



NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. **081-2127799**

This site audit is a:

- ☒ **statutory audit**
☐ ~~non-statutory audit~~

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name: **Andrew Kohlrusch**

Company: **GHD Pty Ltd**

Address: **Level 15, 133 Castlereagh Street, Sydney**

Postcode: **2000**

Phone: **0447 685 055**

Email: **andrew.kohlrusch@ghd.com**

Site details

Address: **Devon Street, Rosehill on the Camellia Peninsula NSW**

Postcode: **2142**

Property description

(Attach a separate list if several properties are included in the site audit)

Stage 2 Audit Area 4 (the Stage 2 AA4) comprises the proposed Lot 64 which is part of Lot 57 in Deposited Plan 1280734 as defined by survey plans included in the Long-Term Environmental Management Plan (LTEMP). The LTEMP is attached to this SAS as required by NSW EPA.

Local government area: **City of Parramatta Council**

Area of site (include units, e.g. hectares): **2.35 hectares**

Current zoning: **E5 – Heavy Industrial**

Regulation and notification

To the best of my knowledge:

- ☒ **the site is the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*, as follows: (provide the no. if applicable)**
- ☒ **Declaration no. 20131110**
- ☒ **Order no. Preliminary Investigation Order 20121001**
- ☐ ~~Proposal no~~
- ☐ ~~Notice no~~
- ☐ ~~the site is not the subject of a declaration, order, proposal or notice under the Contaminated Land Management Act 1997 or the Environmentally Hazardous Chemicals Act 1985~~

To the best of my knowledge:

- ☒ **the site has been notified to the EPA under section 60 of the Contaminated Land Management Act 1997**
- ☐ ~~site has not been notified to the EPA under section 60 of the Contaminated Land Management Act 1997.~~

Site audit commissioned

by Name: Adam Speers

Company: **Viva Energy Australia Pty Ltd**

Address: **Level 31 (Suite 2), Governor Macquarie Tower, 1 Farrer Place, Sydney NSW**

Postcode: **2000**

Phone: **0400 214 857**

Email: **adam.speers@vivaenergy.com.au**

Contact details for contact person (if different from above)

Name

Phone

Email

Nature of statutory requirements (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land Management Act 1997*
(e.g. management order; please specify, including date of issue)

☐ Requirements imposed by an environmental planning instrument
(please specify, including date of issue)

☒ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)

- **Development Consent (SSD 9302) dated 7 May 2020, Consent Authority - Minister for Planning and Public Spaces – in relation to remediation of the site.**

- **Development Consent (SSD 10459) dated 31 January 2021, Consent Authority - Minister for Planning and Public Spaces – in relation to subdivision of Lot 100 DP 1168951.**

☐ Requirements under other legislation (please specify, including date of issue)

Purpose of site audit

☐ ~~A1 To determine land use suitability~~

~~Intended uses of the land:~~

OR

☒ A2 To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land are **commercial/industrial as per the site's zoning E5 – Heavy Industrial under the Parramatta Council LEP 2023.**

OR

(Tick all that apply)

☐ ~~B1 To determine the nature and extent of contamination~~

☐ ~~B2 To determine the appropriateness of:~~

☐ ~~an investigation plan~~

☐ ~~a remediation plan~~

☐ ~~management plan~~

☐ ~~B3 To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*~~

☐ ~~B4 To determine the compliance with an approved:~~

☐ ~~voluntary **management proposal** or~~

☐ ~~management **order** under the *Contaminated Land Management Act 1997*~~

☐ ~~B5 To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.~~

~~Intended uses of the land:~~

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation: – Environmental Resources Management Australia Pty Ltd ('ERM').

Titles of reports reviewed:

- ERM (2024a). Clyde Western Area Remediation Project, Quarter 4 (2023) Stage 2 Groundwater Monitoring Project, 14 March 2024 (the Quarter 4 2023 GMP).
- ERM (2024b). Clyde Western Area Remediation Project, Stage 2 Validation Report (Audit Area 4), 13 June 2024 (**the Stage 2 AA4 Validation**).
- ERM (2024c). Clyde Western Area Remediation Project Proposed Lot 64– Long Term Environmental Management Plan, 12 June 2024 (the **Stage 2 AA4 LTEMP**).
- ERM (2023a). Clyde Western Area Remediation Project – Proposed Lot 64 – Baseline Ground Gas Monitoring Events, 14 July 2023 (the Bulk Ground Gases Assessment).

- ERM (2023b). Clyde Western Area Remediation Project Proposed Lot 64 – AEC-4, Capping Construction Technical Specification, Rev04, 22 August 2023 (the Capping Technical Specification).
- ERM (2021b). Supplementary Environmental Site Assessment – Southern Buried Waste Area (AEC-4), 7 June 2021 (the AEC-4 Supplementary Assessment)
- ERM (2021e). Clyde Western Area Remediation Project - Remediation Options Analysis – “AEC – 4”, 7 June 2021 (the AEC-4 ROA).
- ERM (2021d). Clyde Western Area Remediation Project, Stage 2 - Detailed Remediation Action Plan, 9 June 2021 (the Stage 2 RAP).

Other information reviewed, including previous site audit reports and statements relating to the site:

- GHD (2021). Site Audit Report - Western Area Remediation Project - Remedial Action Plan (Stage 2 Area), Ref no. 065-2127799, 13 August 2021.
- ERM (2018). Clyde Terminal Durham Street Rosehill NSW, PFAS Conceptual Site Model and Model and Flux Assessment, 20 December 2018.
- AECOM (2019). Viva Energy Clyde Western Area Remediation Project – Appendix C: Conceptual Remedial Action Plan, 21 January 2019.
- ERM (2020a). Clyde Western Area Remediation Project - Remediation Site Investigation, 7 February 2020.
- ERM (2020b). Clyde Western Area Remediation Project, Human Health and Ecological Risk Assessment, 16 February 2020.
- ERM (2020c). Clyde Western Area Remediation Project – Remedial Options Assessment, Rev2, 7 April 2020.
- ERM (2021c). Clyde Western Area Remediation Project – Stage 2 Environmental Site Assessment, 17 June 2021.
- ERM (2021d). Clyde Western Area Remediation Project, Stage 2 - Detailed Remediation Action Plan, 9 June 2021.
- ERM (2021e) Clyde Western Area Remediation Project – Groundwater Monitoring Program – Stage 2, Final, July 2021.

Site audit report details

Title Clyde Western Area Remediation Project - Stage 2 Audit Area 4, Site Audit Report No. 081-2127799

Report no. SAR 081-2127799

Date 14 June 2024

Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section.
(Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
 - o (B1) the nature and extent of contamination, and/or
 - o (B2) the appropriateness of an investigation, remediation or management plan¹, and/or
 - o (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
 - o (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
 - o (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

¹ For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

~~I certify that, in my opinion:~~

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
 - ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
 - ☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
 - ☐ ~~Day care centre, preschool, primary school~~
 - ☐ ~~Residential with minimal opportunity for soil access, including units~~
 - ☐ ~~Secondary school~~
 - ☐ ~~Park, recreational open space, playing field~~
 - ☐ ~~Commercial/industrial~~
 - ☐ ~~Other (please specify):~~
-

OR

- ☐ ~~I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.~~

Overall comments:

Section A2

I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan² (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ ~~Residential, including substantial vegetable garden and poultry~~
- ☐ ~~Residential, including substantial vegetable garden, excluding poultry~~
- ☐ ~~Residential with accessible soil, including garden (minimal home grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~
- ☐ ~~Day care centre, preschool, primary school~~
- ☐ ~~Residential with minimal opportunity for soil access, including units~~
- ☐ ~~Secondary school~~
- ☐ ~~Park, recreational open space, playing field~~
- ☒ **Commercial/industrial** - as per the uses permitted under the site zoning E5
- ☐ ~~Other (please specify):~~

EMP details

Title *Clyde Western Area Remediation Project - Proposed Lot 64 – Long Term Environmental Management Plan, Reference 0561882, Revision 3*

Author ERM

Date 12 June 2024

No. of pages 141

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

- ☐ ~~requires operation and/or maintenance of **active** control systems³~~
- ☒ requires maintenance of **passive** control systems only³.

² Refer to Part IV for an explanation of an environmental management plan.

³ Refer to Part IV for definitions of active and passive control systems.

Purpose of the EMP:

The purposes of the EMP prepared by ERM for the Proposed Lot 64 (also referred to as Stage 2 Audit Area 4 – AA4) were to:

- Summarise the nature and extent of residual contamination within the proposed Lot 64 following remedial works – which incorporated construction of a cap over the buried waste.
- Specify methodologies and protocols to prevent and/or mitigate human health and environment exposure associated with residual contamination in soil and groundwater.
- Provide approaches for appropriate environmental management of future construction activities should the underlying contaminated soil or groundwater be encountered, including specifications for reinstating the capping layer (if required).
- Detail ongoing monitoring requirements.
- Outline considerations for future use of the site.
- Outline protocols for management of unexpected findings.

Description of the nature of the residual contamination:

- The residual contamination (soil and groundwater) is contained within the capped area and is not accessible to future commercial and/or industrial receptors under regular site operations.
- Beneath the cap are soils and groundwater impacted by asbestos (friable and bonded), PAH, chromium VI, petroleum hydrocarbon chain fractions and LNAPL/sludge within soils and groundwater (very low to non-mobile).

Summary of the actions required by the EMP:

- Although the groundwater contamination has been shown to be stable and immobile, ongoing monitoring of groundwater conditions is required to confirm that contamination is not migrating off-site. Following remediation, it is proposed that monitoring will occur biannually following completion of a post remediation sampling event. The requirement for ongoing sampling is to be reviewed annually based on trend analysis and reported concentrations, as detailed in the GWMP.
- Intrusive excavation works that could potentially affect the capping layer – Implementation of environmental management controls as detailed in the AA4 LTEMP for works including intrusive operations, excavation of fill and natural soil materials to facilitate removal, realignment or construction of any subsurface infrastructure near the boundary of the capping layer; maintenance and / or upgrade of site utility services; temporary stockpiling of excavated material resulting from on-site intrusive works; and off-site disposal of any contaminated soil / groundwater .

How the EMP can reasonably be made to be legally enforceable:

Legal enforceability is implemented via condition B10(a) and (b) of the Development Consent number SSD 9302 which state:

- *B10. Upon completion of the Site Audit Statement and Site Audit Report, the Applicant must: (a) Implement the approved LTEMP (b) Provide evidence to the Planning Secretary that the LTEMP is listed on the relevant planning certificate for the land, issued under section 10.7 of the EP&A Act.*

How there will be appropriate public notification:

Notification of the Stage 2 AA4 LTEMP will be placed on the Section 10.7(5) planning certificate issued under the *Environmental Planning and Assessment Act 1979*. Parramatta Council were contacted in this regard during the audit and confirmed that this action will be implemented. A copy of this communication was included in the SAR no. 081-2127799.

Overall comments:

The auditor considered that the Stage 2 AA4 LTEMP was prepared in a manner consistent with the relevant NSW EPA Consultant Guidelines (NSW EPA, 2020).

The auditor noted that the Stage 2 AA4 LTEMP appropriately identified the residual contamination and provided an adequate description of the objectives, scope of works, and the roles and responsibilities of the parties involved in its implementation and management. Contingency actions were outlined in Table 7-1 of the Stage 2 AA4 LTEMP.

The auditor concurred that the management and mitigation measures associated with the residual impacted soils are passive and can be readily managed based on the proposed future commercial/industrial land use scenario.

The auditor notes that the design of future buildings to include appropriate management controls and measures assessed consistent with the Hazardous Ground Gas Guidelines. At this stage no enclosed buildings exist or are proposed within Proposed Lot 64. However, should any future buildings be proposed, the design must include appropriate management controls and measures assessed consistent with the *Hazardous Ground Gas Guidelines*.

The auditor noted that groundwater and hazardous ground gases should be monitored as per the LTEMP.

The issue of this SAS (SAS no. 081-2127799) closed out the remediation within the Stage 2 area.

Section B

Purpose of the plan⁴ which is the subject of this audit:

I certify that, in my opinion:

(B1)

- ☐ The nature and extent of the contamination **has** been appropriately determined
- ☐ The nature and extent of the contamination **has not** been appropriately determined

AND/OR (B2)

- ☐ The investigation, remediation or management plan **is** appropriate for the purpose stated above
- ☐ The investigation, remediation or management plan **is not** appropriate for the purpose stated above

AND/OR (B3)

- ☐ The site testing plan:
 - ☐ **is** appropriate to determine
 - ☐ **is not** appropriate to determineif groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

AND/OR (B4)

- ☐ The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):
 - ☐ have been complied with
 - ☐ have not been complied with.

*voluntary management proposal no. _____

**management order no. _____

AND/OR (B5)

- ☐ The site **can be made suitable** for the following uses:
 - ☐ (Tick all appropriate uses and strike out those not applicable.)
 - ☐ Residential, including substantial vegetable garden and poultry
 - ☐ Residential, including substantial vegetable garden, excluding poultry
 - ☐ Residential with accessible soil, including garden (minimal home grown produce contributing less than 10% fruit and vegetable intake), excluding poultry
 - ☐ Day care centre, preschool, primary school
 - ☐ Residential with minimal opportunity for soil access, including units

⁴ For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Site Audit Statement

- ☐ ~~Secondary school~~
 - ☐ ~~Park, recreational open space, playing field~~
 - ☐ ~~Commercial/industrial~~
 - ☐ ~~Other (please specify):~~
-

~~IF the site is remediated/managed*~~ in accordance with the following plan (attached):

~~*Strike out as appropriate~~

~~Plan title~~

~~Plan author RM~~

~~Plan date~~

~~No. of pages~~

~~SUBJECT to compliance with the following condition(s):~~

~~Overall comments:~~

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997*.

Accreditation no. 0403

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997*, and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed 

Date 14 June 2024

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of the *Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**:
nswauditors@epa.nsw.gov.au or as specified by the EPA
- AND
- the **local council** for the land which is the subject of the audit.

Copy of Stage 2 AA4

PREPARED FOR



Clyde Western Area Remediation Project

Proposed Lot 64 – Long Term
Environmental Management Plan

Viva Energy Australia Pty Ltd

DATE
12 June 2024

REFERENCE
0561882



DOCUMENT DETAILS

DOCUMENT TITLE	Clyde Western Area Remediation Project
DOCUMENT SUBTITLE	Proposed Lot 64 – Long Term Environmental Management Plan
PROJECT NUMBER	0561882
Date	12 June 2024
Version	Final
Author	Theresa Nguyen
Client name	Viva Energy Australia Pty Ltd

DOCUMENT HISTORY

				ERM APPROVAL TO ISSUE		
VERSION	REVISION	AUTHOR	REVIEWED BY	NAME	DATE	COMMENTS
Draft	0	Theresa Nguyen	Stephen Mulligan / Peter Lavelle	Peter Lavelle	21/03/2024	Preliminary Draft for Viva Energy Review
Final	1	Theresa Nguyen	Stephen Mulligan / Peter Lavelle	Peter Lavelle	12/04/2024	Final - incorporation of Site Auditor's comments
Final	2	Theresa Nguyen	Stephen Mulligan / Peter Lavelle	Peter Lavelle	26/04/2024	Final - incorporation of Site Auditor's comments
Final	3	Theresa Nguyen	Stephen Mulligan / Peter Lavelle	Peter Lavelle	7/05/2024	
Final	4	Theresa Nguyen	Peter Lavelle	Peter Lavelle	12/06/2024	

SIGNATURE PAGE

Clyde Western Area Remediation Project

Proposed Lot 64 – Long Term Environmental Management Plan

0561882



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GLOSSARY

Glossary Terms	Definition
AEC-4	The Southern Buried Waste Area which is located within proposed Lot 64 of the 'Stage 2' portion of the Clyde Western Area Remediation Project (WARP).
the Site	Land located on the Camellia Peninsula, owned by VE Property Pty Ltd. The Site is currently identified as part Lot 57 DP 1280734.
the Western Area	A largely vacant area of land, approximately 25 ha in size, located in the south western part of the Site. The land previously contained a variety of refinery assets that have now been removed.
the Project	The proposal to remediate the contaminated soils in the Western Area to a commercial/industrial standard
the Stage 2 Area	An area situated within the eastern portion of the former Process West area adjoining the current Clyde Terminal. The Stage 2 Area extends from Devon Street in the North to the Duck River at the southern boundary of the Western Area. The LTEMP applies to part of the Stage 2 Area.
Proposed Lot 64	Part of Lot 57 DP 1280734, located within the southern portion of the Stage 2 Area, as Approved under SSD 10459. Proposed Lot 64 is shown on <i>Figure 1</i> , <i>Appendix A</i> and in the Site Survey (<i>Appendix B</i>). The area of proposed Lot 64 totals 23,500 m ² and includes the capped extent.
the Land Custodian	The legal owner(s) of the site identified as proposed Lot 64 of the Stage 2 Area, from time to time.

Glossary Terms	Definition
Site Operator	The entity in occupation of (or portions of) Proposed Lot 64 who is responsible for day-to-day operations. This will include any contractors carrying out works on the site and tenants of Proposed Lot 64 from time to time.
Suitably Qualified Environmental Specialist	An environmental specialist deemed to be suitably qualified per the New South Wales Environment Protection Authority's <i>Contaminated Land Consultant Certification Policy</i> (NSW EPA, 2022).

EXECUTIVE SUMMARY

Introduction

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Viva Energy Australia Pty Ltd (Viva Energy) to prepare this Long-Term Environmental Management Plan (LTEMP) to outline required environmental management procedures and controls for the ongoing use of part of Proposed Lot 64 within the 'Stage 2' portion of the Clyde Western Area Remediation Project (WARP) was approved under SSD9302. The portion of proposed Lot 64 that is subject to the ongoing environmental management requirements contained in this LTEMP are referred to as 'Proposed Lot 64'. Proposed Lot 64 is shown on *Figure 1, Appendix A*.

Background Information

Ongoing management of residual contamination is required within the constructed capped area, as well as areas outside of the cap within Proposed Lot 64 upon completion of remediation and validation works, in accordance with the LTEMP. The Layout of Lot 64 is shown within *Figure 1, Appendix A*.

The LTEMP applies to works within Proposed Lot 64, including but not limited to maintenance, operational use of Proposed Lot 64, construction, and any other work that may have the potential to penetrate the liner of the capped area. Additionally, the LTEMP outlines monitoring works that are to be undertaken following remediation, including post works verification monitoring of capping surface integrity, ground gases, and groundwater.

The controls outlined within this plan are intended as passive mitigation measures to manage potential risks to human health. ERM considers Proposed Lot 64 will be suitable for use under a commercial / industrial land use scenario, given that appropriate controls are implemented to manage potential gas/ vapour accumulation in enclosed air spaces of future buildings.

Application of this LTEMP

This LTEMP documents the nature and extent of residual contamination on-site and outlines the mechanisms required for managing potential residual risks into the future. This LTEMP also outlines the monitoring requirements of the capping layer integrity and groundwater conditions. The monitoring requirements of this LTEMP must be complied with at all times, including throughout routine maintenance and/or construction works.

Residual Contamination Following Remediation Works

Residual contamination is considered to be contained within the capped area and is not accessible to future receptors under regular Site operations.

The capped area within Lot 64 is in place to control risks of the following exposure pathways to residual contamination:

- Hydrocarbon and chromium impacted soils that present a potential risk to commercial workers and constructions workers directly contacting soils, as shown on *Figure 2, Appendix A*.
- Hydrocarbon impacted soils beneath the capping layer that present a potential risk to commercial receptors via vapour intrusion, as shown on *Figure 2, Appendix A*.

- Friable asbestos and bonded asbestos containing materials in subsurface soils at several locations throughout the Management Area, as shown on *Figure 2, Appendix A*.
- LNAPL in groundwater, as shown on *Figure 3, Appendix A*.

A description of the residual contamination and the associated risks is presented within Sections 4 and 5.

Required Environmental Management Controls

Adherence to this LTEMP is required to ensure the suitability for commercial/industrial land uses within the Site and Proposed Lot 64. Design of future buildings to include appropriate management controls and measures assessed consistent with the Hazardous Ground Gas Guidelines. At this stage no enclosed buildings exist or are proposed within Proposed Lot 64. However, should any future buildings be proposed, the design must include appropriate management controls and measures assessed consistent with the *Hazardous Ground Gas Guidelines*¹.

Based on the nature and extent of residual contamination identified within the Management Area, the following controls are required under various operational scenarios:

- Where intrusive excavation works are proposed – the environmental management controls detailed in *Sections 6* of this LTEMP must be implemented.
- Where works involve no intrusive excavation (i.e. normal site operations) – management controls are applicable following completion of remediation and validation of Proposed Lot 64.
- As per Development Consent SSD9302, the conditions B22 (d) to B22 (g) outline requirements for ongoing passive management and mitigation of groundwater risks, including monitoring of natural attenuation, trigger levels for investigation of adverse impacts to Duck River, contingency actions and monitoring of effectiveness of management measures. These requirements are addressed within *Section 6* of this LTEMP, and the Stage 2 Groundwater Monitoring Program (GWMP) prepared by ERM in 2021.

¹ NSW EPA (2020) *Assessment and Management of Hazardous Ground Gases*. May 2020.

1. INTRODUCTION AND BACKGROUND

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Viva Energy Australia Pty Ltd (Viva Energy) to prepare this Long-Term Environmental Management Plan (LTEMP) for a portion of the Clyde Western Area, referred to as 'Proposed Lot 64' to outline required environmental management procedures and controls for future Site Operators that may have control of Proposed Lot 64.

The portion of Proposed Lot 64 subject to this LTEMP formed part of 'Stage 2' of the Clyde Western Area Remediation Project (WARP) and is referred to as 'Proposed Lot 64' in this LTEMP.

The extent of Proposed Lot 64 subject to this LTEMP is shown on Figure 1, Appendix A. This extent is defined by the boundaries of those parts of Lot 57 DP 1280734 forming Proposed Lot 64, as authorised for subdivision under State Significant Development Consent 10459.

This LTEMP must be implemented following completion of remediation and validation works.

Prior to the commencement of any operational, maintenance or construction works, all site personnel / contractors are to be inducted into the requirements of this LTEMP.

