of the building	1.0	
Permanent monitoring system installed in the underfloor venting or dilution system	2.0	

Measure or system element	Score	Comment
Pathway intervention external to building footprint		
Vertical barriers	(g)	Required for residential and public buildings at CS 4 and above
Vertical venting system	(g)	
<ul style="list-style-type: none"> (a) Verified by post construction monitoring (b) Refer Appendix 6 of NSW EPA (2020) (c) Building Code of Australia (d) Score depends on site specific conditions and design (e) For example, Geosynthetic Certification Institute (f) Refer Appendix 7 of NSW EPA (2020) (g) Score depends on site specific conditions and design, but scores of 4.0+ should be achievable 		

8 DISCUSSION AND CONCLUSIONS

8.1 GROUND GAS CHARACTERISATION

The objective of the in situ ground gas assessment was to characterise the ground gas at the Site in association with varying atmospheric pressures. This was achieved using GasClam continuous ground gas loggers. The ground gas does show variability as a function of atmospheric pressure. The lowest pressure recorded was 981 mb – this is considered a suitably low pressure to represent a worst case ground gas regime.

The characteristic situation (CS) for ground gas beneath the Site is driven by carbon dioxide – the 2023 monitoring plus previous 2008-2010 data and data obtained from Veolia for May 2022 regarding landfill monitoring bores (around the periphery of the landfill) indicates methane is not present – it is not clear as to whether the landfill is in Phase II or has passed Phase IV based on carbon dioxide being dominant. If in Phase II then methane may start to be generated at some point in the future (Figure 8-1).

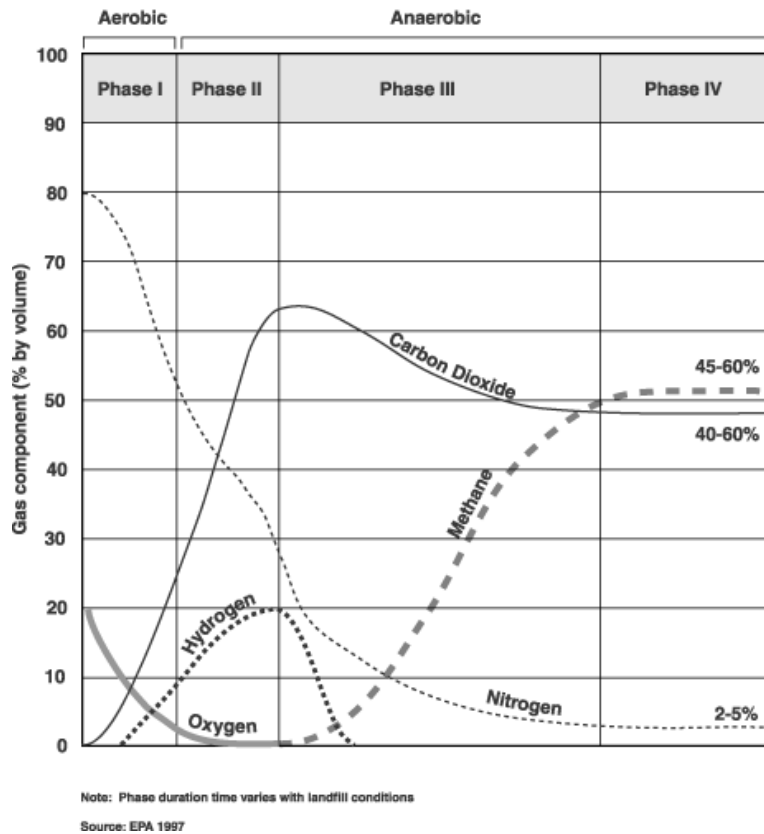


Figure 8-1 Production phases of typical landfill gas (ATSDR 1998)

The rate and volume of landfill gas produced at a specific site depend on the characteristics of the waste (e.g., composition and age of the refuse) and a number of environmental factors (e.g., the presence of oxygen in the landfill, moisture content, and temperature).

Waste composition. The more organic waste present in a landfill, the more landfill gas (e.g., carbon dioxide, methane, nitrogen, and hydrogen sulfide) is produced by the bacteria during decomposition. The more chemicals disposed of in the landfill, the more likely NMOCs and other gases will be produced either through volatilization or chemical reactions.

Age of refuse. Generally, more recently buried waste (i.e., waste buried less than 10 years) produces more landfill gas through bacterial decomposition, volatilization, and chemical reactions than does older waste (buried more than 10 years). Peak gas production usually occurs from 5 to 7 years after the waste is buried.

Presence of oxygen in the landfill. Methane will be produced only when oxygen is no longer present in the landfill.

Moisture content. The presence of moisture (unsaturated conditions) in a landfill increases gas production because it encourages bacterial decomposition. Moisture may also promote chemical reactions that produce gases.

Temperature. As the landfill's temperature rises, bacterial activity increases, resulting in increased gas production. Increased temperature may also increase rates of volatilization and chemical reactions. The box on the following page provides more detailed information about how these variables affect the rate and volume of landfill gas production.

These are all variable that will affect the type and magnitude of gas generated and emitted by the landfill over time.

8.2 CHARACTERISTIC SITUATION

The Characteristic Situation (CS) is driven by carbon dioxide and is calculated as CS₂ on the basis that carbon dioxide in the ground exceeds 5% vol/vol (maximum is 15.6%). Offsite CO₂ was reported as 22.2% v/v.

8.3 LIKELY REQUIREMENTS

Given the ambiguous gas profile associated with the landfill, as to current and future gas composition and the CS₂ determination, further risk assessment is likely required coupled with possible ground gas protection measures when considering a residential development.

As per EPA guidance note EPA 969/12, a site contamination auditor would need to be engaged to audit further assessment and design and implementation of management measures.

Refer also to the Statement of Limitations presented in Appendix S.

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SITE PLAN

Site Diagram

10-20 Halls Road, Highbury, SA 5089



Legend Site Boundary Internal Parcel Boundaries	Total Area: 18428m ² Total Perimeter: 560m	Scale:
	Disclaimers: Measurements are approximate only and may have been simplified or smaller lengths removed for readability. Parcels that make up a small percentage of the total site area have not been labelled for increased legibility.	Data Source Aerial Imagery: © Aerometrex Pty Ltd
		Date: 24 May 2022

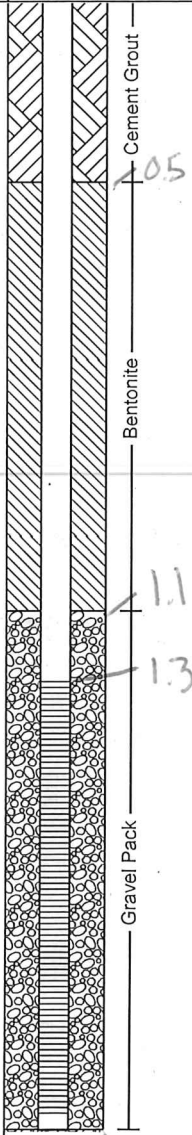
APPENDIX A

GEOLOGICAL & SOIL INFORMATION

GAS MONITORING WELL CONSTRUCTION LOG - MW06

PROJECT NUMBER 00-01	DRILL RIG	GRAVEL PACK 1.1-6.0m
PROJECT NAME	DRILLING METHOD Solid Auger	CASING 0-1.3
CLIENT	TOTAL DEPTH 6m BCL	SCREEN 1.3-6.0m
DRILLING DATE 13/1/23	DRILL DIAMETER 120mm	STICK UP N/A (Latic)
DRILLING COMPANY A&S	CASING DIAMETER 50mm	COORDINATES
DRILLER Andrew and Jeff	SLOT APERTURE	COORD. SYS.

LOGGED BY **A Vaughan**

Depth (m)	Well Installation	Graphic Log	Lithology	Samples	Moisture	Consistency	PID	Comments
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5		<p style="text-align: center;">F</p> <p style="text-align: center;">N</p> <p style="text-align: center;">N</p>	<p>0 Gravel, cream/blue, gravels up to 30mm in ϕ (angular), some clays stuck to gravels, no odour or staining.</p> <p>-1.0 Crawnelly sandy clay, low ^{med} plast, dark brown, gravels up to 10mm in ϕ, some fine sands, no o/s</p> <p>-1.5 qr sa clay, l-m plast, brown, fine qr sa, qr up to 10mm in ϕ, no o/s</p> <p style="text-align: center;">↓</p> <p>6.0 Crawching slightly lighter w/ depth + med plast clay</p> <p>-2.5 Cw sand, orange, f-m qr, qr < 5mm in ϕ, some mod plast clay content, no o/s</p> <p>-3.5 sa clay, l-m plast, d brown, fqr sa, no o/s</p> <p>-4.0 Cl qr sand, br, f-c grains, l-m plast clays, qp up to 10mm in ϕ, no o/s</p> <p>- less gravel content and mod plast clays</p>	<p>0-0.5</p> <p>1.0</p> <p>1.5</p> <p>2.0</p> <p>2.5</p> <p>3.0</p> <p>3.5</p> <p>4.0</p> <p>4.5</p> <p>5.0</p> <p>5.5</p> <p>6.0</p>	<p style="text-align: center;">D</p> <p style="text-align: center;">↓</p>	<p>L</p> <p>L</p> <p>L</p> <p>L/S</p> <p>L</p> <p>L/H</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p> <p>L</p>		

@ 5m BCL ↓
EOH @ 6m BCL



GAS MONITORING WELL CONSTRUCTION LOG - MW05

PROJECT NUMBER: 00-01	DRILL RIG: <i>Freezing</i>	GRAVEL PACK: 0-11
PROJECT NAME: <i>Highway</i>	DRILLING METHOD: <i>sand Augers</i>	CASING: 0-13
CLIENT:	TOTAL DEPTH: 6 m BCL	SCREEN: 1.3-6.0
DRILLING DATE: 13/1/23	DRILL DIAMETER: 120 mm	STICK UP: NA
DRILLING COMPANY: ALS	CASING DIAMETER: 50 mm	COORDINATES:
DRILLER: <i>Andrew and Jeff</i>	SLOT APERTURE:	COORD. SYS.:

LOGGED BY: *A Vaughan*

Depth (m)	Well Installation	Graphic Log	Lithology	Samples	Moisture	Consistency	PID	Comments
0.0	Cement Grout	F	Cravey silt, grey, gravel up to 8 mm in ϕ , no o/s	0	D	L		
0.5				0.5				
1.0				1.0				
1.0	Bentonite	N	gr silt, light grey, up to 18 mm in ϕ , no o/s	1.5				
1.5				2.0				
2.0				2.5				
2.5	Gravel Pack	N	-3.0 clay, orange/brown, L-m plast, no o/s	3.5		L/F		
3.0				4.0				
3.5				4.5				
4.0				5.0				
4.5				5.5				
5.0				6.0				
5.5								

↓ clay content
EOT @ 6.0m BCL

GAS MONITORING WELL CONSTRUCTION LOG - MW04

PROJECT NUMBER 00-01	DRILL RIG EZY-Rock	GRAVEL PACK 1.1-6.0
PROJECT NAME Highway	DRILLING METHOD Solid Auger	CASING 0-1.1
CLIENT	TOTAL DEPTH 6m	SCREEN 1.3-6.0
DRILLING DATE 13/1/23	DRILL DIAMETER 120mm	STICK UP N/A
DRILLING COMPANY ARS	CASING DIAMETER 50mm	COORDINATES Gotic
DRILLER Andrew and Jeff	SLOT APERTURE	COORD. SYS. -

LOGGED BY A Vaughan

Depth (m)	Well Installation	Graphic Log	Lithology	Samples	Moisture	Consistency	PID	Comments
0.0		Z	Sand, cream, f-m gr, no o/s	0	D	L		
0.5		Z		0.5				
1.0		Z	Sand, brown/orange, f-m gr, no o/s	1.0				
1.5				1.5				
2.0				2.0				
2.5				2.5				
3.0			SILT, brown/orange, no o/s	3.0				
3.5				3.5				
4.0			Clayey sand, brown/orange, f-m gr, l-med plast clays, no o/s	4.0				
4.5				4.5				
5.0				5.0				
5.5				5.5				
6.0				6.0				

GAS MONITORING WELL CONSTRUCTION LOG - MW03

PROJECT NUMBER	DRILL RIG	GRAVEL PACK 1.1-5.0
PROJECT NAME	DRILLING METHOD	CASING
CLIENT	TOTAL DEPTH 6m BCL	SCREEN
DRILLING DATE	DRILL DIAMETER	STICK UP
DRILLING COMPANY	CASING DIAMETER	COORDINATES
DRILLER	SLOT APERTURE	COORD. SYS.

LOGGED BY

Depth (m)	Well Installation	Graphic Log	Lithology	Samples	Moisture	Consistency	PID	Comments
0			Sand, cream, f-m grains, no o/s	0	D	L		
0.5				0.5				
1.0			gravelly sand, cream, f-m gr, gravels up to 10mm ind some	1.0				
1.5			fragments present, no o/s	1.5				
2.0			cracking darker w/ depth @ 1.5m BCL	2.0				
2.5				2.5				
3.0			clay, brown, l-m plast, some gr up to 5mm in sl present, no o/s	3.0				
3.5				3.5				
4.0			cracking to red w/ depth / dark brown	4.0				
4.5			s, sand, light br/cream, f-m gr some clay content present, no o/s	4.5				
5.0				5.0				
5.5			clayey sand, brown, f-m gr, l-m plast clays, no o/s	5.5				

↓
EOH @ 6.0m BCL

GAS MONITORING WELL CONSTRUCTION LOG - MW0 2

PROJECT NUMBER	DRILL RIG	GRAVEL PACK
PROJECT NAME	DRILLING METHOD	CASING
CLIENT	TOTAL DEPTH 6m	SCREEN
DRILLING DATE	DRILL DIAMETER	STICK UP
DRILLING COMPANY	CASING DIAMETER	COORDINATES E:
DRILLER	SLOT APERTURE	COORD. SYS. N:

GDA 2020

LOGGED BY S Wilcocke

Depth (m)	Well Installation	Graphic Log	Lithology	Samples	Moisture	Consistency	PID	Comments
0.5	Cement Grout	F	Sand, dk brown, fine grain trace gravels < 5mm, no o/s	0	D	S		Constructed as per Sp (MHO)
1.0		↓	Gravelly sand, Silt, light brown grading orange with depth	0.5 1.0 1.5 2.0	↓	↓		
1.5	Bentonite	N	quartz fragments fine grain nodules	2.5 3.0	↓	↓		Natural Gravelly Sand orange fine grain no o/s
2.0		↓	Sand, yellow grading orange then light grey @ 3m	3.5 4.0 4.5	↓	↓		
2.5		↓	M-C grain (nodules) trace clay at 2.5	5.0 5.5	↓	↓		
3.0		↓	becoming orange again at 3.5 with grey sand nodules	6.0	↓	↓		
3.5	Gravel Pack	↓	some finer grains at 3.5m					
4.0		↓	trace mica at 4.0m					
4.5		↓	grading light brown with white sand					
5.0		↓	5.0 pockets at 4.5					
5.5		↓	Silt, white, no o/s brown sand nodules					

5.5 sand, orange, M-C grain no o/s

EOL @ 6m



GAS MONITORING WELL CONSTRUCTION LOG - MW0 1

PROJECT NUMBER	DRILL RIG <i>Ezi probe</i>	GRAVEL PACK <i>1.1 - 6m</i>
PROJECT NAME	DRILLING METHOD <i>SOLIDS</i>	CASING <i>0 - 1.3m</i>
CLIENT	TOTAL DEPTH <i>6m</i>	SCREEN <i>1.3 - 6m</i>
DRILLING DATE <i>12.1.23</i>	DRILL DIAMETER <i>120mm</i>	STICK UP <i>Gatic</i>
DRILLING COMPANY <i>A&S Drilling</i>	CASING DIAMETER <i>6mm</i>	COORDINATES <i>E:291512</i>
DRILLER <i>Andrew Watt</i>	SLOT APERTURE <i>0.5mm</i>	COORD. SYS. <i>GDA 2020 N: 6141832</i>

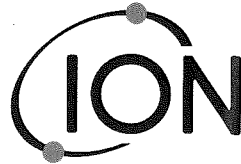
LOGGED BY *S Wilcock*

Depth (m)	Well Installation	Graphic Log	Lithology	Samples	Moisture	Consistency	PID	Comments
0.0								
0.5								
0.6								
1.0								
1.5								
2.0								
2.5								
3.0								
3.5								
4.0								
4.5								
5.0								
5.5								

for
5m
Silt, white, no ds
f-m grain sand
grading light brown at depth
COH @ 6m

APPENDIX B GAS CLAM CALIBRATION

CALIBRATION CERTIFICATE



Date of Calibration: - 19th October 2022

Certificate Number: - 262534

Calibrated by: - T.Payne

Signed:

Customer: - Air-Met Scientific Pty Ltd

Description: - GasClam2

Manufacturer: - Elok - Opava

Type Number: - Version 8.0

Serial Number: - 000051/02/20

Service Due date: - October 2023

This instrument has been factory calibrated to fully documented procedures in accordance with our ISO 9001:2015 Quality Management System.

Measurement standards are derived from volumetric and time sources which have been calibrated at an accredited laboratory traceable to National or International standards. The following list indicates the serial numbers of equipment used during the calibration procedure.

BAR02	PRESS06	C9625 / A14784 ¹	C9124 / A14783 ¹	C9673 / A15012 ¹
-------	---------	-----------------------------	-----------------------------	-----------------------------

¹ Gas mixtures prepared using equipment traceable to N.P.L. standards against Suppliers Certificate No.

The instrument has been calibrated at a temperature of 21.3°C ± 0.25°C and a barometric pressure of 1025.0 mbar ± 2 mbar.

ION Science hereby certify that on the day of calibration the instrument was working according to the manufacturer's original sales specification as checked by the calibration procedure, unless otherwise stated.

Copies of this certificate may only be reproduced in full.

Calibrations are valid as certified only on date of Calibration. For correct instrument operation please see the User Manual.

RESULTS ON DESPATCH

Applied Concentration		Instrument Indication	
Isobutylene	102 ppm	N/A	VOC
Hydrogen Sulphide	20 ppm	19.6 ppm	Hydrogen Sulphide
Carbon Monoxide	40 ppm	39 ppm	Carbon Monoxide
Oxygen	20.9 % O ₂	20.9 %	Oxygen
Methane	59.82 % CH ₄	60 %	Methane
Carbon Dioxide	40.18 % CO ₂	39.7 %	Carbon Dioxide
Barometric Pressure	1025.0 mbar	1024	mbar
Borehole Pressure	1025.0 mbar	1025	mbar

The estimated applied gas uncertainty is ± 2.0%

Comments: -

PD-FM-077-08

Unrivalled Gas Detection.

ION Science Ltd, The Hive, Butts Lane, Fowlmere, Cambs, SG8 7SL, UK

T +44 (0)1763 208503

E info@ionscience.com

W ionscience.com

CHECKLIST FOR



GASCLAM

KIT CONTENTS

GasClam	✓	Filters x 3	✓
Communication Cable	✓	O-Ring (Bottom) x 5	✓
Start Cable	✓	O-Ring (Top) x 5	✓
Gasclam Snorkel Assembly	✓	Moisture Filter x 3	✓
Box Spanner	✓	Hose Barb (for vent)	✓
Allen Key x 2	✓	Sensor Blanks x 3	✓
Safety Notice	✓	Charger	✓
		Battery Pack (x2)	✓

QUALITY CHECK

Software version:	6.1.11
Firmware version:	08.04

Final instrument inspection date:		26/10/22
-----------------------------------	--	----------

PD-FM-073-07

Unrivalled Gas Detection.

ION Science Ltd, The Hive, Butts Lane, Fowlmere, Cambs, SG8 7SL, UK

T +44 (0)1763 208503

E info@ionscience.com

W ionscience.com



CALIBRATION CERTIFICATE

Date of Calibration: - 19th October 2022

Certificate Number: - 262535

Calibrated by: - T.Payne

Signed: -

Customer: - Air-Met Scientific Pty Ltd

Description: - GasClam2

Manufacturer: - Elok - Opava

Type Number: - Version 8.0

Serial Number: - 000052/02/20

Service Due date: - October 2023

This instrument has been factory calibrated to fully documented procedures in accordance with our ISO 9001:2015 Quality Management System.

Measurement standards are derived from volumetric and time sources which have been calibrated at an accredited laboratory traceable to National or International standards. The following list indicates the serial numbers of equipment used during the calibration procedure.

BAR02	PRESS06	C9625 / A14784 ¹	C9124 / A14783 ¹	C9673 / A15012 ¹
-------	---------	-----------------------------	-----------------------------	-----------------------------

¹ Gas mixtures prepared using equipment traceable to N.P.L. standards against Suppliers Certificate No.

The instrument has been calibrated at a temperature of 21.0°C ± 0.25°C and a barometric pressure of 1016.7 mbar ± 2 mbar.

ION Science hereby certify that on the day of calibration the instrument was working according to the manufacturer's original sales specification as checked by the calibration procedure, unless otherwise stated.

Copies of this certificate may only be reproduced in full.

Calibrations are valid as certified only on date of Calibration. For correct instrument operation please see the User Manual.

RESULTS ON DESPATCH

Applied Concentration		Instrument Indication	
Isobutylene	102 ppm	N/A	VOC
Hydrogen Sulphide	20 ppm	20 ppm	Hydrogen Sulphide
Carbon Monoxide	40 ppm	41.5 ppm	Carbon Monoxide
Oxygen	20.9 % O ₂	20.9 %	Oxygen
Methane	59.82 % CH ₄	58.7 %	Methane
Carbon Dioxide	40.18 % CO ₂	40.1 %	Carbon Dioxide
Barometric Pressure	1016.7 mbar	1016	mbar
Borehole Pressure	1016.7 mbar	1016	mbar

The estimated applied gas uncertainty is ± 2.0%

Comments:-

PD-FM-077-08

Unrivalled Gas Detection.

ION Science Ltd, The Hive, Butts Lane, Fowlmere, Cambs, SG8 7SL, UK

T +44 (0)1763 208503

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W ionscience.com



CHECKLIST FOR

GASCLAM

KIT CONTENTS

GasClam	<input checked="" type="checkbox"/>	Filters x 3	<input checked="" type="checkbox"/>
Communication Cable	<input checked="" type="checkbox"/>	O-Ring (Bottom) x 5	<input checked="" type="checkbox"/>
Start Cable	<input checked="" type="checkbox"/>	O-Ring (Top) x 5	<input checked="" type="checkbox"/>
Gasclam Snorkel Assembly	<input checked="" type="checkbox"/>	Moisture Filter x 3	<input checked="" type="checkbox"/>
Box Spanner	<input checked="" type="checkbox"/>	Hose Barb (for vent)	<input checked="" type="checkbox"/>
Allen Key x 2	<input checked="" type="checkbox"/>	Sensor Blanks x 3	<input checked="" type="checkbox"/>
Safety Notice	<input checked="" type="checkbox"/>	Charger	<input checked="" type="checkbox"/>
		Battery Pack (x2)	<input checked="" type="checkbox"/>

QUALITY CHECK

Software version:	6.1.11
Firmware version:	08.04

Final instrument inspection date:		26/10/22
-----------------------------------	--	----------

PDFM-073-07

Unrivalled Gas Detection.

ION Science Ltd, The Hive, Butts Lane, Fowlmere, Cambs, SG8 7SL, UK

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E info@ionscience.com

W ionscience.com

GasClam Calibration Results

Serial Number: SN000038-09-14
Gasclam Name: GA21-BH423

Software Version: 6.1.11
Firmware Version: 8.4

12 January 2023 14:44

1
1
1

Sensor Type: Hydrogen Sulphide (200ppm)

Offset: -8267 Enter Values 1: 0 ppm Enter Values 2: 25 ppm
Slope: 3.9922 AD Values 1: 2071 AD Values 2: 2199

Calibration: 12.01.2023

Installation: 13.09.2022 Pumping Time: 256

Units: ppm Error: 0 mV Calibration Type: Two-point
Decimal Places: 1 Warm Up Time: 1 User: 1
Range: 200 Response Time: 30 Location: 1

Sensor Type: Carbon Monoxide (500ppm)

Offset: -5918 Enter Values 1: 0 ppm Enter Values 2: 100 ppm
Slope: 2.7669 AD Values 1: 2139 AD Values 2: 2435

Calibration: 12.01.2023

Installation: 13.09.2022 Pumping Time: 256

Units: ppm Error: 0 mV Calibration Type: Two-point
Decimal Places: 1 Warm Up Time: 1 User: 1
Range: 500 Response Time: 30 Location: 1

Sensor Type: Methane (100%)

Offset: -928 Enter Values 1: 0 % Enter Values 2: 60 %
Slope: 1.4032 AD Values 1: 662 AD Values 2: 2413

Calibration: 12.01.2023

Installation: 13.09.2022 Pumping Time: 256

Units: % Error: 30 mV Calibration Type: Two-point
Decimal Places: 1 Warm Up Time: 30 User: 1
Range: 100 Response Time: 30 Location: 1

Sensor Type: Carbon Dioxide (100%)

Offset: -1446 Enter Values 1: 0 % Enter Values 2: 40 %
Slope: 2.2046 AD Values 1: 656 AD Values 2: 1399

Calibration: 12.01.2023

Installation: 13.09.2022 Pumping Time: 256

Units: % Error: 30 mV Calibration Type: Two-point
Decimal Places: 1 Warm Up Time: 30 User: 1
Range: 100 Response Time: 30 Location: 1



GasClam Calibration Results

1/1

Serial Number: SN000052-02-20

Software Version: 6.1.11

Gasclam Name: CMW1

Firmware Version: 8.4

12 January 2023 16:50

1
1
1

Sensor Type: Hydrogen Sulphide (200ppm)

Offset: -6843 Enter Values 1: 0 ppm Enter Values 2: 25 ppm
Slope: 3.3399 AD Values 1: 2049 AD Values 2: 2202

Calibration: 12.01.2023 **Installation:** 01.01.2000 **Pumping Time:** 256

Units: ppm **Error:** 0 mV **Calibration Type:** Two-point
Warm Up Time: 1 **User:** 1
Decimal Places: 1 **Response Time:** 30 **Location:** 1

Sensor Type: Carbon Monoxide (500ppm)

Offset: -4173 Enter Values 1: 0 ppm Enter Values 2: 100 ppm
Slope: 2.0272 AD Values 1: 2059 AD Values 2: 2463

Calibration: 12.01.2023 **Installation:** 01.01.2000 **Pumping Time:** 256

Units: ppm **Error:** 0 mV **Calibration Type:** Two-point
Warm Up Time: 1 **User:** 1
Decimal Places: 1 **Response Time:** 30 **Location:** 1

Sensor Type: Oxygen

Offset: -13078 Enter Values 1: 20.9 % Enter Values 2: 21 %
Slope: 5.3333 AD Values 1: 3094 AD Values 2: 3097

Calibration: 07.12.2022 **Installation:** 01.01.2000 **Pumping Time:** 256

Units: % **Error:** 0 mV **Calibration Type:** Two-point
Warm Up Time: 1 **User:** 1
Decimal Places: 1 **Response Time:** 30 **Location:** 1

Sensor Type: Methane (100%)

Offset: -759 Enter Values 1: 0 % Enter Values 2: 60 %
Slope: 1.1562 AD Values 1: 657 AD Values 2: 2782

Calibration: 12.01.2023 **Installation:** 01.01.2000 **Pumping Time:** 256

Units: % **Error:** 30 mV **Calibration Type:** Two-point
Warm Up Time: 30 **User:** 1
Decimal Places: 1 **Response Time:** 30 **Location:** 1

Sensor Type: Carbon Dioxide (100%)

Offset: -1213 Enter Values 1: 0 % Enter Values 2: 40 %
Slope: 1.855 AD Values 1: 654 AD Values 2: 1537

Calibration: 12.01.2023 **Installation:** 01.01.2000 **Pumping Time:** 256

Units: % **Error:** 30 mV **Calibration Type:** Two-point
Warm Up Time: 30 **User:** 1
Decimal Places: 1 **Response Time:** 30 **Location:** 1



GasClam Calibration Results

1/1

Serial Number: SN000051-02-20

Software Version: 6.1.11

1

Gasclam Name: CMW2

Firmware Version: 8.4

12 January 2023 16:08

1

Sensor Type: Hydrogen Sulphide (200ppm)

Offset: -7122 **Enter Values 1:** 0 ppm **Enter Values 2:** 25 ppm
Slope: 3.4762 **AD Values 1:** 2049 **AD Values 2:** 2196

Calibration: 12.01.2023

Installation: 01.01.2000

Pumping Time: 256

Units: ppm

Error: 0 mV

Calibration Type: Two-point

Decimal Places: 1

Warm Up Time: 1

User: 1

Range: 200

Response Time: 30

Location: 1

Sensor Type: Carbon Monoxide (500ppm)

Offset: -4174 **Enter Values 1:** 0 ppm **Enter Values 2:** 100 ppm
Slope: 2.0373 **AD Values 1:** 2049 **AD Values 2:** 2451

Calibration: 12.01.2023

Installation: 01.01.2000

Pumping Time: 256

Units: ppm

Error: 0 mV

Calibration Type: Two-point

Decimal Places: 1

Warm Up Time: 1

User: 1

Range: 500

Response Time: 30

Location: 1

Sensor Type: Methane (100%)

Offset: -790 **Enter Values 1:** 0 % **Enter Values 2:** 60 %
Slope: 1.2032 **AD Values 1:** 657 **AD Values 2:** 2699

Calibration: 12.01.2023

Installation: 01.01.2000

Pumping Time: 256

Units: %

Error: 30 mV

Calibration Type: Two-point

Decimal Places: 1

Warm Up Time: 30

User: 1

Range: 100

Response Time: 30

Location: 1

Sensor Type: Carbon Dioxide (100%)

Offset: -1149 **Enter Values 1:** 0 % **Enter Values 2:** 40 %
Slope: 1.7519 **AD Values 1:** 656 **AD Values 2:** 1591

Calibration: 12.01.2023

Installation: 01.01.2000

Pumping Time: 256

Units: %

Error: 30 mV

Calibration Type: Two-point

Decimal Places: 1

Warm Up Time: 30

User: 1

Range: 100

Response Time: 30

Location: 1

APPENDIX C VEOLIA DATA MAY 2022

Highbury Landfill - SUEZ Landfill Gas Monitoring Wells

Date: 24/05/2022

LOCATION ID	CH ₄ Criteria % v/v	CH ₄ % v/v	CO ₂ % v/v	O ₂ % v/v	CO ppm	H ₂ S ppm	BALANCE %	Magnehelic Kilopascals	Testo mb	REL.PRESSURE mb	DATE	Depth Class	Actual Depth (m)	Screened Interval (m)	Comment
HBYPW002	5.0	0.0	6.4	14.6	0	0	78.9	0.00	0.00	-0.13	24/05/2022	Middle	9.3	2.1 - 9.3	
HBYPW102	5.0	0.0	1.3	19.0	0	0	79.5	0.10	-1.29	-1.20	24/05/2022	Deep	29.9	11.9 - 29.9	
HBYPW009	5.0	0.0	0.1	20.1	0	0	79.7	0.00	0.00	-0.15	24/05/2022	Deep	32.5	2.0 - 32.5	
HBYPW008	5.0	0.2	2.5	17.7	0	1	79.5	0.00	0.10	-0.08	24/05/2022	Deep	31.5	3.0 - 31.5	
HBYPW101	2.5	0.0	11.9	7.8	0	0	80.3	0.00	-0.07	-0.15	24/05/2022	Shallow	3.8	1.8 - 3.8	
HBYPW001	5.0	0.0	5.4	14.7	0	0	79.5	0.00	-0.08	-0.14	24/05/2022	Middle	10.3	2.6 - 10.7	
HBYPW202	2.5	0.0	4.5	15.7	0	0	79.7	0.00	-0.11	-0.12	24/05/2022	Shallow	4.2	2.7 - 4.2	
HBYPW003	5.0	0.0	10.6	7.9	0	0	81.3	0.00	0.00	-0.09	24/05/2022	Middle	9.4	2.6 - 9.4	
HBYPW104	5.0	0.8	2.6	17.8	0	0	78.9	-0.08	-1.06	-1.22	24/05/2022	Deep	27.8	11.8 - 27.8	
HBYPW004	5.0	0.0	4.1	16.7	0	0	79.2	0.00	-0.04	-0.10	24/05/2022	Middle	9.2	2.0 - 9.2	
HBYPW204	2.5	0.0	2.0	18.3	0	0	79.6	0.00	0.00	-0.01	24/05/2022	Shallow	4.0	2.8 - 4.0	
HBYPW005	5.0	0.0	2.8	16.9	0	0	80.2	0.00	0.00	-0.20	24/05/2022	Middle	8.0	2.6 - 8.0	
HBYPW205	5.0	4.8	22.3	2.8	0	0	70.0	0.00	0.00	-0.07	24/05/2022	Shallow	2.5	1.4 - 2.5	
HBYPW206	2.5	0.4	3.9	13.7	0	0	82.0	0.00	-0.03	-0.05	24/05/2022	Shallow	3.0	1.4 - 3.0	
HBYPW106	5.0	0.0	7.5	12.4	0	0	80.0	0.00	0.04	-0.11	24/05/2022	Middle	6.5	3.5 - 6.5	
HBYPW006	5.0	0.0	0.1	20.4	0	0	79.4	0.02	-0.15	-0.15	24/05/2022	Deep	28	9.0 - 28.0	
HBYLB13A	2.5	0.0	8.6	11.5	0	0	79.8	0.00	0.00	-0.08	24/05/2022	Shallow	5.0	2.5 - 5.0	
HBYLB13B	5.0	0.0	8.3	12.4	0	0	79.2	0.00	0.00	-0.11	24/05/2022	Middle	8.5	6.0 - 8.5	
HBYLB12A	2.5	0.0	8.8	13.2	0	0	77.8	0.00	-0.10	-0.02	24/05/2022	Shallow	4.5	2.5 - 4.5	
HBYLB12B	5.0	0.0	17.8	5.2	0	0	76.9	0.00	0.16	-0.04	24/05/2022	Middle	9.5	6.5 - 9.5	
HBYPW11A	2.5	0.0	9.0	12.9	0	0	78.0	0.00	0.00	0.08	24/05/2022	Shallow	5.0	3.0 - 5.0	
HBYPW11B	5.0	0.0	13.0	8.8	0	0	78.1	0.00	0.15	-0.03	24/05/2022	Middle	9.7	8.0 - 9.7	
HBYLB02A	2.5	0.0	4.5	16.5	0	0	78.8	0.00	0.04	0.08	24/05/2022	Shallow	4.1	1.6 - 4.1	
HBYLB02B	5.0	0.0	12.1	9.9	0	0	78.0	0.00	-0.03	-0.08	24/05/2022	Middle	10.0	6.5 - 10.0	
HBYLB10A	2.5	0.0	4.5	16.5	0	0	78.9	0.00	0.08	-0.03	24/05/2022	Shallow	3.8	1.4 - 3.8	
HBYLB10B	5.0	0.0	17.0	5.0	0	0	78.0	0.00	0.02	-0.15	24/05/2022	Middle	10.0	6.5 - 10.0	
HBYLB01A	2.5	0.0	13.5	7.5	0	0	78.9	0.00	0.00	-0.11	24/05/2022	Shallow	6.0	3.5 - 6.0	
HBYLB01B	5.0	0.0	18.0	1.5	0	0	80.5	0.00	-0.40	-0.14	24/05/2022	Middle	10.0	7.5 - 10.0	

APPENDIX D

STATEMENT OF LIMITATIONS

STATEMENT OF LIMITATIONS & IMPORTANT INFORMATION REGARDING YOUR REPORT

INTRODUCTION

This report has been prepared by Land & Water Consulting for you, as Land & Water Consulting's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Land & Water Consulting may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Land & Water Consulting has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

No warranty or guarantee of the site conditions is intended.