1.1 BACKGROUND AND SITE IDENTIFICATION

The Western Area is an approximately 25 hectare (ha) parcel of land currently owned by VE Property Pty Ltd within the footprint of the wider Clyde Terminal Site and is bordered to the south by the Duck River, to the east by current Clyde Terminal Operations and to the north and west by other Industrial zoned properties. Proposed Lot 64 is situated within the Western Area, as presented in *Figure 1, Appendix A*. Proposed Lot 64 was historically a portion of vacant land and a security road located within the Site.

Specific site identification details are summarised in *Table 1-1*, below.

TABLE 1-1 – SITE IDENTIFICATION

Item	Description
Site Owner	VE Property Pty Ltd
Site Occupier	VE Property Pty Ltd
Site Address	13 Devon Street, Rosehill NSW
Coordinates	33°49'57.85"S, 151° 1'54.98"E
Current Legal Description	Part Lot 57 DP 1280734 (Referred to in this LTEMP as Proposed Lot 64).
Local Government Authority	City of Parramatta Council
Current Zoning	E5 – Heavy Industrial under the Parramatta Council Local Environmental Plan 2011
Current Land Uses	Vacant site

Item	Description
Future Proposed Land Use	- Commercial / Industrial. - Upon completion of remediation and validation works, the Site is suitable for commercial / industrial land uses with no enclosed above ground infrastructure for occupation, basement structures or beneficial re-use of groundwater.
Permissible Land Use(s) 1	Noting the post-remediation restrictions on enclosed above ground infrastructure for occupation, basement structures and beneficial re-use of groundwater, permissible uses under the site zoning (with consent) includes: Agricultural produce industries; Building identification signs; Business identification signs; Depots; Freight transport facilities; General industries; Hardware and building supplies; Hazardous storage establishments; Heavy industries; Horticulture; Kiosks; Medical centres; Offensive storage establishments; Pubs; Roads; Rural supplies; Sawmill or log processing works; Take away food and drink premises; Timber yards; Warehouse or distribution centres; Water storage facilities.
Area ²	The area of the Proposed Lot 64 totals 23,500 m ² , as per subdivision survey plans provided as Attachment B.
Elevation	Between approximately 3 to 6 metres relative to Australian Height Datum (m AHD)

Source:

1. City of Parramatta Council Local Environmental Plan (2011).

2. Plan of Proposed Subdivision of Lot 100 DP1168951, (Landpartners Pty Ltd). Sheet 4 of 44.

1.2 PURPOSE OF THE LTEMP

The specific objectives of this LTEMP are to:

- summarise background environmental information, known and likely conditions within Proposed Lot 64, to inform the Land Custodian, workers and managers of the potential risks to human health and / or the environment arising from contact with residual contamination;
- outline methods and procedures to avoid and / or mitigate potential adverse effects on human health and / or the environment associated with the residual contaminated soil and groundwater;
- provide a recommended methodology for the appropriate environmental management of construction works that may encounter residual contaminated soil and groundwater;
- provide detail on the re-instatement of the capping layer following damage or intrusion;
- detail the ongoing monitoring requirements of the capping layer;
- detail ongoing groundwater monitoring requirements;
- detail ongoing management requirements to perform inspection and monitoring of the remediated Management Area;
- provide environmental requirements for the sourcing and placement of backfill material;
- discuss safety measures / considerations for dealing with potentially contaminated soil and groundwater; and
- outline restrictions to potential future land uses under current zoning as detailed within Table 1-1.

All work related to excavation, movement, handling, importation and placement of fill and soil materials and / or groundwater within the Site, and Proposed Lot 64 should be carried out in accordance with this LTEMP and in compliance with relevant legislation detailed within Section 2.

This LTEMP is considered to represent an active management approach, involving ongoing monitoring of groundwater conditions and integrity of the capping layer reducing access and surface water infiltration to below ground contamination.

1.3 LIMITATIONS TO THIS LTEMP

This LTEMP is land-use specific and applies to commercial / industrial uses, excluding enclosed above ground infrastructure for occupation, or underground basement structures, such as underground car parks.

Groundwater is not to be extracted for use within Proposed Lot 64 and future beneficial re-uses of groundwater have not been considered as part of this LTEMP. Additionally, consideration must be made of any activities or change in use for Proposed Lot 64 which is likely to significantly alter groundwater infiltration and / or groundwater flow direction. If activities which may affect groundwater conditions or extractive use of groundwater is proposed, further assessment of the suitability of groundwater must be completed by a Suitably Qualified Environmental Specialist with the findings reviewed and endorsed by a New South Wales Environment Protection Authority (NSW EPA) accredited Site Auditor. Other limitations are outlined in *Section 1.3* of this document.

If, in the future, any land uses differ from the commercial / industrial use described above (including above ground / basement infrastructure) reflected in ERM (2020) Human Health and Ecological Risk Assessment (HHERA), this LTEMP will need to be reviewed and updated in accordance with the procedures contained in *Section 2.4*.

1.4 DOCUMENTS RELEVANT TO THE APPLICATION OF THIS LTEMP

The *Clyde Western Area Remediation Project – Proposed Lot 64-AEC-4 Capping Construction Technical Specification*, dated 12 March 2024 (ERM, 2024) is considered to be relevant to the application of this LTEMP. It is the responsibility of the Site Operator to manage Proposed Lot 64, and the capped area in compliance with this document.

2. STATUTORY REQUIREMENTS

2.1 LEGAL ENFORCEABILITY AND PUBLIC NOTIFICATION OF THIS EMP

Condition B10 of State significant development consent 9302 granted under the Environmental Planning and Assessment Act 1979 (the 'EP&A Act') provides as follows:

B10. Upon completion of the Site Audit Statement and Site Audit Report, the Applicant must:

(a) Implement the approved LTEMP

(b) Provide evidence to the Planning Secretary that the LTEMP is listed on the relevant planning certificate for the land, issued under section 10.7 of the EP&A Act

In addition, condition A9 of State significant development consent 10459 provides as follows:

A9. The Applicant must implement the Long Term Environmental Management Plan (LTEMP) approved under condition B8 of SSD 9302 and provide evidence to the Planning Secretary that the LTEMP is listed on the relevant planning certificate(s) issued under section 10.7 of the EP&A Act for each lot created by Stages 1A and B, 2 and 3 as shown in the 'Subdivision Drawings prepared by Land Partners' in Appendix 1

Accordingly:

- This LTEMP was prepared in accordance with development consent SSD 9302. It is also enforceable under development consent SSD 10459, granted under the EP&A Act.
- As per conditions B10(b) and A9 and relevant NSW EPA requirements, Parramatta Council will be provided with a copy of this LTEMP and requested to add a notation on the planning certificates issued for Proposed Lot 64 under section 10.7 of the EP&A Act confirming that they are subject to this LTEMP.

No other planning controls are required for future development that may interact with remaining contamination at depth.

2.2 LICENCE AND APPROVAL REQUIREMENTS

The Site Operator is responsible for controlling works within Proposed Lot 64. Under the LTEMP, intrusive works including excavation works which penetrate beneath the depth of the 'marker geotextile' layer is generally prohibited to protect the underlying LLDPE liner. Should intrusive works be required within Proposed Lot 64, the contingency actions associated with reinstatement of the cap outlined in Section 7 of this LTEMP will apply.

2.3 REGULATORY FRAMEWORK

All operational personnel carrying out any intrusive works or monitoring works in Proposed Lot 64 must comply with the applicable environmental regulatory requirements in NSW.

2.4 DOCUMENT REVISION

This LTEMP may be reviewed and updated as necessary from time to time. Therefore, it is the responsibility of the reader of this document to ensure they have the current version of the LTEMP.

Any updates to this LTEMP must be reviewed and endorsed by a NSW EPA Accredited Site Auditor.

The master document, with the up-to-date version of the LTEMP will be available from the Land Custodian.

The current version of this LTEMP is detailed within the Table 2-1 below. Any subsequent revisions of this LTEMP must include a clear date / revision identifier to enable the most recent to be readily identified.

TABLE 2-1 – LTEMP REVISION

Document Name	Document Revision Number	Date
Clyde Western Area Remediation Project: Proposed Lot 64 – Long Term Environmental Management Plan	Draft – Revision 0	12/4/2024

3. APPLICATION AND RESPONSIBILITIES

Adherence to this LTEMP is required to ensure the suitability for commercial/industrial land uses within the Site and Proposed Lot 64. Design of future buildings to include appropriate management controls and measures assessed consistent with the Hazardous Ground Gas Guidelines. At this stage no enclosed buildings exist or are proposed within Proposed Lot 64. However, should any future buildings be proposed, the design must include appropriate management controls and measures assessed consistent with the *Hazardous Ground Gas Guidelines*².

Based on the nature and extent of residual contamination identified within the Management Area, the following controls are required under various operational scenarios:

- Where intrusive excavation works are proposed – the environmental management controls detailed in *Sections 6* of this LTEMP must be implemented.
- Where works involve no intrusive excavation (i.e. normal site operations) – management controls are applicable following completion of remediation and validation of Proposed Lot 64.
- As per Development Consent SSD9302, the conditions B22 (d) to B22 (g) outline requirements for ongoing passive management and mitigation of groundwater risks, including monitoring of natural attenuation, trigger levels for investigation of adverse impacts to Duck River, contingency actions and monitoring of effectiveness of management measures. These requirements are addressed within *Section 6* of this LTEMP, and the Stage 2 Groundwater Monitoring Program (GWMP) prepared by ERM in 2021.

3.1 IMPLEMENTATION OF THIS LTEMP

No works involving any intrusive excavations are to be undertaken within Proposed Lot 64 until all relevant personnel / contractors have been inducted into the requirements of this LTEMP.

The LTEMP should be acknowledged in relevant management plans prepared for any intrusive investigations. For smaller intrusive works this is likely to take the form of a safe work method statement while a Construction Environmental Management Plan (CEMP) may be required for more significant development and construction activities.

3.2 AREA TO WHICH THIS LTEMP APPLIES

This LTEMP applies to the entire Management Area.

Specific mitigation measures if excavation works are required to be undertaken apply to the extent of Capped Area and areas outside of the cap extent, as shown on on Figure 2, Appendix A, which are described within Section 4 of this LTEMP.

² NSW EPA (2020) *Assessment and Management of Hazardous Ground Gases*. May 2020.

3.3 APPLICATION OF LTEMP

Under regular operational conditions, the controls in this LTEMP that are applicable include the ongoing periodic monitoring requirements of the capping layer integrity and groundwater conditions.

Further controls are required immediately upon the initiation of any works that involve construction or maintenance that may have the potential to affect the capping layer. This includes the following activities within Proposed Lot 64:

- intrusive works which may alter the integrity of the capping layer;
- excavation of fill and natural soil materials to facilitate removal, realignment or construction of any subsurface infrastructure near the boundary of the capping layer;
- maintenance and / or upgrade of utility services;
- temporary stockpiling of excavated material resulting from on-site intrusive works; and
- off-site disposal of any waste contaminated soil / groundwater (if required).

Due to the historical land uses within Proposed Lot 64 (i.e. former refinery), all intrusive excavation works must be undertaken in consideration of potential unexpected finds of contamination. Where unexpected finds are encountered during works, they are to be managed in accordance with the requirements outlined within Section 6.1 of this LTEMP.

Where future beneficial use of groundwater, or future activities which may influence groundwater infiltration rates and / or flow direction is proposed, an assessment of suitability must be undertaken by a suitably qualified environmental professional. The assessment and any recommendations for re-use must be reviewed and endorsed by a NSW EPA accredited Site Auditor.

3.4 ROLES AND RESPONSIBILITIES

The following Table 3-1 summarises the requirements to be implemented within Proposed Lot 64.

TABLE 3-1 – LTEMP ROLES AND RESPONSIBILITIES

Position / Company	Responsibility
The Land Custodian and Site Auditor	Approve the LTEMP
The Land Custodian	- Ensure all workers and contractors conducting intrusive works are aware of the requirements of this LTEMP. - Maintain records of all works undertaken within the Management Area as required within this LTEMP.
Site Operator (including Contractors and Subcontractors)	- Implement the LTEMP. - Provide adequate training in this LTEMP for all employees and contractors during site induction, and as required on an ongoing basis during the works. - Require any contractors conducting intrusive works to comply with this LTEMP. - Conduct monitoring as required in the LTEMP. - Complete all necessary registers, databases and records required in the LTEMP. - Assess any potentially contaminating unexpected finds in consideration of the use of Proposed Lot 64. - Undertake inspections and monitoring of operations within Proposed Lot 64 to ensure they are carried out in an environmentally responsible manner and meet the requirements of this LTEMP. - Notify the Land Custodian / nominated representative of any environmental issues arising. - Assess the requirement and (where necessary) engage a Suitably Qualified Environmental Specialist to undertake additional monitoring of unexpected finds. - Engage a Suitably Qualified Environmental Specialist to undertake the required ongoing monitoring requirements, including capping layer integrity inspections and groundwater conditions assessments.
Qualified Environmental Specialist	Where required, a Suitably Qualified Environmental Specialist is to be engaged to manage, monitor and evaluate environmental controls, demonstrate compliance with this LTEMP and assess specific requirements associated with works within areas of known residual contamination and / or unexpected finds.

4. RESIDUAL CONTAMINATION SUMMARY

4.1 SITE GEOLOGY AND HYDROGEOLOGY

A detailed assessment of geology and hydrogeology at the Site which is relevant to Proposed Lot 64 is provided within the Lot 64 Validation Report (ERM, 2024). A summary of the geology of Proposed Lot 64 during historical investigations is detailed below:

- Heterogeneous fill materials were identified to a depth of 4.0 m Below Ground Level (BGL). ERM notes that previous test pitting was terminated within fill materials in AEC-4 and as such the potential for deeper fill was noted to exist.
- The fill material is described as an uncompacted mixture of silt, clay and gravel, with localised areas of slag, furnace ash, black sludge, concrete, bricks, timber, metal pipes, tiles and glass.
- LNAPL and “sludge materials” were identified at variable depths and locations throughout the fill materials.
- Field observations (and subsequent laboratory analysis) identified Asbestos Containing Material (ACM) and fibrous asbestos at a number of locations. Based on the nature and extent of fill within AEC-4, it was considered asbestos may be widely distributed throughout the fill matrix.

The majority of residual hydrocarbon contamination requiring management has been encountered within coarser grained fill materials and/or sandy lenses within residual clay and may appear as visibly stained dark brown, grey or black.

Groundwater is present within fill and anthropogenic structures, such as backfill around drainage features at depths between approximately 0.2 – 5 m BGL and generally flows towards the Duck River in the south to south-east; however, has been observed to flow to the south-west in the western portion due to localised groundwater mounding following rainfall events.

4.2 RESIDUAL CONTAMINATION REQUIRING MANAGEMENT

Remediation works involving installation of a capping layer have been completed within Proposed Lot 64. The capping layer eliminates exposure pathways through physical separation between contaminants and on-site commercial/industrial and off-site ecological receptors.

Asbestos impacted soils are managed *in-situ* within the former security access road portion of Proposed Lot 64 which extends along the southern and south-eastern portions of the Management Area (as shown on *Figure 1, Appendix A*). The area forms part of a Riparian Corridor which cannot be disturbed to preserve established vegetation. It is therefore considered that risk to on-site commercial industrial receptors is limited due to lack of access. The location of *in-situ* asbestos impacted materials is presented in *Figure 2, Appendix A*. A summary of residual contamination both within, and outside of the capped area is provided in *Table 4-1*.

TABLE 4-1 – TYPES OF RESIDUAL CONTAMINATION PRESENT

Known Residual Contamination	Description
Soil	
Asbestos	- Bonded ACM and friable asbestos in soils have been identified in several locations (see <i>Figure 2, Appendix A</i> and detailed in <i>Appendix D</i>). - Exceedances of NEPM HSL-D (Asbestos) remain present in the riparian corridors, historically identified in two locations which are not within the footprint of the ACC (TP19/21 and TP19/68)³. - Given the long history of industrial land use and surrounding industries, the possibility of discovering further asbestos impacted soils in the subsurface on-site cannot be discounted. - If asbestos is identified during intrusive works, any finds should be investigated as per the unexpected finds methodology detailed within <i>Section 6.1</i> and appropriate health & safety and waste management measures implemented.
Benzene	- Contaminated soil exceeding commercial vapour intrusion criteria are present in three locations (see <i>Figure 2, Appendix A</i>). - These exceedances are not considered to pose a risk to human health or ecological receptors based on the risk profile of future site uses, which are proposed to be limited to open air storage/ car parking by this LTEMP. - Furthermore, no mechanism for ground gas migration into any future indoor spaces or subsurface structures nearby to proposed Lot 64.
Carcinogenic Polycyclic Aromatic Hydrocarbons (PAH) – benzo(a)pyrene Toxic Equivalent Quotient (TEQ)	- Contaminated soil exceeding direct contact criteria for commercial workers are present one location (see <i>Figure 2, Appendix A</i>). - This exceedances is not considered to pose a risk to human health or ecological receptors based on the risk profile of future site uses, which are proposed to be limited to open air storage/ car parking by this LTEMP. - Furthermore, no mechanism for ground gas migration into any future indoor spaces or subsurface structures nearby to proposed Lot 64.
Hexavalent chromium	Contaminated soil exceeding direct contact criteria for construction workers and commercial vapour intrusion criteria are present in several locations (see <i>Figure 2, Appendix A</i>).
Light Non-Aqueous Phase Liquids (LNAPL)	- Contaminated soil exceeding direct contact criteria for commercial workers and commercial vapour intrusion criteria are present in several locations (see <i>Figure 2, Appendix A</i>). - Residual Light Non-Aqueous Phase Liquids (LNAPL) or soil contamination exceeding 'TRH Management Limits' are present in several locations (see <i>Figure 2, Appendix A</i>).
Groundwater	
Benzene	- Contaminated groundwater exceeding off-site recreational (human health) criteria is present within on-site areas during historical investigations. - Concentrations of benzene detected in November 2023 at MW20-3 was noted to be below the adopted recreational criterion (10 ug/L), therefore these impacts have been demonstrated to be stable and immobile through previous environmental assessments. - Groundwater monitoring requirements with contingencies are outlined in the GWMP.

³ ERM (2021), *Clyde Western Area Remediation Project, Stage 2 – Detailed Remediation Action Plan*, Final, Revision 2, Dated 08 July 2021.

Known Residual Contamination	Description
LNAPL	- Historical investigations have identified LNAPL groundwater present in several locations (see <i>Figure 3, Appendix A</i>). - Groundwater monitoring of nearby wells have demonstrated no down gradient migration of LNAPL from these isolated areas. Associated dissolved phase concentrations are limited in extent and are delineated to within the Stage 2 boundary of the WARP². - LNAPL was identified at MW12/01, MW20/06 and MW20/07 during the Q4 2023 GME, as presented in <i>Figure 5, Appendix A</i>. An updated LNAPL CSM developed for the Stage 2 WARP area identifies that there is a low potential for residual LNAPL to act as an ongoing source of impact to groundwater⁴. - Current and historical monitoring data has demonstrated that LNAPL impacts are appropriately characterised, stable, and delineated to the Site.
PAHs including anthracene, benzo(a)pyrene, fluoranthene, naphthalene and phenanthrene	- Contaminated groundwater exceeding off-site ecological criteria present during historical investigations, however PAH concentrations were below the adopted site criteria during the Q4 2023 GME. - Therefore, the impact has been demonstrated to be stable and immobile through previous environmental assessments.
PFAS	- Historical monitoring data has identified contaminated groundwater present at the Site which exceeds ecological and recreational screening criteria. - In 2023, an assessment of potential off-site mass contributions of PFAS from the Site with the following conclusions: - Potential offsite ecological impacts of PFOS exceeding ecological direct toxicity criteria in individual downgradient wells from AEC-4 are considered consistent with the magnitude of concentrations assessed via mass flux estimates of groundwater at the site boundary for other areas of Stage 2 (ERM 2018). - Potential direct toxicity risks to offsite receptors were unlikely considering low mass contribution and overall volume of receiving water body. Offsite assessment of bioaccumulative effects of PFAS in waterways are unlikely to provide meaningful input into site-based PFAS management given magnitude of other offsite contributions to these systems.

4.3 LOCATION AND EXTENT OF RESIDUAL CONTAMINATION

As outlined in *Section 3.2*, this LTEMP applies to Proposed Lot 64 where residual contaminated materials are present beneath the Management Area's surface, as indicated in *Figure 2, Appendix A*. The following residual sources of contamination are known to exist within Proposed Lot 64, including beneath the capped area and outside of the capped extent:

⁴ ERM (2024), *Clyde Western Area Remediation Project - Quarter 4 (2023) Stage 2 Groundwater Monitoring Project*, Final Revision 1, Dated 14 March 2024.

TABLE 4-2 – LOCATION OF RESIDUAL CONTAMINATION

Type of Residual Contamination	Criteria Exceeded	Within Capped Area	Outside of Capped Area
Soil			
Asbestos impacted soil (bonded and/or friable)	Commercial / industrial human health criteria	- TP19/21 (2.0 m) - TP19/81 (1.0 m)	- TP19/68 (1.0 m) - TP19/74 (1.5 m) - TP19/76 (2.2 m)
Benzene	Commercial / industrial vapour intrusion criteria	- TP19/19 (0.6 m) - TP19/23 (1.5 m) - TP19/77 (4.0 m)	N/A
Carcinogenic Polycyclic Aromatic Hydrocarbons (PAH) – benzo(a)pyrene Toxic Equivalent Quotient (TEQ)	Commercial / industrial direct contact criteria	TP19/25 (1.3 m)	N/A
Hexavalent chromium impacted soil	Commercial / industrial direct contact criteria	SB5B (1.0 m)	N/A
Hydrocarbon impacted soil	- Commercial / industrial direct contact criteria - Commercial / industrial vapour intrusion criteria	- MW12/01 (2.0 m) - TP18/27 (1.2 to 3m) - TP19/19 (0.6 m) - TP19/21 (2.8 m) - TP19/23 (1.5 m) - TP19/25 (1.3 m) - TP19/77 (1.4 to 4 m)	N/A
	Management limits exceeded	Depths between 0.6 and 6m BGL: - MW12/01 - MW20/03 - MW20/06 - MW20/07 - MW20/13 - TP18/27 - TP19/19 - TP19/21 - TP19/23 - TP19/24 - TP19/25 - TP19/77 - TP19/83 - TP19/84 - TP19/85 - TP19/87 - SB5B	- MW12/20 (2.0 m) - TP19/75 (1.5 m)
Groundwater (2023)			
LNAPL impacted groundwater	Observed presence in groundwater monitoring wells	- MW12/01 - MW20/06 - MW20/07	N/A
PFOS	Ecological criteria (off-site) 95% protection	N/A	MW20/17

5. POTENTIAL RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

5.1 RISKS WHERE NO INTRUSIVE EXCAVATION WORKS ARE UNDERTAKEN

There are no identified risks to human health or the environment associated with residual contamination if not disturbed. Ongoing monitoring of the capping layer integrity and groundwater conditions as outlined in *Section 6* is required to confirm no risks to human health or the environment exist in the future.

5.2 POTENTIAL RISKS - EXCAVATION WITHIN CAPPED AREA

Excavation into the capped area (shown on Figure 2) is to avoided and not undertaken without the prior engagement and advice of a Qualified Environmental Specialist, as per the contingency measures outlined in *Section 7* of this LTEMP.

The construction on a capping layer was undertaken to mitigate risks to future receptors via the following pathways:

- **Physical Separation:** Mitigate against potential for inadvertent direct contact with contaminated soils or disturbance of asbestos in soils by future on-site workers conducting excavations, via installation of separation layers, including geotextile and LLDPE geomembrane liners over contaminated materials;
- **Infiltration Reduction:** Mitigate against surface water infiltration at the ground surface, via installation of an impermeable LLDPE liner, therefore reducing potential contaminant mass flux and LNAPL in groundwater from the buried waste area. The constructed liner also serves as a barrier for vertical migration of vapour and gas from underlying hydrocarbon contaminated soil materials.

The following table outlines the potential risk to human health and the environment if the capping layer is penetrated and material beneath is disturbed. These risks may result from unauthorised excavation and/or works, where the risk of encountering residual contamination is summarised in *Table 5-1*.

TABLE 5-1 – POTENTIAL RISKS OF DAMAGE TO THE CAPPING LAYER

Contaminant	Source	Potential Human Health Risks	Potential Environmental Risks	Potential Exposure Pathways
Asbestos	Fibre cement fragments containing asbestos and loose asbestos bundles in soils	Asbestos fibres can cause asbestosis, lung cancer and mesothelioma if inhaled	Asbestos is inert within the environment and therefore poses no known environmental risk	Human Health: Inhalation of asbestos fibres could occur via soil disturbance of friable asbestos containing soils. Potential for this exposure pathway may exist if capping is penetrated. Ecological: Nil
Benzene	Residual contamination within soils and groundwater	Inhaling benzene vapours can result in dizziness, drowsiness and unconsciousness, and in the long term can effect tissues that form blood cells, especially bone marrow, and can cause cancer	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Health: Soil –direct contact and/or inhalation by commercial workers. Potential for this exposure pathway may exist if capping is penetrated. Ecological: Surface water / sediment run-off to adjacent storm water drains. Uncontrolled release of dust / odours / impacted soils or groundwater may occur if capping layer severely damaged.

Contaminant	Source	Potential Human Health Risks	Potential Environmental Risks	Potential Exposure Pathways
Carcinogenic PAH - benzo(a)pyrene TEQ	Residual contamination within soils	Direct contact with benzo(a)pyrene can cause a skin rash and skin, lung and bladder cancer	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Health: Direct contact by commercial workers. Potential for this exposure pathway may exist if capping is penetrated. Ecological: Surface water / sediment run-off to adjacent storm water drains. Uncontrolled release of dust / odours / impacted soils or groundwater may occur if capping layer severely damaged.
Hexavalent chromium	Residual contamination within soils	Direct contact with hexavalent chromium can cause dermatitis, skin ulcers and permanent eye damage	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Health: Direct contact by on-site commercial / industrial receptors. Potential for this exposure pathway may exist if capping is penetrated. Ecological: Surface water / sediment run-off to adjacent storm water drains. Uncontrolled release of dust / odours / impacted soils or groundwater if capping layer severely damaged.
PAHs including anthracene, benzo(a)pyrene, fluoranthene, naphthalene and phenanthrene	Residual contamination in groundwater	Direct contact with PAHs can cause a skin rash and skin, lung and bladder cancer	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Health: Direct contact by off-site recreational receptors. Ecological: Surface water / sediment run-off to adjacent storm water drains. Uncontrolled release of dust / odours / impacted soils or groundwater if capping layer severely damaged.
Total Recoverable Hydrocarbons (C6-C10) and LNAPL	Residual contamination within soils and groundwater	Inhaling hydrocarbon vapours can result in irregular heartbeats, shortness of beat, neurological problems and can cause cancer	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Health: Soil – indoor inhalation of vapours by commercial workers. Pooling of ground gases. Potential for this exposure pathway if capping is penetrated. Ecological: Surface water / sediment run-off to adjacent storm water

Contaminant	Source	Potential Human Health Risks	Potential Environmental Risks	Potential Exposure Pathways
				drains. Uncontrolled release of dust / odours / impacted soils or groundwater if capping layer severely damaged.
Total Recoverable Hydrocarbons (C10-C16, C16-C34) and LNAPL	Residual contamination within soils	Direct contact with total recoverable hydrocarbons can cause skin irritation, tissue breakdown, chemical burns which can lead to absorption and acute toxic systemic manifestations	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Health: Direct contact by commercial workers. Potential for this exposure pathway if capping is penetrated. Ecological: Surface water / sediment run-off to adjacent storm water drains. Uncontrolled release of dust / odours / impacted soils or groundwater if capping layer severely damaged.

5.3 POTENTIAL RISKS - EXCAVATION WORKS OUTSIDE OF CAP EXTENT

The following table outlines the potential risk to human health and the environment if excavation works are undertaken outside of the capped extent and the material is disturbed without proper management controls.

Planned excavations outside of the capped area to be undertaken following the advice of a Qualified Environmental Specialist to determine potential interaction with capped area and ensure preferential pathways are not introduced through via service trenches/utilities installed within the vicinity of the Cap.

These risks may result from excavation works, including the installation of services, stockpiling of excavated materials and works that encounter residual contamination identified within *Figures 2 or 3, Appendix A* or additional unexpected finds.

TABLE 5-2 – POTENTIAL RISKS OF INTRUSIVE WORKS UNDERTAKEN OUTSIDE THE CAPPED AREA

Contaminant	Source	Human Health Risks	Environmental Risks	Exposure Pathways
Total Recoverable Hydrocarbons (C10-C16, C16-C34) and LNAPL	Residual contamination within soils and oily water / sludge	Limited to generation of nuisance odours during subsurface intrusive works resulting from degraded hydrocarbons within open excavations	Risks associated with contamination transported to potentially sensitive receptors (see exposure pathways)	Human Exposure Pathways: Limited to aesthetic considerations including potential for generation of odours during subsurface intrusive works

Contaminant	Source	Human Health Risks	Environmental Risks	Exposure Pathways
				Environmental Exposure Pathways: Surface water / sediment run-off to adjacent stormwater drains. Uncontrolled release of dust / odours generated during excavation works.
Asbestos	Asbestos in soils (as identified in Appendix D)	Asbestos fibres can cause asbestosis, lung cancer and mesothelioma if inhaled	Asbestos is inert within the environment and therefore poses no known environmental risk	Human Exposure Pathways: Inhalation of liberated asbestos fibres could occur via breakage or disturbance of asbestos containing materials during excavation works. Environmental Exposure Pathways: Nil

6. ENVIRONMENTAL MANAGEMENT

Adherence to this LTEMP is required to ensure the suitability for commercial/industrial land uses within the Site and Proposed Lot 64. Design of future buildings to include appropriate management controls and measures assessed consistent with the Hazardous Ground Gas Guidelines. At this stage no enclosed buildings exist or are proposed within Proposed Lot 64. However, should any future buildings be proposed, the design must include appropriate management controls and measures assessed consistent with the *Hazardous Ground Gas Guidelines*⁵.

Based on the nature and extent of residual contamination identified within the Management Area, the following controls are required under various operational scenarios:

- Where intrusive excavation works are proposed – the environmental management controls detailed in *Sections 6* of this LTEMP must be implemented.
- Where works involve no intrusive excavation (i.e. normal site operations) – management controls are applicable following completion of remediation and validation of Proposed Lot 64.
- As per Development Consent SSD9302, the conditions B22 (d) to B22 (g) outline requirements for ongoing passive management and mitigation of groundwater risks, including monitoring of natural attenuation, trigger levels for investigation of adverse impacts to Duck River, contingency actions and monitoring of effectiveness of management measures. These requirements are addressed within *Section 6* of this LTEMP, and the Stage 2 Groundwater Monitoring Program (GWMP) prepared by ERM in 2021.

6.1 ENVIRONMENTAL MANAGEMENT REQUIREMENTS

Within Proposed Lot 64, the future construction of enclosed spaces will not be in direct contact with contaminated waste material (service trenches, pits and buildings) and potential for ground gas accumulation will be limited through implementation of design controls on future buildings within the AEC-4 footprint under this legally enforceable LTEMP.

As outlined above, the overall objective of this LTEMP are to mitigate risk associated with residual contamination within Proposed Lot 64 so that:

- the assessed risks to human health and the environment arising from direct contact with and inhalation of residual contamination is understood by all workers and managers of Proposed Lot 64;
- prior to the commencement of any construction and maintenance works, appropriate systems and controls are put in place to mitigate the potential risks posed by residual contamination; and
- all ongoing operational, monitoring and maintenance requirements are adhered to by the Site Operator.

⁵ NSW EPA (2020) *Assessment and Management of Hazardous Ground Gases*. May 2020.

Due to the capping layer creating physical separation to subsurface residual soil contamination and reducing the potential of surface water infiltration, ongoing monitoring of the capping layer integrity is required to confirm the capping layer continues to serve these purposes. Following the initial 18-month period of inspections and monitoring, if no major issues have been identified, inspections of Proposed Lot 64 should be conducted in perpetuity on an annual basis subject to the requirements of this LTEMP and observations from previous inspections, management actions and results of environmental monitoring. Should no major actions be required following the first 18 months, it is intended that inspections will be undertaken in line with the environmental monitoring works described within this LTEMP.

Although the groundwater contamination has been shown to be stable and immobile, ongoing monitoring of groundwater conditions is required to confirm that contamination is not migrating off-site. Following remediation, it is proposed that monitoring will occur biannually (every 6 months) following completion of a post remediation sampling event.

The Requirement for ongoing sampling is to be reviewed annually (ie every two GMEs) based on trend analysis and reported concentrations, as detailed in the GWMP. These monitoring requirements are summarised in Table 6-1.

Prior to the commencement of any works, it is the responsibility of the Site Operator to identify whether works within Proposed Lot 64 will require intrusive excavation. Where any intrusive works are undertaken within Management Area, the controls within the following table must be implemented.

TABLE 6-1 – SITE ENVIRONMENTAL MANAGEMENT REQUIREMENTS

Item	Requirements
All Intrusive Works Undertaken within Proposed Lot 64	
Training and Competence	The Site Operator is to establish that all workers are suitably qualified to undertake required works and inducted into all relevant requirements stipulated within this LTEMP. The induction will include outlining all requirements within this LTEMP and other relevant documentation, the location of known residual contamination (as per <i>Figures 2 and 3, Appendix A</i>) and the identification of unexpected finds of contamination (via visual and olfactory means).

Item	Requirements
Health and Safety Plan	The Site Operator or contactor carrying out the works is to prepare a task specific health and safety plan that includes suitable protection measures for working with residual hydrocarbon, hexavalent chromium and asbestos contamination including but not limited to: • training requirements; • air / dust / odour monitoring procedures; • respiratory protection; • minimum Personal Protective Equipment (PPE) requirements; • signage requirements; • security within the Site and Proposed Lot 64; • exposure mitigation measures (dust suppression etc.); • vehicle / machinery / plant safety; and • general occupational health and safety.
Engagement of Environmental Specialist	Where excavation works are required to be undertaken outside of the capped area of Lot 64, or within the services trench and shallow footings of the capped area: The Site Operator or nominated representative is to engage a Suitably Qualified Environmental Specialist prior to undertaking intrusive works, to undertake a review of health and safety management procedures, manage, monitor and evaluate environmental controls and demonstrate compliance with this LTEMP. Excavation works are not to be undertaken at Proposed Lot 64 within the footprint of the capped area. In the event that the membrane of the capped area is accidentally penetrated, the Site Operator or nominated representative is to consult with a Suitably Qualified Environmental Specialist to assess: • Whether contaminated materials below the marker layer have been exposed. • The extent of potential damage to the installed geotextile marker layer or LLDPE geomembrane. • Where disturbance/ damage to the marker layer/ LLDPE geomembrane is identified, contingency actions associated with damage to the cap outlined in Section 7 of this LTEMP will apply.
Environmental Monitoring	Environmental monitoring is to be undertaken for odour management purposes during all maintenance and construction works within Proposed Lot 64. • The specific monitoring methodology / regime should be developed by the Suitably Qualified Environmental Specialist and based on the specific tasks / construction methodology. • The Suitably Qualified Environmental Specialist shall determine whether action levels (odour, dust) are to be developed to incorporate thresholds where intrusive works are to cease and control measures are to be re-assessed / implemented. These action levels are to be based on relevant regulatory guidance at the time of works and are to be incorporated into Health and Safety Planning documentation when undertaking works. It is a requirements of this LTEMP that Groundwater Monitoring requirements, as per the GWMP (Appendix E), Ground Gas Monitoring as per Ground Gas Monitoring Program (Appendix F), and capping inspections (as per Table 6-2) are undertaken.
Task Specific Works Plan	Excavation works are not to be undertaken within the footprint of the capped area, as shown in Figure 1-3, Appendix A. Where excavation works are required to be undertaken outside of the capped area of Proposed Lot 64, the contractor is to ensure that a Task Specific Works Plan is prepared by a suitably qualified environmental professional to ensure all environmental risks are appropriately managed prior to commencement. • The Works Plan should be prepared for the specific works to be undertaken. • The Works Plan should be prepared in accordance with good industry practice standards at the time of works and must comply with all relevant NSW EPA regulatory guideline criteria relating to contaminated sites. The plans should include (but not be limited to) the following details: • Risks to human health and the environment – potential risks associated with the work should be highlighted.

Item	Requirements
	• General site management – Details of required inductions of employees or contractors. • Procedures and methodologies to be used for undertaking the works. • Specific details of ways to limit disturbance of impacted soils / groundwater / redundant site drainage infrastructure etc. (e.g. soil boring as opposed to open trenching). • Mitigation measures. • Air / dust monitoring action levels, around areas of residual hydrocarbon impacts; • Personal protective equipment. • Other protection measures (cabin ventilation, etc.). • Roles and responsibilities for implementing the mitigation measures. • Soil and groundwater management controls - As a minimum the following requirements should be detailed: ◦ Any groundwater extracted during intrusive works is to be disposed in accordance with all legal requirements. ◦ Excavated soils should be placed within a bunded area to minimise potential run off. ◦ Soil / concrete material should be kept moist to limit dust. ◦ Excavated materials, where possible, be replaced in the same location. Where this is not practicable, material must be disposed of in accordance with all legal requirements. • Reinstatement of the site surface. • Waste management including waste disposal. • Record Keeping, audit and review.
Excavation works and temporary stockpiling	To reduce and / or prevent the exposure of human receptors at within Proposed Lot 64 to potential contamination within on-site soils, the following will be undertaken during any intrusive excavation works within Proposed Lot 64 (but outside of the capped area): • To reduce the area of disturbed material, the number of areas subject to excavation works at any one time can be minimised. • During excavation works, measures to reduce dust emissions such as spraying with water, addition of soil binding agents etc. should be undertaken. • During excavation and materials handling, sufficient odour control such as covers, tarps, odour control sprays etc., are to be implemented during works to minimise any disturbance to neighbouring premises. • Where material requires off-site disposal, excavated material should be placed directly into a tipper truck and, where possible, material should not be placed into temporary stockpiles awaiting off-site disposal. • Where material requires stockpiling prior to off-site disposal, appropriate dust and sediment controls must be in place. Smaller volumes can be contained within an enclosed or covered skip. • All materials movement within the Site, including Proposed Lot 64 must be recorded within an appropriate Materials Tracking Register.
Excavation of stockpiles containing asbestos	To reduce and / or prevent the exposure of human receptors at the Site to asbestos within on-site stockpiles, the following will be undertaken during any intrusive excavation works of stockpiles: • To reduce the area of disturbed material, the number of areas subject to excavation works at any one time can be minimised. • During excavation works, measures to reduce dust emissions such as spraying with water, addition of soil binding agents etc. should be undertaken. • Asbestos controls are to be applied as per an Asbestos Management Plan or similar document outlining asbestos controls to limit exposure to human receptors and cross contamination of other site materials/areas. Examples include dust suppression (as above), exclusion zone around excavation area and relocation area, with appropriate personal protective equipment implemented (i.e. P2 respirator, coveralls, boot covers and gloves). • Updated locations of stockpiles are to be incorporated within the Asbestos Register (<i>Appendix D</i>), with the soil surface of the stockpile's former footprint to be visually cleared of asbestos containing materials by a Suitably Qualified Environmental Specialist.

Item	Requirements
	- If asbestos stockpiles are relocated below ground level, they must be reinstated beneath the capping layer and marker layer. Each layer is to be validated as intact and surfaces visually cleared of asbestos containing materials by a Suitably Qualified Environmental Specialist. - Where material requires off-site disposal, excavated material should be placed directly into a tipper truck and, where possible, material should not be placed into temporary stockpiles awaiting off-site disposal.
Materials handling and disposal	Soil - Excavated materials are to be either re-instated within the same location and depth (in accordance with relevant planning / DA conditions) or disposed off-site to a suitably licenced landfill / receiving facility in accordance with relevant NSW EPA waste disposal guidance at the time of works. Groundwater - Any groundwater extracted from excavation works outside of the capped area is to be managed or disposed in accordance with relevant NSW EPA made or endorsed waste disposal guidance at the time of works.
Sediment and Stormwater Run-off Controls	During works, sediment and surface water run-off controls will be implemented to minimise generation and transport of potentially contaminated sediments and surface water on and off-site. Controls will be developed based on a specific management plan (which may be a safe work method statement or Construction Environmental Management Plan [CEMP] depending on the nature of the works) specific to the location / nature of works to be undertaken. Controls may include (but not be limited to): - sediment control; - clean water diversions; - stormwater drain protection; and - Environmental Management Controls as per <i>Managing Urban Stormwater – Soils and Construction (Landcom 2004)</i>, or its most recent update.
Imported Fill Material	If imported fill is required at the Site, only construction materials or certified Excavated Natural Material (ENM) or 'Virgin Excavated Natural Material' (VENM) materials are to be imported for use. If ENM / VENM is imported to the Site accompanied by an ENM / VENM certificate, sampling will not be required. The ENM / VENM certificate should at a minimum: - state that the material has been classified as ENM / VENM (in accordance with relevant NSW EPA guidance) and is suitable for re-use within the Site; and - include a summary of the site history of the source site, the findings of any environmental site investigations undertaken at that site and the results of any soil analysis undertaken. If the ENM / VENM certificate does not meet these requirements, it must be approved in writing from the NSW EPA (e.g. via a Resource Recovery Exemption). All ENM / VENM / imported material classification reports are to be provided to the Land Custodian or their nominated representative and included within compliance reporting upon completion of works (<i>Section 6.3</i>).
Unexpected Finds Management	During excavation works there is the potential of encountering additional in-ground finds outside of the capped extent of Lot 64. Unexpected finds may include (but not be limited to): - additional asbestos containing materials; - additional LNAPL / hydrocarbon impact; - buried building rubble; - unusual soil staining and discoloration; and - odours emanating from the ground during earthworks. Unexpected finds within the capped extent of Lot 64 may include visual or olfactory indicators of contamination that are not outlined above. Where unexpected finds are uncovered: - works are to cease immediately in the vicinity of the excavation; - the Land Custodian or their nominated representative is to be informed immediately; - the area surrounding the unexpected find is to be barricaded to ensure the area is not further disturbed; and - a Suitably Qualified Environmental Specialist is to visit the Site, assess the discovery and undertake assessment / provide recommendations.

Item	Requirements
	The Suitably Qualified Environmental Specialist is to advise on the required course of action for the find. This may include: • sample collection and analysis; • a detailed assessment (if required); and • preparation of an assessment report and remediation plan (if required). All reports are to be prepared in accordance with relevant NSW EPA guidance and provided to the Land Custodian for record keeping requirements. Should finds of asbestos containing materials be reported, the asbestos register (<i>Appendix D</i>) should be updated accordingly.
Excavation Re-instatement	Upon completion of excavation works, the area must be re-instated with excavated material in the order in which it was excavated or with other approved imported fill materials.
Biodiversity Management Measures - Green and Golden Bell Frog (GGBF)	
Green and Golden Bell Frog (GGBF)	Pursuant to a Biodiversity Development Assessment Report dated 3 Dec 2018 prepared by Biosis (see appendix I of the Environmental Impact Statement [EIS] for SSD 9302) there is no residual GGBF habitat within Proposed Lot 64. In addition, the further earthworks authorised under development consent SSD 10459, when completed, will permanently remove the potential for the ponding of water that might provide habitat for the GGBF.

6.2 FINAL LANDFORM CONSTRUCTION WITHIN THE CAPPED AREA

Following installation of the liner materials to meet remediation requirements for the capped area, the subsections below outline the requirements for completion of the final landform.

6.2.1 MATERIALS AND CONSTRUCTION

Engineered fill materials must meet the requirements which are stated in *Table 6-1* of this LTEMP. Furthermore, any materials applied to the capped area must confirm with the requirements specified within *Section 5.5.3* of the *Clyde Western Area Remediation Project – Proposed Lot 64-AEC-4 Capping Construction Technical Specification*, dated 12 March 2024 (ERM, 2024).

Materials and construction methodologies for pavement and landform construction within the capped area are to confirm to Civil Design Drawing CO13919.06-CC30 and CO13919.06-CC56 provided within *Appendix G*.