This report was prepared for the sole use of you, the Client and may not contain sufficient information for purposes of other parties or for other uses. Any reliance on this report by third parties shall be at such parties sole risk. This report shall only be presented in full and may not be used to support any other objectives than those set out in the report, except where written approval with comments are provided by Land & Water Consulting.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

LIMITATIONS OF THE REPORT

The scope of works undertaken and the report prepared to complete the assessment was in accordance with the information provided by the client and the specifications for works required under the contract. As such, works undertaken and statements made are based on those specifications (such as levels of risks and significance of any contamination) and should be considered and interpreted within this context. The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

Your environmental report should not be used without reference to Land & Water Consulting in the first instance:

- When the nature of the proposed development is changed, for example if a residential development is proposed instead of a commercial one;
- When the size or configuration of the proposed development is altered;
- When the location or orientation of the proposed structures are modified;
- When there is a change in ownership;
- For application to an adjacent site.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statutes and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

ENVIRONMENTAL ASSESSMENT “FINDINGS” ARE PROFESSIONAL ESTIMATES

The information in this report is considered to be accurate with respect to conditions encountered at the site at the time of investigation and considering the inherent limitations associated with extrapolating information from a sample set. Note however that site assessment identifies actual subsurface conditions only at those specific points where samples are taken, when they are taken. Environmental data derived through sampling and analysis are interpreted by consultants who then render an opinion about overall subsurface conditions, the nature and extent of contamination and potential impacts on the use of the land. Actual conditions may differ from those inferred to exist as no professional and no subsurface assessment program can reveal every detail within the ground across a site. Subsurface conditions can vary across a particular site and no practical degree of sampling can ever eliminate the possibility that conditions may be present at a site that have not been represented through sampling.

SUBSURFACE CONDITIONS CAN CHANGE

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Land & Water Consulting should be kept apprised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions. Since subsurface conditions (including contamination concentrations) can change within a limited period of time and space, this inherent limitation to the representation of site conditions provided by this report should always be taken into consideration particularly if the report is used after a delay in time.

DATA SHOULD NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

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Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Additional Landfill Gas Monitoring and Soil Investigation Program - 10-14 and 16-20 Halls Road, Highbury

- Draft
- 24 February 2010



Additional Landfill Gas Monitoring and Soil Investigation Program - 10-14 and 16-20 Halls Road, Highbury

- Draft
- 24 February 2010

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Name of document:	10-14 and 16-20 Halls Road, Highbury
Document version:	Draft
Project number:	VE23296

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Executive Summary

Sinclair Knight Merz Pty Ltd (SKM) was engaged by Hallan Nominees Pty Ltd (Hallan) to undertake additional landfill gas monitoring and intrusive soil works at the 10-14 and 16-20 Halls Road, Highbury, South Australia ('the site').

The site is located to the immediate north of a closed landfill owned by SITA Environmental. A Phase I Environmental Site Assessment was undertaken by Resource & Environmental Management Pty Ltd (now incorporated into SKM) in 2007. The key site features included fill material, former location of Above Ground Storage Tanks (ASTs), transformer and historical site features such as a AST and bowser (northwest portion of the site), loading bay and crushing shed. The landfill located on the southern boundary of the site was identified as posing a potential offsite source of contamination.

SKM has previously undertaken a Phase II Environmental Site Assessment program for the site which identified heavy metal (cobalt, lead, arsenic and antimony) soil exceedences in the northwest corner of the site, adjacent to a storage shed, and in the roadways adjacent to the crushing shed. Potential aesthetic limitations were also identified in fill material mainly located in the central and south east portion of the site associated with the presence of cement, bitumen, bricks and plastic. A single groundwater monitoring well was installed on the southern boundary of the site. The results of the groundwater assessment program (with the exception of selenium and ammonia) did not identify contaminant concentration exceeding relevant SA EPA (2003) criteria. Landfill gas monitoring was undertaken on the southern site boundary which indicated that methane concentrations increased from below detection to a maximum of 0.3% v/v (5 minutes after purging) which is below the SA EPA (2007) *Environmental Management of Landfill Facility* criteria of 1% v/v.

An additional program of works was undertaken to assist in providing sufficient information to allow for the Auditor to assess the suitability of the site for residential land use development.

Delineation bores drilled in the north western corner of the site to vertically delineate heavy metal contamination reported heavy metal concentrations below laboratory limits of reporting or adopted guidelines with the exception of one surficial sample which exceeded NEPM (HIL) A guideline criteria for lead.

It is considered unlikely that elevated heavy metal concentrations are present within the natural soil profile.

Aesthetically impacted fill material was estimated to be approximately 4,700 m³ for the central and southern portions of the site.

Delineation soil bores installed in the vicinity of groundwater monitoring well MW1_001 to assess whether soil beneath the site is acting as a source of ammonia to groundwater indicated that it is unlikely that N identified in the surficial soil would impact groundwater quality beneath the site. It is

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considered that the marginally elevated ammonia concentration reported in groundwater is indicative of minor diffusion of ammonia from the landfill area to the south.

The monitoring of landfill gas over six events reported no significant concentrations of methane. However, significant carbon dioxide was reported above guideline criteria in three of the six events. No elevated concentrations of gas were reported in Event 6, when gas extraction was not occurring.

The gas monitoring results were used to calculate a gas screening value of 0.24 l/hr; which is deemed a Low Risk with respect to end site use, with the CO₂ source potentially being attributable to natural soil organic content.

It is therefore considered that the concentrations of CO₂ reported on site represent a low risk to future site users based on the current ground gas regime.

1. Introduction

Sinclair Knight Merz Pty Ltd (SKM) was engaged by Hallan Nominees Pty Ltd (Hallan) to undertake additional landfill gas monitoring and intrusive soil works at the 10-14 and 16-20 Halls Road, Highbury, South Australia ('the site') in accordance with SKM's proposal dated 27 October 2009.

1.1. Background

The site is situated in Highbury within the Torrens River Catchment and is located approximately 14 km north east of the Adelaide CBD and comprises an area of approximately 1.85 Hectares of land. The site is proposed for residential development, and will be subject to a Ministerial Plan Amendment Report (PAR) process to allow for subsequent zoning changes for proposed residential use. The location and layout of the site is presented as Figure 1.

The site is located to the immediate north of a closed landfill owned by SITA Environmental. This landfill was in operation between 1975 and 1993 and accepted an approximate total volume of waste of 872,000 tonnes, comprising mainly inert commercial / industrial waste. An assessment of the gas generation profile of this landfill using the US EPA LandGEM software indicates that the gas generation rate peaked in approximately 1994, and is now in decline. The gas generated in the landfill is currently under extraction by Energy Developments Limited. A plan of the extraction network is presented as Figure 2.

A Phase I Environmental Site Assessment was undertaken by Resource & Environmental Management Pty Ltd (now incorporated into SKM) in 2007. The key site features included fill material, former location of Above Ground Storage Tanks (ASTs), transformer and historical site features such as a AST and bowser (northwest portion of the site), loading bay and crushing shed. The landfill located on the southern boundary of the site was identified as posing a potential offsite source of contamination.

SKM has previously undertaken a Phase II Environmental Site Assessment program for the site which included thirty-four grid based and targeted soil investigation locations in May 2008. Of these locations, only three locations reported concentrations exceeding one or more of the NEPM (1999) HIL and EIL guidelines for Heavy Metals (cobalt, lead, arsenic and antimony). The soil exceedences were identified in the northwest corner of the site, adjacent to a storage shed, or in the roadways adjacent to the crushing shed (Table 1.1). The 2008 sampling locations are presented in Figure 3.

Table 1.1 – 2008 Soil Exceedances in the Northwest Corner of Site (all values as mg/kg)

2008 Location	Antimony	Cobalt	Lead	Zinc
Guideline Criteria	15 ¹	100 ²	300 ²	200 ³
SB1_004	51	No exceedance	380	No exceedance
SB1_006	37	130	No exceedance	1000
SB1_007	110	130	530	560

Additionally, low pH soil was encountered in two locations; the lowest pH (4.9) reported at a depth of 1.6-1.9 m below ground level (m bgl) and therefore should not have a significant impact of the proposed future site use. The other low pH was reported in a surficial soil sample, although this was the only low pH sample within the upper 1.6 m of the site, and therefore was not considered significant. A total of 13 of 33 soil samples tested reported a soil pH greater than 8.5.

Potential aesthetic limitations were also identified in fill material mainly located in the central and south east portion of the site associated with the presence of cement, bitumen, bricks and plastic.

A single groundwater monitoring well was installed into the water table aquifer on the southern boundary of the site. A further existing monitoring well located in the landfill adjacent to the southern boundary was also monitored. The results of the groundwater assessment program (with the exception of selenium and ammonia) did not identify contaminant concentration exceeding relevant SA EPA (2003) criteria.

Based on SKM's experience with other sites in South Australia and published information regarding elevated selenium concentration in groundwater (Fitzgerald et al, 1999) the concentrations of selenium in groundwater were considered to represent natural conditions and not a result of historical or current site use.

Ammonia was identified at a concentration exceeding the SA EPA (2003) Aquatic ecosystems (freshwater) criteria in monitoring well MW1_001. With the site located up-gradient of the adjacent landfill, and it was considered possible that diffusion of a possible ammonia plume from beneath

¹ Dutch Intervention Level

² NEPM (1999) A Criteria

³ NEPM (1999) Ecological Investigation Level

the landfill site has occurred resulting in marginal ammonia concentrations in groundwater beneath the site.

As the site is up-gradient of a landfill, landfill gas monitoring was undertaken on the newly installed groundwater monitoring well located on the southern site boundary (MW1_001) and also on two monitoring wells installed in the adjacent landfill (LF8 and LF9). Monitoring of these wells was undertaken to assess whether migration of landfill gas is occurring from the adjacent historical landfill onto the site.

The monitoring indicated that methane concentrations in MW1_001 increased from below detection to a maximum of 0.3% v/v (5 minutes after purging) which is below the SA EPA (2007) *Environmental Management of Landfill Facility* criteria of 1% v/v. Methane gas monitored in LF9 and LF8 on 18 March 2008 by Energy Developments Pty Ltd was reported at 0.1% and 0.0% v/v, respectively. Concentrations of CO₂ did not exceed the SA EPA (2007) criteria (1.5% v/v) in any of the wells monitored (MW1_001, LF8 and LF9) pre or post purge. Based on the results of the landfill gas monitoring of wells located along the southern boundary of the site, no significant migration of landfill gas from the landfill to the site was identified during the 2008 investigation.

The additional program of works was undertaken to assist in providing sufficient information to allow for the Auditor to assess the suitability of the site for residential land use development. The scope of works undertaken is outlined in Section 1.2.

1.2. Scope of Works

The scope of works undertaken included:

- Task 1: Delineation of the vertical extent of heavy metal contamination identified in the soil bores located in the northwest portion of the site.
- Task 2: Delineation of aesthetically impacted fill identified in the central and south east portion of the site prior to the development of the site for residential land use.
- Task 3: Limited analysis of fill samples to be undertaken for nitrate and ammonia to rule out the site as a source (i.e. with respect to the elevated ammonia levels in the groundwater).
- Task 4: Monitoring of groundwater in monitoring well MW1_001 to provide further discussion on the potential impacts of the concentrations of ammonia identified in groundwater.
- Task 5: Undertaking six additional rounds of landfill gas monitoring over a range of barometric pressure to provide an assessment of whether landfill gas identified in these wells is static or is flowing and potentially poses a risk for future site users.

2. Soil Investigation Program

2.1. Soil Sampling Methodology

A total of 16 soil bores were drilled on 12 November 2009. The location of each intrusive investigation was selected based on access restrictions and the presence of any underground services.

A licensed service locator was engaged prior to the commencement of the field program to identify all potential underground services beneath the site and to clear all proposed soil investigation locations.

Soil bore investigation locations are detailed in Table 2.1, and presented on Figure 4.

Table 2.1 – Soil Bores per Task

Task	Purpose	Soil Bore
1	Vertical delineation of previously reported elevated heavy metal concentrations (See Table 1.1)	DB01 – delineation of SB1_004 DB02 – delineation of SB1_006 DB03 – delineation of SB1_007
2	Lateral and vertical delineation of aesthetically impacted fill material previously encountered in the central / southeast area of the site.	DB04-DB09 and DB12 –DB16
3	Investigation / Delineation of soil ammonia / nitrate concentrations in the vicinity of groundwater monitoring well MW1_001.	DB10 and DB11.

Soil bores were installed using a 4-wheeled drive mounted environmental drilling rig utilising the push tube technique. All drilling equipment was steam cleaned prior to the commencement of drilling and between locations to minimise the potential of cross contamination between sampling locations. Samples were collected using a fresh pair of nitrile disposable gloves at each sampling depth.

During drilling fill material was logged in accordance with the Unified Soil Classification (USC) system by an experience SKM Environmental Scientist who also noted evidence of contamination (e.g. suspicious fill, staining or odour). Fill / soil from each depth / change in strata was monitored

for volatile organic compounds using a Photo Ionisation Detector (PID). All PID readings were reported at 0 ppm. Soil lithological logs are presented in Appendix A, including PID readings⁴.

Collected samples were placed in chilled laboratory supplied and cleaned glass jars with Teflon lined lids which were sealed, labelled and placed on ice in an insulated cooler prior and transported to the laboratory under standard chain of custody protocols.

QA/QC samples included 1 in 20 inter laboratory duplicated and 1 in 20 intra laboratory duplicates and equipment rinsate blanks (for each day of the field program).

2.1.1. Soil Analytical Program

A total of 28 soil samples were collected with selected samples submitted for analysis. Table 2.2 details the adopted analytical program.

Table 2.2 - Number of samples analysed by the primary laboratory

Area	Number of Samples	Analysis
Task 1 - Heavy Metals, North West Corner	9	pH, Heavy Metals (Co, Pb, As, Sb, Zn, Be, Mn)
Task 3 – Nitrate and Ammonia	6	pH, Total N, Ammonia as N, Nitrate/Nitrite

The primary laboratory for soil analysis was MGT Environmental Consulting (MGT), a National Association of Testing Authority (NATA) registered laboratory. The secondary laboratory was Australian Laboratory Services Pty Ltd (ALS), another NATA registered laboratory.

Rinsate blanks were collected at the end of the day through the push tube following decontamination. The demineralised water that was used was provided by the laboratories specifically for rinsate blanks.

2.1.2. Soil Analytical Assessment Criteria

Analytical data for the soil samples are compared against the following published guideline values to determine the suitability of the site for future use:

- National Environmental Protection (Assessment of Site Contamination) Measure (NEPM, 1999), A – Residential Use guidelines;

⁴ SKM PIDs are calibrated internally according to manufacturer criteria and recorded in a calibration log prior to use.
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- National Environmental Protection (Assessment of Site Contamination) Measure (NEPM, 1999), D – Residential Use with Minimal Soil Access guidelines;
- National Environmental Protection (Assessment of Site Contamination) Measure (NEPM, 1999), E – Parks, Recreational Open Space and Playing Field guidelines;
- National Environmental Protection (Assessment of Site Contamination) Measure (NEPM, 1999), F – Commercial/ Industrial guidelines; and
- National Environmental Protection (Assessment of Site Contamination) Measure (NEPM, 1999), EIL – Ecological Investigation Levels.

When the above guidelines did not specify a limit for a given contaminant, the following criterion was used as a reference:

- NSW EPA (1994) Guidelines for Assessment of Service Stations – Sensitive Land Use; and
- Dutch Intervention Levels (DIL) (MHSPE, 2000).

2.2. Results

Soil analytical results are presented in Table 1 and certified analytical reports are presented in Appendix B. Soil lithological logs are presented in Appendix A.

2.2.1. Task 1 – Heavy Metal – North Western Corner

The geology of the northern area of the site generally consisted of fill comprising gravelly silty sand to a maximum depth of 0.4 m bgl, overlying red / orange / cream fine to medium grained sand / clayey sand.

Surficial soil samples (0.0 – 0.1 m bgl) collected during the Phase 2 ESA (SKM, 2008) reported elevated concentrations of antimony, cobalt, lead and zinc in soil bores SB01_004, SB01_006 and SB1_007 (see Table 1.1).

Delineation soil bore DB01, installed to vertically delineate heavy metal contamination in soil bore SB01_004 (antimony and lead), did not report concentrations of heavy metals (antimony, arsenic, beryllium, cobalt, lead, manganese and zinc) above adopted guideline values at all depths sampled.

Delineation soil bore DB02, installed to vertically delineate heavy metal contamination in soil bore SB01_006 (antimony, cobalt and zinc), did not report concentrations of heavy metals (antimony, arsenic, beryllium, cobalt, lead, manganese and zinc) above adopted guideline values at all depths sampled.

Delineation soil bore DB03 installed to vertically delineate heavy metal contamination in soil bore SB01_007 (antimony, cobalt, lead and zinc) reported a lead concentration of 980 mg/kg, which exceeds the adopted NEPM (1999) A guideline criteria of 300 mg/kg, in surficial fill sample 0.0-0.1 m bgl. Soil samples 0.1-0.3 m bgl and 0.6-0.8 m bgl reported lead concentrations below adopted guideline criteria indicating that elevated heavy metal concentrations are not present within the natural soil profile.

All remaining heavy metal concentrations were reported below LOR or adopted guidelines.

The previously reported concentrations associated with surficial samples are not reflected in the delineation soil bore analytical results, indicating that the elevated concentrations are restricted to the surficial fill layer and that the vertical profile of heavy metal concentrations has been adequately delineated.

It is noted that lower concentrations of heavy metals were reported in the surficial layer during this assessment in comparison to the 2008 assessment. This may be attributed to heterogeneity of the fill material located in the top 10 cm of the soil profile in this area.

With respect to soil pH, the reported results indicate that soil pH is relatively low throughout the soil profile, indicating that pH is naturally low and that site concentrations are representative of background concentrations.

2.2.2. Task 2 - Aesthetically Impacted Fill

The central portion of the site generally consisted of brown sandy clay underlain by brown, orange or cream sand / clayey sand. Aesthetic material (comprising bricks) was observed in soil bore DB10 only. However fill material, consistent with that observed in the Phase 2 investigation, was encountered in soil bores DB07 to DB12. The depth of fill material in these soil bores ranged between 1.4 m bgl (DB08) to 2.1 m bgl (DB07). The volume of aesthetically impacted fill material in the area outline in Figure 5 is approximated at 4,700 m³.

2.2.3. Task 3 – Nitrate/ Ammonia

Soil bores DB10 and DB11 were installed in the vicinity of groundwater monitoring well MW1_001 to assess whether soil beneath the site is a source of ammonia in groundwater.

The geology encountered in soil bores DB10 and DB11 consisted of fill comprising sandy clay/ clayey sand with brick fragments to a maximum depth of 1.9 m bgl. The fill material overlaid brown or red / orange sand / clayey sand.

Soil analytical results reported the following:

- ammonia, nitrate and nitrite concentrations were reported below LOR in all soil samples analysed.

- Total Nitrogen concentrations ranged between 26 mg/kg (DB11_2.2-2.4) to 1,800 mg/kg (DB11_0-0.1).
- Total Kjeldahl Nitrogen (TKN) concentrations matched Total Nitrogen at each location and depth and ranged between 26 mg/kg (DB11_2.2-2.4) to 1,800 mg/kg (DB11_0-0.1), indicating that all N is present as TKN.

TKN comprises ammonia (NH₃) and organic N. As ammonia was reported below LOR, then N is present as organic N. This is further discussed in Section 5.0.

3. Groundwater Investigation Program

3.1. Groundwater Sampling Methodology

The groundwater monitoring well MW1_001 was gauged and sampled on 18 November 2009. An interface water level probe in addition to petroleum detection paste was used to assess whether there was any measureable thickness of Phase Separated Hydrocarbons (PSH) in the monitoring well located on site. No PSH was observed in the groundwater monitoring well MW1_001 on site.

The monitoring well was purged of at least three purge volumes, or purged dry using dedicated disposable bailers prior to sampling. The purging process was undertaken so that the groundwater sample collected was representative of groundwater in the aquifer in that location. Field chemical parameters were recorded after each bore volume was removed to ensure stable geochemical conditions existed prior to the collection of the groundwater sample. The pH, redox, electrical conductivity and temperature meters were calibrated prior to the commencement of purging each day. The groundwater purge sheet detailing the field chemical parameters are provided in Appendix C.

Groundwater samples were placed in laboratory cleaned bottles containing appropriate preservatives, and then placed into a chilled esky for transport to ALS as the primary laboratory (NATA accredited) and MGT Environmental Pty Ltd as the secondary laboratory, also a NATA accredited laboratory. Intra-duplicate and inter-duplicate groundwater samples were also collected and sent to ALS and MGT.

3.1.1. Groundwater Analytical Program and Assessment Criteria

Groundwater sampled from monitoring well MW1_001 was analysed for pH, Total N, Ammonia, Nitrate/ Nitrite and Total Kjeldahl Nitrogen.

Analytical data for groundwater sample MW1_001 have been compared against the following published criteria values:

- SA EPA (2003) Water Quality Policy – Potable Use;
- SA EPA (2003) Water Quality Policy – Irrigation;
- SA EPA (2003) Water Quality Policy – Livestock;
- SA EPA (2003) Water Quality Policy – Aquatic Ecosystems (Fresh); and
- Dutch Intervention Levels (MHSPE, 2000).

3.2. Results

3.2.1. Hydrogeology

The groundwater level in MW1_001 was gauged on 17 November 2009 using an electronic dip meter. The water level was 27.568 m Top of Casing (m TOC) (Refer to Table 2). Groundwater level data was reduced relative to the Australian Height Datum (AHD) and using data from the adjoining Holcim Australia Pty Ltd site, groundwater flow is interpreted to be occurring in a south easterly direction.

3.2.2. Groundwater Field Parameters

Field Parameters (Table 3) measured during the groundwater sampling program indicate the following hydro-geochemical conditions exist in groundwater sampled from MW1_001:

- pH was 6.8 compared to 7.78 in May 2008;
- Electrical conductivity (EC) was 2.46 mS/cm compared to 3.17 mS/cm in May 2008;
- Redox potential was 103 mV compared to 48.2 mV in May 2008; and
- Temperature was 18.9°C compared to 13.6°C in May 2008.

3.2.3. Groundwater Analytical Results

Groundwater analytical results are presented in Table 4 and certified analytical laboratory reports are presented in Appendix D.

Ammonia concentrations were reported in excess of the SA EPA (2003) – Aquatic Ecosystems (Fresh) guideline of 0.5 mg/L in groundwater sampled from MW1_001 (0.8 mg/L). All remaining nutrients were below LOR or adopted guideline criteria.

4. Landfill Gas Investigation Program

4.1. Landfill Gas Monitoring

The well headspace in groundwater monitoring well MW1_001 located on the southern boundary of the site (adjacent to the landfill) was assessed for methane and carbon dioxide over six separate gauging events.

The barometric pressure, well pressure head, methane and carbon dioxide were measured using a calibrated GA2000 Landfill Gas Extraction Meter⁵ prior to air purging one bore volume with a SKC air pump. The SKC air pump purged air from the well at 3 L/min. Water levels undertaken on the 17 November 2009 were used to calculate the required purge volumes during the landfill gas monitoring program.

The bore flow rate (l/hr) was monitored pre-purge using a Geotechnical Instruments Flow Pod attached to the GA2000. During air purging, methane and carbon dioxide were measured using the GA2000 Landfill Gas Extraction Metre which was connected to the SKC air pump with a T piece. The pump was then turned off and gas levels measured at time zero, two and five minute intervals using the GA2000 Landfill Gas Extraction Metre which draws air from the well at 500 mL/min.

Landfill gas sampling events were undertaken as presented in Table 4.1. Meteorological conditions, as measured by the Bureau of Meteorology at the Adelaide Kent Town station (No. 023090), on sampling days are presented in Table 4.1.

Table 4.1 – Meteorological Conditions

Date	Maximum Temperature (°C)	Minimum Temperature (°C)	Mean Daily Pressure (hPa)	Daily Rainfall (mm)
27/11/09	32.4	18.9	1003.7	0
28/11/09	20.3	13.2	1002.6	15
10/12/09	19.4	14.8	1013.4	1.8
11/12/09	21.2	11.6	1022.5	2.6
17/12/09	21.5	19.9	1015.3	7.8
19/1/10	22.2	11.6	1021.4	0.2
23/1/10	27.7	17.6	1014.7	0

⁵ Calibration certificates are presented in Appendix F.
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4.2. Results

Results of the landfill gas investigation of MW1_001 are detailed in Table 5 and are summarised below.

4.2.1. Methane Gas Monitoring Results

Initial methane concentrations were below the detection limit, prior to purging the, for all landfill gas sampling events. Post purging, methane gas concentrations ranged from below detection (10 and 17 December 2010) to a maximum concentration of 0.6% v/v, which does not exceed the SA EPA (2007) Environmental Management of Landfill Facility criteria of 1% v/v.

4.2.2. Carbon Dioxide Monitoring Results

Initial CO₂ concentrations ranged between 0.0% v/v (14 January 2009) to 15.3% v/v (27 November 2009) which is above adopted SA EPA (2007) criteria for CO₂ 1.5% v/v.

Post purging, CO₂ concentrations ranged from below detection (10 and 17 December 2009) to 18.3% v/v (27 November 2009) which is above adopted SA EPA (2007) criteria for CO₂ 1.5% v/v.

4.2.3. Gas Presence

Based on the results of the landfill gas monitoring undertaken at the well located on the southern boundary of the site, no significant migration of methane gas from the landfill area was reported under varying atmospheric pressure conditions.

Concentrations of CO₂ were detected in excess of the SA EPA (2007) criteria during both low and high atmospheric pressures.

The highest concentrations of CO₂ were reported on the first monitoring event. High concentrations of CO₂ were also reported during events four and five following purging (Figure 6).

Events four and five were undertaken in periods of high atmospheric pressure.

Event six was undertaken during a period when no gas extraction was occurring. No significant concentrations of carbon dioxide (or methane) were reported during this event.

5. Analytical Data Quality

The quality of analytical data produced for this project has been assessed with reference to the following issues:

- sampling technique;
- preservation and storage of samples upon collection and during transportation to the laboratory;
- sample holding times;
- analytical procedures;
- laboratory limits of reporting;
- field duplicate agreement;
- laboratory quality assurance/ quality control (QA/QC) procedures; and
- the occurrence of apparently unusual or anomalous results.

Laboratory QA/QC procedures and results are detailed in the certified laboratory reports contained in Appendices B and D. A summary of the data quality assessment a summary of the field duplicate relative percentage differences are included as Appendix E.

All samples were collected, stored and transported to the laboratory in accordance with standard SKM chain of custody protocols which are consistent with the requirements of Schedule B(2) of the NEPM (NEPC, 1999). Laboratory analysis was undertaken within specified holding times and in accordance with National Association of Testing Authorities (NATA) accepted analytical procedures and the requirements of Schedule B(3) of the NEPM (NEPC, 1999).

Elevated relative percentage differences between primary soil and groundwater samples and duplicate samples however the exceedences are only marginal and do not significantly impact the overall interpretation of results.

Laboratory quality control information from the primary laboratory indicated an acceptable degree of QA/QC information was collected and reported for the soil and groundwater analysis with the data providing confidence in the accuracy and precision of reported results, subject to limitations outlined above and in the data quality assessment summary in Appendix E.

6. Discussion and Conclusion

6.1. Soil Investigation Program

Heavy Metal – North Western Corner

Delineation soil bores DB01, DB02 and DB03 were drilled in the north western corner of the site to vertically delineate heavy metal contamination identified in surficial samples (0.0-0.1 m bgl) obtained from soil bores SB01_004, SB01_006 and SB01_007 installed by SKM in 2008.

Delineation soil bores DB01 and DB02 did not report any elevated concentrations of heavy metals throughout the entire soil profile and did not reflect heavy metal concentrations reported by SKM in 2008. This may be attributed to heterogeneity of the fill material located in the top 10 cm of the soil profile in this area.

Delineation soil bore DB03 reported a lead concentration of 980 mg/kg, in excess of adopted NEPM (1999) A guideline, in fill soil sample 0-0.1 m bgl. However, soil samples from 0.1-0.3 m bgl and 0.6-0.8 m bgl reported lead concentrations below adopted guideline values indicating that elevated lead concentration is not present within the natural soil profile. All remaining heavy metal concentrations were reported below LOR or adopted guidelines.

It is considered unlikely that elevated heavy metal concentrations are present within the natural soil profile.

Aesthetically Impacted Fill

Aesthetically impacted fill material was observed in soil bore DB10 only however aesthetically impacted fill material (loose bricks, inert plastic fragments), consistent with that observed in the Phase 2 investigation, was encountered in soil bores DB07 to DB12. Based on these observations a volume of aesthetically impacted material was estimated to be approximately 4,700 m³ for the central and southern portions of the site.

Soil as Ammonia Source to Groundwater

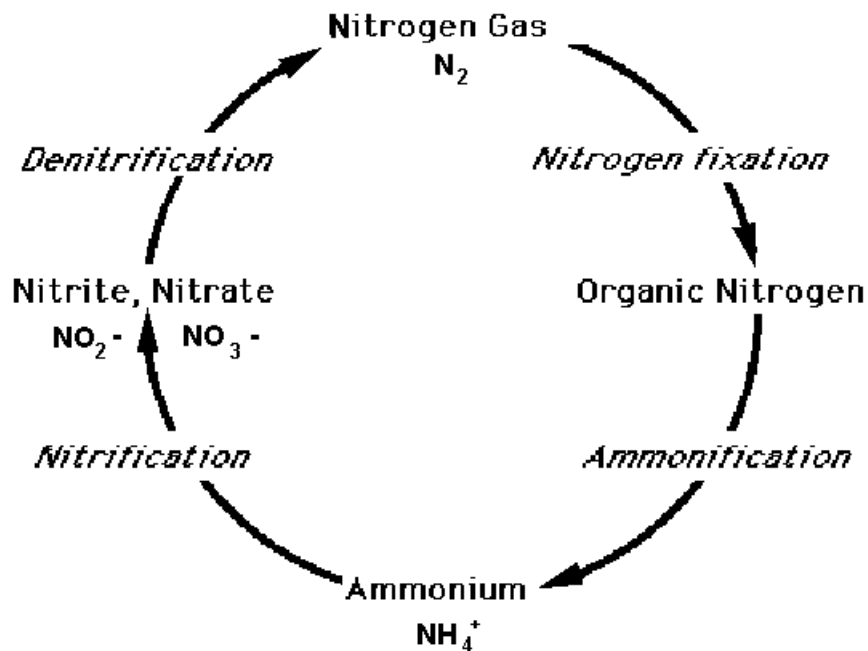
Delineation soil bores DB10 and DB11 were installed in the vicinity of groundwater monitoring well MW1_001 to assess whether soil beneath the site is acting as a source of ammonia to groundwater.

Soil analytical results reported ammonia, nitrate and nitrite concentrations below LOR in all soil samples analysed. Based on TKN analysis (and noting that ammonia is below LOR), it is considered that the soil nitrogen is present as organic N. This form of N is a result of both fixation of N₂ from the atmosphere (hence highest concentrations in the surficial layer, which most likely represents the N component of the organic matter content of the soil) and the breakdown of amino acids and other organic N sources (e.g. proteins and urea, Figure 6.1). The breakdown rate of

organic matter will generally be very slow under current (undisturbed) conditions, and N is likely to be utilised by vegetation (grasses) that germinate during winter.

Based on the low TKN concentration at depth it is considered unlikely that N identified in the surficial soil would impact groundwater quality beneath the site.

Figure 6.1 – Simplified Nitrogen Cycle.



6.2. Groundwater Investigation Program

Groundwater sampled from groundwater monitoring well MW1_001 reported concentrations of ammonia marginally in excess of the SA EPA (2003) – Aquatic Ecosystems (Fresh) criteria which is consistent with groundwater results reported by SKM in 2008.

It is considered that the marginally elevated ammonia is indicative of minor diffusion of ammonia from the landfill area to the south.

6.3. Landfill Gas

The monitoring of landfill gas over six events reported no significant concentrations of methane. However, carbon dioxide was reported above guideline criteria in events 1, 2, 4 and 5 (Event 2 concentration was not considered significant).

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Event 1 reported elevated CO₂ both before purging and after purging. Event 1 was the first monitoring event undertaken since May 2008 (although the groundwater level was monitored in this well in November 17, no active abstraction of the well headspace was undertaken) and thus the elevated concentrations in this location in Event 1 may be a function of build up of carbon dioxide over time in the well zone.

Events 4 and 5 reported elevated CO₂ concentrations after purging. This indicates that purging drew carbon dioxide into the well from the surrounding soil. This may explain why high carbon dioxide concentrations occurred during periods of high atmospheric pressure (i.e. high pressure should limit concentrations). Thus the flow of carbon dioxide does not appear to be significantly associated with atmospheric pressure, and thus advective (lateral) migration of carbon dioxide (usually pressure driven) is not considered significant.

The gas monitoring results along with qualitative analysis can be developed to provide a semi-quantitative estimate of the risk associated with elevated CO₂ at the site. The system employed here to assess the risk is that originally developed by Wilson and Card (1996), which is now widely used by consultants and regulators, especially in the UK, to assess the risks posed by gassing sites (CIRIA, 2007).

The classification system is summarised in Table 6.1.

The method uses both gas concentration and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flow, known as a Gas Screening Value (GSV) (Boyle and Witherington, 2007).

GSV's (reported as litres of gas per hour) are equal to the maximum borehole flow rate (l/hr) x maximum gas concentration (% v/v).

The GSV is compared to the characteristic situations in Table 6.1. The higher the classification, the higher the risk from the presence of gas.

Note that no elevated concentrations of gas were reported in Event 6, when gas extraction was not occurring.

Table 6.1 – Characteristic situations based on Gas Screening Value (CIRIA 2007)

Characteristic situation (CIRIA R149)	Risk Classification	Gas Screening Value (GSV) (l/hr)	Additional Factors	Typical source of generation
1	Very Low Risk	<0.07	Typically methane at 1% and/or carbon dioxide at 5% - otherwise consider Situation 2	Natural soils with organic content – ‘typical’ made ground
2	Low Risk	<0.7	Borehole air flow rate not to exceed 70 l/hr – otherwise consider increase to Situation 3	Natural soil, high peat / organic content – ‘typical’ made ground
3	Moderate Risk	<3.5		Old landfill, inert waste, mine working flooded
4	Moderate to High Risk	<15	Quantitative risk assessment required to evaluate scope of measures	Mine working – susceptible to flooding, completed landfill
5	High Risk	<70		Mine working - unflooded inactive with shallow workings near surface
6	Very High Risk	>70		Recent landfill site

A review of the monitoring data indicates that the highest carbon dioxide concentration reported was 18.3 % v/v. The highest gas flow reported was 1.3 l/hr. The GSV for CO₂ is calculated as:

$$0.183 \times 1.3 \text{ l/hr} = 0.24 \text{ l/hr}$$

Based on the above GSV the characteristic situation can be determined as Situation 2, which is deemed as Low Risk, with the source potentially being attributable to natural soil organic content.

It is therefore considered that the concentrations of CO₂ reported on site represent a low risk to future site users based on the current ground gas regime. As the gas generation rate in the landfill to the south is predicted to be in decline, it is considered unlikely that the CO₂ concentration would increase significantly over time.

The concentrations of CO₂ do not appear to be influenced by atmospheric pressure; however the lateral and vertical migration may be affected by changes in soil porosity over the seasons, which would indicate higher flows in summer. It is recommended that additional seasonal monitoring of gas at the site is undertaken in order to confirm the findings reported here.

7. Recommendations

It is considered that the requirements of the additional scope of work have been met. The findings of the gas monitoring component indicates that the elevated carbon dioxide concentrations represent a low risk to site users, however it is recommended that the gas regime is further confirmed over seasonal monitoring.

- Undertake further seasonal monitoring (once a month over autumn and winter) of the ground gas regime to confirm that the regime will not change under seasonal conditions.
- Prepare a Remediation Action Plan (RAP) to render the site suitable for the proposed residential development (i.e. with reference to the aesthetic fill).
- Prepare an executive summary style Detailed Risk Assessment of groundwater contamination issues to demonstrate that the marginal concentrations of ammonia are unlikely to pose a potential significant risk to human health and down hydraulic gradient beneficial uses of groundwater.

8. Statement of Limitations

This report has been prepared in accordance with the program outlined in the proposal prepared for Hallan Nominees, dated 27th October 2009. The services performed by SKM have been conducted in a manner consistent with the level of quality and skills generally exercised by members of its profession and consulting practice. No warranty or guarantee of site conditions is intended.

This report is solely for the use of Hallan Nominees and may not contain sufficient information for purposes of other parties or for other uses. Any reliance on this report by third parties shall be at such parties' sole risk. This report shall only be presented in full and may not be used to support any other objectives than those set out in the report, except where written approval with comments are provided by SKM.

The information in this report is considered to be accurate with respect to information provided and conditions encountered at the site at the time of investigation and considering the inherent limitations associated with extrapolating information from a sample data set. Subsurface conditions can vary across a particular site and no practical degree of sampling can ever eliminate the possibility that conditions may be present at a site that have not been represented through sampling. Actual conditions in areas not sampled may differ from predictions.

SKM has used the methodology and sources of information outlined within this report and has made no independent verification of this information beyond the agreed scope of works. SKM assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that the information provided to SKM was false.

Since subsurface conditions (including contamination concentrations) can change within a limited period of time and space, this inherent limitation to the representation of site conditions provided by this report should always be taken into consideration particularly if the report is used after a delay in time. No responsibility for any changes in site conditions beyond the time of this investigation is assumed by SKM.

9. References

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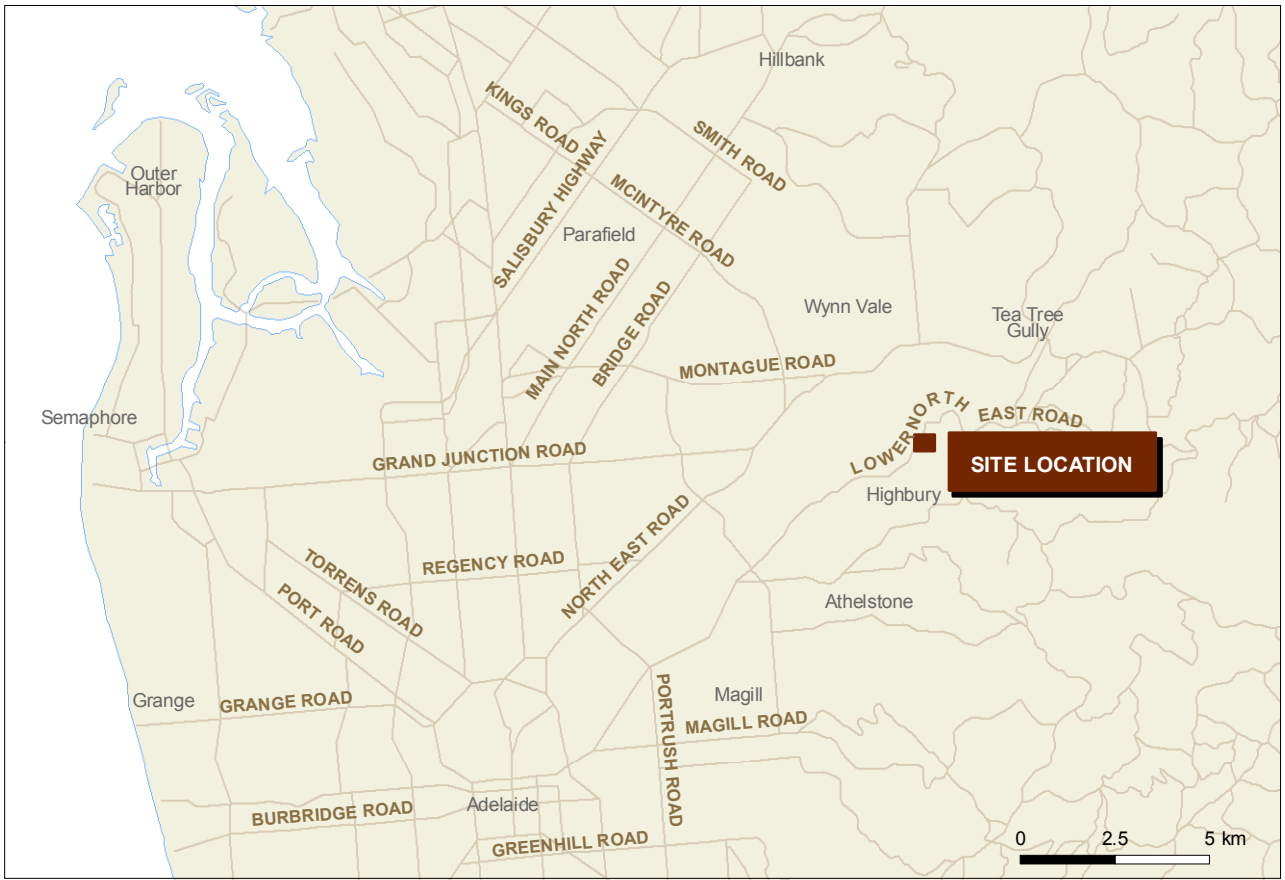
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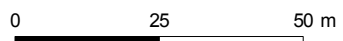
Figures



R:/GIS/Dequetteville/Gawler and Highbury/Highbury/Maps/site location - majestic.mxd



HALLAN NOMINEES
SITE LOCATION PLAN



I:\ESA\Projects\VE\23296\Technical\Spatial\Maps\Figure3 - 2008 ESA Investigation Plan.mxd

- Push tube soil bore
- Nested groundwater well
- Test pit
- Approximate Site Boundary
- Grid locations



HALLAN NOMINEES
2008 ESA INVESTIGATION PLAN

Figure
3



0 25 50 m

L:\ESA\Projects\VE23296\Technical\Spatial Maps\Figure 4 - Delineation Bore Location.sxd

- ELEM_TEXT**
- Approximate Site Boundary
 - + MW1_001
 - Grid locations
 - ◆ Hallan - Delineation Bores



Figure

SKM **HALLAN NOMINEES**
DELINEATION BORE LOCATIONS **4**



0 25 50 m

I:\VESA\Projects\VE23299\Technical\Spatial Maps\Figure 5 - Aesthetic Fill Volume.mxd

- ELEM_TEXT**
- + MW1_001
 - Grid locations
 - + Hallan - Delineation Bores
 - Aesthetic_Fill_Hallan
 - Approximate Site Boundary

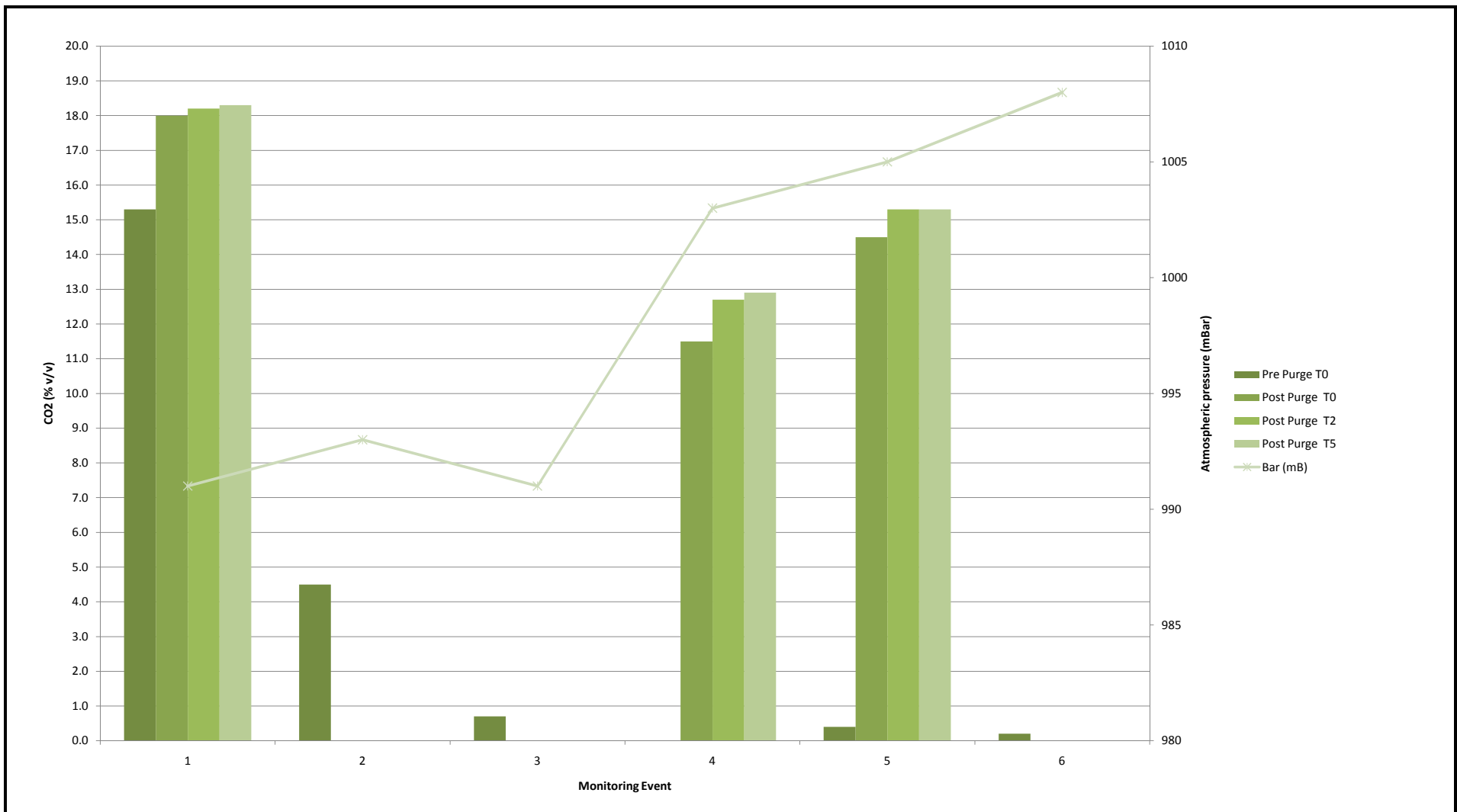


**HALLAN NOMINEES
AESTHETIC FILL VOLUME**

Figure

5

January 2010



Hallan Nominees
Carbon Dioxide & Atmospheric Pressure over 6 events

PROJECT

VE23296

FIGURE

6

January-10



Tables

Table 1 - Summary of Soil Analytical Data and Exceedences - pH, Heavy Metals and Nutrients
Halls Road, Highbury

Analyte	Moisture	Antimony	Arsenic	Beryllium	Cobalt	Lead	Zinc	Manganese	Ammonia(N)	Nitrate & Nitrite (N)	Nitrate (as N)	Nitrite (as N)	pH (1:5 Aqueous extract)	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)
Units	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	1	10	2	2	5	5	5	5	5	5	5	5	0.1	10	5
Dutch Intervention		15	55		240	530	720								
EPA 1994 Health and Ecological						300									
NEPM (1999) EIL			20			600	200	500							
NEPM (1999) A			100	20	100	300	7000	1500							
NEPM (1999) D			400	80	400	1200	28000	6000							
NEPM (1999) E			200	40	200	600	14000	3000							
NEPM (1999) F			500	100	500	1500	35000	7500							

Field ID	Sample Depth	Date	pH	Moisture	Antimony	Arsenic	Beryllium	Cobalt	Lead	Zinc	Manganese	Ammonia(N)	Nitrate & Nitrite (N)	Nitrate (as N)	Nitrite (as N)	pH (1:5 Aqueous extract)	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)
DB01	0-0.1	12/11/2009	7.6	<10	<2	<2	<5	10	29	80	-	-	-	-	-	7.8	-	-
DB01	0.1-0.3	12/11/2009	5.3	<10	2.5	<2	<5	<5	<5	7.6	-	-	-	-	-	7.1	-	-
DB01	1.4-1.6	12/11/2009	5.9	<10	<2	<2	<5	<5	<5	34	-	-	-	-	-	4.8	-	-
DB02	0-0.1	12/11/2009	8.2	<10	4.1	<2	<5	26	70	120	-	-	-	-	-	7.3	-	-
DB02	0.1-0.3	12/11/2009	8.9	<10	4.1	<2	<5	7	5	130	-	-	-	-	-	8	-	-
DBDUP2		12/11/2009	7.2	<10	4.3	<2	<5	<5	<5	57	-	-	-	-	-	-	-	-
DBDUP2		12/11/2009	12.3	<5	<5	<1	<2	<5	<5	23	-	-	-	-	-	7.3	-	-
DB02	1.3-1.5	12/11/2009	8.2	<10	2.9	<2	<5	<5	<5	60	-	-	-	-	-	5.7	-	-
DB03	0-0.1	12/11/2009	7.1	<10	14	<2	<5	980	61	130	-	-	-	-	-	8.5	-	-
DB03	0.1-0.3	12/11/2009	7.5	<10	5.8	<2	<5	19	25	77	-	-	-	-	-	8.4	-	-
DB03	0.6-0.8	12/11/2009	13	<10	5.6	<2	<5	11	<5	15	-	-	-	-	-	5.4	-	-
DB10	0-0.2	12/11/2009	5.7	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	8.6	1000	1000
DB10	0.7-0.9	12/11/2009	13	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	8.7	390	390
DB10	1.9-2.1	12/11/2009	9.9	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	7.6	330	330
DBDUP3		12/11/2009	19	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	-	42	42
DBDUP3		12/11/2009	17.2	-	-	-	-	-	-	-	<20	2.2	2.22	<0.1	<0.1	-	530	530
DB11	0-0.1	12/11/2009	7.7	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	8.5	1800	1800
DB11	0.4-0.6	12/11/2009	16	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	7.6	660	660
DB11	2.2-2.4	12/11/2009	6.9	-	-	-	-	-	-	-	<5	<5	<5	<5	<5	6.8	26	26

Table 2. Groundwater Monitoring Well Details and Water Level Elevation Data

Hallan - Highbury Site

Monitoring Well	Easting	Northing	Depth of Well (mPVC)	Screen (m)	Top of Casing Reduced Level (mAHD)	May-08		Nov-09	
						Water Level (m PVC) 28 May 2008	Reduced Water Level (m AHD) 28 May 2008	Water Level (m PVC) 17 November 2009	Reduced Water Level (m AHD) 17 November 2009
MW1_001	291561.29	6141739.577	31.18	15	159.727	27.568	132.159	27.625	132.102
Landfill_Deep			51.76	-	-	-	-	-	-

Note:

Table 3. Summary of Groundwater Field Parameters

Hallan - Highbury Site

Monitoring Well	Nov-09				
	pH	Electrical Conductivity (mS/cm)	Total Dissolved Solids (mg/L)*	Redox (mV)	Temperature (°C)
MW1_001	6.80	2.46	1,599	103	18.9

Note:


* TDS calculated by multiplying EC by a factor of 650


Table 4 - Summary of Groundwater Analytical Results - Heavy Metals and Nutrients

		Heavy Metals														Inorganics									
		Antimony	Arsenic	Beryllium	Cadmium	Chromium (total)	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Tin	Zinc	pH	Ammonia	Nitrate (as N)	Nitrite (as N)	Nitrite + Nitrate (as N)	Total Kjeldahl Nitrogen (as N)	Total Nitrogen (as N)	Total Phosphate (P)	Cyanide Total	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
ALS LOR		0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.0001	0.001	0.001	0.001	0.001	0.001	0.01	0.01	0.01	0.01	0.01	0.1	0.1	0.01	0.004	
MGT LOR		0.005	0.001	0.001	0.0002	0.001	0.001	0.001	0.001	0.0001	0.005	0.001	0.001	0.001	0.005	0.01	0.01	0.02	0.02	0.05	0.1	0.2	0.05	0.005	
Dutch Intervention		0.02	0.06		0.006	0.03	0.1	0.075	0.075	0.0003	0.3	0.075		0.8											
SA EPA (2003) - Possible Use		0.003	0.007		0.002		2	0.01	0.001	0.05	0.02	0.01					10	1						0.08	
SA EPA (2003) - Aquatic Ecosystem (Fresh)		0.03	0.05	0.004	0.002			0.005	0.005	0.0001	0.15	0.005					0.5					5	0.5		
SA EPA (2003) - Agriculture/aquaculture (irrigation)			0.1	0.1	0.01	1	0.05	0.2	0.2	0.002	0.01	0.02	0.02	2											
SA EPA (2003) - Agriculture/aquaculture (livestock)			0.5	0.1	0.01	1	1	0.5	0.1	0.002	0.01	1	0.02	20			30	10							
Field ID	Sampled Date	Laboratory No.																							
LANDFILL DEEP_10/6/08	10/06/2008	228359	<0.005	<0.001	<0.001	<0.0002	0.004	<0.001	<0.001	<0.001	<0.0001	<0.005	<0.001	<0.001	<0.005	0.015	-	<0.05	0.09	-	-	-	-	0.16	<0.005
MW1_001	4/06/2008	228104	<0.005	0.002	<0.001	<0.0002	0.005	<0.001	0.002	<0.001	<0.0001	<0.005	0.002	0.006	<0.005	<0.001	-	0.75	<0.02	-	-	-	-	0.13	<0.005
MW1_001	17/11/2009	EM0911667	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	0.8	0.04	<0.01	0.04	2.1	2.1	-	-	
DUP1_001	17/11/2009	EM0911667	-	-	-	-	-	-	-	-	-	-	-	-	-	6.65	0.83	0.04	<0.01	0.04	2.2	2.2	-	-	
DUP1_001	17/11/2009	255455	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	0.69	<0.02	<0.02	<0.05	0.9	0.9	-	-	

Table 5 - Summary of Ground Gas Results
Additonal Environmental Investigation, Hallan Nominees, Highbury
Project No. VE23296

Landfill Gas Monitoring Well	Date	Purge	Minutes	CH4 (%)	CO2 (%)	O2 (%)	Balance (%)	CO (ppm)	H2S (ppm)	Bar (mB)	Average Flow (l/hr)
MW1_001	27/11/2009	Pre Purge	T0	0.0	15.3	2.6	82.1	6.0	0.0	991	-
MW1_001	27/11/2009	Post Purge	T0	0.6	18.0	-	-	-	-	-	-
MW1_001	27/11/2009	Post Purge	T2	0.6	18.2	-	-	-	-	-	-
MW1_001	27/11/2009	Post Purge	T5	0.6	18.3	-	-	-	-	-	-
MW1_001	10/12/2009	Pre Purge	T0	0.0	4.5	17	78.3	4.0	0.0	993	-5.5
MW1_001	10/12/2009	Post Purge	T0	0.0	0.0	-	-	-	-	-	-
MW1_001	10/12/2009	Post Purge	T2	0.0	0.0	-	-	-	-	-	-
MW1_001	10/12/2009	Post Purge	T5	0.0	0.0	-	-	-	-	-	-
MW1_001	17/12/2009	Pre Purge	T0	0.0	0.7	20.9	78.5	0.0	0.0	991	-3.3
MW1_001	17/12/2009	Post Purge	T0	0.0	0.0	-	-	-	-	-	-
MW1_001	17/12/2009	Post Purge	T2	0.0	0.0	-	-	-	-	-	-
MW1_001	17/12/2009	Post Purge	T5	0.0	0.0	-	-	-	-	-	-
MW1_001	14/01/2010	Pre Purge	T0	0.0	0.0	21.1	78.8	0.0	1.0	1003	-
MW1_001	14/01/2010	Post Purge	T0	0.0	11.5	-	-	-	-	-	-
MW1_001	14/01/2010	Post Purge	T2	0.0	12.7	-	-	-	-	-	-
MW1_001	14/01/2010	Post Purge	T5	0.0	12.9	-	-	-	-	-	-
MW1_001	19/01/2010	Pre Purge	T0	0.0	0.4	20.3	79.2	0.0	0.0	1005	1.4
MW1_001	19/01/2010	Post Purge	T0	0.0	14.5	-	-	-	-	-	-
MW1_001	19/01/2010	Post Purge	T2	0.0	15.3	-	-	-	-	-	-
MW1_001	19/01/2010	Post Purge	T5	0.0	15.3	-	-	-	-	-	-
MW1_001	23/01/2010	Pre Purge	T0	0.0	0.2	20.1	78.6	20.0	0.0	1008	-0.6
MW1_001	23/01/2010	Post Purge	T0	0.0	0.0	-	-	-	-	-	-
MW1_001	23/01/2010	Post Purge	T2	0.0	0.0	-	-	-	-	-	-
MW1_001	23/01/2010	Post Purge	T5	0.0	0.0	-	-	-	-	-	-
Max				0.6	18.3						
Mean				0.1	7.5						
st dev				0.2	7.7						

 Exceed SA EPA Environmental Management of Landfill Facilities
Criteria for Monitoring Bores at the Boundary of the Landfill
Facility (1.5% v/v for Carbon Dioxide)

 Exceed SA EPA Environmental Management of Landfill Facilities
Criteria for Monitoring Bores at the Boundary of the Landfill
Facility (1% v/v for CH4)



Appendices



Appendix A – Soil Lithological Logs



SOIL BORE LOG

SOIL BORE NUMBER

DB01

PROJECT NUMBER: VE23296	TOTAL DEPTH (m): 2.0
PROJECT NAME: Hallan Nominees Additional Soil Investigations	DATE COMMENCED: 12/11/2009
LOCATION: Halls Road, Highbury	DATE COMPLETED: 12/11/2009
DRILLING CO: In Depth Drilling	DRILLING METHOD: Pushtube/Solid Flight Auger
	BOREHOLE DIAMETER: 50mm/115mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

	0.0		FILL: Silty Sand, brown, fine to medium grained, minor gravels up to 10mm in diameter, no odour/staining SAND: Red/orange, fine to medium grained, minor light grey sand intrusions, no odour/staining	D	L	0	DB01_0-0.1		
				D	D	0	DB01_0.1-0.3		
	0.5			D	D	0	DB01_0.8-1.0		
	1.0			D	D	0	DB01_1.4-1.6		
	1.5		SAND: Light orange, fine to medium grained, no odour/staining	D	L/D	0	DB01_1.6-1.8		
		D		L/D	0	DB01_1.8-2.0			
2.0		EOH at 2.0 m							
2.5									
3.0									

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED:

DATE: 12/11/2009
 DATE: 18/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB02

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 1.5

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0			FILL: Silty Sand, brown, fine grained, no odour/staining	D	L	0	DB02_0-0.1	
				SAND: Red/orange, fine to medium grained, minor light grey sand intrusions, minor clay content, no odour/staining	D	D	0	DB02_0.1-0.3 (DBDUP2)	
	0.5				D	D	0	DB02_0.8-1.0	
	1.0				D	D	0	DB02_1.3-1.5	
	1.5			Refusal on sandstone at 1.5m					
	2.0								
	2.5								
	3.0								

MOISTURE
W = Wet
M = Moist
D = Dry

STRENGTH
Fine Grain Coarse Grain
S = Soft L = Loose
F = Firm D = Dense
H = Hard VD = Very Dense

LOGGED: MC
CHECKED:

DATE: 12/11/2009
DATE:



SOIL BORE LOG

SOIL BORE NUMBER

DB03

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 2.0

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

	0.0			FILL: Silty Sand, brown, fine to medium grained, minor gravels up to 10mm in diameter, no odour/staining	D	L	0	DB03_0-0.1	
				FILL: Clayey Sand, brown with red and orange mottling, moderate plasticity, fine to medium grained, no odour/staining	D	D	0	DB03_0.1-0.3	
	0.5			SAND: Cream, medium grained, no odour/staining	D	L	0	DB03_0.4-0.6	
				CLAYEY SAND: Red/brown with orange mottling, fine to medium grained, moderate plasticity, no odour/staining	D	D	0	DB03_0.6-0.8 (DBDUP1)	
	1.5			SAND: Orange/red, medium grained, minor clay content, no odour/staining	D	L/D	0	DB03_1.3-1.5	
				CLAYEY SAND: Orange/red with light grey sand intrusions, fine to medium grained, moderate plasticity, no odour/staining	D	D	0	DB03_1.7-2.0	
	2.0			EOH at 2.0m					
2.5									
3.0									

MOISTURE

W = Wet
M = Moist
D = Dry

STRENGTH

Fine Grain Coarse Grain
S = Soft L = Loose
F = Firm D = Dense
H = Hard VD = Very Dense

LOGGED: MC

CHECKED:

DATE: 12/11/2009

DATE: 12/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB04

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 1.8

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0			FILL: Sandy Clay, dark brown, moderate plasticity, medium grained, no odour/staining	D	F	0		
				FILL: Sand, brown, medium grained, minor gravels up to 10mm in diameter, no odour/staining	D	L	0		
				FILL: Clayey Sand, red/orange, fine to medium grained, low plasticity, no odour/staining	D	D	0		
				SAND: Cream, fine to medium grained, no odour/staining	D	L	0		
				EOH at 1.8m					

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED:

DATE: 12/11/2009
 DATE: 12/11/2009
 Page 1 of 1



SOIL BORE LOG

SOIL BORE NUMBER

DB05

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 1.8

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0		D	F	0			
	0.5		D	D	0			
	1.0		D	L	0			
	1.5		D	L	0			
	2.0			EOH at 1.8m				
	2.5							
	3.0							

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED: *[Signature]*

DATE: 12/11/2009
 DATE: *[Signature]*
 Page 1 of 1



SOIL BORE LOG

SOIL BORE NUMBER

DB06

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 2.0

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0	[Graphic Log: Yellow dotted pattern]		SAND: Cream, fine to medium grained, no odour/staining	D	L	0			
	0.5									
	1.0									
	1.5			SAND: Cream/orange, fine to medium grained, no odour/staining	D	L/D	0			
	2.0		SAND: Orange/red, medium grained, no odour/staining	D	L/D	0				
	2.5									
	3.0			EOH at 2.0m						

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC

CHECKED: *[Signature]*

DATE: 12/11/2009

DATE: 18/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB07

PROJECT NUMBER: VE23296

PROJECT NAME: Hallan Nominees Additional Soil Investigations

LOCATION: Halls Road, Highbury

DRILLING CO: In Depth Drilling

TOTAL DEPTH (m): 3.2

DATE COMMENCED: 12/11/2009

DATE COMPLETED: 12/11/2009

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0		FILL: Sandy Clay, dark brown/black, mottled white, pink, orange and red, low to moderate plasticity, fine to medium grained, minor white siltstone gravels up to 20mm in diameter, no odour/staining	D	F	0		
	0.5		FILL: Gravelly Sand, grey, fine to medium grained, gravels up to 10mm in diameter, no odour/staining	D	F	0		
	1.0		FILL: Sandy Clay, dark brown/black, mottled white, pink, orange and red, low to moderate plasticity, fine to medium grained, minor white siltstone gravels up to 20mm in diameter, no odour/staining					
	1.5							
	2.0		SAND: Brown, fine to medium grained, no odour/staining	D	L			
2.5	SAND: Orange/red, fine to medium grained, some cemented sands, no odour/staining	D	L/D					
3.0								
3.5	EOH at 3.2m							

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain
 S = Soft
 F = Firm
 H = Hard
 Coarse Grain
 L = Loose
 D = Dense
 VD = Very Dense

LOGGED: MC
 CHECKED:

DATE: 12/11/2009
 DATE:



SOIL BORE LOG

SOIL BORE NUMBER

DB08

PROJECT NUMBER: VE23296

PROJECT NAME: Hallan Nominees Additional Soil Investigations

LOCATION: Halls Road, Highbury

DRILLING CO: In Depth Drilling

TOTAL DEPTH (m): 2.2

DATE COMMENCED: 12/11/2009

DATE COMPLETED: 12/11/2009

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0		FILL: Sandy Clay, dark brown/black, mottled white, pink, orange and red, low to moderate plasticity, fine to medium grained, minor white siltstone gravels up to 20mm in diameter, no odour/staining	D	F	0		
	0.5							
	1.0							
	1.5		SAND: Brown/orange, medium grained, no odour/staining	D	L	0		
	2.0							
	2.5		EOH at 2.2m					
	3.0							

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC

CHECKED:

DATE: 12/11/2009

DATE: 12/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB09

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 2.5

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0		D	F	0			
	FILL: Sandy Clay, dark brown/black, mottled white, pink, orange and red, low to moderate plasticity, fine to medium grained, minor white siltstone gravels up to 20mm in diameter, no odour/staining							
	1.5		W	L	0	DB09_1.5-1.7		
	1.7		D/M	L	0			
	1.9	D	D	0				
	2.0	CLAYEY SAND: Red/orange, fine to medium grained, low to moderate plasticity, no odour/staining						
	2.5	EOH at 2.5m						
	3.0							

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC

CHECKED: *[Signature]*

DATE: 12/11/2009

DATE: 18/1/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB10

PROJECT NUMBER: VE23296

PROJECT NAME: Hallan Nominees Additional Soil Investigations

LOCATION: Halls Road, Highbury

DRILLING CO: In Depth Drilling

TOTAL DEPTH (m): 2.8

DATE COMMENCED: 12/11/2009

DATE COMPLETED: 12/11/2009

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.			MATERIAL PROPERTIES				FIELD RECORD INFORMATION		
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0		FILL: Sandy Clay, dark brown/black with orange and white mottling, moderate plasticity, fine to medium grained, minor gravels up to 20mm in diameter, no odour/staining Brick fragments at 0.4m	D	F	0	DB10_0-0.2	
	0.5			D	F	0	DB10_0.7-0.9	
	1.0			D	F	0	DB10_1.4-1.6	
	1.5			D	D	0	DB10_1.9-2.1 (DBDUP3)	
	2.0	CLAYEY SAND: Red/orange with minor light grey sand intrusions, fine to medium grained, low plasticity, no odour/staining	D	D	0	DB10_2.6-2.8		
	2.5		D	D	0	DB10_2.6-2.8		
	3.0	EOH at 2.8m						

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED: *[Signature]*

DATE: 12/11/2009
 DATE: 18/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB11

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 2.4

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

	0.0		FILL: Clayey Sand, dark brown/black, fine to medium grained, moderate plasticity, minor white siltstone gravels up to 5mm in diameter, no odour/staining	D	L/D	0	DB11_0-0.1	
	0.5		FILL: Sandy Clay, dark brown/black, minor pink and white mottling, moderate plasticity, fine to medium grained, no odour/staining	D	F	0	DB11_0.4-0.6	
	1.0			D	F	0	DB11_1.1-1.3	
	1.5		SAND: Brown, medium grained, no odour/staining	D	L	0	DB11_1.5-1.7	
	2.0		CLAYEY SAND: Red/orange, fine to medium grained, moderate plasticity, no odour/staining	D	D	0	DB11_1.7-1.9	
2.5		EOH at 2.4m	D	D	0	DB11_2.2-2.4 (OBDUP4)		
3.0								

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC

CHECKED:

DATE: 12/11/2009

DATE: 12/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB12

PROJECT NUMBER: VE23296

PROJECT NAME: Hallan Nominees Additional Soil Investigations

LOCATION: Halls Road, Highbury

DRILLING CO: In Depth Drilling

TOTAL DEPTH (m): 2.0

DATE COMMENCED: 12/11/2009

DATE COMPLETED: 12/11/2009

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0		D	F	0		
	0.5						
	1.0						
	1.5		D	D	0		
	2.0						
	2.5						
	3.0						

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED: *hgr*

DATE: 12/11/2009
 DATE: 12/11/2009
 Page 1 of 1



SOIL BORE LOG

SOIL BORE NUMBER

DB13

PROJECT NUMBER: VE23296

PROJECT NAME: Hallan Nomlnees Additional Soil Investigations

LOCATION: Halls Road, Highbury

DRILLING CO: In Depth Drilling

TOTAL DEPTH (m): 2.0

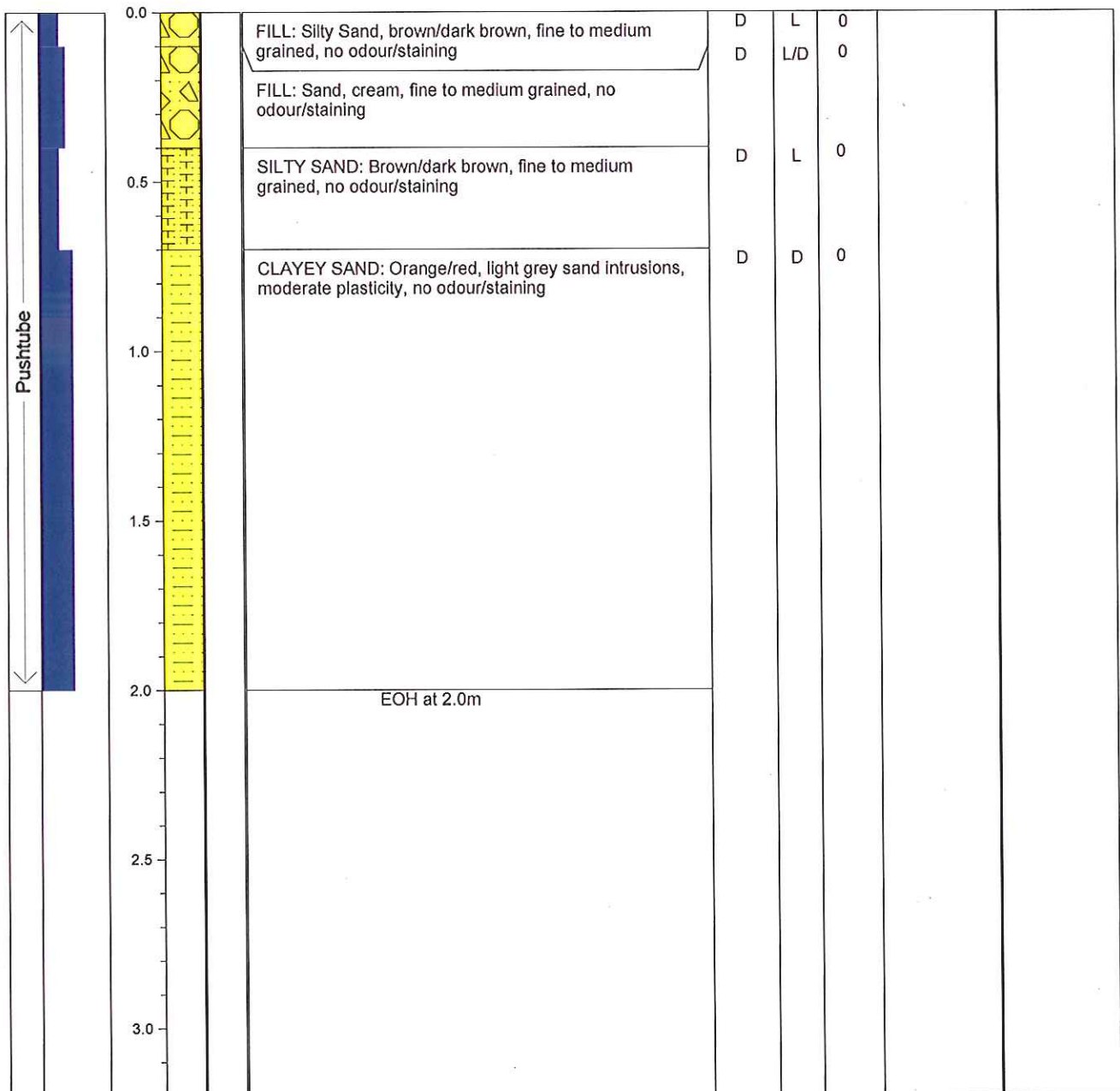
DATE COMMENCED: 12/11/2009

DATE COMPLETED: 12/11/2009

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS



MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED: *[Signature]*

DATE: 12/11/2009
 DATE: *12/11/2009*



SOIL BORE LOG

SOIL BORE NUMBER

DB14

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 1.5

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.			MATERIAL PROPERTIES				FIELD RECORD INFORMATION		
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

	0.0			SAND: Brown, fine to medium grained, no odour/staining	D	L	0		
	0.5			CLAYEY SAND: Orange/red, light grey sand intrusions, moderate plasticity, no odour/staining	D	D	0		
	1.5			EOH at 1.5m					
	2.0								
	2.5								
	3.0								