6.2.2 INSPECTION AND TESTING

Inspection and Testing shall be conducted by the Geotechnical Consultant under Full Time (Level 1) Supervision to meet compaction requirements as per Pavement Design.

Engineered fill materials are also subject to the documentation, testing and inspection requirements specified within *Section 5.5.3* of the Technical Specification (ERM, 2024).

Survey of the final finished surface is to be undertaken by the contractor and subject to final inspection by the Validation Consultant to verify that a minimum slope of 1% is maintained, such that stormwater runoff will not pool on the finished capped area.

6.3 INSPECTIONS, REPORTING AND LTEMP REVIEW

The table below outlines the inspection, reporting and review requirements related to this LTEMP.

TABLE 6-2 – LTEMP REPORTING

Report	Requirement
Capping Inspections	Regular site inspections of Proposed Lot 64 are to be undertaken to assess the condition of capping, and integrity of the completed remedial works. At a minimum, inspections of the cap within Proposed Lot 64: • Inspection of the capping to assess the integrity, and whether any activities have been undertaken, or issues have arisen within the capped area which may require maintenance; • Inspect vegetation growth surrounding the capped area, and determine whether any management works such as slashing is required; and • Observe whether there is suitable control of surface water run-off with minimal sediment transport outside of the designed flow paths. Inspections of Proposed Lot 64 should take place monthly for the first six months following completion of the remedial activities. After the first six months, inspections should be reduced to quarterly for a further twelve months (i.e. every three months). Following the initial 18-month period of inspections and monitoring, if no major issues have been identified, inspections of Proposed Lot 64 should be conducted in perpetuity on an annual basis subject to the requirements of this LTEMP and observations from previous inspections, management actions and results of environmental monitoring. Should no major actions be required following the first 18 months, it is intended that inspections will be undertaken in line with the environmental monitoring works described within this LTEMP.
Post Construction Gas Monitoring Events	The Ground Gas Monitoring Program (GGMP) has been developed for Proposed Lot 64, the GGMP was developed in accordance with the <i>Solid Waste Landfill Guidelines</i> (NSW EPA, 2016) and the conditions of SSD 9302. Post-remediation gas monitoring requirements are detailed within the GGMP and form part of this LTEMP. The objective of this post-remediation ground gas monitoring plan is to utilise the collected dataset to assess the efficacy of the remediation strategy of Proposed Lot 64 by encapsulation of residual contamination. Should elevated levels of methane be detected above 1% v/v, the Site Operator must notify NSW EPA within 24 hours, and adhere to the Action Requirements, as described in Section 6 of the GGMP.
Groundwater Monitoring Reports	A GWMP has been developed for the Stage 2 Area, which includes Proposed Lot 64. The GWMP was developed in accordance with the consent conditions associated with approval SSD 9302. Post remediation groundwater monitoring requirements are detailed within the GWMP, and forms part of the requirements of this LTEMP. The specific conditions of SSD 9302 and their objectives include: • Condition B22 (d): detail ongoing monitoring following demobilisation, to verify that natural attenuation of groundwater contamination is occurring over time; • Condition B22 (e): include trigger levels for investigating potential adverse impacts to the Duck River, including triggers for indicating if further remediation of groundwater is required; • Condition B22 (f): outline contingency actions to be implemented if monitoring indicates that natural attenuation is not occurring, or groundwater is having an adverse impact on the Duck River; • Condition B22 (g): monitor the effectiveness of management measures and contingency actions for reducing impacts To demonstrate ongoing stability of groundwater conditions and that residual groundwater impacts do not present a risk to the ecological values of receptors, specifically the Duck River. The monitoring program to be implemented post-remediation is presented as Table B2 of the GWMP presented in <i>Appendix D</i>.

Report	Requirement
Material Classification Reports	• All reports relating to unexpected finds, off-site disposal of fill materials and importation of any materials used for construction / backfilling purposes are to be provided to the Land Custodian upon completion of works. • Reports are to include details of laboratory analysis and subsequent classification information and materials tracking information detailing the total volume and final placement / disposal location.
Non-Conformance Reporting	• Any non-conformances with this LTEMP will be recorded in a Non-Conformance and Corrective Action Report. Details of the non-conformance, including any immediate corrective actions undertaken, are to be recorded by the Site Operator. • It is the responsibility of the Site Operator to immediately initiate corrective actions, if required. Once completed, the Site Operator will provide details of the actions undertaken on the Non-Conformance Report and sign, date and file the report.
LTEMP Review	This LTEMP should be reviewed by the Land Custodian or their nominated representative upon completion of all intrusive excavation activities (outside of the capped area) and / or after incidents or reported findings, to ensure that: • information and environmental management strategies remain current; • any opportunities for improvement are identified; and • changes to legislation, environmental standards licence and approval conditions are identified and complied with. Information obtained during intrusive works including (but not limited to) the following sources may be utilised to review the LTEMP: • Details of the works undertaken including relevant photographs. • Details of any unexpected finds (nature, location, extent and results of testing / analysis undertaken, photographs). • Any pertinent additional safety controls that were required to be implemented during intrusive works. The assessment should take into account all changes such as (but not limited to): • changes to Site conditions, or conditions within Proposed Lot 64; • work requirements; • legislation; and • environmental condition. If during the review process described above, areas for improvement are identified, or it be determined that the LTEMP requires revision, any changes to the document will require agreement by at least the following stakeholders: • Land Custodian (or nominated representative); • Suitably Qualified Environmental Specialist; and • a NSW EPA accredited Site Auditor.
Record Keeping	All records related to implementation of the LTEMP should be maintained by the Land Custodian or their nominated representative in a consolidated and easily accessible location.

7. CONTINGENCY ACTIONS

The purpose of the contingency plan is to identify unexpected situations that could occur, and specify procedures that can be implemented to manage such situations and prevent or minimise adverse impacts to the environment and human health.

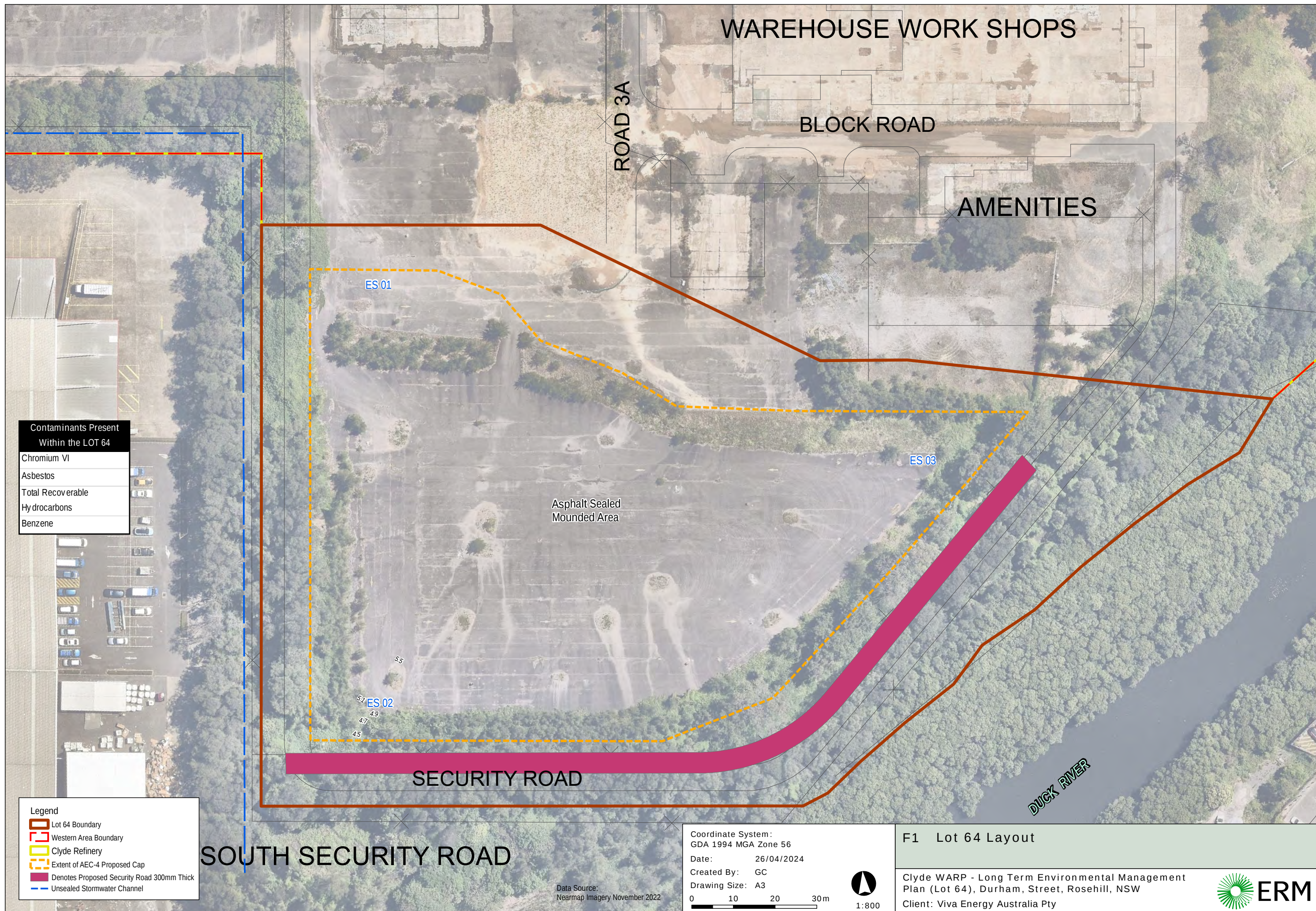
Details of the procedures are defined in the Table 7-1 below:

TABLE 7-1 – CONTINGENCY ACTIONS

Item	Contingency Action
Asbestos in soils – outside of capping extent	- Where asbestos contaminated soil is identified outside the capped extent of Lot 64 during development works, any finds should be investigated as per the unexpected finds methodology detailed within <i>Section 6.1</i>. - Identified asbestos remaining on-site should be included on an updated version of the Asbestos Register (provided as <i>Appendix D</i>).
LNAPL / hydrocarbon contamination – outside of capping extent	Where LNAPL / hydrocarbon impacted soil and / or groundwater is identified outside the capped extent of Lot 64 during development works, any finds should be investigated as per the unexpected finds methodology detailed within <i>Section 6.1</i>.
Penetration of LLPDE liner required for future construction	Engagement of Suitably Qualified Environmental Specialist / NSW EPA accredited Site Auditor to assess environmental risk and required repairs/ design to reinstate integrity of capping/ liner.
Degradation / cracking of asphalt pavement surface, resulting in greater potential for ingress of runoff into buried waste materials	Inspections of Proposed Lot 64 should take place monthly for the first six months following completion of the remedial activities. After the first six months, inspections should be reduced to quarterly for a further twelve months (i.e. every three months). Following the initial 18 month period of inspections and monitoring, if no major issues have been identified, the inspections should be conducted in perpetuity subject to the requirements of this LTEMP and observations from previous inspections, management actions and results of environmental monitoring. Should no major actions be required following the first 18 months, it is intended that inspections will be undertaken in line with the environmental monitoring works described within this LTEMP.
Groundwater monitoring well network (destroyed/ unserviceable wells)	- Engagement of Suitably Qualified Environmental Specialist to assess impact of well loss on meeting the groundwater monitoring objectives. - If required, wells will be re-installed.
Post-remediation groundwater monitoring – potential off-site migration	Contingency measures associated with groundwater monitoring works are outlined in Section 3.7 of the GWMP (Appendix E)
Hazardous ground gas concentrations identified in stormwater pits post construction of the capped area	- Enclosed space monitoring as per the GGMP. - Gas concentration levels will be compared with the 'Gas Accumulation Criterion' for enclosed structures (methane <1% v/v) as per Section 5.4 of the <i>Solid Waste Landfill Guidelines</i> (NSW EPA, 2016). Should elevated levels of methane be detected above 1% v/v, the measures outlines within these guidelines will apply.



APPENDIX A FIGURES



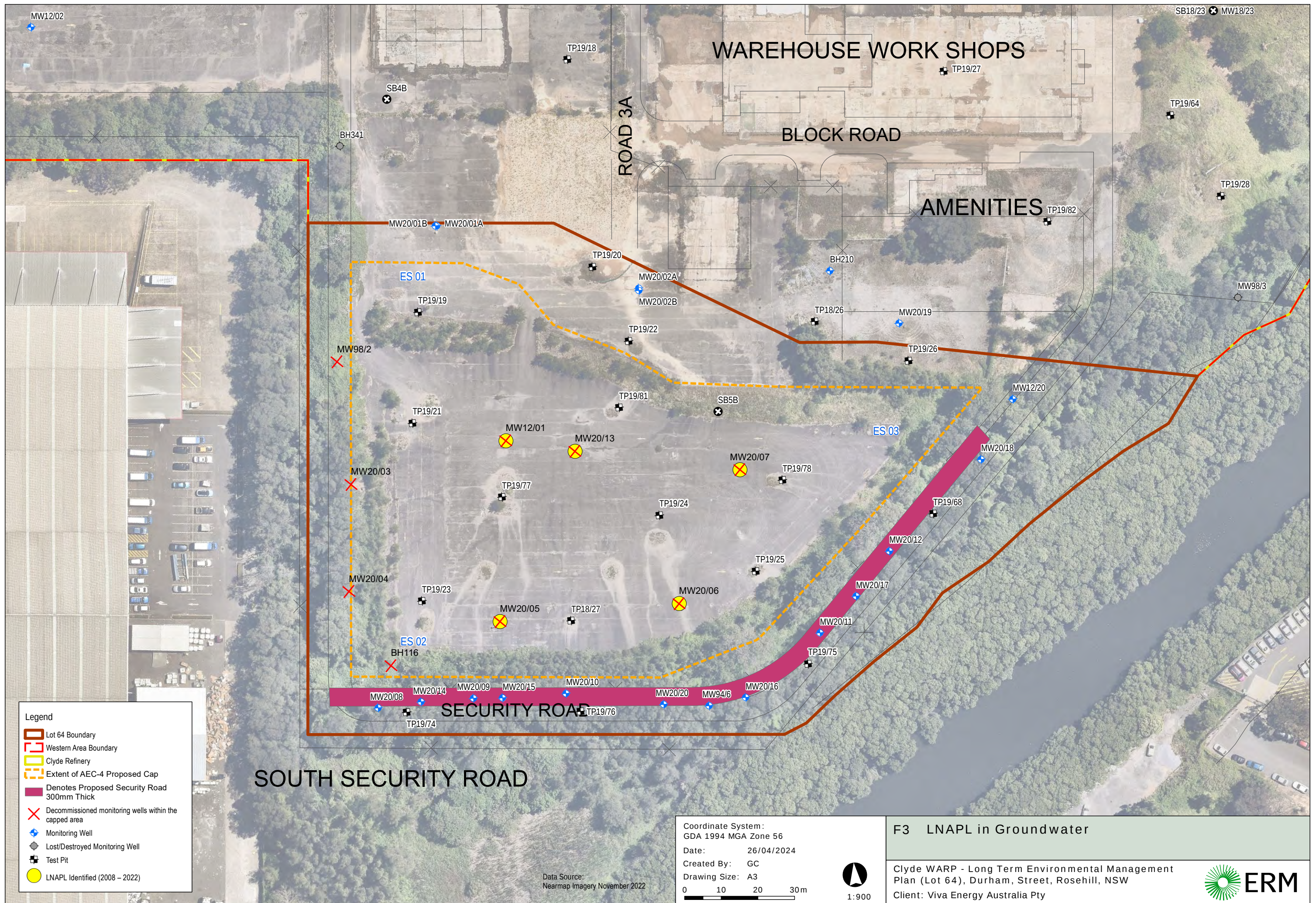
Contaminants Present Within the LOT 64	
Chromium VI	
Asbestos	
Total Recoverable	
Hydrocarbons	
Benzene	

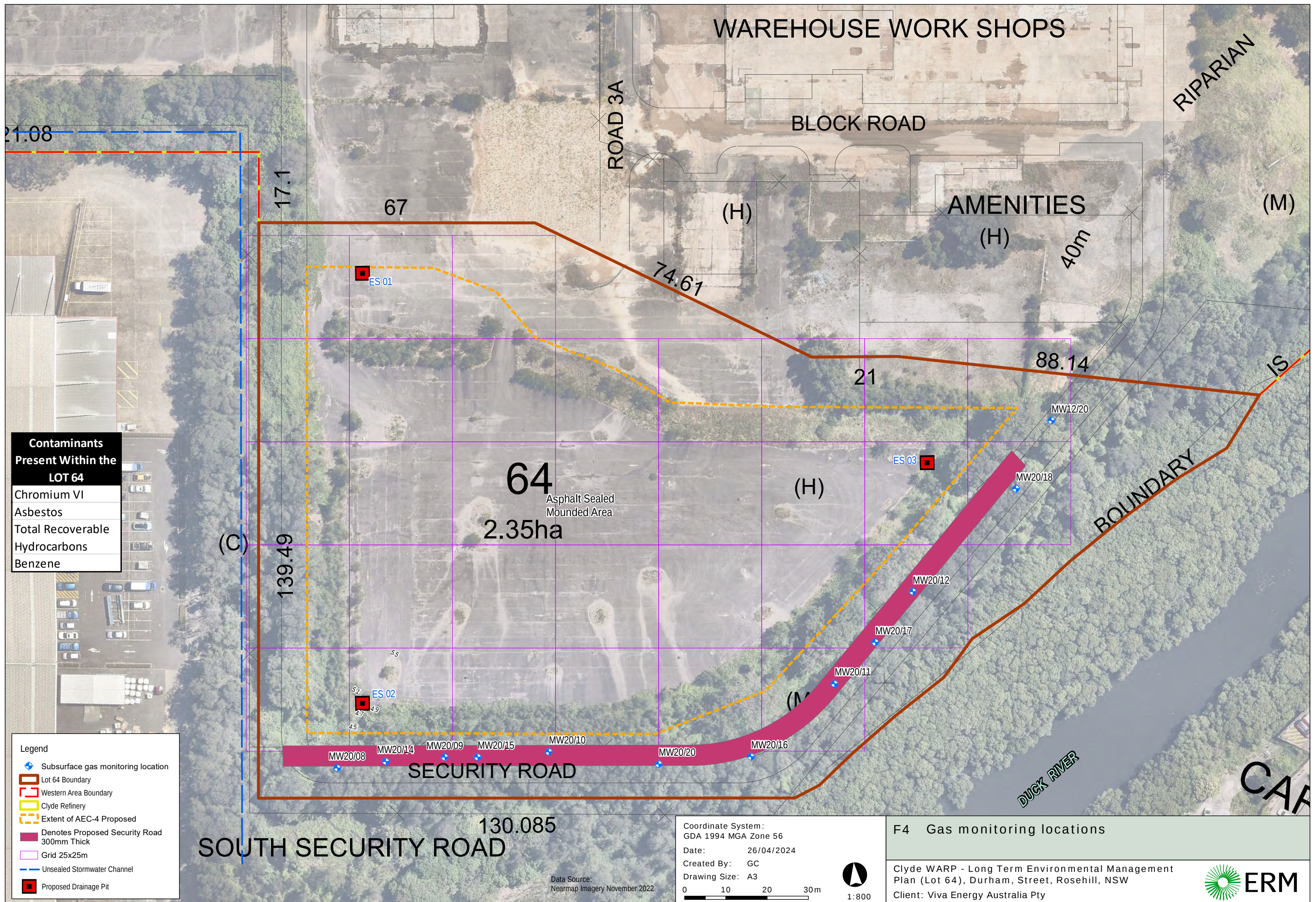
Legend	
	Lot 64 Boundary
	Western Area Boundary
	Clyde Refinery
	Extent of AEC-4 Proposed Cap
	Denotes Proposed Security Road 300mm Thick
	Unsealed Stormwater Channel

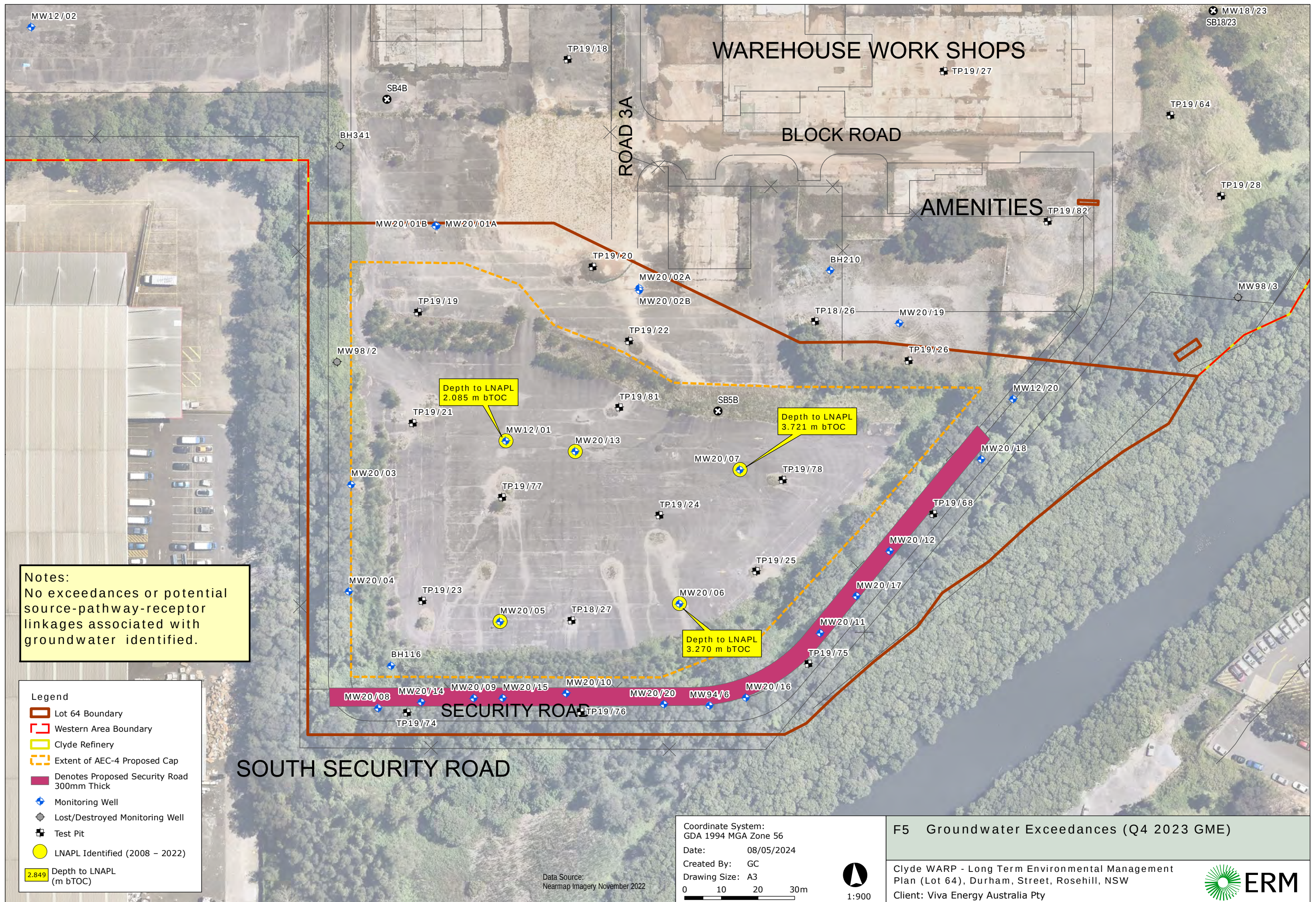
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GDA 1994 MGA Zone 56
Date: 26/04/2024
Created By: GC
Drawing Size: A3
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1:800

F1 Lot 64 Layout
Clyde WARP - Long Term Environmental Management
Plan (Lot 64), Durham, Street, Rosehill, NSW
Client: Viva Energy Australia Pty









Notes:
No exceedances or potential
source-pathway-receptor
linkages associated with
groundwater identified.