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
 Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC

CHECKED: *Jee*

DATE: 12/11/2009

DATE: 12/11/2009



SOIL BORE LOG

SOIL BORE NUMBER

DB15

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 0.7

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0 0.5 1.0 1.5 2.0 2.5 3.0	[Dotted pattern]		<p>SAND: Cream, fine to medium grained, no odour/staining</p> <hr/> <p>EOH at 0.7m</p>	D	L	0		
----------	---	------------------	--	--	---	---	---	--	--

MOISTURE
 W = Wet
 M = Moist
 D = Dry

STRENGTH
Fine Grain Coarse Grain
 S = Soft L = Loose
 F = Firm D = Dense
 H = Hard VD = Very Dense

LOGGED: MC
 CHECKED: *[Signature]*

DATE: 12/11/2009
 DATE: *12/11/2009*



SOIL BORE LOG

SOIL BORE NUMBER

DB16

PROJECT NUMBER: VE23296

TOTAL DEPTH (m): 1.8

PROJECT NAME: Hallan Nominees Additional Soil Investigations

DATE COMMENCED: 12/11/2009

LOCATION: Halls Road, Highbury

DATE COMPLETED: 12/11/2009

DRILLING CO: In Depth Drilling

DRILLING METHOD: Pushtube

BOREHOLE DIAMETER: 50mm

DRILLING INFO.		MATERIAL PROPERTIES				FIELD RECORD INFORMATION			
METHOD (no resistance) PENETRATION (refusal)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION	MATERIAL DESCRIPTION	MOISTURE CONDITION	STRENGTH	PID (ppm)	SAMPLE ID	COMMENTS

Pushtube	0.0			SAND: Brown/light brown, fine to medium grained, no odour/staining	D	L	0		
	0.5			SAND: Cream, fine to medium grained, no odour/staining	D	L	0		
	1.0			CLAYEY SAND: Red/orange, fine to medium grained, moderate plasticity, no odour/staining	D	D	0		
	1.8			EOH at 1.8m					

MOISTURE

W = Wet
M = Moist
D = Dry

STRENGTH

Fine Grain	Coarse Grain
S = Soft	L = Loose
F = Firm	D = Dense
H = Hard	VD = Very Dense

LOGGED: MC

CHECKED: *JG*

DATE: 12/11/2009

DATE: 12/11/2009



Appendix B – Certified Soil Laboratory Reports



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EM0911418	Page	: 1 of 3
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Melbourne
Contact	: MS DANNI HAWORTH	Contact	: Steven McGrath
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: DHaworth@skm.com.au	E-mail	: steven.mcgrath@alsenviro.com
Telephone	: +61 08 8424 3800	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8424 3810	Facsimile	: +61-3-8549 9601
Project	: VE23296	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 13-NOV-2009
C-O-C number	: ----	Issue Date	: 20-NOV-2009
Sampler	: MC	No. of samples received	: 5
Site	: ----	No. of samples analysed	: 2
Quote number	: EN/003/09		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Instrument Chemist	Inorganics
Nikki Stepniewski	Non-metallic Supervisor	Inorganics
Terrance Hettipathirana	Team Leader - Metals	Inorganics

Environmental Division Melbourne

Part of the **ALS Laboratory Group**

4 Westall Rd Springvale VIC Australia 3171

Tel. +61-3-8549 9600 Fax. +61-3-8549 9601 www.alsglobal.com

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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: **SOIL**

Client sample ID
 Client sampling date / time

				DBDUP2	DBDUP3	----	----	----
				12-NOV-2009 15:00	12-NOV-2009 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EM0911418-002	EM0911418-003	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.3	----	----	----	----
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	12.3	17.2	----	----	----
EG005T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	----	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	<2	----	----	----	----
Lead	7439-92-1	5	mg/kg	<5	----	----	----	----
Manganese	7439-96-5	5	mg/kg	23	----	----	----	----
Zinc	7440-66-6	5	mg/kg	<5	----	----	----	----
EK055: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	----	<20	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	----	0.100	mg/kg	----	<0.100	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)	----	0.100	mg/kg	----	2.22	----	----	----
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	2.2	----	----	----
EK061G: Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	----	530	----	----	----
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	20	mg/kg	----	530	----	----	----



Environmental Division

QUALITY CONTROL REPORT

Work Order	: EM0911418	Page	: 1 of 5
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Melbourne
Contact	: MS DANNI HAWORTH	Contact	: Steven McGrath
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: DHaworth@skm.com.au	E-mail	: steven.mcgrath@alsenviro.com
Telephone	: +61 08 8424 3800	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8424 3810	Facsimile	: +61-3-8549 9601
Project	: VE23296	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 13-NOV-2009
C-O-C number	: ----	Issue Date	: 20-NOV-2009
Sampler	: MC	No. of samples received	: 5
Order number	: ----	No. of samples analysed	: 2
Quote number	: EN/003/09		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Instrument Chemist	Inorganics
Nikki Stepniewski	Non-metallic Supervisor	Inorganics
Terrance Hettipathirana	Team Leader - Metals	Inorganics

Environmental Division Melbourne

Part of the **ALS Laboratory Group**

4 Westall Rd Springvale VIC Australia 3171

Tel. +61-3-8549 9600 Fax. +61-3-8549 9601 www.alsglobal.com

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Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA002 : pH (Soils) (QC Lot: 1165177)									
EM0911398-001	Anonymous	EA002: pH Value	----	0.1	pH Unit	4.7	4.7	0.0	0% - 20%
EM0911427-005	Anonymous	EA002: pH Value	----	0.1	pH Unit	5.0	5.0	0.0	0% - 20%
EA055: Moisture Content (QC Lot: 1165196)									
EM0911412-020	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	9.7	10.6	8.8	0% - 50%
EM0911424-010	Anonymous	EA055-103: Moisture Content (dried @ 103°C)	----	1.0	%	29.7	29.6	0.4	0% - 20%
EG005T: Total Metals by ICP-AES (QC Lot: 1165341)									
EM0911412-027	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	<2	0.0	No Limit
		EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	<5	19	116	No Limit
EM0911462-001	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	8	8	0.0	No Limit
		EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	121	111	8.8	0% - 20%
		EG005T: Manganese	7439-96-5	5	mg/kg	273	264	3.2	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	185	183	1.1	0% - 20%
EK055: Ammonia as N (QC Lot: 1167550)									
EM0911398-001	Anonymous	EK055: Ammonia as N	7664-41-7	20	mg/kg	30	30	0.0	No Limit
EM0911418-003	DBDUP3	EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	<20	0.0	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1165180)									
EM0911418-003	DBDUP3	EK057G: Nitrite as N (Sol.)	----	0.100	mg/kg	<0.100	<0.100	0.0	No Limit
EK059G: NOX as N by Discrete Analyser (QC Lot: 1165181)									
EM0911418-003	DBDUP3	EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	2.2	2.1	6.8	0% - 20%
EK061G: Total Kjeldahl Nitrogen as N (QC Lot: 1166214)									
EM0911418-003	DBDUP3	EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	530	480	9.3	0% - 20%



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: SOIL

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
				Result	Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit			LCS	Low	High
EG005T: Total Metals by ICP-AES (QCLot: 1165341)								
EG005T: Antimony	7440-36-0	5	mg/kg	<5	----	----	----	----
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	13.6 mg/kg	102	82.8	119
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	----	----	----	----
EG005T: Lead	7439-92-1	5	mg/kg	<5	54.9 mg/kg	96.8	85.4	115
EG005T: Manganese	7439-96-5	5	mg/kg	<5	----	----	----	----
EG005T: Zinc	7440-66-6	5	mg/kg	<5	105 mg/kg	87.8	81.3	111
EK055: Ammonia as N (QCLot: 1167550)								
EK055: Ammonia as N	7664-41-7	20	mg/kg	<20	25 mg/kg	101	81.7	109
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1165180)								
EK057G: Nitrite as N (Sol.)	----	0.1	mg/kg	<0.100	2.5 mg/kg	98.4	89.2	104
EK059G: NOX as N by Discrete Analyser (QCLot: 1165181)								
EK059G: Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	<0.1	2.5 mg/kg	77.5	75.4	119
EK061G: Total Kjeldahl Nitrogen as N (QCLot: 1166214)								
EK061G: Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	1000 mg/kg	105	71.2	113



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

				<i>Matrix Spike (MS) Report</i>			
<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Method: Compound</i>	<i>CAS Number</i>	<i>Spike</i>	<i>Recovery Limits (%)</i>		
				<i>Concentration</i>	<i>MS</i>	<i>Low</i>	<i>High</i>
EG005T: Total Metals by ICP-AES (QCLot: 1165341)							
EM0911405-001	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	84.2	70	130
		EG005T: Beryllium	7440-41-7	50 mg/kg	97.7	70	130
		EG005T: Lead	7439-92-1	50 mg/kg	99.7	70	130
		EG005T: Manganese	7439-96-5	50 mg/kg	99.8	70	130
		EG005T: Zinc	7440-66-6	50 mg/kg	95.4	70	130
EK055: Ammonia as N (QCLot: 1167550)							
EM0911412-001	Anonymous	EK055: Ammonia as N	7664-41-7	100 mg/kg	75.1	70	130
EK061G: Total Kjeldahl Nitrogen as N (QCLot: 1166214)							
EM0911258-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	2500 mg/kg	102	70	130



Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EM0911418	Page	: 1 of 5
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Melbourne
Contact	: MS DANNI HAWORTH	Contact	: Steven McGrath
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: DHaworth@skm.com.au	E-mail	: steven.mcgrath@alsenviro.com
Telephone	: +61 08 8424 3800	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8424 3810	Facsimile	: +61-3-8549 9601
Project	: VE23296	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 13-NOV-2009
Sampler	: MC	Issue Date	: 20-NOV-2009
Order number	: ----		
Quote number	: EN/003/09	No. of samples received	: 5
		No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Environmental Division Melbourne

Part of the **ALS Laboratory Group**

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Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **SOIL**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002 : pH (Soils)							
Soil Glass Jar - Unpreserved DBDUP2	12-NOV-2009	17-NOV-2009	19-NOV-2009	✓	17-NOV-2009	17-NOV-2009	✓
EA055: Moisture Content							
Soil Glass Jar - Unpreserved DBDUP2, DBDUP3	12-NOV-2009	----	----	----	17-NOV-2009	19-NOV-2009	✓
EG005T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved DBDUP2	12-NOV-2009	17-NOV-2009	11-MAY-2010	✓	18-NOV-2009	11-MAY-2010	✓
EK055: Ammonia as N							
Soil Glass Jar - Unpreserved DBDUP3	12-NOV-2009	----	----	----	19-NOV-2009	11-MAY-2010	✓
EK057G: Nitrite as N by Discrete Analyser							
Soil Glass Jar - Unpreserved DBDUP3	12-NOV-2009	17-NOV-2009	11-MAY-2010	✓	17-NOV-2009	11-MAY-2010	✓
EK059G: NOX as N by Discrete Analyser							
Soil Glass Jar - Unpreserved DBDUP3	12-NOV-2009	17-NOV-2009	11-MAY-2010	✓	17-NOV-2009	11-MAY-2010	✓
EK061G: Total Kjeldahl Nitrogen as N							
Soil Glass Jar - Unpreserved DBDUP3	12-NOV-2009	18-NOV-2009	11-MAY-2010	✓	19-NOV-2009	11-MAY-2010	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
Analytical Methods							
Laboratory Duplicates (DUP)							
Buchi Ammonia	EK055	2	11	18.2	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Moisture Content	EA055-103	2	17	11.8	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	1	100.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	1	100.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH (1:5)	EA002	2	12	16.7	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	2	50.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	2	13	15.4	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Buchi Ammonia	EK055	1	11	9.1	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	1	100.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	1	100.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	2	50.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	13	7.7	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Buchi Ammonia	EK055	1	11	9.1	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	1	1	100.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N - Soluble by Discrete Analyser	EK057G	1	1	100.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	2	50.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	13	7.7	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Buchi Ammonia	EK055	1	11	9.1	5.0	✔	ALS QCS3 requirement
TKN as N By Discrete Analyser	EK061G	1	2	50.0	5.0	✔	ALS QCS3 requirement
Total Metals by ICP-AES	EG005T	1	13	7.7	5.0	✔	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	(APHA 21st ed., 4500H+) pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (1999) Schedule B(3) (Method 103)
Moisture Content	EA055-103	SOIL	A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (1999) Schedule B(3) (Method 102)
Total Metals by ICP-AES	EG005T	SOIL	(APHA 21st ed., 3120; USEPA SW 846 - 6010) (ICPAES) Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (1999) Schedule B(3)
Buchi Ammonia	EK055	SOIL	APHA 21st ed., 4500 NH3+-B&G, H Samples are steam distilled (Buchi) prior to analysis and quantified using titration, FIA or Discrete Analyser.
Nitrite as N - Soluble by Discrete Analyser	EK057G	SOIL	APHA 21st ed., 4500 NO3- B. Nitrite in a water extract is determined by direct colourimetry by Discrete Analyser.
Nitrate as N - Soluble by Discrete Analyser	EK058G	SOIL	APHA 21st ed., 4500 NO3--F. Nitrate in the 1:5 soil:water extract is reduced to nitrite by way of a cadmium reduction column followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results.
Nitrite and Nitrate as N (NOx)- Soluble by Discrete Analyser	EK059G	SOIL	APHA 21st ed., 4500 NO3- F. Combined oxidised Nitrogen (NO2+NO3) in a water extract is determined by Cadmium Reduction, and direct colourimetry by Discrete Analyser.
TKN as N By Discrete Analyser	EK061G	SOIL	APHA 21st ed., 4500-Norg-D Soil samples are digested using Kjeldahl digestion followed by determination by Discrete Analyser.
Total Nitrogen as N (TKN + NOx) By Discrete Analyser	EK062G	SOIL	APHA 21st ed., 4500 Norg/NO3- Total Nitrogen is determined as the sum of TKN and Oxidised Nitrogen, each determined seperately as N.
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	SOIL	APHA 21st ed., 4500 Norg- D; APHA 21st ed., 4500 P - H. Macro Kjeldahl digestion.
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	USEPA 200.2 Mod. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM (1999) Schedule B(3) (Method 202)



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.
- For all matrices, no Matrix Spike outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

CHAIN OF CUSTODY FORM



From : SKM Pty Ltd
 ABN: 37 001 024 095
 Level 5, 33 King William St, Adelaide, SA 5000
 ph: (08) 8424 3800 fax: (08) 8424 3810

LAB USE ONLY
 QUOTE NUMBER Project No:VE23298

Job Code: Project Manager: James Fox

Due Date: Sample(s): MC

Custody seal intact? Checked:

Sample code? Received by Laboratory by: **Danni**

Date: **13/11/2009** Date: 12/1/09

Time:

Container Identification	Size	Type	Presence	Analytes
				Heavy Metals (Co,Pb,As,Sb,Zn,Bo,Mn),
				Total N, Ammonia as N, Nitrate and Nitrite
				Soil pH

Lab Id	Date	Time	Matrix	Sample Identification	Comments	Tick required analytes
1	12/11/2009		Soil	DBDUP1		✓
2	12/11/2009		Soil	DBDUP2		✓
3	12/11/2009		Soil	DBDUP3		✓
4				DBDUP 4		
5				replace		
TOTAL						

Environmental Division
 Melbourne
 Work Order
EM0911418

Telephone : + 61-3-8549 9600

Notes:
 Standard 5 day turn around times.
 Please email results to Danni Haworth and James Fox
 Please note short holding times

Ranil Weerakkody

From: Cowin, Michael (SKM) [MCowin@skm.com.au]
Sent: Friday, 13 November 2009 12:06 PM
To: Steven McGrath
Cc: Samples Melbourne; Fox, James (SKM); Haworth, Danni (SKM)
Subject: Analysis for Project VE23296
Attachments: VE23296_ALS COC.pdf

Hi Steven,

Please find attached the completed COC with analysis for project **VE23296**. The samples will be received today.

If you have any questions regarding the analysis please do not hesitate to contact me.

Kind regards,

Michael Cowin
Environmental Scientist

Sinclair Knight Merz
Level 5, 33 King William Street
Adelaide SA 5000

Mailing Address:
PO Box 8291
Station Arcade
SA 5000

Tel: +61 8 8245 5375
Fax: +61 8 8424 3810
Mobile: 0401 275 633

Email: mcowin@skm.com.au

Sinclair Knight Merz
achieve outstanding client success
For further information, visit our website www.skmconsulting.com

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This email has been scanned through the CBL Domain

CHAIN OF CUSTODY FORM



From : SKM Pty Ltd
 ABN: 37 001 024 095
 Level 5, 33 King William St, Adelaide, SA 5000
 ph: (08) 8424 3800 fax: (08) 8424 3810

ALS.

LAB USE ONLY
 QUOTE NUMBER: JE23296
 Job Code:
 Due Date:
 Custody seal intact? NO
 Sample cold? No
 Received for Laboratory by: *Alanic*
 Date: 13/11/09
 Time: 02
 Project No: JE23296
 Project Manager: James Fox
 Sampler(s): MC
 Checked:
 Date: 12/11/09

Size	Container Identification
Type	
Pressure	
Analytes	

Lab Id	Date	Time	Matrix	Sample Identification	Comments	Tick required analytes
	12/11/09		Soil	DBDUP1		
				DBDUP2		
				DBDUP3		
				DBDUP4.		
			Water	Tripblank		
TOTAL						

↓
 ↓
 ↓

~~Analysis to follow~~

Notes:

CERTIFICATE OF ANALYSIS

Sinclair Knight Merz Pty Ltd
Level 5 33 King William Road
ADELAIDE
SA 5000
Site: VE23296

Report Number: 255141-B-V1 Page 1 of 5
Order Number:
Date Received: Nov 13, 2009
Date Sampled: Nov 12, 2009
Date Reported: Nov 24, 2009
Contact: Danni Haworth

Methods

- USEPA 6010B Heavy Metals & USEPA 7470/71 Mercury
- APHA 4500-NH3 Ammonia Nitrogen by FIA
- APHA 4500-NO3 Nitrate Nitrogen by FIA
- APHA 4500-NO2 Nitrite Nitrogen by FIA
- APHA 4500 TKN
- APHA 4500-N Nitrogen
- Method 102 - ANZECC - % Moisture
- APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA
- APHA 4500 pH by Direct Measurement
- APHA 2510 Conductivity by Direct Measurement

Comments

Notes

Authorised

Report Number: 255141-B-V1



Michael Wright
Senior Principal Chemist
NATA Signatory



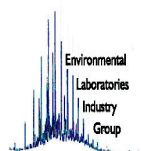
Rhonda Chouman
Client Manager
NATA Signatory



Andrew Cook
Chief Inorganic Chemist



NATA Corporate Accreditation Number 1261
The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to national standards of measurement. This document shall not be reproduced except in full



GLOSSARY OF TERMS

UNITS

mg/kg	milligrams per Kilogram	mg/l	milligrams per litre
ug/l	micrograms per litre	ppm	Parts per million
ppb	Parts per billion	%	Percentage
org/100ml	Organisms per 100 millilitres	NTU	Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate Duplicate	The addition of a like compound to the analyte target and reported as percentage recovery. A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environment Protection Authority
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice

QC - ACCEPTANCE CRITERIA

RPD Duplicates	Results <10 times the LOR : No Limit Results between 10-20 times LOR : RPD must lie between 0-50% Results >20 times LOR : RPD must lie between 0-20%
LCS Recoveries	Recoveries must lie between 70-130% - Phenols 30-130%
CRM Recoveries	Recoveries must lie between 70-130% - Phenols 30-130%
Method Blanks	Not to exceed LOR
SPIKE Recoveries	Recoveries must lie between 70-130% - Phenols 30-130%
Surrogate Recoveries	Recoveries must lie between 50-150% - Phenols 20-130%

GENERAL COMMENTS

- All results in this report supersede any previously corresponded results.
- All soil results are reported on a dry basis.
- Samples are analysed on an as received basis.

QC DATA GENERAL COMMENTS

- Where a result is reported as a less than (<), higher than the nominated LOR this is due to either Matrix Interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
- Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
- Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
- Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
- For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
- Duplicate RPD's are calculated from raw analytical data thus it is possible to have two two sets of data below the LOR with a positive RPD - eg: LOR 0.1, Result A = <0.1 (raw data is 0.02) & Result B = <0.1 (raw data is 0.03) resulting in a RPD of 40% calculated from the raw data.

REPORT SPECIFIC NOTES

Company Name: Sinclair Knight Merz Pty Ltd-SA
Address: Level 5 33 King William Road
 ADELAIDE
 SA 5000

Order No.:
Report #: 255141
Phone: 08 8424 3800
Fax: 08 8424 3810

Received: Nov 13, 2009 12:00
Due: Nov 20, 2009 02:47
Priority: 5 Day
Contact name: Danni Haworth

Client Job No.: VE23296

mgt Client Manager: Rhonda Chouman

Sample Detail					% Moisture	Ammonia(N)	Antimony	Arsenic	Beryllium	Cobalt	Conductivity screen for salinity	Lead	Manganese	Nitrate (as N)	Nitrite (as N)	pH (1:5 Aqueous extract)	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)	Zinc
Laboratory where analysis is conducted																			
Melbourne Laboratory - NATA Site #1254					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site #18217																			
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID															
DB01_0-0.1	Nov 12, 2009		Soil	M09-No03548	X		X	X	X	X		X	X			X			X
DB01_0.1-0.3	Nov 12, 2009		Soil	M09-No03549	X		X	X	X	X		X	X			X			X
DB01_1.4-1.6	Nov 12, 2009		Soil	M09-No03550	X		X	X	X	X		X	X			X			X
DB02_0-0.1	Nov 12, 2009		Soil	M09-No03551	X		X	X	X	X		X	X			X			X
DB02_0.1-0.3	Nov 12, 2009		Soil	M09-No03552	X		X	X	X	X		X	X			X			X
DB02_1.3-1.5	Nov 12, 2009		Soil	M09-No03553	X		X	X	X	X		X	X			X			X
DB03_0-0.1	Nov 12, 2009		Soil	M09-No03554	X		X	X	X	X		X	X			X			X
DB03_0.1-0.3	Nov 12, 2009		Soil	M09-No03555	X		X	X	X	X		X	X			X			X
DB03_0.6-0.8	Nov 12, 2009		Soil	M09-No03556	X		X	X	X	X		X	X			X			X
DB10_0-0.2	Nov 12, 2009		Soil	M09-No03557	X	X								X	X	X	X	X	
DB10_0.7-0.9	Nov 12, 2009		Soil	M09-No03558	X	X								X	X	X	X	X	
DB10_1.9-2.1	Nov 12, 2009		Soil	M09-No03559	X	X								X	X	X	X	X	
DB11_0-0.1	Nov 12, 2009		Soil	M09-No03560	X	X								X	X	X	X	X	

Sample Detail					% Moisture	Ammonia(N)	Antimony	Arsenic	Beryllium	Cobalt	Conductivity screen for salinity	Lead	Manganese	Nitrate (as N)	Nitrite (as N)	pH (1:5 Aqueous extract)	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)	Zinc
Laboratory where analysis is conducted																			
Melbourne Laboratory - NATA Site #1254					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site #18217																			
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID															
DB11_0.4-0.6	Nov 12, 2009		Soil	M09-No03561	X	X								X	X	X	X	X	
DB11_2.2-2.4	Nov 12, 2009		Soil	M09-No03562	X	X								X	X	X	X	X	
DBDUP2	Nov 12, 2009		Soil	M09-No03563	X		X	X	X	X		X	X						X
DBDUP3	Nov 12, 2009		Soil	M09-No03564	X	X								X	X		X	X	
RINSATE	Nov 12, 2009		Water	M09-No03565	X	X					X			X	X		X	X	

Sinclair Knight Merz Pty Ltd Level 5 33 King William Road ADELAIDE SA 5000	Client Sample ID		RINSATE
	Lab Number		M09-No03565
	Matrix		Water
	Sample Date		Nov 12, 2009
Analysis Type	LOR	Units	
Ammonia(N)	0.01	mg/L	< 0.05
Nitrate & Nitrite (N)	0.05	mg/L	< 0.05
Nitrate (as N)	0.02	mg/L	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02
Total Kjeldahl Nitrogen (N)	0.1	mg/L	< 0.1
Total Nitrogen (N)	0.2	mg/L	< 0.2

Sinclair Knight Merz Pty Ltd Level 5 33 King William Road ADELAIDE SA 5000	Client Sample ID	RINSATE	RINSATE	RPD	SPIKE	LCS
	Lab Number	09-No03565	09-No03565	09-No03565	09-No03565	Batch
	QA Description		Duplicate	Duplicate % RPD	Spike % Recovery	% Recovery
	Matrix	Water	Water	Water	Water	Water
	Sample Date	Nov 12, 2009	Nov 12, 2009	Nov 12, 2009	Nov 12, 2009	Nov 12, 2009
	Analysis Type	Units			% RPD	% Recovery
Ammonia(N)		< 0.05	< 0.01	< 1	104	103
Nitrate & Nitrite (N)		< 0.05	< 0.05	< 1	110	97
Nitrate (as N)		< 0.02	< 0.02	< 1	110	97
Nitrite (as N)		< 0.02	< 0.02	< 1	102	104
Total Kjeldahl Nitrogen (N)		< 0.1	< 0.1	< 1	98	-

Company Name: Sinclair Knight Merz Pty Ltd-SA
Address: Level 5 33 King William Road
 ADELAIDE
 SA 5000

Order No.:
Report #: 255141
Phone: 08 8424 3800
Fax: 08 8424 3810

Received: Nov 13, 2009 12:00
Due: Nov 20, 2009 02:47
Priority: 5 Day
Contact name: Danni Haworth

Client Job No.: VE23296

mgt Client Manager: Rhonda Chouman

Sample Detail					% Moisture	Ammonia(N)	Antimony	Arsenic	Beryllium	Cobalt	Conductivity screen for salinity	Lead	Manganese	Nitrate (as N)	Nitrite (as N)	pH (1:5 Aqueous extract)	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)	Zinc	
Laboratory where analysis is conducted																				
Melbourne Laboratory - NATA Site #1254					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site #18217																				
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID																
DB01_0-0.1	Nov 12, 2009		Soil	M09-No03548	X		X	X	X	X		X	X			X				X
DB01_0.1-0.3	Nov 12, 2009		Soil	M09-No03549	X		X	X	X	X		X	X			X				X
DB01_1.4-1.6	Nov 12, 2009		Soil	M09-No03550	X		X	X	X	X		X	X			X				X
DB02_0-0.1	Nov 12, 2009		Soil	M09-No03551	X		X	X	X	X		X	X			X				X
DB02_0.1-0.3	Nov 12, 2009		Soil	M09-No03552	X		X	X	X	X		X	X			X				X
DB02_1.3-1.5	Nov 12, 2009		Soil	M09-No03553	X		X	X	X	X		X	X			X				X
DB03_0-0.1	Nov 12, 2009		Soil	M09-No03554	X		X	X	X	X		X	X			X				X
DB03_0.1-0.3	Nov 12, 2009		Soil	M09-No03555	X		X	X	X	X		X	X			X				X
DB03_0.6-0.8	Nov 12, 2009		Soil	M09-No03556	X		X	X	X	X		X	X			X				X
DB10_0-0.2	Nov 12, 2009		Soil	M09-No03557	X	X								X	X	X	X	X		
DB10_0.7-0.9	Nov 12, 2009		Soil	M09-No03558	X	X								X	X	X	X	X		
DB10_1.9-2.1	Nov 12, 2009		Soil	M09-No03559	X	X								X	X	X	X	X		
DB11_0-0.1	Nov 12, 2009		Soil	M09-No03560	X	X								X	X	X	X	X		

Sample Detail					% Moisture	Ammonia(N)	Antimony	Arsenic	Beryllium	Cobalt	Conductivity screen for salinity	Lead	Manganese	Nitrate (as N)	Nitrite (as N)	pH (1:5 Aqueous extract)	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)	Zinc
Laboratory where analysis is conducted																			
Melbourne Laboratory - NATA Site #1254					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site #18217																			
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID															
DB11_0.4-0.6	Nov 12, 2009		Soil	M09-No03561	X	X								X	X	X	X	X	
DB11_2.2-2.4	Nov 12, 2009		Soil	M09-No03562	X	X								X	X	X	X	X	
DBDUP2	Nov 12, 2009		Soil	M09-No03563	X		X	X	X	X		X	X						X
DBDUP3	Nov 12, 2009		Soil	M09-No03564	X	X								X	X		X	X	
RINSATE	Nov 12, 2009		Water	M09-No03565	X	X					X			X	X		X	X	

Sample Receipt Advice

Company name: **Sinclair Knight Merz Pty Ltd-SA**

Contact name: Michael Cowin
Client job number: VE23296
COC number: Not provided
Turn around time: 5 Day
Date received: Nov 13, 2009
MGT lab reference: **255141**

Sample information

- A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- All samples have been received as described on the above COC.
- COC has been completed correctly.
- All samples were provided chilled.
- Appropriately preserved sample containers have been used.
- All samples were received in good condition.
- Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

Contact notes

If you have any questions with respect to these samples please contact:

Rhonda Chouman on Phone : (03) 9564 7055 or by e.mail: rhouman@mgtenv.com.au

Results will be delivered electronically via e.mail to Michael Cowin - mcowin@skm.com.au.

mgt Sample Receipt

796 798 991

CHAIN OF CUSTODY FORM



From : SKM Pty Ltd
 ABN: 37 001 024 095
 Level 5, 33 King William St, Adelaide, SA 5000
 ph: (08) 8424 3800 fax: (08) 8424 3810

LAB USE ONLY
 QUOTE NUMBER
 Job Code:
 Due Date:
 Custody seal intact?
 Sample cold?
 Received for Laboratory by:
 Date: 12/11
 Time:

Project No: VE23296
 Project Manager: James Fox
 Sampler(s): MC
 Checked:
 Date: 12/11/09

Container Identification			
Size	Type	Preserv	Analytes
			Heavy Metals (Co, Pb, As, Sb, Zn, Be, Mn)
			Total N, Ammonia as N, Nitrite and Nitrate
			Soil pH

Lab Id	Date	Time	Matrix	Sample Identification	Comments	Tick required analytes				
	12/11/2009		Soil	DB01_0-0.1		✓		✓		
	12/11/2009		Soil	DB01_0.1-0.3		✓		✓		
	12/11/2009		Soil	DB01-0.8-1.0						
	12/11/2009		Soil	DB01_1.4-1.8		✓		✓		
	12/11/2009		Soil	DB01_1.8-1.8						
	12/11/2009		Soil	DB01_1.8-2.0						
	12/11/2009		Soil	DB02_0-0.1		✓		✓		
	12/11/2009		Soil	DB02_0.1-0.3		✓		✓		
	12/11/2009		Soil	DB02_0.8-1.0						
	12/11/2009		Soil	DB02_1.3-1.5		✓		✓		
	12/11/2009		Soil	DB03_0-0.1		✓		✓		
	12/11/2009		Soil	DB03_0.1-0.3		✓		✓		
	12/11/2009		Soil	DB03_0.4-0.8						
	12/11/2009		Soil	DB03_0.8-0.8		✓		✓		
	12/11/2009		Soil	DB03_1.3-1.5						
	12/11/2009		Soil	DB03_1.7-2.0						
	12/11/2009		Soil	DB10_0-0.2			✓	✓		
	12/11/2009		Soil	DB10_0.7-0.9			✓	✓		
	12/11/2009		Soil	DB10_1.4-1.8						
	12/11/2009		Soil	DB10_1.9-2.1			✓	✓		
	12/11/2009		Soil	DB10_2.8-2.8						
	12/11/2009		Soil	DB11_0-0.1			✓	✓		
	12/11/2009		Soil	DB11_0.4-0.8			✓	✓		
	12/11/2009		Soil	DB11_1.1-1.3						
	12/11/2009		Soil	DB11_1.5-1.7						
	12/11/2009		Soil	DB11_1.7-1.9						
	12/11/2009		Soil	DB11_2.2-2.4			✓	✓		
	12/11/2009		Soil	DB09_1.5-1.7						
	12/11/2009		Soil	DBDUP1						
	12/11/2009		Soil	DBDUP2		✓				
	12/11/2009		Soil	DBDUP3			✓			
	12/11/2009		Water	Rinsate			✓			
				TRIP BLANK						
					TOTAL					

Notes:
 Standard 5 day turn around times.
 Please email results to Danni Haworth and James Fox
 Please note short holding times

JAMES
 255141



Appendix C – Groundwater Purge Sheet

Bore Purging and Groundwater Sampling Data Sheet

DUPI - 001

General Information			
Client:	Halls Road		
Job Number:	VE23296	Bore Locked (Y/N)	
Project:	Halls Road GME 2009	Well ID No.	MW1-001
Location:	Highbury	Chem Kit No.	
Depth to Groundwater (m-TOSC):		Well depth (m-PVC)	31.18
Depth to Groundwater (mPVC):	27.625	Free product thickness:	
Depth to Groundwater (m-BGL):		RL from TOC:	

Weather Conditions	
Rain:	-
Temperature:	39°C
Cloud Cover:	90%
Location Conditions:	Grass and weeds near tree on private block
Wind Direction:	-
Wind Speed:	-
Upwind Activities:	-

Field Comments		
Other Comments and Observations:	r = 0.025	H = 31.18 - 27.625
- Bore Conditions	R = 0.0572	h = 3.555
- Fate of Tubing, etc. (left in hole/disposal)		
- Purge Volume Calculations in Liters (screened & unscreened sections)		
$PV = [(H \times \pi \times r^2) + 0.2(h \times \pi \times (R^2 - r^2))] \times 1000$		$PV = [(3.555 \times \pi \times (0.025^2)) + 0.2 \times (3.555 \times \pi \times (0.0572^2 - 0.025^2))] \times 1000$
where H = height of water column (m)	R = Bore Radius (m)	PV = 6.98 + 5.91
h = thickness of saturated filterpack (m)	r = PVC Radius (m)	PV = 12.89 L

Purging Information						
Date:	18/11/09	Name:	NH			
Method:	Baller	Tubing Material:	Teflon	Pump Depth		
Start Time:	2:55 pm	Finish Time:	4:00 pm	Pump Speed		
Purge Volume (L)	13	No times purged	3	Total Purge Volumes (litres)	39	
Time	Volume Removed (L)	pH	E.C. (mS/cm)	Redox (mV)	Temp (Cels)	Appearance (Colour / Odour / Turbidity)
3:08	13	7.55	2.41	136	22.4	Orange / no odour / sheer / high
3:22	13	6.84	2.42	108	19.2	" " " "
3:40	13	6.80	2.46	103	18.9	" " " "
		ok	ok			
Purging should continue until measurements for pH are within 0.05 pH unit, EC is within 3%, Redox is within 10mV and Temperature is within 0.5 degC of the previous set of parameters.						