Legend

Lot 64 Boundary

Western Area Boundary

Clyde Refinery

Extent of AEC-4 Proposed Cap

Denotes Proposed Security Road
300mm Thick

Monitoring Well

Lost/Destroyed Monitoring Well

Test Pit

LNAPL Identified (2008 – 2022)

2.849 Depth to LNAPL
(m bTOC)

Coordinate System:
GDA 1994 MGA Zone 56

Date: 08/05/2024

Created By: GC

Drawing Size: A3

0 10 20 30m

1:900

F5 Groundwater Exceedances (Q4 2023 GME)

Clyde WARP - Long Term Environmental Management
Plan (Lot 64), Durham, Street, Rosehill, NSW

Client: Viva Energy Australia Pty

AEC-4 Proposed Cap Vertices		
Point ID	Eastings	Northings
1	317827.83	6254609.47
2	317827.84	6254609.59
3	317839.56	6254721.94
4	317869.99	6254718.41
5	317884.53	6254711.15
6	317892.78	6254699.11
7	317911.39	6254689.46
8	317923.60	6254680.02
9	317952.05	6254675.91
10	318007.33	6254669.85
11	317971.14	6254635.86
12	317939.96	6254608.51
13	317938.85	6254607.86
14	317911.84	6254600.44

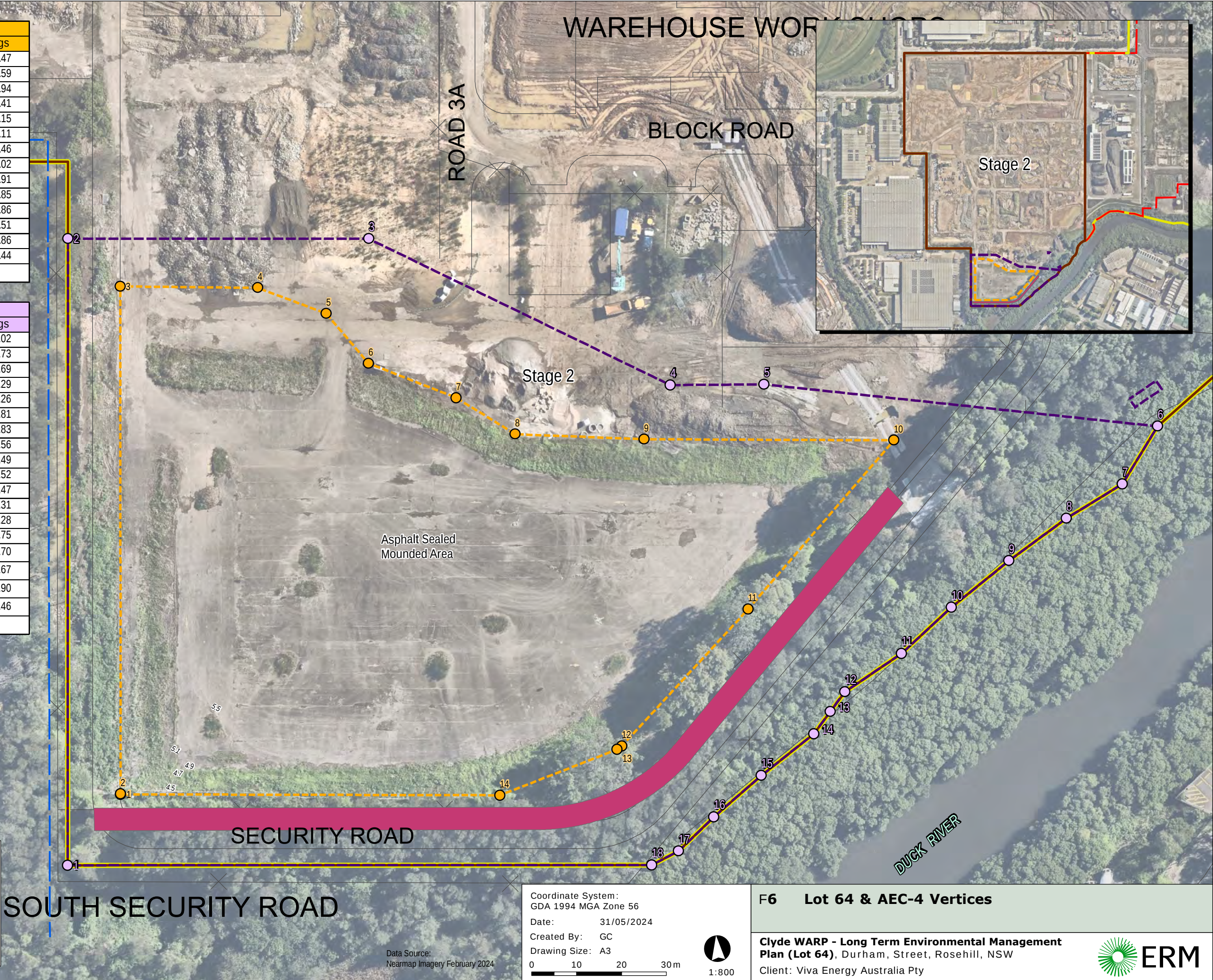
Coordinate System: GDA1994 MGA Zone 56

Lot 64 Vertices		
Point ID	Eastings	Northings
1	317814.42	6254595.02
2	317829.09	6254733.73
3	317895.72	6254726.69
4	317959.08	6254687.29
5	317979.88	6254685.26
6	318066.07	6254666.81
7	318056.91	6254654.83
8	318043.74	6254648.56
9	318030.00	6254640.49
10	318016.18	6254631.52
11	318004.07	6254622.47
12	317990.61	6254615.31
13	317986.94	6254611.28
14	317982.79	6254606.75
15	317970.15	6254598.70
16	317958.71	6254590.67
17	317950.05	6254583.90
18	317943.80	6254581.46

Coordinate System: GDA1994 MGA Zone 56

Legend

Lot 64 Boundary
 Stage 2
 Western Area Boundary
 Clyde Refinery
 Extent of AEC-4 Proposed Cap
 Denotes Proposed Security Road 300mm Thick
 Unsealed Stormwater Channel



Coordinate System:

GDA 1994 MGA Zone 56

Date:

31/05/2024

Created By:

GC

Drawing Size:

A3

0 10 20 30 m

1:800

F6 Lot 64 & AEC-4 Vertices

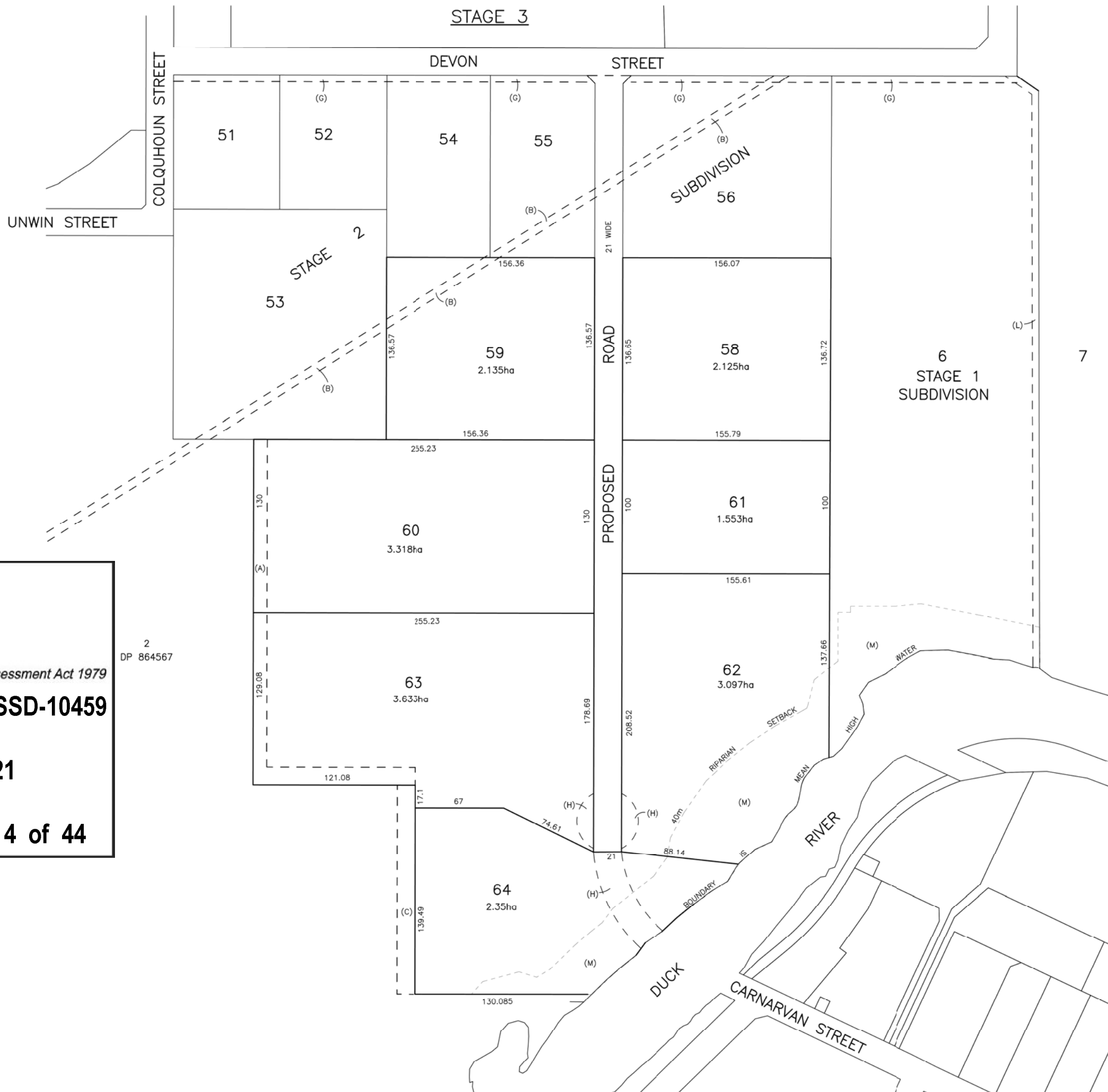
Clyde WARP - Long Term Environmental Management Plan (Lot 64), Durham, Street, Rosehill, NSW
 Client: Viva Energy Australia Pty





APPENDIX B SITE SURVEY

M.G.A.



CLIENT

VE PROPERTY PTY LTD

PROJECT

PLAN OF
PROPOSED SUBDIVISION
OF
LOT 57 OF STAGE 2 OF
SUBDIVISION OF
LOT 100 IN DP1168951
STAGE 3

NOTES

The title boundaries shown hereon were not marked at the time of survey and have been determined by plan dimensions only and not by field survey.

Services shown hereon have been located where possible by field survey. If not able to be so located, services have been plotted from the records of relevant authorities where available and have been noted accordingly on the plan. Where such records do not exist or are inadequate a notation has been made hereon.

Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.

6	GKO	23/11/2020	LOT 61 & 62 AMENDED
7	GKO	11/11/2020	AMEND RIPARIAN SETBACK & (H)
6	GKO	02/11/2020	LANDSCAPE SETBACK REMOVED
5	GKO	29/10/2020	PLAN AMENDED
4	GKO	20/10/2020	LOT BOUNDARIES AMENDED
3	GKO	24/07/2020	EASEMENTS DETAIL ADDED
2	GKO	17/07/2020	EASEMENT AMENDED
1	GKO	22/06/2020	INITIAL ISSUE

SYM	CODE	DESCRIPTION	SYM	CODE	DESCRIPTION
BN	BN	BIN	OFM	OFM	OPTICAL FIBRE MARKER
BM	BM	BENCH MARK	OPF	OPF	OPTICAL FIBRE PIT
BO	BO	BOLLARD	TM	TM	PALM TREE
DUM	DUM	DRAINAGE MANHOLE	SE	SE	SEAT
EFP	EFP	ELEC FUSE BOX	TS	TS	SHRUB
ELP	ELP	ELEC GARDEN LIGHT	TCA	TCA	TELSTRA PIT
EL	EL	ELEC GREEN PILLAR	SLH	SLH	SEWER LAMP HOLE
LP	LP	ELEC LIGHT POLE	SMH	SMH	SEWER MANHOLE
EP	EP	ELEC SINGLE PIT	SWP	SWP	SEWER VENT PIPE
SPL	SPL	ELEC STAY POLE	SI	SI	SIGN
PP	PP	ELEC POWER POLE	BS	BS	BUS STOP SIGN
ELP	ELP	ELEC POLE/LIGHT	T	T	TREE
HWMT	HWMT	ELE POLE/TRANSFORM	SGL	SGL	TRAFFIC LIGHT
FD	FD	FUEL DIP	SCL	SCL	TRAFFIC CONTROLLER
GM	GM	GAS MAIN	SJX	SJX	TRAFFIC JUNCTION BOX
GMR	GMR	GAS METER	US	US	UNKNOWN SERVICE
GV	GV	GAS VALVE	WAV	WAV	WATER AIR VALVE
AG	AG	GATE	WMR	WMR	WATER METER
GUL	GUL	GULLY PIT	WEP	WEP	WATER PUMP
HYD	HYD	HYDRANT	WSP	WSP	WATER STOP VALVE
BOP	BOP	BORHPOLE	WTF	WTF	WATER TAP

Symbols shown are indicative only. The symbol size and orientation does not necessarily represent the real size or orientation of the feature.

DRAINAGE PIPE U/G	---
DRAIN	---
ELECT. CABLE A/G	---
ELEC. CABLE U/G	---
GAS PIPE	---
FENCE LINE	---
SEWERAGE PIPE	---
TELSTRA CABLE	---
WATER PIPE	---

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built environment consultants

HEIGHT DATUM AHD	LOCAL AUTHORITY CITY OF PARRAMATTA
HEIGHT ORIGIN N/A	SCALE 1:1500 (A1)
MERIDIAN N/A	CONTOUR INTERVAL N/A
COORD SYSTEM MGA	SURVEYOR DATE OF SURVEY
CCAD FILE 74707 ver 9 final subdivision	DRAWN DATE
AUTOCAD FILE SY074707.000.13.8	CHECKED DATE
ARCHIVE FILE SY074707.000.13.6	APPROVED DATE
PLAN NUMBER SY074707.000.13.8	SHEET 1 OF 1



Planning,
Industry &
Environment

Issued under the Environmental Planning and Assessment Act 1979

Approved Application No: SSD-10459

Granted on: 31 January 2021

Signed: JF Sheet No: 4 of 44

- NOTES:
- ALL DIMENSIONS SHOWN HEREON ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY
 - NO CADASTRAL SURVEY HAS BEEN UNDERTAKEN
- (A) EASEMENT TO DRAIN WATER 10.2 & 13.4 WIDE (AC 424785)
(B) EASEMENT 6.095 WIDE (B309159) - SYDNEY WATER PIPELINE
(C) EASEMENT TO DRAIN WATER 13.4 WIDE (AC424784)
(G) PROPOSED EASEMENT FOR SERVICES 5 WIDE
(H) RIGHT OF ACCESS 21 WIDE AND VARIABLE WIDTH
(L) EASEMENT FOR OVERLAND FLOW 5 WIDE
(M) EASEMENT FOR PEDESTRIAN ACCESS 40 WIDE & VARIABLE WIDTH





APPENDIX C

RESIDUAL CONTAMINATION SUMMARY



Table C-1: Residual Chemical Contamination in Soil Data
Clyde WARP - Lot 64

						TRH Aliphatic/Aromatic Split														TRH Silica Gel Cleanup											
						TRH >C5-C7 (Benzene) Aromatic	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C16-C21 Aliphatic	TRH >C21-C35 Aliphatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	TRH >C10-C16 Fraction SG less Naphthalene	TRH >C10-C14 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C10-C40 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36	TRH >C34-C40 Silica Gel Cleanup				
EQL						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	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				
						0.1	10	10	10	10	10	10	0.1	1	10	10	10	10	50	20	50	50	50	50	100	50	100				
Clyde WARP SSSL (Direct Contact - Commercial)							1200000	24000	24000	24000	470000	470000		9500	9500	9500	7100	7100													
Clyde WARP SSSL (Direct Contact - Construction Worker)							310000	62000	62000	62000	370000	370000		25000	25000	25000	18000	18000													
Clyde WARP SSSL (Direct Contact - IMW)							3700000	740000	740000	740000	4400000	4400000		300000	300000	300000	220000	220000													
Clyde WARP SSSL (Vapour Intrusion - Commercial) 0.15m							480	760	430	4300				110	280	430															
Clyde WARP SSSL (Vapour Intrusion - Commercial) >1-2m							610	980	600	8300				150	430	2800															
Clyde WARP SSSL (Vapour Intrusion - Commercial) >2 - 4m							880	1400	980	17000				230	750	5100															
Clyde WARP SSSL (Vapour Intrusion - Commercial) > 4m							1400	2200	1800	33000				420	1400	9800															
Clyde WARP SSSL (Vapour Intrusion - Construction Worker)							NL	NL	NL	NL				NL	NL	NL															
Clyde WARP SSSL (Vapour Intrusion - IMW)							NL	NL	NL	NL				NL	NL	NL	NL	NL													
NEPM (1999) Management Limits - Commercial/Industrial (coarse)																				1000					3500		10000				
Field_ID	Sampled_Date_Time	Lab_Report_Number	Location_Code	Sample_Type	Location_Type																										
D01_150719	15/07/2019	665944	TP19/23	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
D01_150719	15/07/2019	669352	TP19/23	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1500	2500	27,500	-	16,000	21,000	10,000	1700				
D01_150719	16/07/2019	666164	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
D01_160719	16/07/2019	669352	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<20	<50	570	-	120	390	450	390				
D01_20200714	14/07/2020	732060	MW20/13	Field_D	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240	220	820	-	400	120	180	<100				
D02_150719	15/07/2019	665944	TP19/77	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
D02_150719	15/07/2019	669352	TP19/77	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1100	2200	17,700	-	12,000	14,000	4600	1700				
D02_160719	16/07/2019	666164	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
D02_160719	16/07/2019	669352	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<20	<50	518	-	78	320	440	400				
D03_20191120	20/11/2019	689333	TP19/87	Field_D		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW12/01_0.15	27/02/2012	328708	MW12/01	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW12/01_2.0	27/02/2012	328708	MW12/01	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW12/01_2.5	27/02/2012	328708	MW12/01	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW12/20_0.4	6/03/2012	329576	MW12/20	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW12/20_2.0	6/03/2012	329576	MW12/20	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW12/20_2.4	6/03/2012	329576	MW12/20	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
MW20/03_0.8	13/07/2020	732060	MW20/03	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<100	-	<100	<100	<100	<100				
MW20/03_3.0	13/07/2020	732060	MW20/03	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2100	2400	6800	-	3700	1500	1000	220				
MW20/03_6.0	13/07/2020	732060	MW20/03	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<100	-	<100	<100	<100	<100				
MW20/04_1.0	13/07/2020	732060	MW20/04	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<100	-	<100	100	<100	<100				
MW20/04_3.5	13/07/2020	732060	MW20/04	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	390	590	3040	-	1700	560	950	270				
MW20/04_4.5	13/07/2020	732060	MW20/04	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<100	-	<100	<100	<100	<100				
MW20/05_3.5	13/07/2020	732060	MW20/05	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<100	-	<100	120	<100	<100				
MW20/06_6.0	14/07/2020	732060	MW20/06	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1500	2400	9900	-	6600	3700	1800	330				
MW20/07_6.0	14/07/2020	732060	MW20/07	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	550	590	2090	-	1100	340	440	<100				
MW20/13_6.0	14/07/2020	732060	MW20/13	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	110	234	-	170	<100	<100	<100				
MW20/17_3.0	9/07/2020	732060	MW20/17	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	480	2780	-	2400	1200	230	240				
QC18_102	7/02/2018	ES1804294	TP18/27	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2320	1390	2320	15,300	16,200	10,000	12,000	3950				
QC18_103	7/02/2018	ES1804294	TP18/27	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,500	8820	11,500	16,900	16,400	8080	4880	<100				
SB5B_1.0	5/02/2018	ES1804047	SB5B	Normal	Soil Bore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
SB5B_4.0	5/02/2018	ES1804047	SB5B	Normal	Soil Bore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
T01_150719	15/07/2019	ES1922291	TP19/23	Interlab_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
T01_160719	16/07/2019	ES1922517	TP19/20	Interlab_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
T01_20200714	14/07/2020	ES2024476	MW20/13	Interlab_D	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	490	250	490	1670	1830	1010	1100	410				
T02_150719	15/07/2019	ES1922291	TP19/77	Interlab_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
T02_160719	16/07/2019	ES1922517	TP19/20	Interlab_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
T03_050218	5/02/2018	184769	SB5B	Interlab_D	Soil Bore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6200	-	8500	-				
TP18/27_0.3	7/02/2018	ES1804294	TP18/27	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<50	<50	<50	<50	<50	<100	<100	<100				
TP18/27_1.2	7/02/2018	ES1804294	TP18/2																												



Table C-1: Residual Chemical Contamination in Soil Data
Clyde WARP - Lot 64

	TRH Aliphatic/Aromatic Split														TRH Silica Gel Cleanup													
	TRH >C5-C7 (benzene) Aromatic	TRH >C6-C8 Aliphatic	TRH >C8-C10 Aliphatic	TRH >C10-C12 Aliphatic	TRH >C12-C16 Aliphatic	TRH >C16-C21 Aliphatic	TRH >C21-C35 Aliphatic	TRH >C7-C8 Aromatic	TRH >C8-C10 Aromatic	TRH >C10-C12 Aromatic	TRH >C12-C16 Aromatic	TRH >C16-C21 Aromatic	TRH >C21-C35 Aromatic	TRH >C10-C16 Fraction SG less Naphthalene	TRH >C10-C14 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C10-C40 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36	TRH >C34-C40 Silica Gel Cleanup						
	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	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg						
EQL	0.1	10	10	10	10	10	10	0.1	1	10	10	10	10	50	20	50	50	50	50	100	50	100						
Clyde WARP SSTL (Direct Contact - Commercial)		1200000	24000	24000	24000	470000	470000		9500	9500	9500	7100	7100															
Clyde WARP SSTL (Direct Contact - Construction Worker)		310000	62000	62000	62000	370000	370000		25000	25000	25000	18000	18000															
Clyde WARP SSTL (Direct Contact - IMW)		3700000	740000	740000	740000	4400000	4400000		300000	300000	300000	220000	220000															
Clyde WARP SSTL (Vapour Intrusion - Commercial) 0.15m		480	760	430	4300				110	280	430																	
Clyde WARP SSTL (Vapour Intrusion - Commercial) >1-2m		610	980	600	8300				150	430	2800																	
Clyde WARP SSTL (Vapour Intrusion - Commercial) >2 - 4m		880	1400	980	17000				230	750	5100																	
Clyde WARP SSTL (Vapour Intrusion - Commercial) > 4m		1400	2200	1800	33000				420	1400	9800																	
Clyde WARP SSTL (Vapour Intrusion - Construction Worker)		NL	NL	NL	NL				NL	NL	NL																	
Clyde WARP SSTL (Vapour Intrusion - IMW)		NL	NL	NL	NL				NL	NL	NL	NL	NL															
NEPM (1999) Management Limits - Commercial/Industrial (coarse)		NL	NL	NL	NL				NL	NL	NL	NL	NL			1000				3500		10000						
Field_ID	Sampled_Date_Time	Lab_Report_Number	Location_Code	Sample_Type	Location_Type	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
TP19/23_1.5	15/07/2019	665944	TP19/23	Normal	Test Pit	3.6	<100	330	1300	2700	3800	12,000	66	140	530	3200	10,000	32,000	-	1900	2800	21,900	-	14,000	17,000	6000	1100	
TP19/23_1.5	15/07/2019	669352	TP19/23	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/23_3.5	15/07/2019	665944	TP19/23	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/23_3.5	15/07/2019	669352	TP19/23	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	<20	<50	<50	<50	<50	<100	<50	<100	<100	<100	<100		
TP19/24_1.5	15/07/2019	665944	TP19/24	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/24_1.5	15/07/2019	669352	TP19/24	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	51	120	1981	-	1200	1500	730	240	-	-	-		
TP19/24_3.0	15/07/2019	665944	TP19/24	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/24_3.0	15/07/2019	669352	TP19/24	Normal	Test Pit	<0.5	<50	200	2400	3500	2000	910	0.8	14	240	1800	1200	460	-	5000	6000	11,720	-	5800	4200	920	150	
TP19/24_4.2	15/07/2019	665944	TP19/24	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/24_4.2	15/07/2019	669352	TP19/24	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	<20	<50	<50	-	<50	<100	<50	<100	<100	<100	<100		
TP19/25_0.5	15/07/2019	665944	TP19/25	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/25_0.5	15/07/2019	669352	TP19/25	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	<20	<50	51	-	51	<100	<50	<100	<100	<100	<100		
TP19/25_1.3	15/07/2019	665944	TP19/25	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/25_1.3	15/07/2019	669352	TP19/25	Normal	Test Pit	<1	<100	360	1200	2400	2500	6600	100	95	130	1700	4500	13,000	-	2100	3100	17,800	-	10,000	13,000	5700	1100	
TP19/74_1.5	19/07/2019	666846	TP19/74	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/74_2.5	19/07/2019	666846	TP19/74	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/75_0.5	19/07/2019	666846	TP19/75	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/75_1.5	19/07/2019	666846	TP19/75	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/75_1.5	19/07/2019	669352	TP19/75	Normal	Test Pit	<0.2	<20	310	820	1700	1500	2100	1.1	6.3	83	510	740	1500	-	3300	4800	17,100	-	8100	9500	5700	1400	
TP19/75_3.0	19/07/2019	666846	TP19/75	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/76_1.5	19/07/2019	666846	TP19/76	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/76_2.2	19/07/2019	666846	TP19/76	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/76_2.2	19/07/2019	669352	TP19/76	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	<20	<50	<50	-	<50	<100	<50	<100	<100	<100	<100		
TP19/77_1.5	15/07/2019	665944	TP19/77	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/77_1.5	15/07/2019	669352	TP19/77	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/77_4.0	15/07/2019	665944	TP19/77	Normal	Test Pit	24	1000	2300	16,000	27,000	19,000	22,000	75	550	2200	11,000	12,000	23,000	-	-	-	-	-	-	-	-		
TP19/77_4.0	15/07/2019	669352	TP19/77	Normal	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/83_1.0	20/11/2019	689333	TP19/83	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/83_3.0	20/11/2019	689333	TP19/83	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/84_1.0	20/11/2019	689333	TP19/84	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/84_2.0	20/11/2019	689333	TP19/84	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/85_1.0	20/11/2019	689333	TP19/85	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/85_2.0	20/11/2019	689333	TP19/85	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/85_3.0	20/11/2019	689333	TP19/85	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/87_1.0	20/11/2019	689333	TP19/87	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/87_2.0	20/11/2019	689333	TP19/87	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
TP19/87_3.0	20/11/2019	689333	TP19/87	Normal		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Statistical Summary						7	7	7	7	7	7	7	7	7	7	7	7	7	40	40	40	7	41	40	41	40		
Number of Results						3	1	7	7	7	7	7	7	7	7	7	7	6	26	27	31	6	32	31	28	25		
Number of Detects						<0.2	<20	200	180	330	290	330	0.8	6.3	27	240	220	230	<50	<20	<50	<50	<50	<100	<50	<100		
Minimum Concentration						3.6	1000	200	180	330	290	330	0.8	6.3	27	240	220	230	490	51	110	51	1830	51	100	180	130	
Minimum Detect						24	1000	2300	16000	27000	19000	22000	100	550	2200	11000	12000	32000	14900	30000	38000	76600	21900	38000	35000	13000	6600	
Maximum Concentration						24	1000	2300	16000	27000	19000	22000	100	550	2200	11000	12000	32000	14900	30000	38000	76600	21900	38000	35000	13000	6600	
Maximum Detect						5.3	169	727	4443	8090	6156	8991	39	141	630	3764	5494	12170	4879	2447	3363	10406	13765	5888	5814	2256	769	
Average Concentration						0.5	25	360	1300	2700	2500	6600	27	95	240	1800	4500	13000	2320	280	485	2345	16400	1700	1150	510	240	
Median Concentration						8.8	367	754	5945	10489	7289	8869	41	189	803	4101	5017	12334	5853	5921	7704	17118	9020	8886	8751	3331	1330	
Standard Deviation						0	1	2	5	2	0	0	0	3	3	4	3	4	0	0	16	0	0	0	15	0	0	
Number of Guideline Exceedances						0	1	2	5	2	0	0	0	3	3	4	3	4	0	0	16	0	0	0	15			

	BTEX							Naphthalene	TRH NEPM (1999)						TRH NEPM (2013)						Metals			PAH								
	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene	TRH C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C15-C36 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction	Chromium	Chromium (hexavalent)	Chromium (Trivalent)	Benz(a) pyrene	Benz(a)pyrene TEQ (half IOR)	Benz(a)pyrene TEQ (LOR)	Benz(a)pyrene TEQ (zero)	Benz(a)pyrene TEQ (lower bound)*	Benz(a)pyrene TEQ (upper bound)*	Benz(a)pyrene TEQ (medium bound)*	
EQL	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	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	mg/kg	mg/kg	mg/kg	
	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.5	10	20	50		50	50	10	10	50	50	100	50	100	2	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Clyde WARP SSSL (Direct Contact - Commercial)	400							9800								28000		17000	27000		27000	21000	3600								40	
Clyde WARP SSSL (Direct Contact - Construction Worker)	1200							67000								69000		45000	64000		64000	8200	1400								200	
Clyde WARP SSSL (Direct Contact - IMW)	15000							810000								830000		540000	770000		770000	100000	17000								3000	
Clyde WARP SSSL (Vapour Intrusion - Commercial) 0.15m	3.2							NL								600		NL														
Clyde WARP SSSL (Vapour Intrusion - Commercial) >1-2m	3.2							NL								770		NL														
Clyde WARP SSSL (Vapour Intrusion - Commercial) >2 - 4m	3.2							NL								NL		NL														
Clyde WARP SSSL (Vapour Intrusion - Commercial) > 4m	3.2							NL								NL		NL														
Clyde WARP SSSL (Vapour Intrusion - Construction Worker)	NL							NL								NL		NL														
Clyde WARP SSSL (Vapour Intrusion - IMW)	NL							NL								NL		NL														
NEPM (1999) Management Limits - Commercial/Industrial (coarse)															700		1000		3500		10000											

Field_ID	Sampled_Date_Time	Lab_Report_Number	Location_Code	Sample_Type	Location_Type	2.7	28	7.9	12	30	42	-	22	190	4300	31,000	-	12,000	47,300	250	170	6700	6678	34,000	45,200	4500	580	-	-	16	-	-	-	27	27	27
D01_150719	15/07/2019	665944	TP19/23	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D01_150719	15/07/2019	669352	TP19/23	Field_D	Test Pit	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	520	-	210	730	<20	<20	<50	<50	1100	1410	310	36	-	-	-	-	-	-	-	-	-
D01_160719	16/07/2019	666164	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
D01_160719	16/07/2019	669352	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
D01_20200714	14/07/2020	732060	MW20/13	Field_D	Monitoring Well	<0.1	0.8	1.1	1.1	2	3.1	-	1 - 6.1	120	310	620	-	220	1150	230	230	360	353.9	100	460	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
D02_150719	15/07/2019	665944	TP19/77	Field_D	Test Pit	<0.5	3.2	2	1	2.4	3.4	-	29	<100	1700	25,000	-	9500	36,200	<100	<100	3200	3171	28,000	33,900	2700	380	-	-	-	-	-	-	-	-	-
D02_150719	15/07/2019	669352	TP19/77	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
D02_160719	16/07/2019	666164	TP19/20	Field_D	Test Pit	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5 - 0.7	27	170	750	-	71	991	64	64	290	289.3	1100	1620	230	59	-	-	<0.5	-	-	-	<0.5	1.2	0.6
D02_160719	16/07/2019	669352	TP19/20	Field_D	Test Pit	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
D03_20191120	20/11/2019	689333	TP19/87	Field_D		0.2	6.1	2.5	3.5	5.8	9.4	-	11	540	2800	16,000	-	4400	23,200	460	440	4300	4289	17,000	22,500	1200	-	-	-	-	-	-	-	-	-	
MW12/01_0_15	27/02/2012	328708	MW12/01	Normal	Monitoring Well	<0.5	<0.5	<0.5	<0.5	<1	<1.5	<1.5	<0.5	<10	<50	<100	180	130	130 - 205	<20	<20	<50	<50	180	-	<100	-	-	-	-	-	-	-	-	-	
MW12/01_2.0	27/02/2012	328708	MW12/01	Normal	Monitoring Well	1.2	780	3.4	6	14	20	800 - 804.6	16 - 33	1200	7400	57,000	74,000	17,000	81,000 - 81,400	1300	510	15,000	15,000	61,000	-	7900	3000	<1	3000	18	-	-	-	-	-	-
MW12/01_2.5	27/02/2012	328708	MW12/01	Normal	Monitoring Well	<0.5	<0.5	<0.5	<0.5	<1	<1.5	<1.5	<0.5	<10	480	3700	4800	1100	5280 - 5300	<20	<20	930	930	4100	-	490	170	-	-	0.9	-	-	-	-	-	-
MW12/20_0.4	6/03/2012	329576	MW12/20	Normal	Monitoring Well	<0.5	<0.5	<0.5	<0.5	<1	<1.5	<1.5	<0.5	<10	<50	150	350	200	350 - 375	<20	<20	<50	<50	330	-	<100	17	-	-	7.9	-	-	-	-	-	-
MW12/20_2.0	6/03/2012	329576	MW12/20	Normal	Monitoring Well	<0.5	<0.5	<0.5	<0.5	<1	<1.5	<1.5	<0.5	<10	76	2100	4700	2600	4776 - 4800	<20	<20	180	180	4200	-	1100	18	-	-	-	-	-	-	-	-	-
MW12/20_2.4	6/03/2012	329576	MW12/20	Normal	Monitoring Well	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	-	-	-	-	-	-	-	-	-
MW20/03_0.8	13/07/2020	732060	MW20/03	Normal	Monitoring Well	<0.1	<0.1	<0.1	0.3	2.2	2.5	-	<0.5	<20	59	100	-	56	215	<20	<20	<50	<50	<100	<100	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/03_3.0	13/07/2020	732060	MW20/03	Normal	Monitoring Well	0.3	0.2	3.9	1	2.5	3.5	-	5 - 9.1	350	2600	5200	-	1600	9400	620	610	2800	2790.9	2200	5340	340	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/03_6.0	13/07/2020	732060	MW20/03	Normal	Monitoring Well	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	330	970	-	<50	1300	35	35	520	520	240	760	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/04_1.0	13/07/2020	732060	MW20/04	Normal	Monitoring Well	<0.1	<0.1	<0.1	0.2	2.2	2.4	-	<0.5	<20	<20	150	-	<50	150	<20	<20	<50	<50	190	190	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/04_3.5	13/07/2020	732060	MW20/04	Normal	Monitoring Well	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	52	-	<50	52	24	24	<50	<50	<100	<100	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/04_4.5	13/07/2020	732060	MW20/04	Normal	Monitoring Well	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	<20	<50	-	<50	<50	<20	<20	<50	<50	<100	<100	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/05_3.5	13/07/2020	732060	MW20/05	Normal	Monitoring Well	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	20	160	-	110	290	<20	<20	<50	<50	160	160	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/06_6.0	14/07/2020	732060	MW20/06	Normal	Monitoring Well	<1	5.2	1.3	2	4	6	-	3.2 - 8.9	<200	2200	14,000	-	1600	17,800	<200	<200	4400	4391.1	9800	14,990	790	-	<1	-	2.8	-	-	-	4.5	4.5	4.5
MW20/07_6.0	14/07/2020	732060	MW20/07	Normal	Monitoring Well	<0.1	0.6	0.9	1.4	5.7	7.1	-	1.5 - 7.6	<470	820	2200	-	710	3730	970	960	940	932.4	890	1990	160	-	<1	-	0.5	-	-	-	0.7	1.4	1
MW20/13_6.0	14/07/2020	732060	MW20/13	Normal	Monitoring Well	<0.1	<0.1	0.2	0.2	0.3	0.4	-	<0.5 - 2	<20	94	350	-	<50	444	49	48	170	168	190	360	<100	-	<1	-	<0.5	-	-	-	<0.5	1.2	0.6
MW20/17_3.0	9/07/2020	732060	MW20/17	Normal	Monitoring Well	<0.1	<0.1	<0.1	<0.1	<0.2	<0.3	-	<0.5	<20	190	4000	-	340	4530	<20	<20	580	580	2900	3920	440	-	<1	-	1.9	-	-	-	3	3	3
QC18_102	7/02/2018	ES1804294	TP18/27	Field_D	Test Pit	0.3	12.5	4.5	7.1	13.9	21	38.3	4	104	2040	20,800	-	9380	32,200	168	130	3750	3750	28,100	36,300	4460	-	-	-	-	-	-	-	-	-	-
QC18_103	7/02/2018	ES1804294	TP18/27	Field_D	Test Pit	0.7	1.1	5.4	4	6	10	17.2	22	234	34,000	11,100	-	480	45,600	521	504	34,400	34,400	6810	41,200	<100	-	-	-	-	-	-	-	-	-	-
SB5B_1.0	5/02/2018	ES1804047	SB5B	Normal	Soil Bore	<0.2	<0.5	0.6	1.6	2.2	3.8	4.4	1 - 3	11	240	11,000	-	10,100	21,300	22	18	340	340	19,200	24,000	4440	37,800	-	-	<0.5	0.6	1.2	<0.5	-	-	-
SB5B_4.0	5/02/2018	ES1804047	SB5B	Normal	Soil Bore	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<1 - 0.6	12	340	5580	-	2640	8560	24	24	720	720	7090	9350	1540	160	-	-	2.8	5.6	5.6	5.6	-	-	-
T01_150719	15/																																			



Table C-1: Residual Chemical Contamination in Soil Data
Clyde WARP - Lot 64

	BTEX							Naphthalene	TRH NEPM (1999)						TRH NEPM (2013)						Metals			PAH							
	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene	TRH C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C15-C36 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH C6-C10 Fraction	TRH C6-C10 less BTEX	TRH >C10-C16 Fraction	TRH >C10-C16 Fraction less N	TRH >C16-C34 Fraction	TRH >C10-C40 Fraction	TRH >C34-C40 Fraction	Chromium	Chromium (hexavalent)	Chromium (Trivalent)	Benz(a) pyrene	Benz(a)pyrene TEQ (half LOR)	Benz(a)pyrene TEQ (LOR)	Benz(a)pyrene TEQ (zero)	Benz(a)pyrene TEQ (lower bound)*	Benz(a)pyrene TEQ (upper bound)*	Benz(a)pyrene TEQ (medium bound)*
EQL	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.5	10	20	50		50	50	10	10	50	50	100	50	100	2	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Clyde WARP SSSL (Direct Contact - Commercial)	400							9800							28000		17000	27000		27000	21000	3600									40
Clyde WARP SSSL (Direct Contact - Construction Worker)	1200							67000							69000		45000	64000		64000	8200	1400									200
Clyde WARP SSSL (Direct Contact - IMW)	15000							810000							830000		540000	770000		770000	100000	17000									3000
Clyde WARP SSSL (Vapour Intrusion - Commercial) 0.15m	3.2							NL							600		NL														
Clyde WARP SSSL (Vapour Intrusion - Commercial) >1-2m	3.2							NL							770		NL														
Clyde WARP SSSL (Vapour Intrusion - Commercial) >2 - 4m	3.2							NL							NL		NL														
Clyde WARP SSSL (Vapour Intrusion - Commercial) > 4m	3.2							NL							NL		NL														
Clyde WARP SSSL (Vapour Intrusion - Construction Worker)	NL							NL							NL		NL														
Clyde WARP SSSL (Vapour Intrusion - IMW)	NL							NL							NL		NL														
NEPM (1999) Management Limits - Commercial/Industrial (coarse)															700		1000		3500		10000										

Field_ID	Sampled_Date_Time	Lab_Report_Number	Location_Code	Sample_Type	Location_Type																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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Table C-2: Residual Groundwater Contamination in Soil Data
Clyde WARP - Lot 64

	MNA					PFAS - Fluorotelomer Sulfonates				PFAS - Long Chain PFCA								PFAS - Long Chain PFSA						PFAS - Short Chain PFCA				S - Short Chain P		
	Ferrous Iron - Fe2+	Methane	Nitrate (as N)	Sulphate	Sulphate (Filtered)	4:2 Fluorotelomer sulfonic acid (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonate	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Perfluorooctanoate (PFOA)	Perfluorononanoic acid (PFNA)	Perfluorodecanoic acid (PFDA)	Perfluoroundecanoic acid (PFUnA)	Perfluorododecanoic acid (PFDoA)	Perfluorotetradecanoic acid (PFTeDA)	Perfluorotridecanoic acid (PFTrDA)	Perfluorohexanesulfonic acid (PFHxS)	Perfluoroheptane sulfonic acid (PFHpS)	Perfluorooctanesulfonic acid (PFOS)	Perfluoronanesulfonic acid (PFNS)	Perfluorodecane sulfonic acid (PFDS)	Perfluoropropanesulfonic acid (PFPrS)	Sum of PFHxS and PFOS	Perfluorobutanoic acid	Perfluoropentanoic acid (PFPeA)	Perfluorohexanoic acid (PFHxA)	Perfluoroheptanoic acid (PFHpA)	Perfluorobutanesulfonic acid (PFBS)	Perfluoropentane sulfonic acid (PPPeS)	
	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.05	0.01	0.01	2	1	0.05	0.05	0.05	0.05	0.01	0.02	0.02	0.02	0.02	0.05	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.1	0.02	0.02	0.02	0.02	0.02	0.05
Clyde WARP SSSL - GW VI - Commercial																														
Clyde WARP SSSL - GW VI - Construction																														
Clyde WARP SSSL - GW VI - IMW																														
NEMP (2020) Freshwater - Slightly to moderately disturbed systems (95%)										220									0.13											
NEMP (2020) Interim Marine - High conservation value systems (99%)										19									0.00023											
NEPM (2013) - Marine Water																														
NEPM (2013) - Recreational				5000	5000																									
NHMRC (2019) HBGV - Recreational Water										10							2		2				2							