Sampling Information						
Date:				Name:		
Method:	Tubing Material			Pump Depth		
Start Time	Finish Time			Pump Speed		
Time	Volume Removed (L)	pH	E.C. (mS/cm)	Redox (mV)	Temp (Cels)	Appearance (Colour / Odour / Turbidity)
← As Above →						
Purger's Name:	NH	Signature:			Date:	18/11/09
Sampler's Name:	NH	Signature:			Date:	18/11/09
Checked by:	JF	Signature:			Date:	27/11/2009

SKM



Appendix D – Certified Groundwater Laboratory Reports



Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: EM0911667	Page	: 1 of 3
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Melbourne
Contact	: ALL REPORTS	Contact	: Steven McGrath
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: CLM-Adelaide@skm.com.au	E-mail	: steven.mcgrath@alsenviro.com
Telephone	: +61 08 8424 3800	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8424 3810	Facsimile	: +61-3-8549 9601
Project	: VE23296	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 19-NOV-2009
C-O-C number	: ----	Issue Date	: 26-NOV-2009
Sampler	: NH	No. of samples received	: 3
Site	: ----	No. of samples analysed	: 2
Quote number	: EN/003/09		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Instrument Chemist	Inorganics

Environmental Division Melbourne

Part of the **ALS Laboratory Group**

4 Westall Rd Springvale VIC Australia 3171

Tel. +61-3-8549 9600 Fax. +61-3-8549 9601 www.alsglobal.com

A Campbell Brothers Limited Company



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting



Analytical Results

Sub-Matrix: **WATER**

			Client sample ID	MW1_001	DUP1_001			
			Client sampling date / time	18-NOV-2009 15:00	18-NOV-2009 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EM0911667-001	EM0911667-002	----	----	----
EA005: pH								
pH Value	----	0.01	pH Unit	6.70	6.65	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.80	0.83	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	0.04	0.04	----	----	----
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.04	0.04	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.1	2.2	----	----	----
EK062G: Total Nitrogen AsN By Discrete Analyset								
^ Total Nitrogen as N	----	0.1	mg/L	2.1	2.2	----	----	----



Environmental Division

QUALITY CONTROL REPORT

Work Order	: EM0911667	Page	: 1 of 5
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Melbourne
Contact	: ALL REPORTS	Contact	: Steven McGrath
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: CLM-Adelaide@skm.com.au	E-mail	: steven.mcgrath@alsenviro.com
Telephone	: +61 08 8424 3800	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8424 3810	Facsimile	: +61-3-8549 9601
Project	: VE23296	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----	Date Samples Received	: 19-NOV-2009
C-O-C number	: ----	Issue Date	: 26-NOV-2009
Sampler	: NH	No. of samples received	: 3
Order number	: ----	No. of samples analysed	: 2
Quote number	: EN/003/09		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Dilani Fernando	Senior Inorganic Instrument Chemist	Inorganics

Environmental Division Melbourne

Part of the **ALS Laboratory Group**

4 Westall Rd Springvale VIC Australia 3171

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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC



Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:- No Limit; Result between 10 and 20 times LOR:- 0% - 50%; Result > 20 times LOR:- 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EA005: pH (QC Lot: 1169486)									
EM0911664-001	Anonymous	EA005: pH Value	----	0.01	pH Unit	6.64	6.65	0.2	0% - 20%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1172108)									
EM0911664-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM0911670-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	23.4	23.2	0.8	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1169848)									
EM0911650-003	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	<0.01	<0.01	0.0	No Limit
EM0911672-001	Anonymous	EK057G: Nitrite as N	----	0.01	mg/L	0.05	0.05	0.0	No Limit
EK059G: NOX as N by Discrete Analyser (QC Lot: 1172107)									
EM0911664-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	2.50	2.34	6.8	0% - 20%
EM0911670-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.02	0.0	No Limit
EK061: Total Kjeldahl Nitrogen (TKN) (QC Lot: 1172229)									
EM0911599-006	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	64.1	60.8	5.2	0% - 20%
EM0911670-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	37.2	36.8	1.1	0% - 20%



Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
Method: Compound	CAS Number	LOR	Unit	Result	Spike Concentration	Spike Recovery (%) LCS	Recovery Limits (%) Low High	
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1172108)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	99.2	80	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1169848)								
EK057G: Nitrite as N	----	0.01	mg/L	<0.01	0.5 mg/L	102	89.9	105
EK059G: NOX as N by Discrete Analyser (QCLot: 1172107)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.5	76.5	120
EK061: Total Kjeldahl Nitrogen (TKN) (QCLot: 1172229)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	101	71.4	111



Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				<i>Matrix Spike (MS) Report</i>				
<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Method: Compound</i>	<i>CAS Number</i>	<i>Spike</i>	<i>Spike Recovery (%)</i>		<i>Recovery Limits (%)</i>	
				<i>Concentration</i>	<i>MS</i>	<i>Low</i>	<i>High</i>	
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1172108)								
EM0911664-003	Anonymous	EK055G: Ammonia as N	7664-41-7	0.5 mg/L	91.0	70	130	
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1169848)								
EM0911647-011	Anonymous	EK057G: Nitrite as N	----	0.5 mg/L	110	70	130	
EK059G: NOX as N by Discrete Analyser (QCLot: 1172107)								
EM0911664-003	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	119	70	130	
EK061: Total Kjeldahl Nitrogen (TKN) (QCLot: 1172229)								
EM0911667-001	MW1_001	EK061G: Total Kjeldahl Nitrogen as N	----	25 mg/L	102	70	130	



Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EM0911667	Page	: 1 of 5
Client	: SINCLAIR KNIGHT MERZ	Laboratory	: Environmental Division Melbourne
Contact	: ALL REPORTS	Contact	: Steven McGrath
Address	: LEVEL 5, 33 KING WILLIAM ST ADELAIDE SA, AUSTRALIA 5000	Address	: 4 Westall Rd Springvale VIC Australia 3171
E-mail	: CLM-Adelaide@skm.com.au	E-mail	: steven.mcgrath@alsenviro.com
Telephone	: +61 08 8424 3800	Telephone	: +61-3-8549 9600
Facsimile	: +61 08 8424 3810	Facsimile	: +61-3-8549 9601
Project	: VE23296	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-O-C number	: ----	Date Samples Received	: 19-NOV-2009
Sampler	: NH	Issue Date	: 26-NOV-2009
Order number	: ----		
Quote number	: EN/003/09	No. of samples received	: 3
		No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

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Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: **WATER**

Evaluation: * = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis			
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EA005: pH								
Clear Plastic Bottle - Natural MW1_001, DUP1_001	18-NOV-2009	----	----	----	20-NOV-2009	18-NOV-2009	*	
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulphuric Acid MW1_001, DUP1_001	18-NOV-2009	---	---	----	24-NOV-2009	16-DEC-2009	✓	
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural MW1_001, DUP1_001	18-NOV-2009	---	---	----	20-NOV-2009	20-NOV-2009	✓	
EK059G: NOX as N by Discrete Analyser								
Clear Plastic Bottle - Sulphuric Acid MW1_001, DUP1_001	18-NOV-2009	---	---	----	24-NOV-2009	16-DEC-2009	✓	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulphuric Acid MW1_001, DUP1_001	18-NOV-2009	25-NOV-2009	16-DEC-2009	✓	25-NOV-2009	16-DEC-2009	✓	



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER** Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
Analytical Methods							
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	10.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	20	10.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
pH	EA005	1	9	11.1	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.0	10.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✔	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.0	5.0	✔	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.0	5.0	✔	ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	20	5.0	5.0	✔	ALS QCS3 requirement
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.0	5.0	✔	ALS QCS3 requirement



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH	EA005	WATER	APHA 21st ed. 4500 H+ B. pH of water samples is determined by ISE either manually or by automated pH meter. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ammonia as N by Discrete analyser	EK055G	WATER	APHA 21st ed., 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a cadmium reduction column followed by quantification by Discrete Analyser. Nitrite is determined separately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Cadmium Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	APHA 21st ed., 4500-Norg D. 25mL water samples are digested using a traditional Kjeldahl digestion followed by determination by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	APHA 21st ed., 4500-Norg / 4500-NO3-. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	APHA 21st ed., 4500 Norg - D; APHA 21st ed., 4500 P - H. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)



Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.
- For all matrices, no Matrix Spike outliers occur.

Regular Sample Surrogates

- For all regular sample matrices, no surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **WATER**

Method	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005: pH						
Clear Plastic Bottle - Natural MW1_001, DUP1_001	----	----	----	20-NOV-2009	18-NOV-2009	2

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- No Quality Control Sample Frequency Outliers exist.

CHAIN OF CUSTODY FORM

SKM

From : SKM Pty Ltd
 ABN: 37 001 024 095
 Level 5, 33 King William St, Adelaide, SA 5000
 ph: (08) 8424 3800 fax: (08) 8424 3810

LAB USE ONLY
 QUOTE NUMBER
 Job Code:
 Due Date:
 Custody seal Intact?
 Sample cold?
 Received for Laboratory by:
 Date:
 Time:

Project No: VE23293* **VE23296**
 Project Manager: Emily Picken
 Sampler(s): NH
 Checked:
 Date: 18/11/09

Container Identification				
Size	Type	Preserv	Analyses	
			pH, Total N, Ammonia	
			Nitrate/Nitrite	
			Total Kjeldahl N	
			Hold	

Lab Id	Date	Time	Matrix	Sample Identification	Comments	Tick required analytes			
1	18/11/2009		Water	MW1_001		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
2	18/11/2009		Water	DUP1_001		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3	18/11/2009		Water	Tripblank3					<input checked="" type="checkbox"/>
URGENT									
SCANNED									

Environmental Division
 Melbourne
 Work Order **EM0911667**



Telephone : +61-3-8549 9600

TOTAL

Notes:
 Standard 5 day turn around time please.
 Sample was filtered in the field for metals.
 Please email Danni Haworth and James on arrival.
 Please note short holding times

MD
20/11

CERTIFICATE OF ANALYSIS

Sinclair Knight Merz Pty Ltd
Level 5 33 King William Road
ADELAIDE
SA 5000
Site: VE23296

Report Number: 255455-V1 Page 1 of 5
Order Number:
Date Received: Nov 19, 2009
Date Sampled: Nov 18, 2009
Date Reported: Nov 25, 2009
Contact: Emily Picken

Methods

- APHA 4500 pH by Direct Measurement - **pH Holding time 30mins. Samples analysed outside holding time.
- APHA 4500-NH3 Ammonia Nitrogen by FIA
- APHA 4500-NO3 Nitrate Nitrogen by FIA
- APHA 4500-NO2 Nitrite Nitrogen by FIA
- APHA 4500 TKN
- APHA 4500-N Nitrogen
- APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA

Comments

Notes

Authorised

Report Number: 255455-V1



Michael Wright
Senior Principal Chemist
NATA Signatory



Rhonda Chouman
Client Manager
NATA Signatory

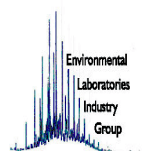


Andrew Cook
Chief Inorganic Chemist



NATA Corporate Accreditation Number 1261

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GLOSSARY OF TERMS

UNITS

mg/kg	milligrams per Kilogram	mg/l	milligrams per litre
ug/l	micrograms per litre	ppm	Parts per million
ppb	Parts per billion	%	Percentage
org/100ml	Organisms per 100 millilitres	NTU	Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate Duplicate	The addition of a like compound to the analyte target and reported as percentage recovery. A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environment Protection Authority
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice

QC - ACCEPTANCE CRITERIA

RPD Duplicates	Results <10 times the LOR : No Limit Results between 10-20 times LOR : RPD must lie between 0-50% Results >20 times LOR : RPD must lie between 0-20%
LCS Recoveries	Recoveries must lie between 70-130% - Phenols 30-130%
CRM Recoveries	Recoveries must lie between 70-130% - Phenols 30-130%
Method Blanks	Not to exceed LOR
SPIKE Recoveries	Recoveries must lie between 70-130% - Phenols 30-130%
Surrogate Recoveries	Recoveries must lie between 50-150% - Phenols 20-130%

GENERAL COMMENTS

- All results in this report supersede any previously corresponded results.
- All soil results are reported on a dry basis.
- Samples are analysed on an as received basis.

QC DATA GENERAL COMMENTS

- Where a result is reported as a less than (<), higher than the nominated LOR this is due to either Matrix Interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
- Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
- Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
- Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
- Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
- For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
- Duplicate RPD's are calculated from raw analytical data thus it is possible to have two two sets of data below the LOR with a positive RPD - eg: LOR 0.1, Result A = <0.1 (raw data is 0.02) & Result B = <0.1 (raw data is 0.03) resulting in a RPD of 40% calculated from the raw data.

REPORT SPECIFIC NOTES

Company Name:	Sinclair Knight Merz Pty Ltd-SA	Order No.:		Received:	Nov 19, 2009 12:00
Address:	Level 5 33 King William Road ADELAIDE SA 5000	Report #:	255455	Due:	Nov 26, 2009 01:04
		Phone:	08 8424 3800	Priority:	5 Day
		Fax:	08 8424 3810	Contact name:	Emily Picken
Client Job No.:	VE23296			mgt Client Manager: Rhonda Chouman	

Sample Detail					Ammonia(N)	Nitrate & Nitrite (N)	Nitrate (as N)	Nitrite (as N)	pH	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)
Laboratory where analysis is conducted											
Melbourne Laboratory - NATA Site #1254					X	X	X	X	X	X	X
Sydney Laboratory - NATA Site #18217											
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID							
DUP1_001	Nov 18, 2009		Water	M09-No05436	X	X	X	X	X	X	X

Sinclair Knight Merz Pty Ltd Level 5 33 King William Road ADELAIDE SA 5000	Client Sample ID		DUP1_001
	Lab Number		M09-No05436
	Matrix		Water
	Sample Date		Nov 18, 2009
Analysis Type	LOR	Units	
Ammonia(N)	0.01	mg/L	0.69
Nitrate & Nitrite (N)	0.05	mg/L	< 0.05
Nitrate (as N)	0.02	mg/L	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02
pH	0.1	units	6.7
Total Kjeldahl Nitrogen (N)	0.1	mg/L	0.9
Total Nitrogen (N)	0.2	mg/L	0.9

Client Sample ID	DUP1_001	DUP1_001	RPD	SPIKE	CRM	LCS	Method blank
Sinclair Knight Merz Pty Ltd							
Level 5 33 King William Road							
ADELAIDE							
SA 5000							
Lab Number	09-No05436	09-No05436	09-No05436	09-No05436	Batch	Batch	Batch
QA Description		Duplicate	Duplicate % RPD	Spike % Recovery	% Recovery	% Recovery	
Matrix	Water	Water	Water	Water	Water	Water	Water
Sample Date	Nov 18, 2009	Nov 18, 2009	Nov 18, 2009	Nov 18, 2009	Nov 18, 2009	Nov 18, 2009	Nov 18, 2009
Analysis Type	Units		% RPD	% Recovery	% Recovery	% Recovery	mg/L
Ammonia(N)	-	-	17	103	106	101	< 0.01
Nitrate & Nitrite (N)	-	-	< 1	106	-	105	< 0.05
Nitrate (as N)	-	-	< 1	106	113	105	< 0.02
Nitrite (as N)	-	-	< 1	108	106	105	< 0.02
pH	6.7	6.8	-	-	-	-	-
Total Kjeldahl Nitrogen (N)	0.9	1.1	5.3	108	90	95	< 0.1

Company Name:	Sinclair Knight Merz Pty Ltd-SA	Order No.:		Received:	Nov 19, 2009 12:00
Address:	Level 5 33 King William Road ADELAIDE SA 5000	Report #:	255455	Due:	Nov 26, 2009 01:04
		Phone:	08 8424 3800	Priority:	5 Day
		Fax:	08 8424 3810	Contact name:	Emily Picken
Client Job No.:	VE23296			mgt Client Manager: Rhonda Chouman	

Sample Detail					Ammonia(N)	Nitrate & Nitrite (N)	Nitrate (as N)	Nitrite (as N)	pH	Total Kjeldahl Nitrogen (N)	Total Nitrogen (N)
Laboratory where analysis is conducted											
Melbourne Laboratory - NATA Site #1254					X	X	X	X	X	X	X
Sydney Laboratory - NATA Site #18217											
Sample ID	Sample Date	Sampling Time	Matrix	LAB ID							
DUP1_001	Nov 18, 2009		Water	M09-No05436	X	X	X	X	X	X	X

Sample Receipt Advice

Company name: **Sinclair Knight Merz Pty Ltd-SA**

Contact name: Emily Picken
Client job number: VE23296
COC number: Not provided
Turn around time: 5 Day
Date received: Nov 19, 2009
MGT lab reference: **255455**

Sample information

- A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- All samples have been received as described on the above COC.
- COC has been completed correctly.
- All samples were provided chilled.
- Appropriately preserved sample containers have been used.
- All samples were received in good condition.
- Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

Contact notes

If you have any questions with respect to these samples please contact:

Rhonda Chouman on Phone : (03) 9564 7055 or by e.mail: rhouman@mgtenv.com.au

Results will be delivered electronically via e.mail to Emily Picken - emilypicken@rem.net.au.

mgt Sample Receipt

7NT: 311243523

CHAIN OF CUSTODY FORM



From : SKM Pty Ltd
ABN: 37 001 024 095
Level 5, 33 King William St, Adelaide, SA 5000
ph: (08) 8424 3800 fax: (08) 8424 3810

LAB USE ONLY
QUOTE NUMBER
Job Code:
Due Date:
Custody seal intact?
Sample code?
Received for Laboratory by: *MCT*
Date: *18/11/09*
Time: *9:15*

Project No: *VE23293* *VE23296*
Project Manager: Emily Picken
Sampler(s): NH
Checked:
Date: 18/11/09

Analytes	Container Identification				
	Size	Type	Preserv		
	pH, Total N, Ammonia				
	Nitrate/Nitrite				
	Total Kjeldahl N				
	Hold				

Lab id	Date	Time	Matrix	Sample Identification	Comments	Tick required analytes				
	18/11/2009		Water	DUP1_001		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
	18/11/2009		Water	Trp/ban2					<input checked="" type="checkbox"/>	
TOTAL										

Notes:
Standard 5 day turn around time please.
Please email Danni Haworth and James Fox on arrival.
Please note short holding times

Larry Wong
Rep # 255455
19/11 @ 9:15am



Appendix E – QA/QC Summary

Appendix E.1 - Summary of RPDs - Metals and Nutrients
497 Cross Keys Road, Cavan

Sample ID	DB02_0.1-0.3	DBDUP2	RPD %	DBDUP2	RPD %	DB10_1.9-2.1	DBDUP3	RPD %	DBDUP3	RPD %	Rinsate	RINSATE
Date Sampled	12/11/2009	12/11/2009		12/11/2009		12/11/2009	12/11/2009		12/11/2009		12/11/2009	12/11/2009
Lab Report No	255141	255141		EM0911418		255141	255141		EM0911418		255141	MGT
Duplication	Primary	Intra		Inter		Primary	Intra		Inter			255149

Analyte	Units	MGT LOR	ALS LOR												
Heavy Metals															
Antimony	mg/kg	10	5	< 10	< 10	-	<5	-	-	-	-	-	-	-	< 0.005
Arsenic	mg/kg	2	5	4.1	4.3	4.8	<5	-	-	-	-	-	-	-	< 0.001
Beryllium	mg/kg	2	1	< 2	< 2	-	<1	-	-	-	-	-	-	-	< 0.001
Cobalt	mg/kg	5	2	< 5	< 5	-	<2	-	-	-	-	-	-	-	< 0.001
Lead	mg/kg	5	5	7	< 5	-	<5	-	-	-	-	-	-	-	< 0.001
Zinc	mg/kg	5	5	5	< 5	-	<5	-	-	-	-	-	-	-	< 0.001
Manganese	mg/kg	5	5	130	57	78.1	23	139.9	-	-	-	-	-	-	-
Nutrients															
Ammonia(N)	mg/kg	5	20	-	-	-	-	-	< 5	< 5	-	<20	-	< 0.05	-
Nitrate & Nitrite (N)	mg/kg	5	0.1	-	-	-	-	-	< 5	< 5	-	2.2	-	< 0.05	-
Nitrate (as N)	mg/kg	5	0.1	-	-	-	-	-	< 5	< 5	-	2.22	-	< 0.02	-
Nitrite (as N)	mg/kg	5	0.1	-	-	-	-	-	< 5	< 5	-	<0.1	-	< 0.02	-
pH (1:5 Aqueous extract)	mg/kg	0.1	0.1	-	-	-	-	-	7.6	-	-	-	-	-	-
Total Kjeldahl Nitrogen (N)	mg/kg	10	20	-	-	-	-	-	330	42	154.8	530	46.5	< 0.1	-
Total Nitrogen (N)	mg/kg	5	20	-	-	-	-	-	330	42	154.8	530	-	< 0.2	-

Notes

Sample in excess of adopted 50% RPD

DATA QUALITY SUMMARY REPORT - SOIL

Project No: VE23296
 Site: Halls Road, Highbury
 Matrix: Soil
 Primary Laboratory: MGT - 255141
 Secondary Laboratory: ALS - EM0911418
 No. of Tests Requested/ Reported: 9 x Heavy Metals and 6 x Nutrients
 Frequency of QA/QC undertaken: 1 in 9 samples duplicated (inter- and intra-laboratory)
 Frequency of QA/QC Required: 1 in 20 samples is required to be duplicated

Data Quality Issue Assessed	Issue Reviewed	Results Acceptable	Comments
Sampling Technique	✓	✓	
Sample Holding Times	✓	✓	
Analytical Procedures	✓	✓	
Laboratory Limits of Reporting (below relevant guideline value)	✓	✓	
Field Duplicate Agreement (RPD%)	✓	✓	See Note 1
Blank Sample Analysis	✓	✓	
Method Blank	NA	NA	
Rinsate Blank	✓	✓	
Trip Blank	NA	NA	
Laboratory Duplicate Agreement (RPD%)	✓	✓	
Matrix Spikes/Matrix Spike Duplicates	✓	✓	
Recovery Percentages	✓	✓	
Duplicate Agreement (RPD%)	✓	✓	
Surrogate Recoveries	✓	✓	
Other Issues	✓	✓	

Other Observations

Note 1 An elevated relative percentage difference between the primary (130 mg/kg) and secondary (23 mg/kg) laboratories was reported for Manganese (139.9%). The reported concentration from the inter-laboratory duplicate is consistent with reported results for the intra-laboratory duplicate sample. The results are not considered to significantly impact the interpretation of results as all concentrations are below adopted guidelines and variation in reported results is common in fill material and maybe associated with the heterogeneity of the soil and not the sampling and/or analytical technique.

Summary Comments:

Soil analytical data can be used as a basis of interpretation, subject to the limitations outlined above.

Recommended Corrective Action:

none



Appendix E.2. RPD Groundwater Analytical Results - Metals and Inorganic Compound
Hallan Nominees Additional Soil Investigations, Halls Road, Highbury
Project No. VE23296

Sample ID	MW1_001	DUP1_001	RPD %	DUP1_001	RPD %
Date Sampled	18/11/2009	18/11/2009		18/11/2009	
Laboratory	ALS	ALS		MGT	
Lab Report No.	EM0911667	EM0911667		255455	

Chemical	ALS LOR	MGT LOR	Units					
pH								
pH	0.01	0.1	pH units	6.7	6.65	0.75	6.7	0.00
Ammonia as N								
Ammonia	0.01	0.05	mg/L	0.8	0.83	3.68	0.69	14.77
Nitrite as N								
Nitrite as N	0.01	0.02	mg/L	<0.01	<0.01	-	<0.02	-
Nitrate as N								
Nitrate as N	0.01	0.02	mg/L	0.04	0.04	0.00	<0.02	-
Nitrite + Nitrate as N								
Nitrite + Nitrate as N	0.01	0.05	mg/L	0.04	0.04	0.00	<0.05	-
Total Kjeldahl Nitrogen as N								
Total Kjeldahl Nitrogen as N	0.1	0.1	mg/L	2.1	2.2	4.65	0.9	80.00
Total Nitrogen as N								
Total Nitrogen as N	0.1	0.2	mg/L	2.1	2.2	4.65	0.9	80.00

Notes:
[Redacted] exceedance of the Adopted Relative Percentage Guidelines (50%)
na - not applicable
LOR - Limits of Reporting

DATA QUALITY SUMMARY REPORT - GROUNDWATER

Project No: VE23296
 Site: Hallan Nominees Additional Soil Investigations, Halls Road, Highbury
 Matrix: GROUNDWATER
 Primary Laboratory: ALS (Batch no. EM0911667)
 Secondary Laboratory: MGT (Batch no. 255455)
 No. of Tests Requested/ Reported:

Frequency of QA/QC undertaken: 1 in 1 samples duplicated
 Frequency of QA/QC Required: 1 in 10 samples is required to be duplicated

Data Quality Issue Assessed	Issue Reviewed	Results Acceptable	Comments
Sampling Technique	✓	Y	
Sample Holding Times	✓	Y	See Note 1
Analytical Procedures	✓	Y	
Laboratory Limits of Reporting (below relevant guideline value)	✓	Y	
Field Duplicate Agreement (RPD%)	✓	Y	See Note 2
Blank Sample Analysis	✓		
Method Blank	✓	Y	
Rinsate Blank	NA	NA	
Trip Blank	✓	Y	
Laboratory Duplicate Agreement (RPD%)	✓	Y	
Matrix Spikes/Matrix Spike Duplicates	✓	Y	
Recovery Percentages	✓	Y	
Duplicate Agreement (RPD%)	✓	Y	
Surrogate Recoveries	✓	Y	
Other Issues (i.e Trip Blank)	✓	Y	

Other Observations:

Note 1: Holding time breaches occurred for analysis of pH in all samples. These breaches were due to sample delivery time, same day as the samples are collected. This is unable to be achieved as NATA registered laboratories are located in the field during sampling and are generally consistent with laboratory results.

Note 2: Intra- and Inter-laboratory field duplicates were taken from groundwater sampled from well MW1_001 (DUP1_001).
 • No elevated RPD's were reported between the primary sample MW1_001 and intra-laboratory duplicate DUP1_001
 • Elevated RPD's were reported between the primary sample MW1_001 and inter-laboratory duplicate DUP1_001 (80%) and Total Nitrogen as N (80%).

Elevated RPD% for Total Kjeldahl Nitrogen as N and Total Nitrogen as N were reported between the primary MW1_001 laboratory DUP1_001. This is not considered significant in terms of the overall interpretation of results as the actual concentrations is considered minor. In addition, the intra-laboratory duplicate is consistent with the primary concentration. These results are therefore not considered to be significant in terms of the overall interpretation of the contamination and require confirmation in subsequent sampling events.

Summary Comments:

Groundwater analytical data can be used as a basis of interpretation, subject to the limitations outlined above.

Recommended Corrective Action:

none





Appendix F – GA2000 Calibration Certificates



ENVIROEQUIP RENTALS

Your Friend in the Field

Equipment Report - GEOTECHNICAL INSTRUMENTS GA2000

This Gas Meter has been performance checked / calibrated* as follows:

Calibration	Cal Value	Reading	Cal Value	Reading	Pass?
CH4	50.60% vol	51 %	0.00% vol	0 %	<input checked="" type="checkbox"/>
CH4 -check only	2.5%CH4	2.5 %			<input checked="" type="checkbox"/>
H2s	25ppm	25 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
O2	21.0% vol	21 %	0.00% vol	0 %	<input checked="" type="checkbox"/>
CO	100ppm	100 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
CO2	40% vol	40 %			<input type="checkbox"/>
Operations Check					
<input checked="" type="checkbox"/> Cleaned/checked	<input type="checkbox"/> In line Filter Check		<input type="checkbox"/> Battery Status @ <u>30</u> %		

* Calibration gas traceability information is available upon request.

Please charge me!

Date: 26/11/09 Checked by: [Signature]

Signed: [Signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum \$20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sampling Probe with In-Line Filter
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1m of Sampling Tube
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry Strap
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Battery Charger and AC/DC Power Supply
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Operating Quick Guide <u>behind foam on lid of case</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Manual <u>behind foam on lid of case</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spare Inline Filters Qty (1)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry case
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Data Cable and Software CD or Diskette
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instrument Battery Status @ <u>30</u> %
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

+ car charger

Processors Signature/ Initials [Signature]

EE Quote Reference		Condition on return
Customer Ref		
Equipment ID	<u>GA2000CAB</u>	
Equipment serial no.		
Return Date	<u> / /</u>	
Return Time		

Phone: (Free Call) 1800 675 756		Fax: (Free Call) 1800 657 123		Email: info@enviroequip.com	
Melbourne Branch 5 Caribbean Drive, Scoresby 3179 Local Tel: 03 9757 4577 Local Fax: 03 9763 2083	Sydney Branch Level 1, 4 Talavera Road, North Ryde 2113 Local Tel: 02 8817 4250 Local Fax: 02 9889 4622	Adelaide Branch 27 Beulah Road, Norwood, South Australia 5067 Local Tel: 08 8334 0000 Local Fax: 08 8363 3110	Brisbane Branch Unit 2/5 Ross St, Newstead 4006 Local Tel: 07 3852 6111 Local Fax: 07 3852 6155	Perth Branch 121 Beringarra Ave Malaga WA 6090 Local Tel: 08 9262 7599 Local Fax: 08 9248 6836	



ENVIROEQUIP RENTALS

Your Friend in the Field

Equipment Report - GEOTECHNICAL INSTRUMENTS GA2000

This Gas Meter has been performance checked / calibrated* as follows:

Calibration	Cal Value	Reading	Cal Value	Reading	Pass?
CH4	60% vol	60 %	0.00% vol	0 %	<input checked="" type="checkbox"/>
CH4 -check only	2.5%CH4	2-4%			<input checked="" type="checkbox"/>
H2s	25ppm	24 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
O2	21.0% vol	%	0.00% vol	0 %	<input checked="" type="checkbox"/>
CO	100ppm	101 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
CO2	40% vol	40 %			<input checked="" type="checkbox"/>
Operations Check					
<input checked="" type="checkbox"/> Cleaned/checked	<input checked="" type="checkbox"/> In line Filter Check		<input checked="" type="checkbox"/> Battery Status @ <u>100</u> %		

* Calibration gas traceability information is available upon request.

Date: 16/12/09 Checked by: Volker

Signed: [Signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum \$20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sampling Probe with In-Line Filter
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1m of Sampling Tube
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry Strap
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Battery Charger and AC/DC Power Supply
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Operating Quick Guide <u>behind foam on lid of case</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Manual <u>behind foam on lid of case</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spare Inline Filters Qty (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry case
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Data Cable and Software CD or Diskette
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instrument Battery Status @ <u>100</u> %
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Flow Pod & Ex Cap Quick Connect</u>

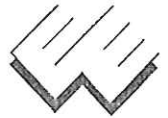
Processors Signature/ Initials

EE Quote Reference		Condition on return
Customer Ref		
Equipment ID	<u>GA2000AB</u>	
Equipment serial no.		
Return Date	<u> / /</u>	
Return Time		

Phone: (Free Call) 1800 675 756		Fax: (Free Call) 1800 657 123		Email: info@enviroequip.com	
Melbourne Branch 5 Caribbean Drive, Scoresby 3179 Local Tel: 03 9757 4577 Local Fax: 03 9763 2083	Sydney Branch Level 1, 4 Talavera Road, North Ryde 2113 Local Tel: 02 8817 4250 Local Fax: 02 9389 4622	Adelaide Branch 27 Beulah Road, Nonwood, South Australia 5067 Local Tel: 08 8334 0000 Local Fax: 08 8363 3110	Brisbane Branch Unit 2/5 Ross St, Newstead 4006 Local Tel: 07 3852 6111 Local Fax: 07 3852 6155	Perth Branch 121 Beringarra Ave Malaga WA 6090 Local Tel: 08 9262 7599 Local Fax: 08 9248 6836	

ENVIROEQUIP RENTALS

Your Friend in the Field



EQUIPMENT CERTIFICATION REPORT

SIDEPAK SP730 PERSONAL SAMPLING PUMP

This SidePak Personal Sampling Pump has been performance checked and calibrated at measured flow rate, in accordance with the client's requirements, as follows:

500 Cubic centimeters / min
(required flow rate by client) Calibrated Flow Rate: 510 cc/min.

Date: 26 / 11 / 9

Checked by: PETER H

Signature: [Signature]

Please check that the following items are received and that all items are cleaned before return.
A minimum \$20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Rec'd	Returned	Description
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instrument Sampling Unit and NiMH Rechargeable battery
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instrument Sampling Unit Operation check / Battery Level ____%
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Battery Charger and Power cord
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sidepak Sampling Pump User Guide & Quick Reference Guide
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Track Pro CD
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	USB communication cable
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Screwdriver / 4 spare battery screws
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry Case

Optional Extras

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Single Non-Adjustable Sorbent Tube Kit with Tube cover
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	37mm Filter Cassette Kit (U-Tube, Vinyl tubing, Luer adapter & clip)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Clean Filter Cassette and Filter paper (37mm, 0.8 Micron MCE)
<u>[Signature]</u>			Processors Signature/ Initials

QUOTE NO.: _____

CLIENT'S REF P/O No: _____

CLIENT'S REF Job No: _____

ID: _____

RETURN DATE: ___/___/___ TIME: _____

SERIAL NO.: SP730C

CONDITION ON RETURN: _____

5 Caribbean Dve Scoresby VIC 3179 Australia

Telephone: 03-97574377

FreeCall (interstate): 1-800-675-756

Rentals Direct Fax: 03-97637141

Head Office Fax: 03-97632083

Email: rentals@enviroequip.com

Internet: www.rentals.enviroequip.com



ENVIROEQUIP RENTALS

Your Friend in the Field

Equipment Report - GEOTECHNICAL INSTRUMENTS GA2000

This Gas Meter has been performance checked / calibrated* as follows:

Calibration	Cal Value	Reading	Cal Value	Reading	Pass?
CH4	60% vol	60 %	0.00% vol	00.0%	<input checked="" type="checkbox"/>
CH4 -check only	2.5%CH4	2.5%			<input checked="" type="checkbox"/>
H2s	25ppm	24 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
O2	21.0% vol	21 %	0.00% vol	0.0 %	<input checked="" type="checkbox"/>
CO	100ppm	101 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
CO2	40% vol	40 %			<input checked="" type="checkbox"/>
Operations Check					
<input checked="" type="checkbox"/> Cleaned/checked	<input checked="" type="checkbox"/> In line Filter Check		<input type="checkbox"/> Battery Status @ 100 %		

* Calibration gas traceability information is available upon request.

Date: 06/12/09 Checked by: Volker

Signed: [Signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum \$20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sampling Probe with In-Line Filter
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1m of Sampling Tube
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry Strap
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Battery Charger and AC/DC Power Supply
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Operating Quick Guide <u>behind foam on lid of case "</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Manual <u>behind foam on lid of case "</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spare Inline Filters Qty (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry case
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Data Cable and Software CD or Diskette
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instrument Battery Status @ <u>100</u> %
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Flow Pod</u>

Processors Signature/ Initials _____

EE Quote Reference	<u>SKM</u>	Condition on return
Customer Ref	<u>GA2000C</u>	
Equipment ID		
Equipment serial no.		
Return Date	<u> / /</u>	
Return Time		

Phone: (Free Call) 1800 675 756		Fax: (Free Call) 1800 657 123		Email: info@enviroequip.com	
<small>Melbourne Branch 5 Caribbean Drive, Scoresby 3179 Local Tel: 03 9757 4577 Local Fax: 03 9763 2083</small>	<small>Sydney Branch Level 1, 4 Talavera Road, North Ryde 2113 Local Tel: 02 8817 4250 Local Fax: 02 9889 4622</small>	<small>Adelaide Branch 27 Beulah Road, Norwood, South Australia 5067 Local Tel: 08 8334 0000 Local Fax: 08 8363 3110</small>	<small>Brisbane Branch Unit 2/5 Ross St, Newstead 4006 Local Tel: 07 3852 6111 Local Fax: 07 3852 6155</small>	<small>Perth Branch 121 Beringarra Ave Malaga WA 6090 Local Tel: 08 9262 7599 Local Fax: 08 9248 6836</small>	



ENVIROEQUIP RENTALS

Your Friend in the Field

Equipment Report - GEOTECHNICAL INSTRUMENTS GEM2000

This Gas Meter has been performance checked / calibrated* as follows:

Calibration	Cal Value	Reading	Cal Value	Reading	Pass?
CH4	60% vol	39.9 %	0.00% vol	00.0 %	<input checked="" type="checkbox"/>
CH4 -check only	2.5%CH4	2.6 %			<input checked="" type="checkbox"/>
H2s	25ppm	25 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
O2	21.0% vol	20.9 %	0.00% vol	0 %	<input checked="" type="checkbox"/>
CO	100ppm	100 ppm	0 ppm	0 ppm	<input checked="" type="checkbox"/>
CO2	40% vol	40.1 %		00.0	<input checked="" type="checkbox"/>
Operations Check					
<input checked="" type="checkbox"/> Cleaned/checked	<input checked="" type="checkbox"/> In line Filter Check	<input checked="" type="checkbox"/> Battery Status @ 80 %			

* Calibration gas traceability information is available upon request.