Field_ID	Location_Code	Well	Sampled_Date_Time																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Statistical Summary																															
Number of Results	18	18	18	1	17	18	18	18	18	18	18	18	18	18	18	18	18	18	1	18	1	18	18	18	18	18	18	18	18	18	
Number of Detects	18	13	5	1	17	0	0	0	0	12	5	0	0	0	0	0	13	0	10	0	0	0	13	0	2	10	7	6	4	0	
Minimum Concentration	3.31	<0.01	<0.01	1300	9	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05		
Minimum Detect	3.31	0.012	0.02	1300	9	ND	ND	ND	ND	0.01	0.02	ND	ND	ND	ND	ND	0.03	ND	0.02	ND	ND	ND	0.06	ND	0.08	0.02	0.02	0.02	0.03	ND	
Maximum Concentration	359	12.1	0.27	1300	4460	<0.05	<0.05	<0.05	<0.05	0.13	0.06	<0.02	<0.02	<0.02	<0.05	<0.02	0.9	<0.02	0.41	<0.01	<0.02	<0.01	1.21	<0.1	0.1	0.24	0.13	0.2	0.12	<0.05	
Maximum Detect	359	12.1	0.27	1300	4460	ND	ND	ND	ND	0.13	0.06	ND	ND	ND	ND	ND	0.9	ND	0.41	ND	ND	ND	1.21	ND	0.1	0.24	0.13	0.2	0.12	ND	
Average Concentration	69	0.93	0.03		1410	0.024	0.025	0.024	0.024	0.031	0.015	0.0097	0.0097	0.0097	0.024	0.0097	0.24	0.0097	0.061		0.0097		0.3	0.049	0.019	0.064	0.033	0.035	0.026	0.025	
Median Concentration	40.25	0.033	0.005	1300	1420	0.025	0.025	0.025	0.025	0.01	0.01	0.01	0.01	0.01	0.025	0.01	0.07	0.01	0.025	0.005	0.01	0.005	0.14	0.05	0.01	0.02	0.01	0.01	0.01	0.025	
Standard Deviation	90	2.9	0.065		1153	0.0047	0	0.0047	0.0047	0.036	0.013	0.0012	0.0012	0.0012	0.0047	0.0012	0.32	0.0012	0.096		0.0012		0.38	0.0059	0.026	0.083	0.039	0.052	0.036	0	
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	

	PFAS - Sulfonamides						PFAS Sums				TRH Silica Gel Cleanup								BTEX							Naphthalene	TRH NEPM (1999)					TRH NEPM (2013)			
	N-Ethyl perfluorooctane sulfonamidoethanol (EtFOSE)	N-Methyl perfluorooctane sulfonamide (MeFOSA)	N-Methyl perfluorooctane sulfonamidoethanol (N-Me-FOSE)	N-Ethyl perfluorooctane sulfonamidoacetic acid (Et)	N-Methyl perfluorooctane sulfonamidoacetic acid	Perfluorooctanesulfonamide (PFOSA)	Sum of enHealth PFAS (PFHxS + PFOS + PFOA)	Sum of PFAS	Sum of PFAS (WA DER List)	Sum of US EPA PFAS (PFOS + PFOA)	TRH >C10-C16 Fraction SG less Naphthalene	TRH >C10-C14 Silica Gel Cleanup	TRH >C10-C16 Silica Gel Cleanup	TRH >C10-C36 Silica Gel Cleanup	TRH >C10-C40 Silica Gel Cleanup	TRH >C15-C28 Silica Gel Cleanup	TRH >C16-C34 Silica Gel Cleanup	TRH >C29-C36	TRH >C34-C40 Silica Gel Cleanup	Benzene	Toluene	Ethylbenzene	Xylene (o)	Xylene (m & p)	Xylene Total	BTEX	Naphthalene	TRH C6-C9 Fraction	TRH >C10-C14 Fraction	TRH >C15-C28 Fraction	TRH >C29-C36 Fraction	TRH >C10-C36 Fraction	TRH (NEPM) C>10-40 Sum	TRH C6-C10 Fraction	TRH C6-C10 less BTEX
EQL	0.05	0.05	0.05	0.02	0.02	0.02	0.01	0.01	0.01	0.01	100	50	100	50	100	100	100	50	100	1	2	2	2	2	2	1	0.004	20	50	100	50	50	0.1	20	20
Clyde WARP SSTL - GW VI - Commercial																				5000							13000								6200
Clyde WARP SSTL - GW VI - Construction																				NL							NL						-	NL	
Clyde WARP SSTL - GW VI - IMW																				NL							NL						-	NL	
NEMP (2020) Freshwater - Slightly to moderately disturbed systems (95																																			
NEMP (2020) Interim Marine - High conservation value systems (99%)																																			
NEPM (2013) - Marine Water																				500							50								
NEPM (2013) - Recreational																				10	8000	3000			6000										
NHMRC (2019) HBGV - Recreational Water																																			

Field_ID	Location_Code	Well	Sampled_Date_Time																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</
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Statistical Summary																																		
Number of Results	18	18	18	18	18	18	1	18	18	1	17	17	17	17	17	17	17	17	18	18	18	18	18	18	17	18	18	18	18	18	18	18	18	18
Number of Detects	0	0	0	0	0	0	0	13	13	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	3	1	4	9	1	9	9	1	1
Minimum Concentration	<0.05	<0.05	<0.05	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<100	<50	<100	<50	<100	<100	<50	<100	<1	<1	<1	<1	<2	<2	<1	<0.004	<20	<50	<100	<50	<50	<0.1	<20	<20
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	0.07	0.07	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	4	2	6	8	15	4.73	120	80	120	200	120	0.12	150	140	
Maximum Concentration	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.01	1.71	1.65	<0.01	<100	<50	<100	<50	<100	<100	<50	<100	3	<2	4	2	6	8	15	19	120	240	2070	200	2310	2.39	150	140
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	1.71	1.65	ND	ND	ND	ND	ND	ND	ND	ND	ND	3	ND	4	2	6	8	15	19	120	240	2070	200	2310	2.39	150	140
Average Concentration	0.025	0.025	0.025	0.011	0.011	0.011		0.48	0.45		50	25	50	25	50	50	25	50	0.64	0.97	1.1	1	1.3	1.4	1.4	0.8	16	56	287	35	322	0.34	18	17
Median Concentration	0.025	0.025	0.025	0.01	0.01	0.01	0.005	0.195	0.185	0.005	50	25	50	25	50	50	25	50	0.5	1	1	1	1	1	0.5	0.002	10	25	85	25	75	0.085	10	10
Standard Deviation	0	0	0	0.0035	0.01	0.0035		0.62	0.58		0	0	0	0	0	0	0	0	0.59	0.12	0.72	0.27	1.2	1.6	3.5	2.8	26	67	477	41	553	0.57	33	31
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0

Field_ID	Location_Code	Well	Sampled_Date_Time																													
BH210	BH210	BH210	23/11/2023	<100	<100	<100	<100	-	<1	-	<1	-	<1	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
D01_231123	MW20/02A	MW20/02A	23/11/2023	<100	<100	<100	<100	-	<1	-	<1	-	<1	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/01A	MW20/01A	MW20/01A	23/11/2023	<100	<100	260	<100	-	6	-	<1	-	6	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/02A	MW20/02A	MW20/02A	23/11/2023	<100	<100	<100	<100	-	<1	-	<1	-	<1	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/03	MW20/03	MW20/03	24/11/2023	640	620	1750	<100	-	4	-	<1	-	4	<0.004	1.22	<0.004	0.284	0.411	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	0.017	<0.002
MW20/04	MW20/04	MW20/04	23/11/2023	200	200	510	<100	-	1	-	<1	-	1	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/08	MW20/08	MW20/08	23/11/2023	<100	<100	<100	<100	-	<1	-	<1	-	<1	<0.004	0.006	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/09	MW20/09	MW20/09	23/11/2023	<100	<100	270	<100	-	3	-	<10	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/10	MW20/10	MW20/10	24/11/2023	<100	<100	<100	<100	-	<1	-	<10	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/11	MW20/11	MW20/11	24/11/2023	110	110	190	<100	-	<10	-	<1	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/12	MW20/12	MW20/12	24/11/2023	<100	<100	200	<100	-	<10	-	<1	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/14	MW20/14	MW20/14	23/11/2023	<100	<100	520	<100	-	1	-	2	-	<1	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/15	MW20/15	MW20/15	24/11/2023	<100	<100	<100	<100	-	<10	-	<10	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/16	MW20/16	MW20/16	24/11/2023	<100	<100	<100	<100	-	<10	-	<1	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/17	MW20/17	MW20/17	24/11/2023	<100	<100	<100	<100	-	1	-	<1	-	1	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW20/18	MW20/18	MW20/18	24/11/2023	<100	<100	<100	<100	-	7	-	<1	-	7	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
MW94/6	MW94/6	MW94/6	24/11/2023	<100	<100	120	<100	-	<10	-	<1	-	<10	<0.004	<0.002	<0.004	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.004	<0.002	<0.004	<0.001	<0.001	<0.001	<0.002	<0.002
T01-231123	BH210	BH210	23/11/2023	220	220	600	<100	<1	-	<5	-	<5	-	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

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Table C-2: Residual Groundwater Contamination in Soil Data
Clyde WARP - Lot 64

				SVOC			
	Phenanthrene	Pyrene	PAHs (Sum of total)	7,12-dimethylbenz(a)anthracene	Benzo(e)pyrene	Coronene	Perylene
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
EQL	0.002	0.001	0.001	0.001	0.001	0.002	0.002
Clyde WARP SSTL - GW VI - Commercial							
Clyde WARP SSTL - GW VI - Construction							
Clyde WARP SSTL - GW VI - IMW							
NEMP (2020) Freshwater - Slightly to moderately disturbed systems (95							
NEMP (2020) Interim Marine - High conservation value systems (99%)							
NEPM (2013) - Marine Water							
NEPM (2013) - Recreational							
NHMRC (2019) HBGV - Recreational Water							

Field_ID	Location_Code	Well	Sampled_Date_Time						
BH210	BH210	BH210	23/11/2023	<0.002	<0.001	0.009	<0.001	<0.001	<0.002
D01_231123	MW20/02A	MW20/02A	23/11/2023	<0.002	<0.001	0.006	<0.001	<0.001	<0.002
MW20/01A	MW20/01A	MW20/01A	23/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/02A	MW20/02A	MW20/02A	23/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/03	MW20/03	MW20/03	24/11/2023	<0.002	<0.001	5.44	<0.001	<0.001	<0.002
MW20/04	MW20/04	MW20/04	23/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/08	MW20/08	MW20/08	23/11/2023	0.006	<0.001	0.006	<0.001	<0.001	<0.002
MW20/09	MW20/09	MW20/09	23/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/10	MW20/10	MW20/10	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/11	MW20/11	MW20/11	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/12	MW20/12	MW20/12	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/14	MW20/14	MW20/14	23/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/15	MW20/15	MW20/15	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/16	MW20/16	MW20/16	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/17	MW20/17	MW20/17	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW20/18	MW20/18	MW20/18	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
MW94/6	MW94/6	MW94/6	24/11/2023	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002
T01-231123	BH210	BH210	23/11/2023	<0.01	<0.01	<0.02	-	-	-

Statistical Summary							
Number of Results	18	18	18	17	17	17	17
Number of Detects	1	0	4	0	0	0	0
Minimum Concentration	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002
Minimum Detect	0.006	ND	0.006	ND	ND	ND	ND
Maximum Concentration	<0.01	<0.01	5.44	<0.001	<0.001	<0.002	<0.002
Maximum Detect	0.006	ND	5.44	ND	ND	ND	ND
Average Concentration	0.0015	0.00075	0.3	0.0005	0.0005	0.001	0.001
Median Concentration	0.001	0.0005	0.0005	0.0005	0.0005	0.001	0.001
Standard Deviation	0.0015	0.0011	1.3	0	0	0	0
Number of Guideline Exceedances	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0



APPENDIX D ASBESTOS REGISER

ASBESTOS REGISTER

As outlined within Section 4, asbestos in sub-surface soils have previously been detected. Asbestos management controls outlined within Section 6 are to be implemented during intrusive works the capped extent of Lot 64, which contains the below locations of contamination.

Date identified	ID	Approximate Eastings	Approximate Northings	Approximate Depth (m BGL)	Description	Friable or non-friable	Accessibility
16 and 19 July 2019	TP19/21	317851.7602	6254676.512	2.0	Fibre cement fragments containing asbestos and soft fibrous plaster like material containing asbestos – in soil	Friable plaster and fibre cement, and non-friable fibre cement	Within Capped Area - Inaccessible under normal site conditions – only accessed via excavation
19 July 2019	TP19/81	317908.2702	6254674.853	1.0	Fibre cement fragments containing asbestos – in soil	Non-friable	Within Capped Area - Inaccessible under normal site conditions – only accessed via excavation
19 July 2019	TP19/68	317990.4378	6254637.083	1.0	Fibre cement fragments containing asbestos – in soil	Non-friable	Inaccessible under normal site conditions (outside capped area, riparian corridor) – only accessed via excavation
19 July 2019	TP19/74	317841.9105	6254598.265	1.5	Weathered fibre cement fragments containing asbestos and loose fibre bundles of asbestos – in soil	Friable fibre cement and loose fibre bundles	Inaccessible under normal site conditions (outside capped area, riparian corridor) – only accessed via excavation
19 July 2019	TP19/76	317889.1246	6254593.531	2.2	Fibre cement fragments containing asbestos and loose fibre bundles of asbestos – in soil	Friable fibre cement and loose fibre bundles	Inaccessible under normal site conditions (outside capped area, riparian corridor) – only accessed via excavation



APPENDIX E GROUNDWATER MONITORING PROGRAM



Clyde Western Area Remediation Project

Groundwater Monitoring Program – Stage 2

14 July 2021

Project No.: 0561882

Document details	
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Signature Page

14 July 2021

Clyde Western Area Remediation Project

Groundwater Monitoring Program – Stage 2



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Glossary

Glossary Term	Definition
the Site	Viva Energy owned land on the Camellia Peninsula consisting of the following Lots: Lot 398 DP41324, Lots 100 and 101 of DP 1168951, Lot 101 DP809340, Lot 2 DP 224288, and Lot 1 DP 383675. It includes the Clyde Terminal, the Parramatta Terminal, the Wetland, the Western Area and other land that is currently vacant or leased to third parties
the Western Area	A largely vacant area of land, approximately 40 Ha in size, located in the south western part of the Site. The land previously contained a variety of refinery assets that have now been removed.
the Clyde Terminal	A part of the Site currently operating as an import, storage and distribution terminal for finished petroleum products including diesel, jet and gasoline fuels. The Clyde Terminal makes up the majority of the central part of Site and operates under SSD 5147 and NSW EPL 570
the Parramatta Terminal	A part of the Site Currently used for distribution activities involving bulk road transport. The Parramatta Terminal is located in the north western part of the Site and operates under EPL 660.
the Wetland	A large undeveloped wetland area in the north-eastern part of the Site close to the confluence of the Parramatta and Duck Rivers.
the Project	The proposal to remediate the contaminated soils in the Western Area to a commercial/industrial standard alongside associated infrastructure removal, waste management, soil and groundwater management, land forming and storm water management activities.
the Project Area	The Project Area is the land within the Western Area where the Project will occur. The extent of the Project Area, within the Western Area, is shown on Figure 1, Appendix A.
The Stage 2 Area	The Stage 2 Area encompasses all areas within the Western Area situated to the west of the Stage 1 Area. The Stage 2 Area extends from Devon Street in the North to the Duck River at the southern boundary of the Western Area, the extent of which is shown on Figure 1 and 2.
AEC-4	Area of Environmental Concern 4 (Southern Buried Waste Area). AEC-4 forms part of the extent of remediation and management required within the Stage 2 Area of the WARP, and is situated within the southern portion of the Stage 2 Area. AEC-4 is shown on Figure 1 and 2.

1. INTRODUCTION

Viva Energy Australia Pty Ltd. (Viva Energy) contracted Environmental Resources Management Australia Pty Ltd (ERM) to prepare a Groundwater Monitoring Program (GWMP) to supplement the Groundwater Monitoring and management Plan (GMP) which has been prepared for the Clyde Western Area Remediation Project ('the Project').

This GWMP has been specifically prepared for 'Stage 2' of the Western Area, as defined in the following sections.

1.1 Background

Viva Energy owns the land associated with the former Clyde Refinery, located at Durham Street, Rosehill on the Camellia Peninsula, NSW ('the Site'). Viva Energy currently operates the Clyde Terminal on part of the former Refinery footprint; however a large part of the former refinery land in the south-western portion (the 'Western Area') is no longer required for operational purposes. As such, Viva Energy is proposing to remediate contaminated soils (as required) within the majority of the Western Area, as shown on Figure 2.

Viva Energy intends to remediate the Western Area to a standard suitable to facilitate future commercial / industrial land use. Due to the scale of remedial works, the Project was declared State Significant Development (SSD) and as such, to assess the potential environmental impacts associated with remediation, an Environmental Impact Statement (EIS) containing a Conceptual Remedial Action Plan (RAP) was prepared (AECOM, 2019a).

Based on correspondence between various Project stakeholders, Viva Energy is proposing to stage the remediation of the Western Area as follows:

- Stage 1 – Former Process West;
- Stage 2 – Former Utilities, Movements and Southern Buried Waste Area; and
- Stage 3 – Former Process East.

This groundwater monitoring program presents the groundwater monitoring requirements to be implemented across Stage 2 of the Project.

A GWMP has previously been developed (ERM, 2021a) to be implemented across all stages of the project. However, given the GWMP is associated with a Long Term Environmental Management Plan (LTEMP) for the 'Stage 1 Area', a separate GWMP has been prepared for the Stage 2 Area such that discrete revisions may be made without impacting upon the management of unrelated portions of land.

This GWMP has been developed in accordance with the consent conditions associated with approval SSD 9302 for the Project. Post remediation groundwater monitoring requirements are detailed within this GWMP and will be appended as a requirement of the Long Term Environmental Management Plans (LTEMPs) prepared for portions of the Western Area. The GMP and GWMP will be subject to Site Auditor review and approval.

1.2 Project Objectives

Viva Energy has developed three main project objectives as follows:

- Ensure on-going operational viability of Clyde Terminal assets and associated licences to operate (including but not limited to Safework NSW Major Hazard Facility (MHF) Licence, Environment Protection Licence (EPL) 570 and the SSD 5147 consent conditions).
- Ensure any future redevelopment decisions are considerate of the operational requirements of the existing terminal.
- Meet applicable regulatory requirements.

1.3 Remediation Objectives and Strategy

The remediation objectives for the Project, as defined within the Conceptual RAP (AECOM, 2019b) are as follows:

- *“Remediate the soil and manage groundwater within the appropriate parts of the Western Area (i.e. the Project Area), to enable the land to be used for commercial / industrial purposes in the future, thereby reducing the risk of contamination from the land adversely affecting human health and the environment;*
- *Ensure any approved remediation process that is implemented adheres to all applicable regulatory requirements so as to limit or eliminate (where possible) adverse effects to human health or ecological receptors...”*

These overarching remediation objectives are applicable to all stages of the Project. Where remediation is required, the focus of the works are:

- Addressing petroleum hydrocarbon impacts on shallow soil horizons;
- Addressing soil/sludge impacts in the drainage network and surrounds;
- Removing Light Non-Aqueous Phase Liquid (LNAPL) trapped within shallow soils to the extent practicable¹; and
- Facilitating the effective removal or mitigation of short or long-term contamination risks to the environment.

The requirement to remove LNAPL would be based on the level of potential human health risk for the proposed commercial/ industrial end use. Given the established stability of LNAPL and associated dissolved phase impacts, removal of LNAPL to reduce groundwater migration is not a key driver. As such, the below risk-based approach, forms the basis for the remediation extents and volumes provided for the Western Area:

- Hydrocarbon impacted soils and LNAPL which have been assessed as posing a risk to future commercial/industrial receptors (via vapour intrusion) are proposed to be removed via excavation of shallow soils to the extent practicable;
- LNAPL which has been assessed as not posing a risk to human health, and immobile is proposed to be managed in-situ via Long Term Environmental Management Plans;
- Previous groundwater monitoring undertaken throughout the Western Area has indicated stable to decreasing concentrations of petroleum hydrocarbons, including Total Recoverable Hydrocarbons and Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) in groundwater over time. Risks to human health and ecological receptors from dissolved phase groundwater

¹ Removal of LNAPL ‘to the extent practicable’ is defined as whereby that residual risks are mitigated or able to be managed passively under a Long Term Environmental Management Plan (LTEMP)

concentrations have not been identified in the Western Area based on the current commercial/industrial land-use.

Given the current assessment that hydrocarbon concentrations are stable to decreasing, it is expected that the remediation works proposed will enhance the current natural attenuation processes. The ongoing groundwater management approach presented within this GWMP is therefore aimed at demonstrating the ongoing stability of groundwater conditions and that residual groundwater impacts do not present a risk to the ecological values of receptors, specifically Duck River.

1.4 Stage 2 Remediation Works Overview

The scope of remediation works based on the remediation strategy and objectives for the project is provided within the Stage 2 RAP (ERM, 2021b) and summarised below.

The proposed remediation methodologies were selected for remediation of contaminated soil and LNAPL within the Stage 2 Area:

- 1) Excavation and on-Site bio-piling (hydrocarbon impacted areas); and/or
- 2) Excavation and off-site disposal of soils (for asbestos impacted soils or as a contingency measure).
- 3) On-site management under a constructed engineered cap (specific approach to AEC-4)
- 4) On-site management with management control outlined within an Long Term Environmental Management Plan (LTEMP) (direct contact risks and residual LNAPL)

Table 1-1 Remediation Methodology Summary

Remediation Methodology	Combined Estimated In-situ Volume (m3)	Remediation Area(s) of Environmental Concern
Excavation and on-Site bio-piling (hydrocarbon impacted areas)	5690	■ AEC-3A, ■ AEC-3D, ■ AEC-3E, ■ AEC-14A, ■ AEC-14B
Excavation and off-site disposal of soils (for asbestos impacted soils or as a contingency measure)	701	■ AEC-1 ■ AEC-3B
On-site management under a constructed engineered cap (Specific to AEC-4)	6968 ¹	■ AEC-4
On-site management with management controls outlined within an LTEMP (direct contact risks and residual LNAPL)	-	■ AEC-2, ■ AEC-3C, ■ AEC-5, ■ AEC-8, ■ AEC-11, ■ AEC-14, ■ AEC-15

Notes: 1. AEC-4 excavation volume refers to anticipated volume of uncontaminated surface material required to be re-worked for capping construction

1.5 Objectives of this GWMP

The objective of the GWMP is to meet the requirements of the Development Consent for the WARP (SSD 9302), and supplement the management and mitigation measures provided in the Groundwater Monitoring and Management Plan (GMP), prepared by AECOM (AECOM, 2020).