Date: 08-01-2010 Checked by: [Signature]

Signed: _____

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum \$20 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Received	Returned	Item
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Sampling Probe with In-Line Filter
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1m of Sampling Tube
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry Strap
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Battery Charger and AC/DC Power Supply
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Operating Quick Guide <u>behind foam on lid of case</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Manual <u>behind foam on lid of case</u>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Spare Inline Filters Qty (2)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry case
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Data Cable and Software CD or Diskette
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Instrument Battery Status @ <u>100</u> %
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Well Cap Quick Connect Fitting
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Processors Signature/ Initials			<u>[Signature]</u>

EE Quote Reference	<u>176 50</u>	Condition on return
Customer Ref		
Equipment ID	<u>GA 2000 WA 1</u>	
Equipment serial no.		
Return Date	<u>1 1</u>	
Return Time		

Melbourne Sydney Brisbane Perth Auckland Kuala Lumpur

5 Caribbean Dye Scoresby VIC 3179 Australia

Telephone: 03-97574377

FreeCall (interstate): 1-800-675-756

Rentals Direct Fax: 03-97637141

Head Office Fax: 03-97632083

Email: rentals@enviroequip.com

Internet: www.rentals.enviroequip.com



Appendix G – LandGEM SITA Assessment

USER INPUTS

Landfill Name or Identifier:

Clear ALL Non-Parameter Inputs/Selections

1: PROVIDE LANDFILL CHARACTERISTICS

Landfill Open Year	<input type="text" value="1975"/>	Waste Design Capacity entered is not used by the model unless 'Have Model Calculate Closure Year?' option is Yes.
Landfill Closure Year	<input type="text" value="1993"/>	
Have Model Calculate Closure Year?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Waste Design Capacity	<input type="text" value="872,000"/>	<input type="text" value="megagrams"/>

Restore Default Model Parameters

2: DETERMINE MODEL PARAMETERS

Methane Generation Rate, k (year ⁻¹)	<input type="text" value="CAA Conventional - 0.05"/>
Potential Methane Generation Capacity, L ₀ (m ³ /Mg)	<input type="text" value="CAA Conventional - 170"/>
NMOC Concentration (ppmv as hexane)	<input type="text" value="CAA - 4,000"/>
Methane Content (% by volume)	<input type="text" value="CAA - 50% by volume"/>

3: SELECT GASES/POLLUTANTS

Gas / Pollutant #1	<input type="text" value="Total landfill gas"/>	Default pollutant parameters are currently being used by model.	Edit Existing or Add New Pollutant Parameters
Gas / Pollutant #2	<input type="text" value="Methane"/>		
Gas / Pollutant #3	<input type="text" value="Carbon dioxide"/>		Restore Default Pollutant Parameters
Gas / Pollutant #4	<input type="text" value="NMOC"/>		

Description/Comments:

4: ENTER WASTE ACCEPTANCE RATES

Input Units:

Year	Input Units (Mg/year)	Calculated Units (short tons/year)
1975	41,500	45,650
1976	41,500	45,650
1977	41,500	45,650
1978	41,500	45,650
1979	41,500	45,650
1980	41,500	45,650
1981	41,500	45,650
1982	41,500	45,650
1983	41,500	45,650
1984	41,500	45,650
1985	41,500	45,650
1986	41,500	45,650
1987	41,500	45,650
1988	41,500	45,650
1989	41,500	45,650
1990	41,500	45,650
1991	41,500	45,650
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RESULTS

Landfill Name or Identifier: Sita

Please choose a third unit of measure to represent all of the emission rates below.
 Closure Year (with 80-year limit) = 1993
 Methane = 50 % by volume
 User-specified Unit: #/3/year

Year	Waste Accepted		Waste-in-Place		Total landfill gas			Methane			Carbon dioxide			NMOC		
	(Mg/year)	(short tons/year)	(Mg)	(short tons)	(Mg/year)	(m ³ /year)	(ft ³ /year)	(Mg/year)	(m ³ /year)	(ft ³ /year)	(Mg/year)	(m ³ /year)	(ft ³ /year)	(Mg/year)	(m ³ /year)	(ft ³ /year)
1975	41,500	45,650	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	41,500	45,650	41,500	45,650	8.615E+02	6.899E+05	2.436E+07	2.301E+02	3.449E+05	1.218E+07	6.314E+02	3.449E+05	1.218E+07	9.891E+00	2.759E+03	9.745E+04
1977	41,500	45,650	83,000	91,300	1.681E+03	1.346E+06	4.754E+07	4.490E+02	6.731E+05	2.377E+07	1.232E+03	6.731E+05	2.377E+07	5.384E+01	1.930E+01	1.902E+05
1978	41,500	45,650	124,500	136,950	2.461E+03	1.970E+06	6.958E+07	6.573E+02	9.852E+05	3.479E+07	1.803E+03	9.852E+05	3.479E+07	2.825E+01	7.881E+03	2.783E+05
1979	41,500	45,650	166,000	182,600	3.202E+03	2.564E+06	9.055E+07	8.553E+02	1.282E+06	4.528E+07	2.347E+03	1.282E+06	4.528E+07	3.676E+01	1.026E+04	3.622E+05
1980	41,500	45,650	207,500	228,250	3.907E+03	3.129E+06	1.105E+08	1.044E+03	1.564E+06	5.525E+07	2.864E+03	1.564E+06	5.525E+07	4.486E+01	1.252E+04	4.420E+05
1981	41,500	45,650	249,000	273,900	4.578E+03	3.666E+06	1.295E+08	1.223E+03	1.833E+06	6.474E+07	3.355E+03	1.833E+06	6.474E+07	5.257E+01	1.466E+04	5.179E+05
1982	41,500	45,650	290,500	319,550	5.217E+03	4.177E+06	1.475E+08	1.393E+03	2.089E+06	7.376E+07	3.823E+03	2.089E+06	7.376E+07	5.989E+01	1.671E+04	5.901E+05
1983	41,500	45,650	332,000	365,200	5.824E+03	4.663E+06	1.647E+08	1.566E+03	2.332E+06	8.234E+07	4.268E+03	2.332E+06	8.234E+07	6.686E+01	1.865E+04	6.588E+05
1984	41,500	45,650	373,500	410,850	6.401E+03	5.126E+06	1.810E+08	1.710E+03	2.563E+06	9.051E+07	4.691E+03	2.563E+06	9.051E+07	7.349E+01	2.050E+04	7.241E+05
1985	41,500	45,650	415,000	456,500	6.951E+03	5.566E+06	1.966E+08	1.857E+03	2.783E+06	9.828E+07	5.094E+03	2.783E+06	9.828E+07	7.980E+01	2.226E+04	7.862E+05
1986	41,500	45,650	456,500	502,150	7.473E+03	5.984E+06	2.113E+08	1.996E+03	2.992E+06	1.057E+08	5.477E+03	2.992E+06	1.057E+08	8.580E+01	2.394E+04	8.453E+05
1987	41,500	45,650	498,000	547,800	7.970E+03	6.382E+06	2.254E+08	2.129E+03	3.191E+06	1.127E+08	5.841E+03	3.191E+06	1.127E+08	9.151E+01	2.553E+04	9.015E+05
1988	41,500	45,650	539,500	593,450	8.443E+03	6.761E+06	2.388E+08	2.255E+03	3.380E+06	1.194E+08	6.188E+03	3.380E+06	1.194E+08	9.694E+01	2.704E+04	9.550E+05
1989	41,500	45,650	581,000	639,100	8.893E+03	7.121E+06	2.515E+08	2.375E+03	3.560E+06	1.257E+08	6.517E+03	3.560E+06	1.257E+08	1.021E+02	2.848E+04	1.006E+06
1990	41,500	45,650	622,500	684,750	9.321E+03	7.464E+06	2.636E+08	2.490E+03	3.732E+06	1.318E+08	6.831E+03	3.732E+06	1.318E+08	1.070E+02	2.985E+04	1.054E+06
1991	41,500	45,650	664,000	730,400	9.728E+03	7.789E+06	2.751E+08	2.598E+03	3.895E+06	1.375E+08	7.129E+03	3.895E+06	1.375E+08	1.117E+02	3.116E+04	1.100E+06
1992	41,500	45,650	705,500	776,050	1.011E+04	8.099E+06	2.860E+08	2.702E+03	4.050E+06	1.430E+08	7.413E+03	4.050E+06	1.430E+08	1.161E+02	3.240E+04	1.144E+06
1993	41,500	45,650	747,000	821,700	1.048E+04	8.394E+06	2.964E+08	2.800E+03	4.197E+06	1.482E+08	7.683E+03	4.197E+06	1.482E+08	1.204E+02	3.358E+04	1.186E+06
1994	0	0	788,500	867,350	1.083E+04	8.675E+06	3.063E+08	2.894E+03	4.337E+06	1.532E+08	7.940E+03	4.337E+06	1.532E+08	1.244E+02	3.470E+04	1.225E+06
1995	0	0	788,500	867,350	1.030E+04	8.252E+06	2.914E+08	2.753E+03	4.126E+06	1.457E+08	7.562E+03	4.126E+06	1.457E+08	1.183E+02	3.301E+04	1.166E+06
1996	0	0	788,500	867,350	9.802E+03	7.849E+06	2.772E+08	2.618E+03	3.925E+06	1.386E+08	7.184E+03	3.925E+06	1.386E+08	1.125E+02	3.140E+04	1.109E+06
1997	0	0	788,500	867,350	9.324E+03	7.466E+06	2.637E+08	2.491E+03	3.733E+06	1.318E+08	6.834E+03	3.733E+06	1.318E+08	1.071E+02	2.987E+04	1.055E+06
1998	0	0	788,500	867,350	8.869E+03	7.102E+06	2.508E+08	2.369E+03	3.551E+06	1.254E+08	6.500E+03	3.551E+06	1.254E+08	1.018E+02	2.841E+04	1.003E+06
1999	0	0	788,500	867,350	8.437E+03	6.756E+06	2.386E+08	2.254E+03	3.378E+06	1.193E+08	6.183E+03	3.378E+06	1.193E+08	9.687E+01	2.702E+04	9.543E+05
2000	0	0	788,500	867,350	8.025E+03	6.426E+06	2.269E+08	2.144E+03	3.213E+06	1.135E+08	5.882E+03	3.213E+06	1.135E+08	9.214E+01	2.571E+04	9.078E+05
2001	0	0	788,500	867,350	7.634E+03	6.113E+06	2.159E+08	2.039E+03	3.056E+06	1.079E+08	5.595E+03	3.056E+06	1.079E+08	8.765E+01	2.445E+04	8.635E+05
2002	0	0	788,500	867,350	7.262E+03	5.815E+06	2.054E+08	1.940E+03	2.907E+06	1.027E+08	5.322E+03	2.907E+06	1.027E+08	8.337E+01	2.326E+04	8.214E+05
2003	0	0	788,500	867,350	6.908E+03	5.531E+06	1.953E+08	1.845E+03	2.766E+06	9.767E+07	5.062E+03	2.766E+06	9.767E+07	7.931E+01	2.213E+04	7.813E+05
2004	0	0	788,500	867,350	6.571E+03	5.261E+06	1.858E+08	1.755E+03	2.631E+06	9.290E+07	4.816E+03	2.631E+06	9.290E+07	7.544E+01	2.105E+04	7.432E+05
2005	0	0	788,500	867,350	6.250E+03	1.767E+06	1.670E+08	1.670E+03	2.502E+06	8.837E+07	4.581E+03	2.502E+06	8.837E+07	7.176E+01	2.002E+04	7.070E+05
2006	0	0	788,500	867,350	5.945E+03	4.761E+06	1.681E+08	1.588E+03	2.380E+06	8.406E+07	4.357E+03	2.380E+06	8.406E+07	6.826E+01	1.904E+04	6.725E+05
2007	0	0	788,500	867,350	5.655E+03	4.529E+06	1.599E+08	1.511E+03	2.264E+06	7.996E+07	4.145E+03	2.264E+06	7.996E+07	6.493E+01	1.811E+04	6.397E+05
2008	0	0	788,500	867,350	5.380E+03	4.308E+06	1.521E+08	1.437E+03	2.154E+06	7.606E+07	3.943E+03	2.154E+06	7.606E+07	6.176E+01	1.723E+04	6.085E+05
2009	0	0	788,500	867,350	5.117E+03	4.098E+06	1.447E+08	1.367E+03	2.049E+06	7.235E+07	3.750E+03	2.049E+06	7.235E+07	5.875E+01	1.639E+04	5.788E+05
2010	0	0	788,500	867,350	4.868E+03	3.898E+06	1.377E+08	1.300E+03	1.949E+06	6.883E+07	3.567E+03	1.949E+06	6.883E+07	5.589E+01	1.559E+04	5.506E+05
2011	0	0	788,500	867,350	4.630E+03	3.708E+06	1.309E+08	1.237E+03	1.854E+06	6.547E+07	3.393E+03	1.854E+06	6.547E+07	5.316E+01	1.483E+04	5.238E+05
2012	0	0	788,500	867,350	4.404E+03	3.527E+06	1.246E+08	1.176E+03	1.763E+06	6.228E+07	3.228E+03	1.763E+06	6.228E+07	5.057E+01	1.411E+04	4.982E+05
2013	0	0	788,500	867,350	4.190E+03	3.355E+06	1.185E+08	1.119E+03	1.677E+06	5.924E+07	3.071E+03	1.677E+06	5.924E+07	4.810E+01	1.342E+04	4.739E+05
2014	0	0	788,500	867,350	3.985E+03	3.191E+06	1.127E+08	1.065E+03	1.596E+06	5.635E+07	2.921E+03	1.596E+06	5.635E+07	4.576E+01	1.277E+04	4.508E+05
2015	0	0	788,500	867,350	3.791E+03	3.036E+06	1.072E+08	1.013E+03	1.518E+06	5.360E+07	2.778E+03	1.518E+06	5.360E+07	4.352E+01	1.214E+04	4.288E+05
2016	0	0	788,500	867,350	3.606E+03	2.888E+06	1.020E+08	9.632E+02	1.444E+06	5.099E+07	2.643E+03	1.444E+06	5.099E+07	4.140E+01	1.155E+04	4.079E+05
2017	0	0	788,500	867,350	3.430E+03	2.747E+06	9.700E+07	9.162E+02	1.373E+06	4.850E+07	2.514E+03	1.373E+06	4.850E+07	3.938E+01	1.099E+04	3.880E+05
2018	0	0	788,500	867,350	3.263E+03	2.613E+06	9.227E+07	8.716E+02	1.306E+06	4.614E+07	2.391E+03	1.306E+06	4.614E+07	3.746E+01	1.045E+04	3.691E+05
2019	0	0	788,500	867,350	3.104E+03	2.485E+06	8.777E+07	8.290E+02	1.243E+06	4.389E+07	2.275E+03	1.243E+06	4.389E+07	3.563E+01	9.941E+03	3.511E+05
2020	0	0	788,500	867,350	2.952E+03	2.364E+06	8.349E+07	7.886E+02	1.182E+06	4.174E+07	2.164E+03	1.182E+06	4.174E+07	3.390E+01	9.457E+03	3.340E+05
2021	0	0	788,500	867,350	2.808E+03	2.249E+06	7.942E+07	7.502E+02	1.124E+06	3.971E+07	2.058E+03	1.124E+06	3.971E+07	3.224E+01	8.995E+03	3.177E+05
2022	0	0	788,500	867,350	2.671E+03	2.139E+06	7.554E+07	7.136E+02	1.070E+06	3.777E+07	1.958E+03	1.070E+06	3.777E+07	3.067E+01	8.557E+03	3.022E+05
2023	0	0	788,500	867,350	2.541E+03	2.035E+06	7.186E+07	6.788E+02	1.017E+06	3.593E+07	1.862E+03	1.017E+06	3.593E+07	2.918E+01	8.139E+03	2.874E+05
2024	0	0	788,500	867,350	2.417E+03	1.936E+06	6.836E+07	6.457E+02	9.678E+05	3.418E+07	1.772E+03	9.678E+05	3.418E+07	2.775E+01	7.742E+03	2.734E+05
2025	0	0	788,500	867,350	2.299E+03	1.841E+06	6.502E+07	6.142E+02	9.206E+05	3.251E+07	1.685E+03	9.206E+05	3.251E+07	2.640E+01	7.365E+03	2.601E+05
2026	0	0	788,500	867,350	2.187E+03	1.751E+06	6.185E+07	5.842E+02	8.757E+05	3.093E+07	1.603E+03	8.757E+05	3.093E+07	2.511E+01	7.006E+03	2.474E+05
2027	0	0	788,500	867,350	2.081E+03	1.666E+06	5.883E+07	5.557E+02	8.330E+05	2.942E+07	1.525E+03	8.330E+05	2.942E+07	2.389E+01	6.664E+03	2.353E+05
2028	0	0	788,500	867,350	1.979E+03	1.585E+06	5.596E+07	5.286E+02	7.924E+05	2.798E+07	1.450E+03	7.9				

RESULTS

Landfill Name or Identifier: Sita _____

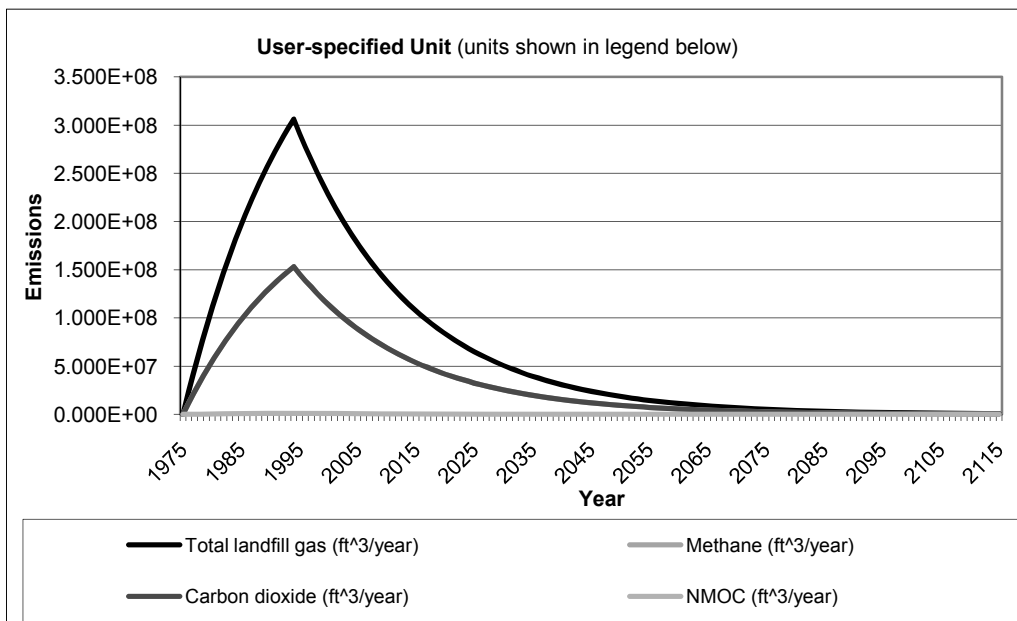
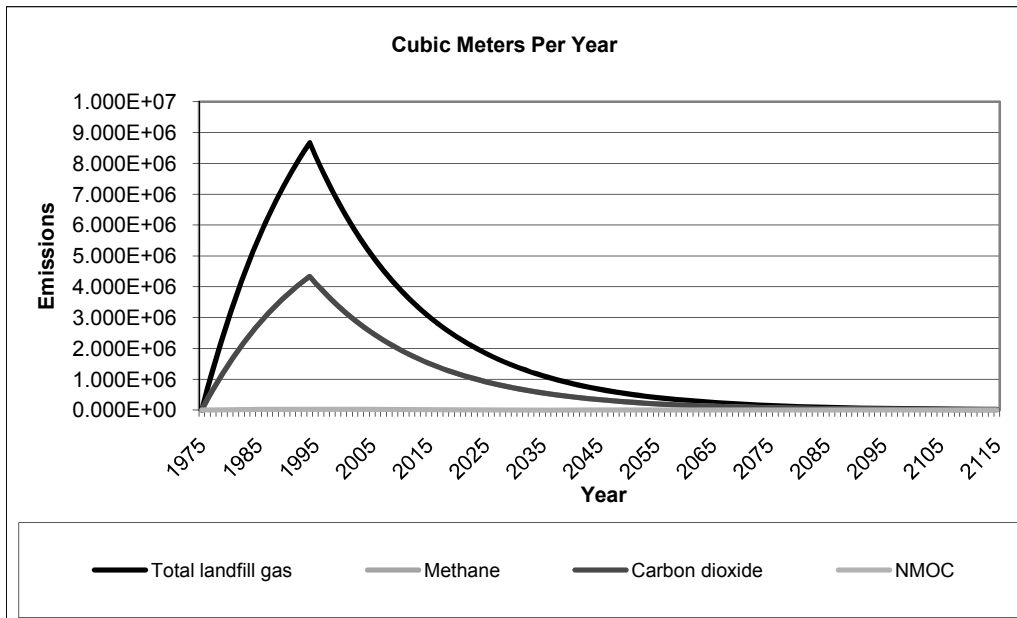
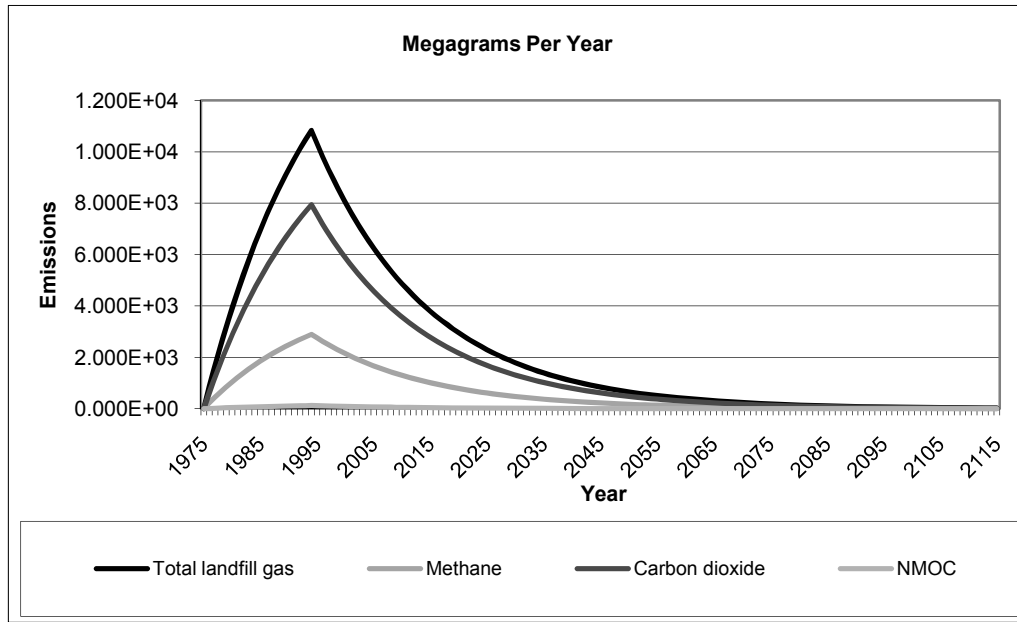
Closure Year (with 80-year limit) = 1993
 Methane = 50 % by volume
 User-specified Unit: #/3/year

Please choose a third unit of measure to represent all of the emission rates below.

Year	Waste Accepted		Waste-In-Place		Total landfill gas			Methane			Carbon dioxide			NMOC		
	(Mg/year)	(short tons/year)	(Mg)	(short tons)	(Mg/year)	(m ³ /year)	(ft ³ /year)	(Mg/year)	(m ³ /year)	(ft ³ /year)	(Mg/year)	(m ³ /year)	(ft ³ /year)	(Mg/year)	(m ³ /year)	(ft ³ /year)
2051	0	0	788,500	867,350	6.266E+02	5.018E+05	1.772E+07	1.674E+02	2.509E+05	8.860E+06	4.593E+02	2.509E+05	8.860E+06	7.195E+00	2.007E+03	7.088E+04
2052	0	0	788,500	867,350	5.961E+02	4.773E+05	1.686E+07	1.592E+02	2.387E+05	8.428E+06	4.369E+02	2.387E+05	8.428E+06	6.844E+00	1.909E+03	6.743E+04
2053	0	0	788,500	867,350	5.670E+02	4.540E+05	1.603E+07	1.515E+02	2.270E+05	8.017E+06	4.156E+02	2.270E+05	8.017E+06	6.510E+00	1.816E+03	6.414E+04
2054	0	0	788,500	867,350	5.394E+02	4.319E+05	1.525E+07	1.441E+02	2.159E+05	7.626E+06	3.953E+02	2.159E+05	7.626E+06	6.192E+00	1.728E+03	6.101E+04
2055	0	0	788,500	867,350	5.130E+02	4.108E+05	1.451E+07	1.370E+02	2.054E+05	7.254E+06	3.760E+02	2.054E+05	7.254E+06	5.890E+00	1.643E+03	5.803E+04
2056	0	0	788,500	867,350	4.880E+02	3.908E+05	1.380E+07	1.304E+02	1.954E+05	6.900E+06	3.577E+02	1.954E+05	6.900E+06	5.603E+00	1.563E+03	5.520E+04
2057	0	0	788,500	867,350	4.642E+02	3.717E+05	1.313E+07	1.240E+02	1.859E+05	6.564E+06	3.402E+02	1.859E+05	6.564E+06	5.330E+00	1.487E+03	5.251E+04
2058	0	0	788,500	867,350	4.416E+02	3.536E+05	1.249E+07	1.180E+02	1.768E+05	6.244E+06	3.236E+02	1.768E+05	6.244E+06	5.070E+00	1.414E+03	4.995E+04
2059	0	0	788,500	867,350	4.200E+02	3.364E+05	1.188E+07	1.122E+02	1.682E+05	5.939E+06	3.078E+02	1.682E+05	5.939E+06	4.823E+00	1.345E+03	4.751E+04
2060	0	0	788,500	867,350	3.996E+02	3.200E+05	1.130E+07	1.067E+02	1.600E+05	5.650E+06	2.928E+02	1.600E+05	5.650E+06	4.587E+00	1.280E+03	4.520E+04
2061	0	0	788,500	867,350	3.801E+02	3.043E+05	1.075E+07	1.015E+02	1.522E+05	5.374E+06	2.786E+02	1.522E+05	5.374E+06	4.364E+00	1.217E+03	4.299E+04
2062	0	0	788,500	867,350	3.615E+02	2.895E+05	1.022E+07	9.657E+01	1.448E+05	5.112E+06	2.650E+02	1.448E+05	5.112E+06	4.151E+00	1.158E+03	4.090E+04
2063	0	0	788,500	867,350	3.439E+02	2.754E+05	9.725E+06	9.186E+01	1.377E+05	4.863E+06	2.520E+02	1.377E+05	4.863E+06	3.948E+00	1.102E+03	3.890E+04
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2065	0	0	788,500	867,350	3.112E+02	2.492E+05	8.800E+06	8.312E+01	1.246E+05	4.400E+06	2.281E+02	1.246E+05	4.400E+06	3.573E+00	9.967E+02	3.520E+04
2066	0	0	788,500	867,350	2.960E+02	2.370E+05	8.371E+06	7.907E+01	1.185E+05	4.185E+06	2.169E+02	1.185E+05	4.185E+06	3.398E+00	9.481E+02	3.348E+04
2067	0	0	788,500	867,350	2.816E+02	2.255E+05	7.962E+06	7.521E+01	1.127E+05	3.981E+06	2.064E+02	1.127E+05	3.981E+06	3.233E+00	9.019E+02	3.185E+04
2068	0	0	788,500	867,350	2.678E+02	2.145E+05	7.574E+06	7.154E+01	1.072E+05	3.787E+06	1.963E+02	1.072E+05	3.787E+06	3.075E+00	8.579E+02	3.030E+04
2069	0	0	788,500	867,350	2.548E+02	2.040E+05	7.205E+06	6.805E+01	1.020E+05	3.602E+06	1.867E+02	1.020E+05	3.602E+06	2.925E+00	8.160E+02	2.882E+04
2070	0	0	788,500	867,350	2.423E+02	1.941E+05	6.853E+06	6.473E+01	9.703E+04	3.427E+06	1.776E+02	9.703E+04	3.427E+06	2.782E+00	7.762E+02	2.741E+04
2071	0	0	788,500	867,350	2.305E+02	1.846E+05	6.519E+06	6.158E+01	9.230E+04	3.260E+06	1.690E+02	9.230E+04	3.260E+06	2.647E+00	7.384E+02	2.604E+04
2072	0	0	788,500	867,350	2.193E+02	1.756E+05	6.201E+06	5.857E+01	8.780E+04	3.101E+06	1.607E+02	8.780E+04	3.101E+06	2.518E+00	7.024E+02	2.480E+04
2073	0	0	788,500	867,350	2.086E+02	1.670E+05	5.899E+06	5.572E+01	8.351E+04	2.949E+06	1.529E+02	8.351E+04	2.949E+06	2.395E+00	6.681E+02	2.359E+04
2074	0	0	788,500	867,350	1.984E+02	1.589E+05	5.611E+06	5.300E+01	7.944E+04	2.805E+06	1.454E+02	7.944E+04	2.805E+06	2.278E+00	6.355E+02	2.244E+04
2075	0	0	788,500	867,350	1.887E+02	1.511E+05	5.337E+06	5.041E+01	7.557E+04	2.669E+06	1.383E+02	7.557E+04	2.669E+06	2.167E+00	6.045E+02	2.135E+04
2076	0	0	788,500	867,350	1.795E+02	1.438E+05	5.077E+06	4.796E+01	7.188E+04	2.539E+06	1.316E+02	7.188E+04	2.539E+06	2.061E+00	5.751E+02	2.031E+04
2077	0	0	788,500	867,350	1.708E+02	1.368E+05	4.829E+06	4.562E+01	6.838E+04	2.415E+06	1.252E+02	6.838E+04	2.415E+06	1.961E+00	5.470E+02	1.932E+04
2078	0	0	788,500	867,350	1.625E+02	1.301E+05	4.594E+06	4.339E+01	6.504E+04	2.297E+06	1.191E+02	6.504E+04	2.297E+06	1.865E+00	5.203E+02	1.838E+04
2079	0	0	788,500	867,350	1.545E+02	1.237E+05	4.370E+06	4.128E+01	6.187E+04	2.185E+06	1.133E+02	6.187E+04	2.185E+06	1.774E+00	4.950E+02	1.748E+04
2080	0	0	788,500	867,350	1.470E+02	1.177E+05	4.157E+06	3.926E+01	5.885E+04	2.078E+06	1.077E+02	5.885E+04	2.078E+06	1.688E+00	4.708E+02	1.663E+04
2081	0	0	788,500	867,350	1.398E+02	1.120E+05	3.954E+06	3.735E+01	5.598E+04	1.977E+06	1.025E+02	5.598E+04	1.977E+06	1.605E+00	4.479E+02	1.582E+04
2082	0	0	788,500	867,350	1.330E+02	1.065E+05	3.761E+06	3.553E+01	5.325E+04	1.881E+06	9.748E+01	5.325E+04	1.881E+06	1.527E+00	4.260E+02	1.504E+04
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2087	0	0	788,500	867,350	1.036E+02	8.294E+04	2.929E+06	2.767E+01	4.147E+04	1.465E+06	7.591E+01	4.147E+04	1.465E+06	1.189E+00	3.318E+02	1.172E+04
2088	0	0	788,500	867,350	9.853E+01	7.890E+04	2.786E+06	2.632E+01	3.945E+04	1.393E+06	7.221E+01	3.945E+04	1.393E+06	1.131E+00	3.156E+02	1.115E+04
2089	0	0	788,500	867,350	9.373E+01	7.505E+04	2.650E+06	2.504E+01	3.753E+04	1.325E+06	6.869E+01	3.753E+04	1.325E+06	1.076E+00	3.002E+02	1.060E+04
2090	0	0	788,500	867,350	8.915E+01	7.139E+04	2.521E+06	2.381E+01	3.570E+04	1.261E+06	6.534E+01	3.570E+04	1.261E+06	1.024E+00	2.856E+02	1.008E+04
2091	0	0	788,500	867,350	8.481E+01	6.791E+04	2.398E+06	2.265E+01	3.395E+04	1.199E+06	6.215E+01	3.395E+04	1.199E+06	9.737E-01	2.716E+02	9.593E+03
2092	0	0	788,500	867,350	8.067E+01	6.460E+04	2.281E+06	2.155E+01	3.230E+04	1.141E+06	5.912E+01	3.230E+04	1.141E+06	9.262E-01	2.584E+02	9.125E+03
2093	0	0	788,500	867,350	7.674E+01	6.145E+04	2.170E+06	2.050E+01	3.072E+04	1.085E+06	5.624E+01	3.072E+04	1.085E+06	8.810E-01	2.458E+02	8.680E+03
2094	0	0	788,500	867,350	7.299E+01	5.845E+04	2.064E+06	1.950E+01	2.922E+04	1.032E+06	5.350E+01	2.922E+04	1.032E+06	8.380E-01	2.338E+02	8.257E+03
2095	0	0	788,500	867,350	6.943E+01	5.560E+04	1.963E+06	1.855E+01	2.780E+04	9.817E+05	5.089E+01	2.780E+04	9.817E+05	7.972E-01	2.224E+02	7.854E+03
2096	0	0	788,500	867,350	6.605E+01	5.289E+04	1.868E+06	1.764E+01	2.644E+04	9.339E+05	4.841E+01	2.644E+04	9.339E+05	7.583E-01	2.116E+02	7.471E+03
2097	0	0	788,500	867,350	6.283E+01	5.031E+04	1.777E+06	1.678E+01	2.515E+04	8.883E+05	4.604E+01	2.515E+04	8.883E+05	7.213E-01	2.012E+02	7.107E+03
2098	0	0	788,500	867,350	5.976E+01	4.785E+04	1.690E+06	1.596E+01	2.393E+04	8.450E+05	4.380E+01	2.393E+04	8.450E+05	6.861E-01	1.914E+02	6.760E+03
2099	0	0	788,500	867,350	5.685E+01	4.552E+04	1.608E+06	1.518E+01	2.276E+04	8.038E+05	4.166E+01	2.276E+04	8.038E+05	6.527E-01	1.821E+02	6.430E+03
2100	0	0	788,500	867,350	5.408E+01	4.330E+04	1.529E+06	1.444E+01	2.165E+04	7.646E+05	3.963E+01	2.165E+04	7.646E+05	6.208E-01	1.732E+02	6.117E+03
2101	0	0	788,500	867,350	5.144E+01	4.119E+04	1.455E+06	1.374E+01	2.059E+04	7.273E+05	3.770E+01	2.059E+04	7.273E+05	5.906E-01	1.648E+02	5.818E+03
2102	0	0	788,500	867,350	4.893E+01	3.918E+04	1.384E+06	1.307E+01	1.959E+04	6.918E+05	3.586E+01	1.959E+04	6.918E+05	5.618E-01	1.567E+02	5.535E+03
2103	0	0	788,500	867,350	4.654E+01	3.727E+04	1.316E+06	1.243E+01	1.863E+04	6.581E+05	3.411E+01	1.863E+04	6.581E+05	5.344E-01	1.491E+02	5.265E+03
2104	0	0	788,500	867,350	4.427E+01	3.545E+04	1.252E+06	1.183E+01	1.773E+04	6.260E+05	3.245E+01	1.773E+04	6.260E+05	5.083E-01	1.	

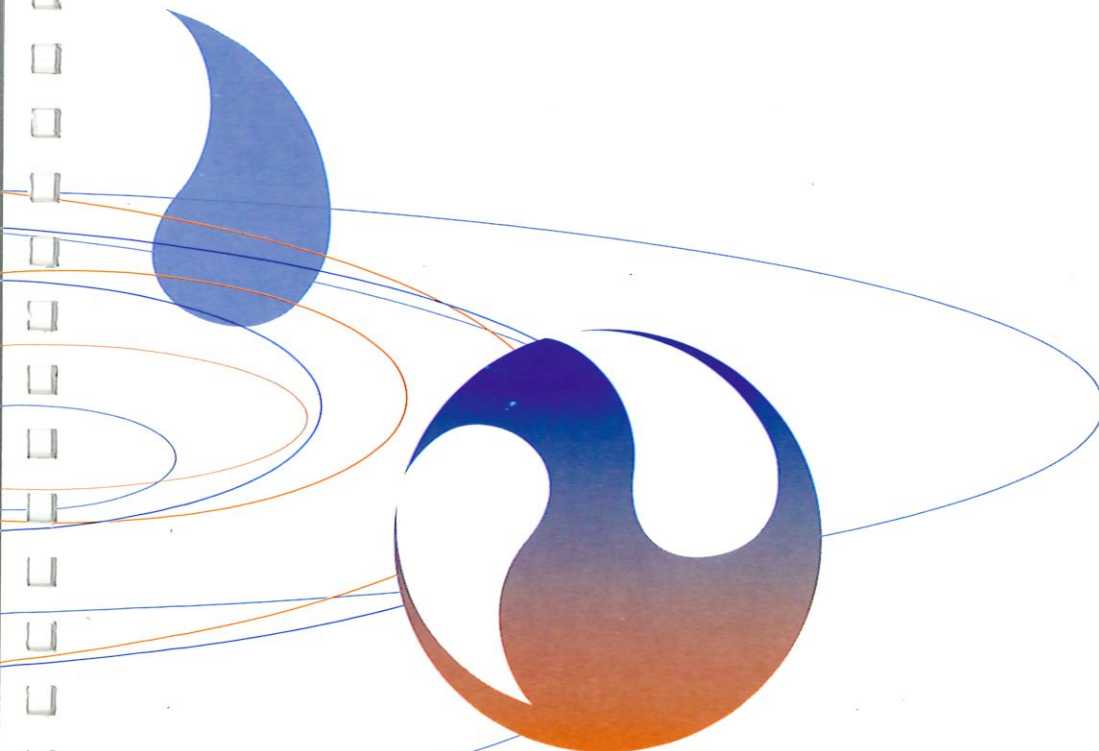
GRAPHS

Landfill Name or Identifier: Sita



**Phase 1 Environmental
Site Assessment**

**Halls Road, Highbury
Hallan Nominees Land**



Prepared for

**Helen Mercer
C/- Hallan Nominees**

ADELAIDE SA 5000

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1 INTRODUCTION

Resource & Environmental Management Pty Ltd (REM) was engaged by Hallan Nominees to undertake a Phase 1 Environmental Site Assessment of a parcel of land located on Halls Road, Highbury, South Australia.

1.1 Objective

The objective of the Phase 1 Environmental site Assessment was to identify potential source(s) of contamination associated with current or historical site use that may impact on the suitability of the site for redevelopment, or warrant further investigation/assessment.

1.2 Scope of Work

The scope of work for the Phase 1 assessment was undertaken in accordance with Schedule B(2) – Guidelines on Data Collection, Sample Design and Reporting outlined in the National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999) with the following activities undertaken as part of the Phase 1 assessment.

- Review of current and previous certificates of title to assess ownership and possible former uses of the site;
- Review of any available maps, surveys and building plans of the site;
- Review of the geology and hydrogeological information pertaining to the site including geological maps and bore search data;
- Review South Australian Environment Protection Authority (SA EPA) Section 7 *The Land and Business (Sale and Conveyancing) Act (1994)* for the site which provides details pertaining to the environmental protection of the site;
- Review of current and historical uses of the site through inspection of aerial photographs and where possible discussion with current or former occupants of the site;
- Identification of surrounding properties and an assessment of the potential for activities on these properties to impact the site;
- A detailed inspection of the site with the site owner to confirm the desktop assessment and identify any other issues including photographic documentation;
- Production of report detailing the findings of the Phase 1 Assessment and providing detailed recommendations for any Phase 2 Investigation requirements under separate cover if required.

2 REGIONAL SETTING

2.1 Location and topography

The site is situated in Highbury within the Torrens River Catchment and is located 14 km north east of Adelaide (Figure 1).

The site is on a grade sloping upwards from south to north and from west to east.

2.2 Climate

A rainfall station is located at Paracombe, approximately 2 km east of the quarry. Table 1.1 shows the average monthly rainfall based upon a 25 year data set. The average annual rainfall for the region is 785 mm. The dominant rainfall months are the winter months (June, July and August) while February receives the least amount of rainfall.

Table 1.1 Average Monthly Rainfall for Paracombe (Sourced from BOM, 2006)

Month	Rainfall (mm)	Month	Rainfall (mm)
January	29	July	120.4
February	17.9	August	103.4
March	34	September	90.4
April	61	October	65.6
May	84.1	November	45.2
June	98.1	December	38.3

2.3 Hydrology

Dominant hydrological features near the site are the Hope Valley Reservoir, located approximately 3 km west of the site, the River Torrens and its tributaries (principally Jacobs Creek). Analysis of daily river flow data (measured at gauging station-A5040529, located at Holbrooks Rd) shows that the River Torrens has flow volumes ranging from no flow during summer months to 1900 ML/day during flood events, with major flooding event in November 2005 saw the River Torrens flow rate increase to 10623 ML/day. On average the mean annual flow rate is 160 ML/day.

2.4 Geology

The regional geology within the study area is varied. The geology immediately surrounding the site is predominately undifferentiated Tertiary rocks, further to the west the geology is dominated by Saddleworth Formation and Skilloalee Dolomite.

2.5 Hydrogeology

2.5.1 Data Sources

Geological and groundwater data were collated for the region from the SA Geodata database, which contains information that was collected at the time of well construction (lithology, groundwater level, groundwater quality, construction details and use). Time series groundwater

level and salinity data were sourced from Obswell another online database accessible from the Department of Water, Land and Biodiversity Conservation (DWLBC) website. Data were collated for over 70 bores located within the regional area (See Appendix A). Regional geology data were sourced from Primary Industries and Resources South Australia (PIRSA) geology maps.

2.5.2 Aquifers

Groundwater is likely encountered within the North Maslin Sands, underlain by the weathered siltstones of the Saddleworth formation. The local aquifer system is likely to be part of a regional unconfined aquifer that extends across the western face of the Mount Lofty Ranges. It is likely that groundwater found within the dolomite and shale is in hydraulic connection with the Stonyfell Quartzite located west of the quarry.

Groundwater levels vary within 2km of the site, and are dependant upon the topography of the area and formation targeted, but range from 2.55m to 48.7m bgl. A number of wells have historically been installed off-site including the adjacent landfill facilities.

Groundwater discharge would occur through spring discharge, baseflow to nearby streams (e.g. the tributaries of the Torrens River), and throughflow to the Adelaide Plains and by extraction of groundwater.

2.5.3 Groundwater salinity

An assessment of the distribution of groundwater salinity measurements collected since 1990 (reported as total dissolved solids (TDS) mg/L) shows that groundwater salinity ranges from 397 mg/L to 3,609 mg/L. Information regarding aquifer sampling and screen interval for the various bores is unknown and would be required for further analysis. It appears that groundwater in the region is used for irrigation, industry, domestic and stock purposes. In general, salinities observed within the North Maslin Sands would be lower than the Saddleworth formation.

3 SITE IDENTIFICATION

3.1 Site Details and Zoning

SITE LOCATION	10-14, 16-20 Halls Road Highbury, SA.
PROPERTY DESCRIPTION	Certificate of Title Number 5768 Folio 114 comprising Allotment 11 Deposited Plan 17357 within the Area named Highbury, Hundred of Yatala; and Certificate of Title Number 5768 Folio 115 comprising Allotment 12 Deposited Plan 17357 within the Area named Highbury, Hundred of Yatala. A copy of the current relevant CT information is contained in Appendix B.
PROPERTY	Approximately 1.85 hectares
LOCAL GOVT. AUTHORITY	City of Tea Tree Gully – Development Plan consolidated 6 th July 2006
ZONING	Extractive Industry (See Appendix C)
PROPRIETORSHIP	Hallan Nominees Pty Ltd
SITE USAGE	Largely vacant with some minor storage. A two-storey dwelling is used as a commercial office building.

3.2 Current Land Use and Setting

The site is currently mainly a vacant parcel of land overgrown with grass/weeds. A two-storey dwelling is used as an office building. The site also contains a number of sheds and some of the vacant areas are used for storage of scrap/waste materials. A site layout plan can be seen in Figure 2.

The land is located within the City of Tea Tree Gully, opposite the Readymix Quarry site and north of the former Pacific Waste and Highbury Landfills. Residential development is also present adjacent the site to the west.

3.3 Proposed Development Land Use

Currently a range of future land uses are being assessed including residential and ongoing vacant parks/recreational type uses.

4 HISTORICAL REVIEW

4.1 Ownership

The site is currently owned by Hallan Nominees Pty Ltd. The site has been operated by Helen Mercer under the proprietor Mercer Nominees Pty Ltd or Hallan Nominees Pty Ltd since 1975.

An historical title search was undertaken of records held at the Land Titles Office. A summary of the current CT and the historical title ownership is presented in Appendix B. The historical CT search showed no record of land use after 1966 however before 1966 the land was used by gardeners, wood carters and building contractors.

4.2 Aerial Photograph Review

An historical review of aerial photographs provided by Alexander and Symonds Surveyors from 1949, 1954, 1963, 1969, 1974, 1979, 1985, 1989, 1995, 2001 and 2005 was undertaken, with the most recent aerial photograph from 2005 also purchased from Mapland (See Appendix D). Observations made from the aerial photograph review are presented in Table 4.1 for each of the aerial photographs.

4.3 Additional Document Review

4.3.1 EPA Section 7 Records

A search of the EPA records held relevant to section 7 – Land and Business (Sale and Conveyancing Act) 1994 was undertaken for information in regard to the following:

- Environmental performance agreements, protection orders, clean-up orders or clean-up authorisations issued for the site.
- Environmental assessment reports held by the EPA that have been prepared by or on behalf of an owner or occupier of the land, by the EPA, or by a Contaminated Site Auditor.
- Whether the site is/was licensed by the EPA to operate as a waste depot.
- Whether the site is/was issued with a licence by the EPA to produce waste of a prescribed kind or to carry out an activity that produces a listed waste on the land.
- Records on the Public Register of waste being deposited on the land between 1 January 1983 and 30 April 1995.

No evidence of any of these activities occurring at the site was recorded. Copies of the EPA Section 7 records are contained in Appendix E.

4.4 Heritage Register

A search of the South Australian Heritage register database was undertaken. (<http://www.environment.sa.gov.au/heritage/assess.html/database>).

This search did not identify any areas of significance within the site area.

Table 4.1 – Historical Aerial Photograph Review

SURVEY: PHOTO	DATE	OBSERVATIONS
0007-0179/ 180/181 Black and white	1949	The site appears to be predominately natural vegetation with the most southern section of the site is being used for farming/cropping. Some sparse residential land use is occurring west of the site boundary. Major quarrying is occurring south of the site. The dolomite quarry located to the east is predominantly natural hills vegetation in the eastern portions, similar to present day. The River Torrens is clearly evident to the south. The land use surrounding the site is predominately farming/residential land.
0149-6857 Black and white	1954	Poor resolution/scale. Features of the site can not be clearly identified. Major quarrying is occurring to the south of the site. Surrounding land use is unchanged since 1949 and includes native vegetation, and farming/residential land. Significant quarrying has continued to occur directly east of the site.
0327- 9659/9660 Black and white	1959	The natural vegetation on the northern section of the site has decrease. Farming/cropping is used for the remainder of the site. The quarry south of the site has been completely excavated with machinery visible on the site. Quarrying has continued in the ReadyMix quarry.
0812/6093 Black and white	1963	Site still appears undeveloped as described in 1959. The quarry south of site appears deeper and sediment ponds evident. There is increased quarrying to the east of the site which now extends down to the River Torrens.
1157/0032 Black and white	1969	Poor resolution. Area largely unchanged since 1963.
2239-0016 Black and white	1979	Poor scale/resolution. Some development appears to have occurred on the site, though majority appears vegetated. Some structures may be present in northern portion of site. Quarrying south of the site appears to cover nearly entire area of the former Pacific Waste/East Waste landfill sites. The extent of the quarrying to the east of the site appears similar to 1969. Residential development has occurred north and west of the site.
3201/0053 Black and white	1985	Poor scale/resolution. Site generally appears consistent with 1979. Quarrying to the south and east of the site boundary has continued while farming activities have begun south west of the site.
4108/0094- 0121 Colour	1989	Poor scale/resolution. Development of a number of structures has occurred on the site. The most southern section of the site appears to have been excavated exposing underlying soils. Residential development has increased in the area to the west of the site. Quarrying to the east is now extensive. Vegetative cover has increased to the south predominantly around the sediment ponds.
5000/0586 Colour	1995	Vegetation on the site has increased. Residential development is dominant to the west of the site. Quarrying activities to the east have continued.

Phase 1 Environmental Site Assessment – Highbury Hallan Nominees Land

5981/0677-0614	2001	The site appears similar to 1995 with an increase in vegetation. The land to the immediate south is now almost fully revegetated. Road tracks are clearly visible.
7012/0170	2005	Four building structures can be identified on the northern section of the site. Two areas on the site can be identified with storage of waste materials or disused machinery. An unsealed track is visible from Halls Road to the shed located in the north eastern corner of the block. Former quarry site to the south is now fully revegetated and some piping that may be associated with landfill gas extraction is visible on the northern site. Residential development surrounds the site beyond the former quarry sites to the east and partly to the north. The quarry site contains three main quarried areas and is predominantly natural hills vegetation in the central and eastern portions with the River Torrens clearly evident to the south

5 SITE INSPECTION

REM completed an inspection of the Highbury site on 16th October 2006. REM was accompanied during the site inspection by Helen Mercer, the current site owner.

Helen Mercer provided the following information pertaining to the current and historical environmental condition of the site:

- 2 to 3 metres of soil had been stripped from the southern portion of the site;
- The two-storey dwelling was constructed in 1992 – 1993 and has always been used as an office;
- Site has been largely vacant, with storage of minor waste materials including steel, timber pallets, machinery etc.;
- Site was historically used for the crushing of materials (brick and shell grit) and for storage and distribution of 'coal' to nearby water filtration plant;
- Concrete pad south west of crushing shed was used to dry 'coal' (sourced from Bowmans);
- Loading bay west of crushing shed was used for storage of finished crushed brick/shell grit product;
- No significant quantities of fuel or oil storage had occurred on the site, beyond the odd small drum (20L) of lubricant, greases etc.;
- AST and bowser present in north west portion of site has never been used; and
- Potentially a bore located on the property that Pacific Waste historically asked permission to install and may have been sampled in the past, however she was not able to recall the time of installation or locate the bore on site.

5.1 Site Observations

The site was largely covered in long grass and large trees, with much of the surface not directly visible. The major site features included a two storey dwelling with green coloured galvanised iron roof located on Halls Road and a number of sheds and waste materials. Site observations made during the inspection are summarised below:

- One large shed (crushing shed) is located north of the dwelling, with a concrete loading bay located directly west of the shed (Plate M1).
- The crushing shed now contains disused equipment, crushing machinery and a truck (Plates M2 and M3). No evidence of historical contamination (eg significant surface staining) was identified. A single 20L drum of lubricant was observed within the shed.
- An ETSA Transformer was located directly east of the crushing shed on Halls Road (Plate M4).
- Smaller galvanised sheds (understood to have concrete floors though locked at the time of inspection) were located west of the main crushing shed, and in the north western corner of the site (Plate S1).
- An above ground storage tank and bowser (5000L approx.) was located east of the shed

in the north west corner of the site (Plate S2). No staining was visible on the surrounding ground surface.

- Some residual brick and shell grit material was presented immediately south of the crushing shed, with some minor surface staining also evident (Plate S3).
- A concrete pad is located west of the main dwelling. No visible staining or evidence of contamination was observed in this area and no residual coal was present. Some gravel (fill) material was observed on the surface. A large (20,000L approx.) storage tank is located adjacent this area, which the owner indicated it was disused and from a former water cart and had never contained fluid on site.
- The broader site is generally covered in grass and shrubs (Plate V1 and V2) with some gravel tracks.
- Waste materials including scrap steel, piping, rusted machinery and wooden pallets were stored in various areas across the site (Plates V3 and V4).

5.2 Surrounding Land Use

The site is located within the locality of Highbury, which contains mixed land uses including residential, industrial (quarrying and landfilling activities) and open space/recreational type use.

Residential development bounds the site to the north and the west, with Lower North East Road located to the north west of the site beyond the residential properties.

The Readymix Quarry is located to the east of the site beyond Halls Road. The site covers an area over 340 hectares of extractive industry and natural vegetation undeveloped land.

The Pacific Waste Management decommissioned landfill borders the southern section of the site. Also located south of the site is land owned by the Highbury Landfill Authority, formerly the East Waste landfill which closed in 1996.

6 POTENTIAL CONTAMINATION ISSUES

Based on a review of historical information obtained for the site and a site inspection on the following potential contamination issues have been identified and are summarised in Table 6.1 below.

Table 6.1 – Summary of Potential Contamination Issues

Site Area	Issue	Potential Contaminants	Risk
Fill Material	Presence of gravels, bricks, shell grits and other fill materials of unknown origin possibly including imported fill.	Broad range including heavy metals, TPH and PAHs	Low to moderate
Historical crushing activities	Bricks and shell grit had been crushed and stored on site. Unknown origin and quality	Broad range including heavy metals, TPH and PAHs (as per fill material)	Low
Historical storage and distribution of 'coal' for water filtration	Coal (though likely activated carbon if used in water filtration) stored on site. Coal may have contained a range of contaminants	Broad range including heavy metals and PAHs	Low to moderate
Equipment Storage (small quantity fuels oils)	Minor quantities of fuel/oil storage	TPH, PAH and other halogenated aliphatic compounds in soil/ groundwater	Low
Waste Debris – aesthetic	Presence of range of scrap and waste materials that may be present an aesthetic limitation	-	Low
Transformer		Potential PCB and/or hydrocarbon impacts in soils	Low
AST's	20000L AST from water cart AST and Bowser (~5,000L) (Owner indicated had not been used)	TPH, PAH, phenols and halogenated aliphatic compounds in soil and/or groundwater	Low to moderate
Concrete Slabs	Underslab termiticide treatments	Arsenic/OC pesticides in soil	Low

6.1 Off-Site Sources

Surrounding land use to the south and east of the site has the potential to present off-site sources of groundwater contamination that may pose some impact on the subject site. Two historical land filling operations were present immediately south of the site and the quarry is located immediately east of the site.

The proximity of these sites present the potential for migration on-site of contaminants via groundwater including the broad range of potential contaminants associated with municipal waste landfills such as heavy metals, inorganics including nutrients (ammonia, nitrates, phosphates),

cyanides and methanes, hydrocarbons, chlorinated hydrocarbons, volatile organic compounds, pesticides and landfill gases including methane. Quarrying activities may present potential groundwater contaminants including heavy metals, hydrocarbons and other volatile organic compounds.

The site most likely located up hydraulic gradient of the landfill, reduces the likelihood of adverse impacts to groundwater beneath the site, however, further investigations would be required to confirm this assessment.

The potential for on-site vapour migration from landfill gas generated from the adjacent landfill also exists, however potentially these landfills would be required to have monitoring and management plans in place including landfill gas extraction systems if required.

No other off-site sources of potential contamination were identified.

7 CONCLUSIONS

From information gathered as part of this Phase 1 Environmental Site Assessment for the Hallan Nominees site located on Halls Road, Highbury the potential for contamination of soil and/or groundwater associated with current and historical activities undertaken on the site is generally considered to range from low to moderate.

A range of potential on-site sources of soil and groundwater contamination have been identified, predominantly related to the previous commercial practices associated with crushing and storage activities at the site.

Off-site sources of groundwater contamination that may potentially impact groundwater quality beneath the site exist due to the proximity to two former landfills located directly south of the site and the quarrying activities to the east.

Further assessment of the extent of these potential contamination issues through a Phase 2 Environmental Site Assessment including soil and groundwater investigations would be required to assess the potential impact and requirement for any management or remediation works to render the site suitable for future site redevelopment.

8 LIMITATIONS

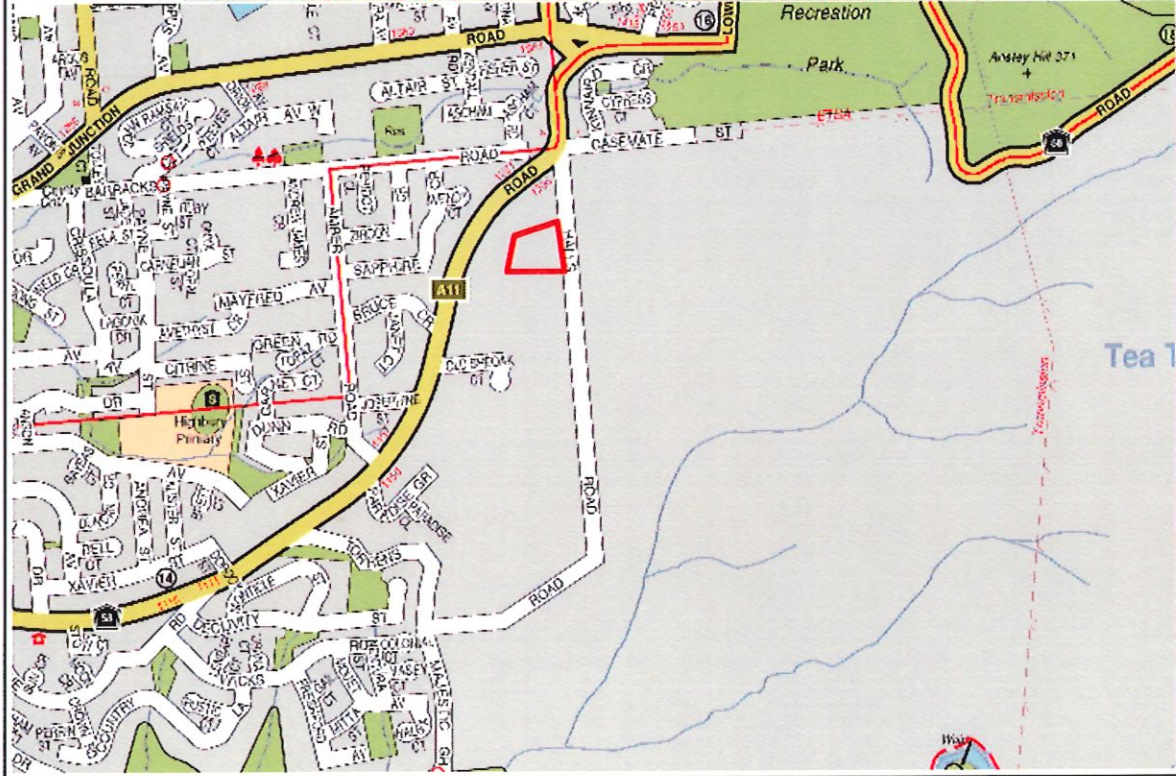
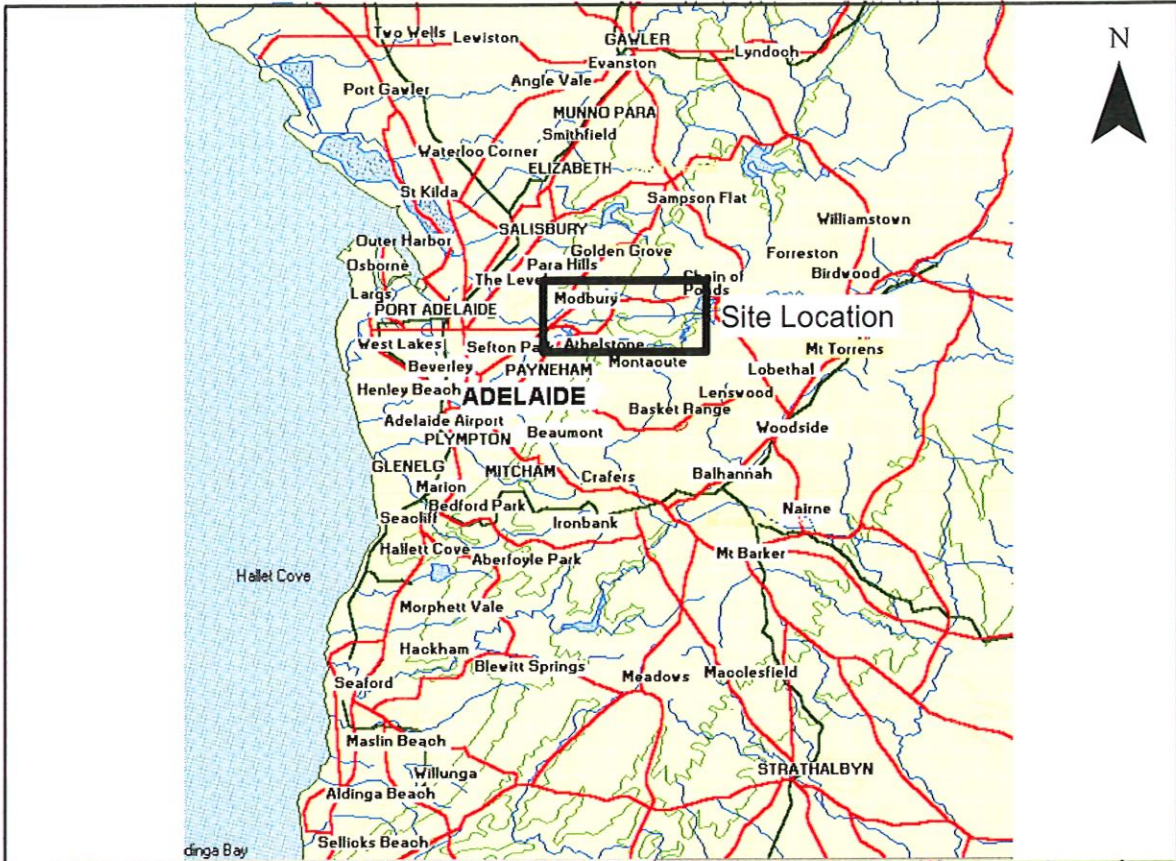
This report has been prepared in accordance with the program outlined in the REM proposal to Hallan Nominees Pty Ltd, dated 10th of October 2006. The services provided by REM have been conducted in a manner consistent with the level of quality and skill generally exercised by members of its profession and consulting practice. No warranty or guarantee of the site conditions is intended.

This report was prepared for the sole use of the Hallan Nominees Pty Ltd and may not contain sufficient information for purposes of other parties or for other uses. The information in this report is considered to be accurate with respect to conditions encountered at the site at the time of investigation and information provided as part of site interviews and from published sources of information. Any reliance on this report by third parties shall be such parties sole risk. This report shall only be presented in full and may not be used to support any other objectives than those set out in the report, except where written approval with comments are provided by REM.

The information in this report is considered to be accurate with respect to conditions encountered at the site at the time of investigation and considering the inherent limitations associated with assessment of information from information at a discrete point in time and sampling set. Subsurface conditions can vary across a particular site and no practical degree of site inspection or sampling can ever eliminate the possibility that conditions may be present at a site that have not been represented through sampling.

Since subsurface conditions (including contamination concentrations) and site activities and potential contamination can change within a limited period of time and space, this inherent limitation to the representation of site conditions provided by this report should always be taken into consideration particularly if the report is used after a delay in time.

Figures



R:/GIS/Dequetteville/Gawler and Highbury/Highbury/Mercer/Location Plan.mxd

Legend
— Approximate Site Boundary



**HALLAN NOMINEES
 LOCATION PLAN**

Figure
1

Project: ET-02-5

December 2006



R:\GIS\Dequetteville\Gawler and Highbury\Highbury\Mercer\Site Layout.mxd



Legend
 — Approximate Site Boundary



**HALLAN NOMINEES
 SITE LAYOUT**

Project: ET-02-5

Figure
2
 DATE

Plates



Plate M1: Material Storage on the western side of the main storage building.

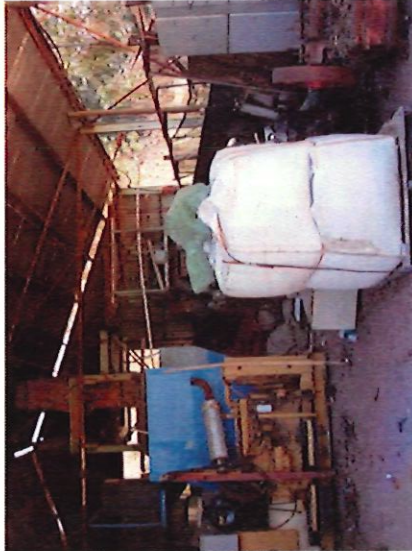


Plate M3: Inside the eastern wall of the main storage building.

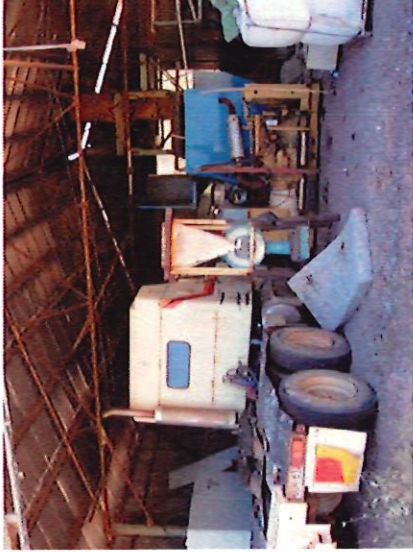


Plate M2: Inside main storage building.

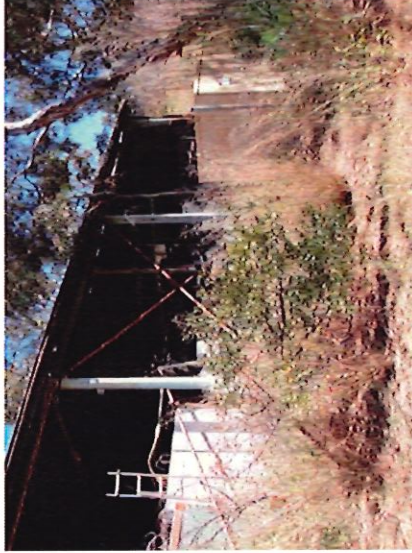


Plate M4: ETSA Transformer located on the eastern wall of the main storage building.

FIGURE
M1-M4

Plates - Main Storage Building and ETSA
Transformer





Plate S1: Storage shed located in the north western corner of the site.



Plate S2: AST located in the north western corner of the site.

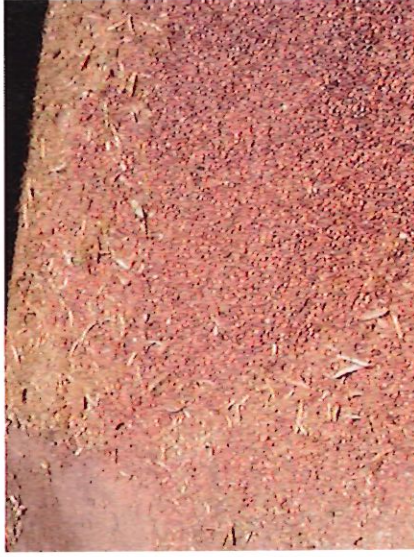


Plate S3: Crushed brick fill typically found on site.



Plates - Storage Sheds, AST and Crushing Material
FIGURE S1-S3



Plate V1: View east of the site - South of residence.

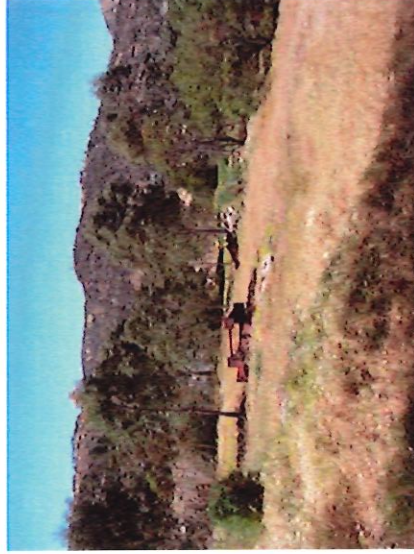


Plate V3: View east of the site.



Plate V2: View east at southern boundary.

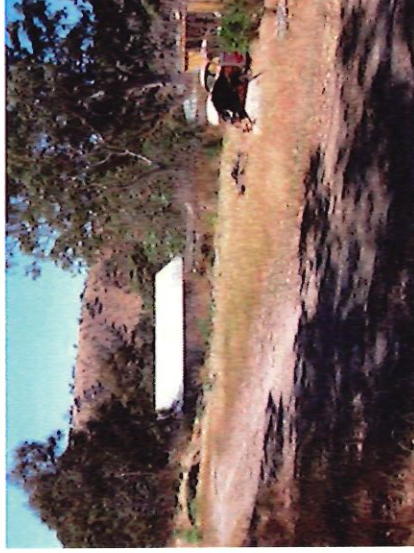


Plate V4: View east to main storage building.



Plates - Site Views

FIGURE

V1-V4

PROJECT

ET-02-5

December-06

Appendix A



Legend

- Approximate Site Boundary
- ◆ Water Well
- ◆ Environmental Well
- ◆ Mineral/Exploration Well



R:\GIS\seawater\gawater and hybur\gibbur\misc\env\Obswell Locations.mxd

**HALLAN NOMINEES
OBSWELL LOCATIONS**



Project: ET-02-5

Figure
A.1
December 2006

Table A.1. Summary of SA Geodata Database Results

Unit_No	EASTINGS (MGA)	NORTHINGS (MGA)	Max Drill Depth	Max Drill Date	SWL	RSWL	Water Level Date	TDS	EC	Salinity Date
6628-5390	293335.73	6142422.3	15.24	7/06/1968						
6628-5472	291677.77	6142167.22								
6628-5473	291265.79	6141511.26								
6628-5474	293498.74	6142229.21	24.38	16/06/1966						
6628-5475	292675.72	6142063.24	11	29/01/1975						
6628-5476	292654.73	6142101.27	11	30/01/1975						
6628-5477	291772.72	6141975.27	15.24	28/02/1961						
6628-5478	291834.8	6141973.25	9.14	28/02/1961						
6628-5479	291855.74	6141873.28	15.24	28/02/1961						
6628-5480	291766.78	6141866.27	15.24	28/02/1961						
6628-5481	291702.78	6141892.22	10.97	24/02/1961						
6628-5482	291691.79	6141796.31	12.19	24/02/1961						
6628-5483	291777.77	6141777.29	12.8	24/02/1961						
6628-5484	291876.79	6141772.21	8.53	24/02/1961						
6628-5485	291896.75	6141671.23	8.53	24/02/1961						
6628-5486	291756.78	6141670.27	7.62	24/02/1961						
6628-5487	291716.73	6141689.22	9.14	28/02/1961						
6628-5488	291653.76	6141674.25	11.58	24/02/1961						
6628-5489	291696.76	6141481.23	7.32	24/02/1961						
6628-5490	291241.77	6141778.29	96.01	19/01/1971	48.77		19/01/1971	827	1500	19/01/1971
6628-5573	293472.79	6139421.26	157	12/07/1972						
6628-5630	292082.81	6141310.21	53.8	1/01/1949	16.56	142.97	18/09/1985	470	855	24/02/1981
6628-5631	292245.74	6141383.27	62.94	1/01/1949	0		1/09/1949	457	831	1/09/1949
6628-5632	291317.77	6141085.27	58.39	1/01/1951						
6628-5633	291594.8	6141177.26			18.29		1/03/1960	1355	2449	1/03/1960
6628-5634	291137.8	6140512.27						1055	1911	24/08/1934
6628-5685	291157.73	6139875.24	19.81	1/05/1931				1971	3547	1/05/1931
6628-5690	291451.77	6140247.3						561	1020	7/02/1977
6628-5691	291732.74	6139827.3	8.53	1/01/1967	6.71	93.29	24/09/1967	670	1216	24/09/1967
6628-11237	291510.84	6141475.26	7.2	4/05/1977						
6628-11238	291510.84	6141475.26	8.2	4/05/1977						
6628-11239	291510.84	6141475.26	11.7	4/05/1977						
6628-11240	291912.82	6141606.26	12.5	5/05/1977						
6628-11241	291912.82	6141606.26	7.5	5/05/1977						
6628-11242	291912.82	6141606.26	3.2	5/05/1977						
6628-11243	291912.82	6141606.26	9.2	6/05/1977						
6628-11244	291912.82	6141606.26	10	6/05/1977						
6628-11428	291580.75	6141722.31	60	11/06/1980	19		11/06/1980	528	960	21/08/1980
6628-11429	291343.76	6140932.27	54	10/06/1980	10		10/06/1980	397	721	21/08/1980
6628-11430	291147.72	6140474.21	24	6/06/1980	2.55	102.81	21/09/1991	1021	1850	11/09/1980
6628-12044	291788.73	6139835.24	22	25/09/1982	11.29	89.41	20/09/1989	829	1503	11/02/1985
6628-12622	291373.74	6139432.24	56	1/12/1983	32		1/12/1983	970	1700	11/02/1985
6628-12849	291305.79	6139251.23	86	1/03/1984	48.7		1/03/1984	944	1710	1/03/1984
6628-13731	292055.78	6141219.26	85.6	21/08/1986	4.5		1/10/1986	683	1240	1/10/1986
6628-15256	291879.76	6141299.27	146	16/11/1990	31.5		16/11/1990	3609	6420	16/11/1990
6628-15451	291353.76	6139518.24	61	12/10/1990	20		15/10/1990	1546	2790	16/10/1990
6628-15603	291360.77	6139399.21	43	5/09/1991	20		5/09/1991	1127	2040	6/09/1991
6628-15908	291359.79	6139651.23	30	1/11/1991	10		2/03/1992	924	1674	2/03/1992
6628-15961	291395.8	6139347.29	80	27/03/1992	39		2/04/1992	1021	1849	2/04/1992
6628-16590	291426.77	6141533.24	36	10/03/1994						
6628-16591	291411.72	6141503.38	44.1	4/03/1994						
6628-16592	291496.69	6141508.31	3.5	6/04/1994						
6628-16593	291441.82	6141708.16	47.7	28/03/1994						
6628-17680	292011.86	6140478.35	52	1/01/1975						
6628-17681	292371.76	6140788.39	52	1/01/1975						
6628-17790	291601.72	6141058.22	12	21/02/1996				1373	2480	21/02/1996
6628-17868	291801.96	6139953.18	62.5	30/03/1996				666	1210	1/04/1996
6628-17984	291796.97	6139883.15	38	9/09/1996				849	1540	19/09/1996
6628-18602	291431.89	6141738.23	42	22/04/1997				1770	3190	22/04/1997
6628-18603	291381.85	6141493.26	36	24/04/1997				1005	1820	24/04/1997
6628-18604	291281.87	6141223.29	46	23/04/1997				1984	3570	23/04/1997
6628-19199	291716.85	6139818.29	23	12/09/1998	11		12/09/1998	794	1440	19/09/1998
6628-19307	291206.82	6142368.25	30	10/11/1998						
6628-19916	291328.06	6141655	50	21/11/1999	38		21/11/1999	1434	2590	21/11/1999
6628-20355	291466.06	6139291.01	94	16/06/2000	42		16/06/2000	1138	2060	16/06/2000
6628-21100	291150.94	6140736.83	24	15/12/2000	16.49		15/12/2000			
6628-21307	291614.54	6141220.19	24	29/12/2002	11.55		29/12/2002			
6628-21665	291286.1	6141215.09	24	15/02/2000						

Appendix B



Title Register Search

LANDS TITLES OFFICE, ADELAIDE

For a Certificate of Title issued pursuant to the Real Property Act 1886

REGISTER SEARCH OF CERTIFICATE OF TITLE * VOLUME 5768 FOLIO 114 *

COST : \$16.10 (GST exempt) PARENT TITLE : CT 4265/750
REGION : GROUND FLOOR, L.T.O. - LGHP12 AUTHORITY : CONVERTED TITLE
AGENT : GRFL BOX NO : 000 DATE OF ISSUE : 04/05/2000
SEARCHED ON : 06/11/2006 AT : 12:17:33 EDITION : 1

REGISTERED PROPRIETOR IN FEE SIMPLE

HALLAN NOMINEES PTY. LTD. OF LOT 47 MAIN ROAD HOUGHTON SA 5131

DESCRIPTION OF LAND

ALLOTMENT 11 DEPOSITED PLAN 17357
IN THE AREA NAMED Highbury
HUNDRED OF YATALA

EASEMENTS

NIL

SCHEDULE OF ENDORSEMENTS

6947630 MORTGAGE TO STATE BANK OF SOUTH AUSTRALIA
6953885 MORTGAGE TO STATE BANK OF SOUTH AUSTRALIA

NOTATIONS

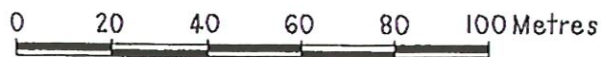
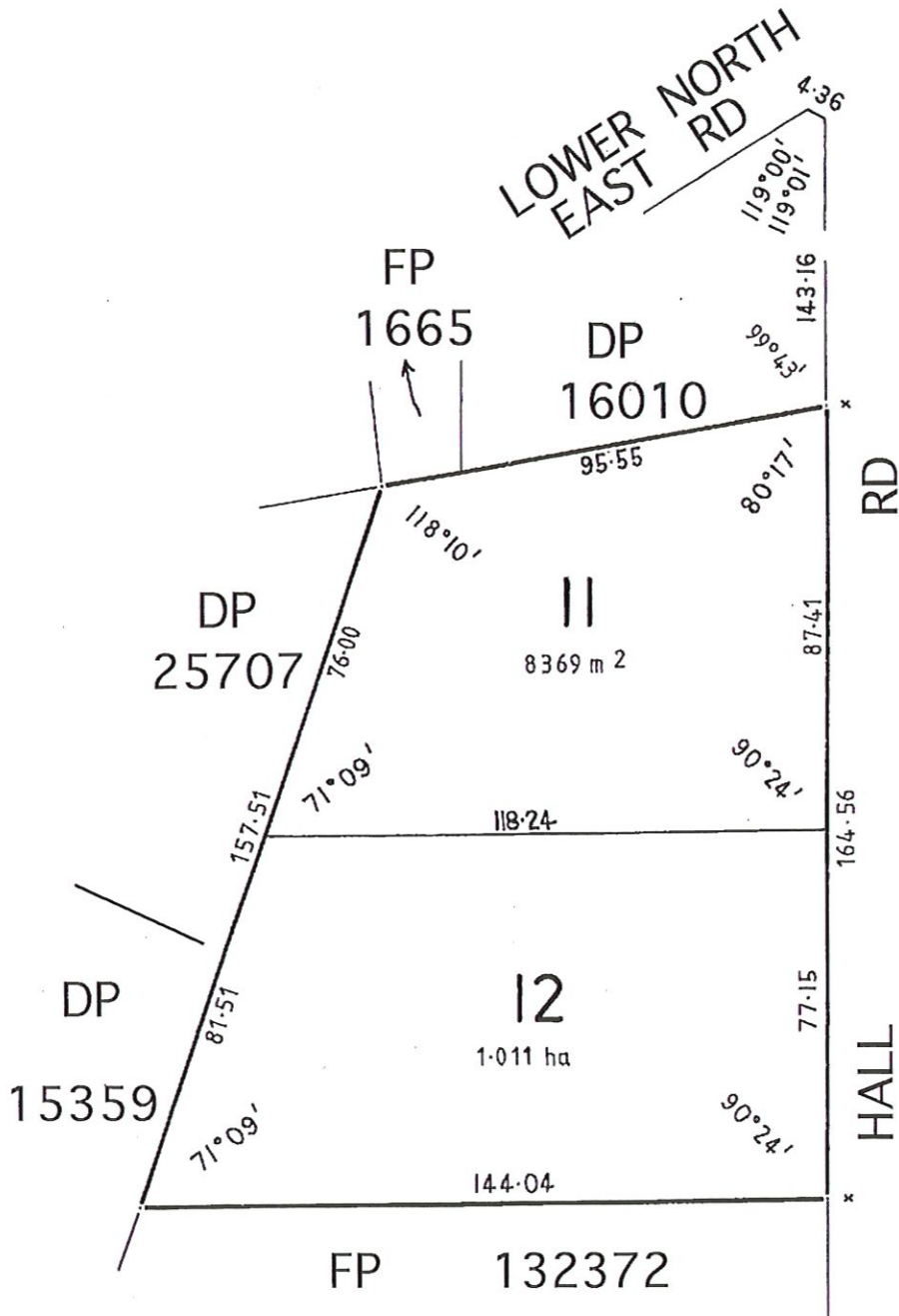
DOCUMENTS AFFECTING THIS TITLE
NIL

REGISTRAR-GENERAL'S NOTES

PLAN FOR LEASE PURPOSES GP 237/86
CONVERTED TITLE-WITH NEXT DEALING LODGE CT 4265/750
COMPARE ADDRESS FOR SERVICE OF NOTICE WITH 6953885

END OF TEXT.







Title Register Search

LANDS TITLES OFFICE, ADELAIDE

For a Certificate of Title issued pursuant to the Real Property Act 1886

REGISTER SEARCH OF CERTIFICATE OF TITLE * VOLUME 5768 FOLIO 115 *

COST : \$16.10 (GST exempt)	PARENT TITLE : CT 4265/751
REGION : GROUND FLOOR; L.T.O. - LGHP12	AUTHORITY : CONVERTED TITLE
AGENT : GRFL BOX NO : 000	DATE OF ISSUE : 04/05/2000
SEARCHED ON : 06/11/2006 AT : 12:17:39	EDITION : 1

REGISTERED PROPRIETOR IN FEE SIMPLE

HALLAN NOMINEES PTY. LTD. OF LOT 47 LOWER NORTH EAST ROAD HOUGHTON SA 5131

DESCRIPTION OF LAND

ALLOTMENT 12 DEPOSITED PLAN 17357
IN THE AREA NAMED Highbury
HUNDRED OF YATALA

EASEMENTS

NIL

SCHEDULE OF ENDORSEMENTS

6947630 MORTGAGE TO STATE BANK OF SOUTH AUSTRALIA
6953885 MORTGAGE TO STATE BANK OF SOUTH AUSTRALIA

NOTATIONS

DOCUMENTS AFFECTING THIS TITLE
NIL

REGISTRAR-GENERAL'S NOTES

CONVERTED TITLE-WITH NEXT DEALING LODGE CT 4265/751
COMPARE ADDRESS FOR SERVICE OF NOTICE WITH 6953885

END OF TEXT.



LANDS TITLES OFFICE ADELAIDE SOUTH AUSTRALIA

DIAGRAM FOR CERTIFICATE OF TITLE VOLUME 5768 FOLIO 115

SEARCH DATE : 06/11/2006 TIME: 12:17:39

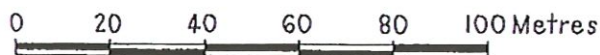
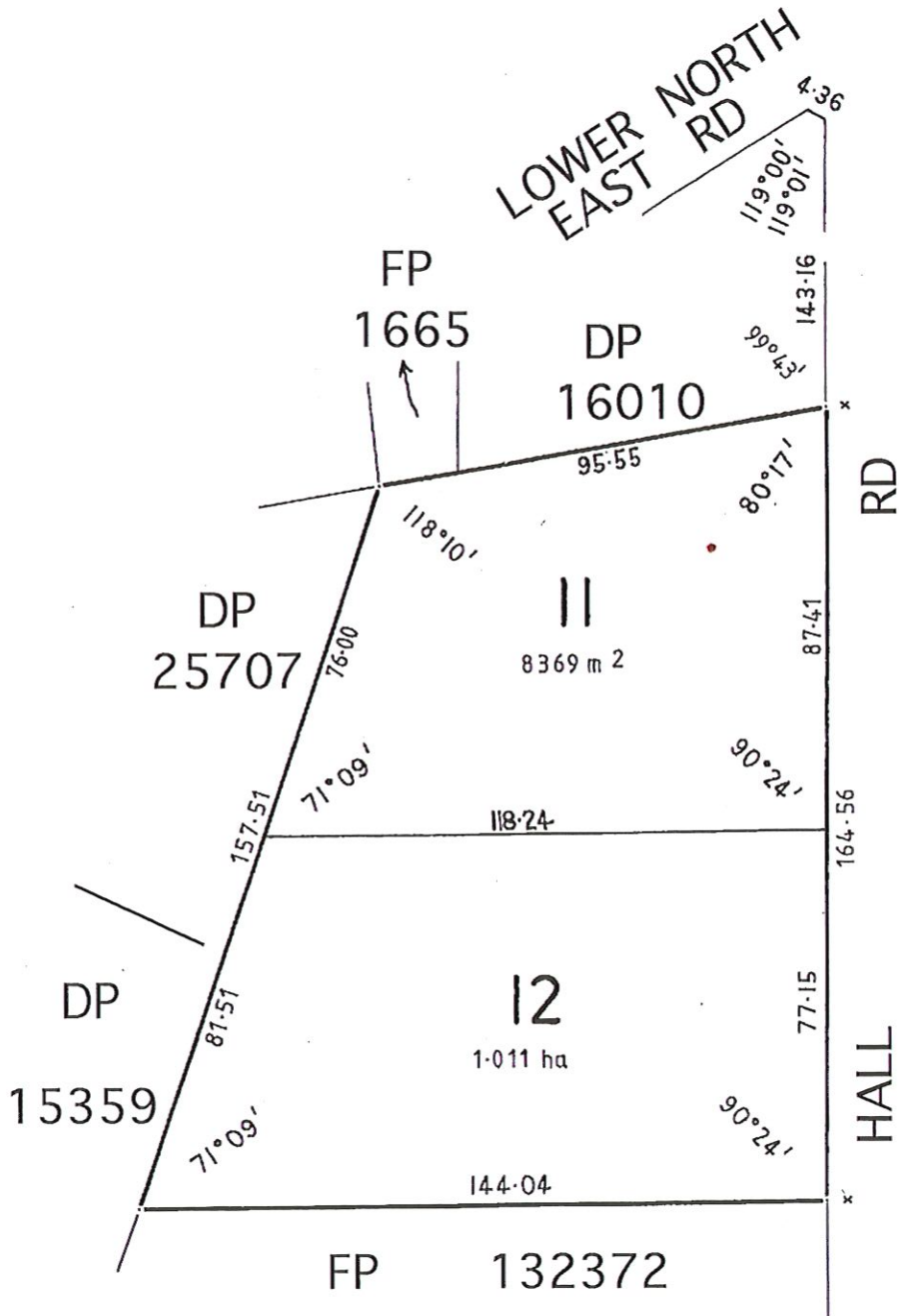


Table B.1: Historical Ownerships and Certificates of Title for Hallan Nominees Highbury

Certificate of Title	From	To	Ownership	Use
Volume 5769 Folio 114	4/05/2000	Present	Hallan Nominees Pty Ltd	
Volume 4265 Folio 750	29/05/1987	4/05/2000	Hallan Nominees Pty Ltd	
Transfer	7/02/1986	29/05/1987	Mercer Nominees Pty Ltd	
Volume 839 Folio 181	22/09/1978	7/02/1986	Hallan Nominees Pty Ltd	
Transfer	8/12/1975	22/09/1978	Mercer Nominees Pty Ltd	
Transfer	27/05/1968	8/12/1975	R.A. and F.W. Hall	
Transfer	15/11/1966	27/05/1968	Hals Holden Company	
Transfer	4/03/1938	15/11/1966	Fredrick William Hall	
Transfer	21/03/1937	4/03/1938	Allan Hall and Walter Benny Bradbrook	Contractor Gardeners Woodcarters
Original Owner	2/08/1910	21/03/1937	Richard Henry Hall Eliza Elizabeth Button	

Certificate of Title	From	To	Ownership	Use
Volume 5768 Folio 115	4/05/2000	Present	Hallan Nominees Pty Ltd	
Volume 4265 Folio 751	29/05/1987	4/05/2000	Hallan Nominees Pty Ltd	
Transfer	7/02/1986	29/05/1987	Mercer Nominees Pty Ltd	
Volume 839 Folio 181	22/09/1978	7/02/1986	Hallan Nominees Pty Ltd	
Transfer	8/12/1975	22/09/1978	Mercer Nominees Pty Ltd	
Transfer	27/05/1968	8/12/1975	R.A. and F.W. Hall	
Transfer	15/11/1966	27/05/1968	Hals Holden Company	
Transfer	4/03/1938	15/11/1966	Fredrick William Hall	
Transfer	21/03/1937	4/03/1938	Allan Hall and Walter Benny Bradbrook	Contractor Gardeners Woodcarters
Original Owner	2/08/1910	21/03/1937	Richard Henry Hall Eliza Elizabeth Button	

Table B.2: Historical Ownerships and Certificates of Title for Hallan Nominees Highway

Certificate of Title	From	To	Ownership	Use
Volume 5769 Follo 114	4/05/2000	Present	Hallan Nominees Pty Ltd	
Volume 5768 Follo 115	4/05/2000	Present	Hallan Nominees Pty Ltd	

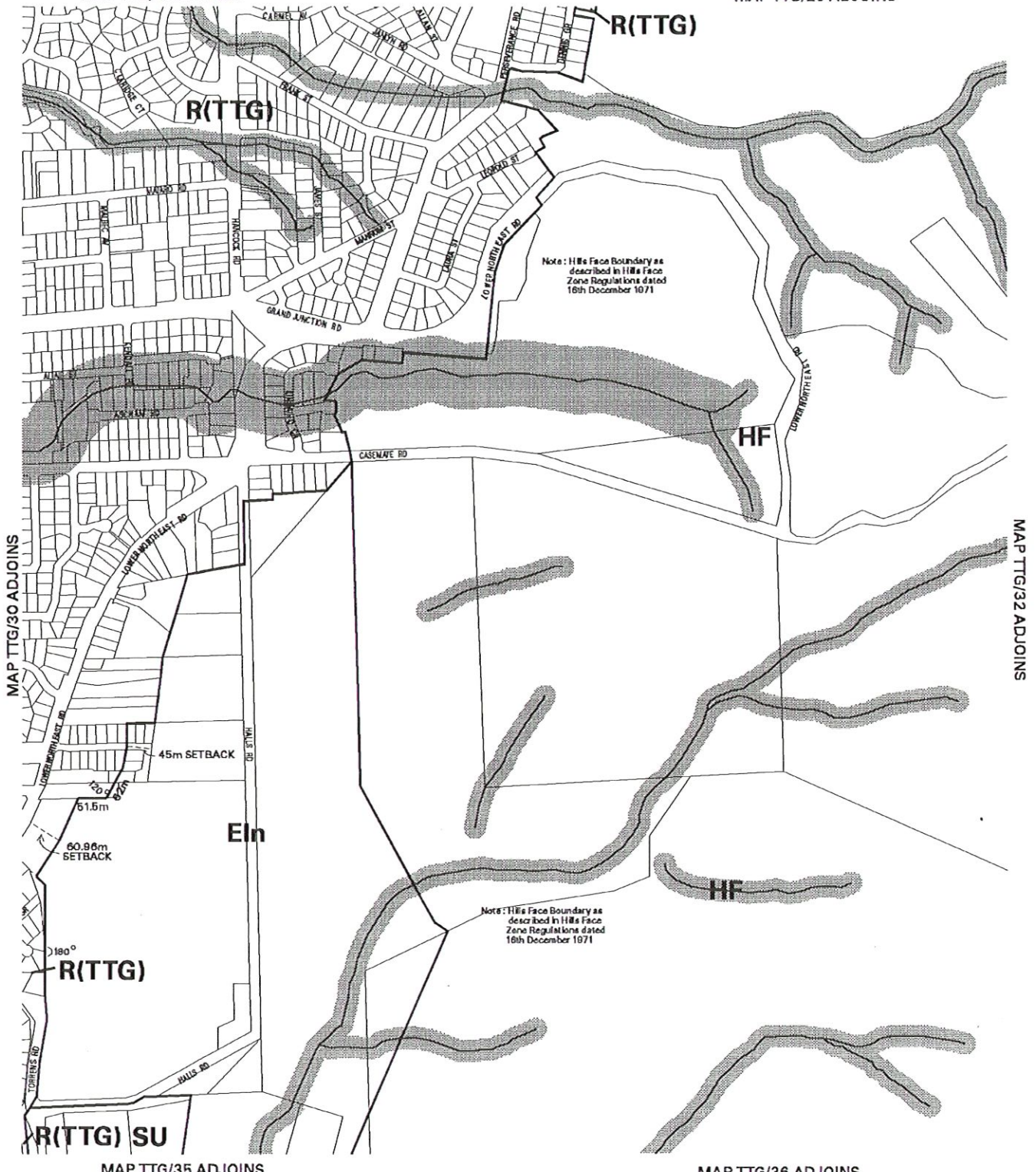
Certificate of Title	From	To	Ownership	Use
Volume 4265 Follo 750	29/05/1987	4/05/2000	Hallan Nominees Pty Ltd	
Transfer	7/02/1986	29/05/1987	Mercer Nominees Pty Ltd	

Certificate of Title	From	To	Ownership	Use
Volume 839 Follo 181	22/09/1978	7/02/1986	Hallan Nominees Pty Ltd	
Transfer	8/12/1975	22/09/1978	Mercer Nominees Pty Ltd	
Transfer	27/05/1968	8/12/1975	R.A. and F.W. Hall	
Transfer	15/11/1966	27/05/1968	Hals Holden Company	
Transfer	4/03/1938	15/11/1966	Fredrick William Hall	Contractor
Transfer	21/03/1937	4/03/1938	Allan Hall and Walter Benny Bradbrook	Gardeners
Original Owner	2/08/1910	21/03/1937	Richard Henry Hall	Woodcarfers
			Eliza Elizabeth Button	


Appendix C

MAP TTG/25 ADJOINS

MAP TTG/26 ADJOINS



EIn Extractive Industry
HF Hills Face
R(TTG) Residential (Tea Tree Gully)
SU Special Uses

— Zone Boundary
 — Creek Centre-line
 River/Creek Floodwater Area

Scale 1:10000



CITY OF TEA TREE GULLY ZONES MAP TTG/31

Consolidated - 6 July 2006

Appendix D

APPENDIX D - HISTORICAL AERIAL PHOTOGRAPHS



1949

APPENDIX D - HISTORICAL AERIAL PHOTOGRAPHS



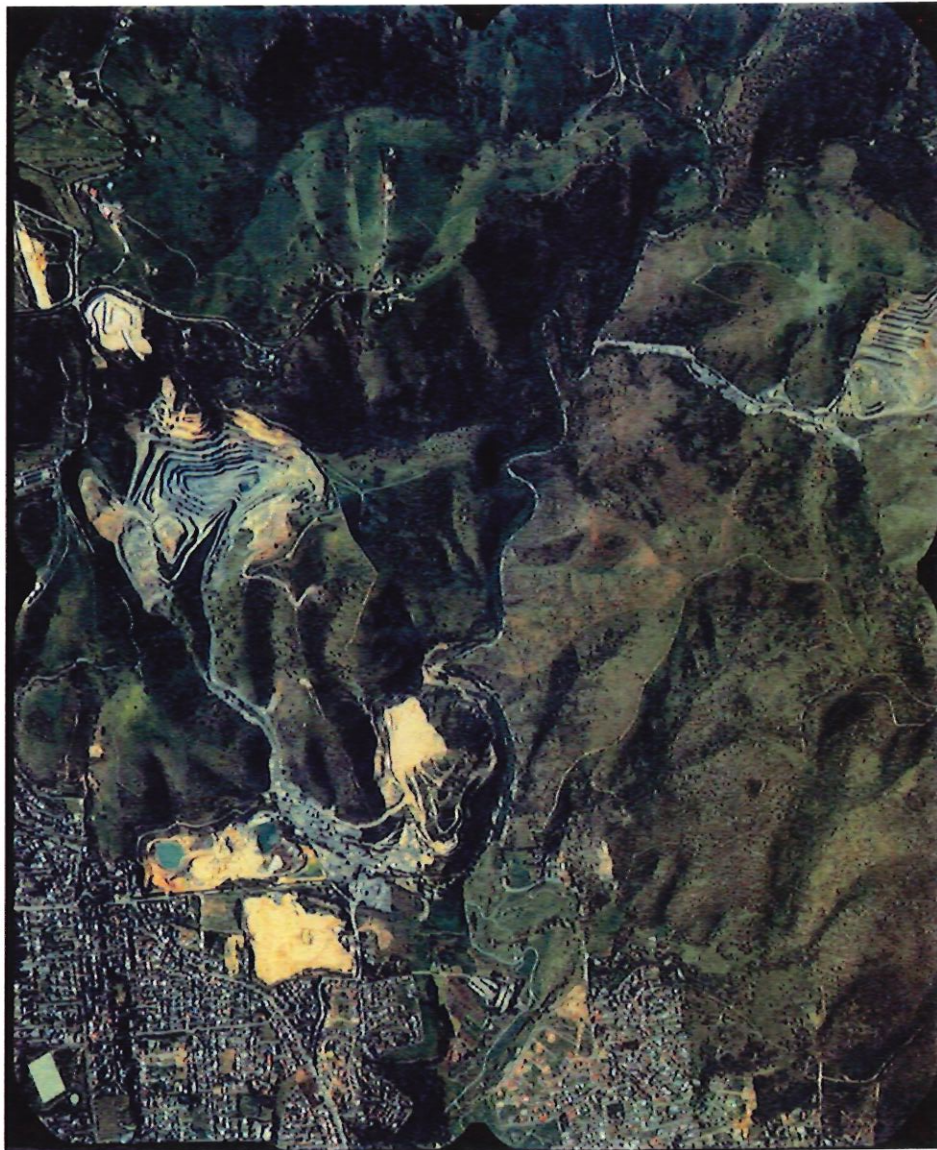
1963

APPENDIX D - HISTORICAL AERIAL PHOTOGRAPHS



1985

APPENDIX D - HISTORICAL AERIAL PHOTOGRAPHS



1995

APPENDIX D - HISTORICAL AERIAL PHOTOGRAPHS



2001

APPENDIX D - HISTORICAL AERIAL PHOTOGRAPHS



2005

Appendix E

Resource And Environmental Management
Suite 9
15 Fullarton Road
KENT TOWN SA 5067

Contact: Rosslyn Farquharson
Telephone: (08)8204 2179

Contact: Gayle Brookshaw
Telephone: (08)8204 1112
Fax: (08)8124 4672

28 November, 2006

Dear Sir/Madam,

Section 7 - Land and Business (Sale and Conveyancing) Act 1994

I refer to your enquiry concerning the parcel of land comprised in

Title Reference CT Volume 5768 Folio 114
Address 10-14 Halls Road, Highbury SA 5089

I advise as follows:

**PARTICULARS OF MORTGAGES, CHARGES & PRESCRIBED ENCUMBRANCES
AFFECTING THE LAND**

- | | | |
|-----|--|----|
| 53. | Environment performance agreement under section 59 of the <i>Environment Protection Act 1993</i> that is registered in relation to the land. | NO |
| 54. | Environment protection order issued under section 93 of the <i>Environment Protection Act 1993</i> that is registered in relation to the land. | NO |
| 55. | Clean-up order issued under section 99 of the <i>Environment Protection Act 1993</i> that is registered in relation to the land. | NO |
| 56. | Clean-up authorisation issued under section 100 of the <i>Environment Protection Act 1993</i> that is registered in relation to the land. | NO |

PARTICULARS RELATING TO ENVIRONMENT PROTECTION

Section 7 - Land and Business (Sale and Conveyancing) Act 1994

The answers to the following questions are shown:

Environmental assessments

2. (3) Does the Environment Protection Authority hold a copy of a report on any environmental assessment of the land or a part of the land carried out at any time -
- (a) by or on behalf of the owner or occupier of the land -
- (i) pursuant to an authorisation, agreement or order under section 52(1)(b), 59, 93, 99, or 100 of the *Environment Protection Act 1993*;
or
- (ii) for the purposes of a notification given under section 83 of that Act;
or
- (b) by the Environment Protection Authority (whether alone or jointly with another authority);
or
- (c) by a Contaminated Site Auditor recognised by the Environment Protection Authority for the purposes of carrying out such an assessment? NO

Waste depots

3. (1) Was a licence to operate a waste depot on the land ever issued under the repealed *South Australian Waste Management Commission Act 1979*, a record of which is on the Public Register? NO
- (2) Was a licence to operate a waste depot on the land ever issued under the repealed *Waste Management Act 1987*, a record of which is on the Public Register? NO
- (3) Is an environmental authorisation currently in force under the *Environment Protection Act 1993* in the form of a licence to operate a waste depot on the land, a record of which is on the Public Register? NO
- (4) Was an environmental authorisation ever issued under the *Environment Protection Act 1993* in the form of a licence to operate a waste depot on the land, being a licence that is no longer in force and a record of which is on the Public Register? NO

Production of certain waste

4. (1) Was a licence under the repealed *South Australian Waste Management Commission Act 1979* ever issued for the production of waste of a prescribed kind (within the meaning of that Act) on the land, a record of which is on the Public Register? NO
- (2) Was a licence under the repealed *Waste Management Act 1987* ever issued for the production of prescribed waste (within the meaning of that Act) on the land, a record of which is on the Public Register? NO


4. (3) Is an environmental authorisation currently in force under the *Environment Protection Act 1993* in the form of a licence to carry out an activity that produces listed waste (within the meaning of that Act) on the land, a record of which is on the Public Register? NO

(4) Was an environmental authorisation ever issued under the *Environment Protection Act 1993* in the form of a licence to carry out an activity that produces listed waste (within the meaning of that Act) on the land, being a licence that is no longer in force and a record of which is on the Public Register? NO

Waste on land

5. Did the former Waste Management Commission under the repealed *Waste Management Act 1987* have any record of waste (within the meaning of that Act) being deposited on the land between 1 January 1983 and 30 April 1995, details of which are on the Public Register? NO

All care and diligence has been taken to access the above information from available records. Historical records provided to the EPA concerning matters arising prior to 1 May 1995 are limited and may not be accurate or complete and therefore the EPA cannot confirm the accuracy of the historical information provided.


Delegate for
ENVIRONMENT PROTECTION AUTHORITY

Resource And Environmental Management
Suite 9
15 Fullarton Road
KENT TOWN SA 5067

Contact: Rosslyn Farquharson
Telephone: (08)8204 2179

Contact: Gayle Brookshaw
Telephone: (08)8204 1112
Fax: (08)8124 4672

28 November, 2006

Dear Sir/Madam,

Section 7 - Land and Business (Sale and Conveyancing) Act 1994

I refer to your enquiry concerning the parcel of land comprised in

Title Reference CT Volume 5768 Folio 115
Address 16-20 Halls Road, HIGHBURY SA 5089

I advise as follows:

**PARTICULARS OF MORTGAGES, CHARGES & PRESCRIBED ENCUMBRANCES
AFFECTING THE LAND**

- | | | |
|-----|--|----|
| 53. | Environment performance agreement under section 59 of the <i>Environment Protection Act 1993</i> that is registered in relation to the land. | NO |
| 54. | Environment protection order issued under section 93 of the <i>Environment Protection Act 1993</i> that is registered in relation to the land. | NO |
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The answers to the following questions are shown:

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- (a) by or on behalf of the owner or occupier of the land -
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NO

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NO

All care and diligence has been taken to access the above information from available records. Historical records provided to the EPA concerning matters arising prior to 1 May 1995 are limited and may not be accurate or complete and therefore the EPA cannot confirm the accuracy of the historical information provided.


Delegate for
ENVIRONMENT PROTECTION AUTHORITY



Melbourne

Suite 21, 1 Ricketts Road
 Mount Waverley VIC 3149
 T 03 8542 7500

Adelaide

335 Carrington Street
 Adelaide SA 5000
 T 08 8223 3488

Perth

7/80 Colin Street
 West Perth WA 6005
 T 08 6268 0181

Sydney


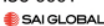

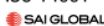

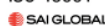
T 02 8644 0681

Brisbane

T 07 3074 9422

OUR VALUES. OUR SPIRIT.

 SAFETY We value our people and stakeholders and are committed to keeping them safe.	 PEOPLE We are professional, positive, knowledgeable and accountable people trying to go above and beyond while maintaining a good work-life balance.	 INTEGRITY We attempt to work and live to high ethical behaviour, decency, honesty and integrity standards, focusing on preserving the environment in a socially responsible manner.	 RESULTS We respect all stakeholders and are outcome-focused, providing timely and pragmatic expert and auditing advice.	 INNOVATION We are a forward-thinking, innovative group.	 TEAMWORK We strive for a workplace that is enjoyable, allows everyone to grow and flourish via mutual respect, encouragement and an open door policy.
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 Quality ISO 9001 	 Environment ISO 14001 	 OHS ISO 45001 
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Environment Protection Authority

GPO Box 2607, Adelaide SA 5001

T: (08) 8204 2004

E: yourepa@sa.gov.au

EPA 63187

Mr Phillip Hitchcock

Australian Environmental Auditors

By email only: phitchcock@envaud.com.au

29 August 2024

Dear Mr Hitchcock,

SITE CONTAMINATION AUDIT – INTERIM AUDIT ADVICE (IAA) COMPLYING

SITE: 10-14 & 16-20 Halls Road, HIGHBURY 5089 SA (CT 5768/114, CT 5768/115)

As previously advised, the Environment Protection Authority (EPA) has received the following interim audit advice (IAA) which was prepared by you as the responsible site contamination auditor¹ (auditor) carrying out a site contamination audit (audit) for the above site:

- Site Contamination Audit (EPA Ref 61387) Summary of Interim Audit Findings 10-14 and 16-20 Halls Road, Highbury, SA - Interim Audit Advice dated 7 August 2024.

The legislative and administrative framework for the site contamination audit system in South Australia is established by the *Environment Protection Act 1993* and the *Environment Protection Regulations 2023* (the Act). Auditors are required to comply with relevant EPA guidelines when carrying out audits, in particular the EPA guideline *Site contamination: Guidelines for the site contamination audit system*.

The EPA has completed its administrative review of the IAA as part of its quality assurance program for the audit system, to ensure the IAA complies with the legislative requirements and relevant EPA guidelines.

The IAA has been determined to be generally complying with the above framework, noting that a revised version to address minor issues was requested by the EPA on 20 August 2024.

It is noted that IAA does not itself constitute a site contamination audit report² (audit report) and should be followed by preparation of a subsequent audit report in order to complete the audit process. As the auditor, you are reminded that IAA does not pre-empt or constrain the final outcome(s) of the audit or any conditions that may need to be placed in the audit report.

The EPA will now notify relevant government bodies about the outcome of its administrative review. The EPA will also provide advice to the local council recommending that the outcomes of the IAA be noted and kept on record and considered in any current or future planning and development for this site, as applicable.

¹ Section 103Z of the *Environment Protection Act 1993*

² Section 3(1) of the *Environment Protection Act 1993*

For your information, the EPA has also determined that information contained in the IAA listed above constitutes information that must be placed in the EPA Public Register under the provisions of section 109(3)(h) of the Act.

Information on the EPA Public Register is made available on the Site Contamination Index of the EPA website (www.epa.sa.gov.au). In accordance with Regulations under the *Land and Business (Sale and Conveyancing) Act 1994*, this information will also be identified by the EPA in Property Interest Reports and EPA Section 7 statements.

If you require further information or wish to discuss the above, please do not hesitate to contact Lachlan Nicholls on 8204 2096 or lachlan.nicholls@sa.gov.au.

Yours sincerely

Wendy Boyce

**PRINCIPAL ADVISER, SITE CONTAMINATION (AUDIT)
ENVIRONMENT PROTECTION AUTHORITY**

cc: Ms Belinda Monier, Future Urban, Level 1, 74 Pirie Street Adelaide, SA 5000