This groundwater monitoring program (GWMP) has been developed by a suitably qualified expert to monitor changes in groundwater levels and quality during and following completion of the remediation works. The plan addresses the below specific items requested in the conditions of consent:

SSD Condition	Objective	Relevant Section of this GWMP
B22 (b)	include a program to monitor groundwater levels and quality during remediation works and following demobilisation;	Section 3
B22 (d)	detail ongoing monitoring following demobilisation, to verify that natural attenuation of groundwater contamination is occurring over time;	Section 3.5 and Table 2, Appendix B
B22 (e)	include trigger levels for investigating potential adverse impacts to the Duck River, including triggers for indicating if further remediation of groundwater is required;	Section 3.3
B22 (f)	outline contingency actions to be implemented if monitoring indicates that natural attenuation is not occurring, or groundwater is having an adverse impact on the Duck River;	Section 3.7
B22 (g)	monitor the effectiveness of management measures and contingency actions for reducing impacts	Section 3.5 and 3.7
B22 (h)	procedures for reporting changes to groundwater conditions that have the potential to create unacceptable risks to the Duck River.	Section 3.6

2. CONCEPTUAL SITE MODEL AND RISK ASSESSMENT SUMMARY

2.1 Introduction

The detailed Conceptual Site Model (CSM) in relation to soil and groundwater conditions within the Western Area is presented in the Remediation Site Investigation Report (ERM, 2020a) and Human Health and Ecological Risk Assessment (HHERA) (ERM, 2020b). The CSM has been further refined based on supplementary investigations undertaken in the Stage 2 Area as detailed within the Stage 2 Remediation Action Plan ('the Stage 2 RAP', ERM 2021b) and therefore has not been reproduced in full within this GWMP. A brief summary of the environmental setting and nature and extent of groundwater impacts has been provided below for context.

2.2 Geology

The geology of the Site, including the Western Area has been characterised into four units, based on investigations completed by ERM and interpretation of soil bore log data obtained during previous investigations. A summary of the strata identified during historical investigations is detailed below:

- **Unit 1 (Fill Material)** - This material is described as a poorly compacted mixture of silt, clay and gravel, with localised areas of slag, furnace ash and concrete. This material was used to raise the level of the surface of the low-lying tidal swamp/mangrove area along the Parramatta and Duck Rivers. The fill material pinches out to the west;
- **Unit 2 (Estuarine Sediments)** - This unit is comprised of silty clay – clayey silt with occasional sandy lenses and shell fragments to a thickness of approximately 4 m. The unit generally thickens towards the Parramatta River and represents the natural profile prior to development and filling; and
- **Units 3 and 4 (Alluvial Sediments and Residual Clay)** - Tertiary alluvial sediments (up to 20 m thick, including clay with sandy lenses) and residual Ashfield Shale were reported in previous investigations.

With the exception of AEC-4, the average thickness of fill material within the Stage 2 Area is 0.6 m and this thickens to between 1.2- 1.5 m further south in proximity to the Duck River. Fill material is underlain by high plasticity orange red and grey clay (alluvial sediments) across the majority of the Stage 2 Area. Localised areas of backfill sand have been identified surrounding subsurface features (pipework) to depths of up to of 2 m bgl.

During historical site investigations, the following ground conditions were identified specific to AEC-4:

- Heterogeneous fill materials were identified to a depth of 4.0 m bgl. ERM notes that previous test pitting was terminated within fill materials in AEC-4 and as such the potential for deeper fill was noted to exist.
- The fill material is described as poorly compacted mixture of silt, clay and gravel, with localised areas of slag, furnace ash, black sludge and concrete. The RSI specifically identified anthropogenic waste such as bricks, timber, metal pipes, tiles and glass.
- LNAPL and "sludge materials" were identified at variable depths and locations throughout the fill materials.
- Field observations (and subsequent laboratory analysis) identified ACM and fibrous asbestos at a number of locations. Based on the nature and extent of fill within AEC-4, it was considered asbestos may be widely distributed throughout the fill matrix.

The Acid Sulfate Soil (ASS) Risk Map for Parramatta/Prospect (scale 1:25,000) produced by the Department of Land and Water Conservation (1997) identified the Western Area as having a high probability of ASS in estuarine sediments adjacent to the Duck River. The Stage 2 Area is classed

predominantly as Class 4. A small portion of Class 2 area is noted to be present at the south-eastern extent of the Stage 2 area.

Recent investigation within AEC-4 has indicated that PASS conditions may exist in natural soils below the depth of fill material in AEC-4. Other parts of the Stage 2 Area are considered to have low potential for PASS/ ASS to be present.

Despite the low potential for ASS/ PASS presence, the collection of field parameters (including pH) during groundwater sampling has been incorporated into the scope of this GWMP (provided in Section 3) to monitor for potential adverse effects associated with excavation of ASS.

2.3 Hydrogeology

A detailed summary of hydrogeology across the wider Western Area has been provided within the RSI Report (ERM, 2020a). A summary relevant to the Stage 2 Area is provided in Table 2-1 below.

Table 2-1 Hydrogeology Summary (Stage 2 Area)

Stage	Comment
Groundwater Depth	Groundwater is represented as a shallow unconfined water bearing zone within the fill material and estuarine-alluvial sediments at depths between 1-3 m bgl. Preferential pathways for groundwater flow have been identified as being present within sandy lenses within the fill and estuarine units along with anthropogenic structures, such as the on-site storm water drainage network.
Groundwater Flow Direction	Direction of groundwater flow may be subject to fluctuation following rainfall events and localised groundwater mounding, but has generally been established to be towards the bounding Duck and Parramatta Rivers. Inferred groundwater flow direction based upon recent gauging activities since demolition works in 2016 is towards the Duck River, to the south and south-east. Within AEC-4, groundwater flows radially in line with site topography from the central northern portion of the buried waste mound towards the Duck River in the south and south east. Groundwater contours indicate a westerly to south-westerly flow towards an unlined drainage channel west of the buried waste mound. Groundwater flow in the north east is effected by the localised mounding of groundwater associated with unsealed ground.
Hydraulic Gradient	Average hydraulic gradients calculated parallel to groundwater flow direction indicated the hydraulic gradient to range between 0.003 m/m along the up gradient portion of the Western Area to 0.011 m/m across the southern portions of the Western Area. Hydraulic gradients were found to increase with proximity to the Duck River (ERM, 2018).
Hydraulic Conductivity	Based on historical assessments undertaken: - Hydraulic conductivity has been established to be low across the large majority of the Site, with estimated hydraulic conductivity values estimated for wells that were screened across clay, sandy clay and gravelly clay typically ranging from 5×10^{-5} m / day to 6×10^{-3} m/day. - Higher hydraulic conductivity values were reported for wells screened across coarser grained sandy clay soils within the southern portion of the Site and are consistent with the more transmissive nature of these geologies. - Generally, hydraulic conductivity values increased from a minimum 5×10^{-5} m/day at the up gradient site boundary to up to 4×10^{-2} m/day closer to the southern site boundary due to the presence of sand/silt estuarine deposits closer to the Duck River. - laterally continuous higher hydraulic conductivity lithological units are not expected to be encountered within the Stage 2 Area. Specifically to AEC-4: - estimated hydraulic conductivity values estimated for wells that were screened across fill (gravelly clay), sandy clay and clay ranged from 1×10^{-3} m / day to 3 m/day.
Tidal Influence	On the basis of static water level data obtained from monitoring wells adjacent to the Duck River (including AEC-4), tidal interaction of surface water within the Duck River with groundwater within is not considered likely to be occurring, and is consistent with tidal assessments undertaken within other area of the Clyde Terminal.

- The focus of investigation activities and resulting refinement of the CSM has been on assessment of the shallow water bearing unit. This is due to the nature of soil and groundwater sources within the Stage 2 Area being at or near surface (historical aboveground storage and pipework and near surface drainage). The presence of fill material underlain by impermeable clay lithology has limited vertical migration and confined impacts in soil and groundwater to within the surficial shallow water bearing unit. This is supported by soil analytical results indicating that COPCs in soil samples collected from within the clay layer (or at depths greater than 2 m bgl) do not exceed the applicable screening criteria.
- Based upon the understanding of geology and hydrogeology at the site, the lateral migration potential of COPCs in groundwater is limited by the low permeability of the lithology, relatively flat hydraulic gradient and low average groundwater velocity. This is supported by the limited extent of impacted groundwater reported, indicating that, where present, areas of impacted groundwater are relatively stable and do not appear to be migrating; and

Given the nature of soil and groundwater sources within the Stage 2 Area (aboveground storage and pipework and near surface drainage), the low permeability clay layer underlying fill material appears to have limited the vertical migration of COPCs. This is supported by the analytical results indicating that COPCs in soil samples collected from within the clay layer (or at depths greater than 2 m bgl) do not exceed applicable screening criteria, with only a few exceptions (i.e. the Southern Buried Waste Area). This is further supported by soil data obtained from depths greater than 2 m bgl.

2.4 Conceptual Site Model Summary

The Western Area has been previously divided into Areas of Environmental Concern (AECs) based on spatial location, contaminants of potential concern (COPCs) and historical land-uses.

The CSM presented below was developed within the ERM (2020) HHERA based on information collected during previous investigations summarised within the RAP (ERM 2021b).

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-1 Old Administration Area	Primary source areas within AEC-1 included former administration buildings and the former substation (11) which has been decommissioned and demolished. Potential sources of contamination are considered to be limited to on-site burial of fill materials. CoPCs assessed included: ■ TRH C6-C40, Metals, PAH, Phenols, Asbestos (fill) ■ PFAS (groundwater only)	<u>Soil</u> ■ Asbestos (ACM)	■ Inhalation of dusts or potential asbestos fibres from isolated ACM impacted soils (TP19/01) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks.	■ No potentially complete SPR linkages to ecological receptors identified
AEC-2 Buried Waste Area 8 – CDU tank farm sludge	Primary sources within AEC-2 include buried waste materials associated within the CDU tank farm sludge that at the time of this RSI remain in-situ. CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols.	<u>Soil</u> ■ LNAPL	■ No exceedances of tier 1 screening criteria are noted for this AEC; ■ Based on the observed presence of LNAPL within the soil profile at TP18/29 within this AEC, aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-3 Southern Contractor Area Including the following sub-areas refined based on SPR linkages: ■ AEC-3A (Former Laboratory Area) ■ AEC-3B (Former Laboratory Area – Asbestos impacts) ■ AEC-3C (Former Contactor Warehouse (PAH hotspot)) ■ AEC-3D (Former Contactor Warehouse) ■ AEC-3E (TRH hotspot TP21/79)	Potential historical sources of impacts which have been decommissioned / removed from AEC-3 included: ■ sample store and laboratory area (AEC-3A and 3B); ■ storage and handling of AFFF products around the former location of Tank 24 and the Former Fire Station area; ■ contractor warehouse (AEC-3D); ■ workshop area; ■ Epoxy resins Plant. Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: ■ TRH C6-C40, BTEXN, Metals, PAH, Phenols, VOC/SVOC, Asbestos Specific to the Epoxy resins plant area: ■ Epichlorohydrin ■ bisphenol-a (BPA) ■ SVOC, VOC. Specific to the Fire Station area: ■ PFAS	<u>Soil</u> ■ LNAPL ■ TRH C6-C10 (F1) ■ Asbestos (ACM) ■ Carcinogenic PAHs <u>Groundwater</u> ■ LNAPL <u>Soil Vapour</u> AEC-3D (SV19/03): ■ TRH >C8-C10 Aliphatic; ■ TRH >C10-C12 Aliphatic; ■ Naphthalene; ■ Methane (associated with LNAPL source) AEC-3A (SV19/05): ■ TRH >C6-C8 Aliphatic; ■ TRH >C8-C10 Aliphatic; ■ TRH >C8-C10 Aromatic; ■ Benzene; ■ Naphthalene; and	■ Inhalation of vapours from hydrocarbon impacted soil, and LNAPL within the soil profile by future on site commercial workers in indoor air (AEC-3A, AEC-3D, AEC-3E); ■ Inhalation of dusts or potential asbestos fibres from isolated ACM in soils (AEC-3B - TP19/32) during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Direct contact or ingestion of soils impacted with carcinogenic PAHs (AEC-3C - TP19/16) or TRH C16-C34 fractions by on-site intrusive maintenance workers or construction workers undertaking earthworks. ■ Based on the observed presence of LNAPL within soil/ and groundwater wells screening LNAPL soil sources within AEC-3A and AEC-3D, soil vapour and ground gas assessment undertaken, elevated LEL/ methane readings in soil vapour there is potential for pooling of ground gases within future excavations. Infiltration of ground gases (methane) into future indoor air spaces is to be addressed via source removal of LNAPL. ■ The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	■ No potentially complete SPR linkages to ecological receptors identified

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
		Methane (associated with LNAPL source)		
AEC-4 Southern Buried Waste Area	Primary sources within AEC-4 include buried waste materials that at the time of this remain in-situ. CoPCs assessed included: TRH C6-C40, BTEXN, Metals, PAH, Phenols, SVOC, pH (associated with acids), Dioxins, PFAS, Asbestos	<u>Soil</u> - LNAPL - TRH C6-C40 - Benzene - Asbestos (ACM and fibres within fill) - Metals (hexavalent chromium) - Carcinogenic PAHs - PFAS <u>Groundwater</u> - LNAPL	<u>Soil</u> - Indoor inhalation of vapours by future commercial/industrial workers (benzene, TRH C6-C10 (F1) fractions) from LNAPL and hydrocarbon impacted soil. - Inhalation of dusts or potential asbestos fibres from ACM and fibrous asbestos and asbestos fines within soil in soils during excavation by current and future on-site intrusive maintenance workers or construction workers undertaking earthworks. - Direct contact or ingestion of impacted soils (TRH >C10-C16 (F2) Fraction, TRH >C16-C34 Fraction, carcinogenic PAHs, hexavalent chromium), by on-site intrusive maintenance workers or construction workers undertaking earthworks. - Based on the observed presence of LNAPL within soil/ and groundwater within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers as well in enclosed air spaces in future development of buildings. The potential effects of LNAPL on future buried infrastructure and aesthetics (particularly odour generation) should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this AEC. <u>Groundwater</u> - No potentially complete SPR linkages were identified for on-site or off-site human health receptors	No potentially complete SPR linkages to ecological receptors identified. - PAHs (including naphthalene, anthracene, benzo(a)pyrene, fluoranthene, phenanthrene) exceeding ecological criteria in groundwater have been identified within the northern portion of AEC-4 but have been laterally delineated to below assessment criteria within the Site. - PFAS (specifically PFOS) has been identified in soil and soil leachate samples within the which within the northern portion of AEC-4 and given high solubility may contribute to future offsite groundwater migration. Requires ongoing monitoring as part of the groundwater monitoring program.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-5 Platformer 3	- Primary sources areas within AEC-5 (platformer 3) have been decommissioned / removed. - Secondary sources include subsurface soils/groundwater containing LNAPL CoPCs assessed included: - TRH C6-C40, BTEXN, Metals, PAH, Phenols	<u>Groundwater</u> LNAPL (MW11/17)	No exceedances of screening criteria are noted for this AEC; Based on the observed presence of LNAPL within shallow groundwater at MW11/17 within this AEC, aesthetics (odour/staining encountered during future earthworks) and the potential effects of hydrocarbons on future buried infrastructure should be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	No potentially complete SPR linkages to ecological receptors identified
AEC-8 Tank farm J	- Primary sources areas within AEC-8 included former fuel storage infrastructure, which has been decommissioned / removed. - Secondary sources include subsurface soils containing LNAPL CoPCs assessed included: - TRH C6-C40, BTEXN, PFAS	<u>Soil</u> LNAPL	Based on the isolated presence of LNAPL within the soil profile at TP18/31 within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans for this area.	No potentially complete SPR linkages to ecological receptors identified
AEC-11 Tank farms A1, A2, A3	- Primary sources areas within AEC-11 included fuel storage infrastructure, which at the time of this RSI remain onsite. - Secondary sources include subsurface soils containing LNAPL and surface / surface materials potentially impacted with PFAS CoPCs assessed included: - TRH C6-C40, BTEXN, Metals, PCB, PFAS, Dioxins	<u>Soil</u> LNAPL	Based on the observed presence of LNAPL within soil within this AEC, there is potential for pooling of ground gases within future excavations undertaken by on-site intrusive maintenance or construction workers. The potential effects of hydrocarbons on future buried infrastructure and aesthetics should also be considered within the detailed RAP and/or future Long Term Environmental Management Plans.	No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
AEC-13 Substation Areas and Transformer Yards	- Primary sources areas within AEC-13 include former substation infrastructure, which has been decommissioned / removed. Substation areas assessed include substation and transformer footprints, as identified on Figure 6 of the RSI Report (ERM, 2020a). - Substations 9 and 23 were unable to be sampled due to their ongoing operation at the time of the investigation. CoPCs assessed included: - BTEXN, Metals, PCBs, Asbestos	<u>Nil</u>	No potentially complete SPR linkages to human health receptors identified.	No potentially complete SPR linkages to ecological receptors identified.
AEC-14 Subsurface drainage network Including the following sub-areas refined based on SPR linkages: - AEC-14A (Compromised Pipe 18D300-5) - AEC-14B (Compromised Pipes 15D100-4, 15D100-5)	- Primary sources areas within AEC-14 include compromised or leaking subsurface drainage infrastructure, which contained hydrocarbon/oily water from product storage and handling areas. - Secondary sources include subsurface soils containing LNAPL and surface materials potentially impacted with PFAS CoPCs assessed included: - TRH C6-C40, BTEXN, Metals, PAH, Phenols, SVOC, pH (associated with acids), Dioxins, PFAS, Asbestos	<u>Soil</u> - LNAPL - TRH C6-C10 - TRH >C10-C12 (Aliphatic) - TRH >C12-C16 (Aromatic) - Carcinogenic PAHs	- Indoor inhalation of vapours from volatile TRH fractions (C6-C16) by future on site commercial workers from hydrocarbon impacted soils at: - AEC-14A (TP20/28) - AEC-14B (TP20/29a, TP20/29b, TP20/29c, TP20/30, TP21/07) - Direct contact with contaminated soils (carcinogenic PAHs) by future on-site construction workers undertaking intrusive works: - AEC14B (TP20/30, TP21/07) The presence of LNAPL and soils exceeding TRH management limits associated with the drainage network in Stage 2 as shown on Figures 6A-6C requires management under a LTEMP for aesthetic/ odour impacts identified during future works.	No potentially complete SPR linkages to ecological receptors identified.
AEC-15 General Site Areas (not	Primary sources areas within AEC-15 include a range of former processing and fuel	<u>Soil</u> LNAPL	No exceedances of screening criteria are noted for this AEC;	No potentially complete SPR linkages to ecological receptors identified.

Area Of Environmental Concern	Potential Sources/ Assessed COPCs	Remaining COPCs	Potentially Complete SPR Linkages	
			Human Health	Ecological
covered within other AECs)	storage infrastructure, which has been removed. - Secondary sources include subsurface soils containing LNAPL CoPCs assessed included: - BTEXN, TRH C6-C40, Metals, PAH, Phenols, Asbestos (fill)		The presence of LNAPL of management limit exceedances for TRH fractions as shown on Figures 6A-6C will require management under a LTEMP for aesthetic/ odour impacts potentially encountered during future excavation works. As identified in the HHERA, inhalation of dusts or potential asbestos fibres from isolated ACM in soils (MW11/14) was conservatively identified as a potential risk based on the presence of asbestos (which was not quantified). Further investigation and quantification in this area was undertaken and it was subsequently found to be compliant with commercial/ industrial criteria (TP21/12).	

2.4.1 Groundwater Impacts

2.4.1.1 LNAPL

LNAPL has been identified during previous groundwater monitoring events at the following monitoring wells located within the Stage 2 Area:

- MW11/17 (AEC-5) – located immediately south of former Platformer 3 Location;
- MW12/01 (AEC-4) – situated within the Southern Buried Waste Area;
- MW20/06 (AEC-4) – situated within the Southern Buried Waste Area;
- MW18/24 (AEC-3A) – situated within the footprint of the former laboratory.

Groundwater monitoring of nearby wells has demonstrated no downgradient migration of LNAPL from these isolated areas. Associated dissolved phase concentrations are limited in extent and are delineated to within the Stage 2 boundary.

2.4.1.2 Dissolved Phase

Concentrations of COPCs in groundwater have been reported below the adopted SSTLs for on-site human health. The following exceedances of off-site criteria for human health and ecological receptors have been reported in the groundwater monitoring dataset during groundwater monitoring events undertaken in the last 5 years (2016 – 2021):

- Naphthalene exceeding offsite ecological criteria at MW12/03 (AEC-3D), MW20/03 and MW20/13 (AEC-4);
- Polycyclic Aromatic Hydrocarbons (PAHs) including phenanthrene, fluoranthene, anthracene and benzo(a)pyrene MW20/01A, MW20/03, MW20/06, MW20/07, BH116, MW20/13 (AEC-4);
- Hexavalent chromium exceeding ecological criteria at MW11/06; and
- Benzene exceeding offsite recreational (human health) criteria at MW20/03 and MW20/13 (AEC-4).

Within soil leachate analysed from soil samples collected within the buried waste mound within AEC-4, naphthalene and zinc were identified to exceed the adopted ecological water criteria in leachate samples collected. Perfluorooctanesulfonic acid (PFOS) and TRH C10-C40 fractions were detected at concentrations exceeding the laboratory Limit of Reporting (LOR) in ASLP analysis conducted on soils but were less than the assessment criteria in groundwater.

Down gradient delineation of the above COPCs has been demonstrated through monitoring data to below relevant criteria in groundwater and therefore potential risks to offsite receptors (Duck River) have not been identified.

2.4.1.3 Baseline Sampling Results

The Quarter 4 2020 Groundwater Monitoring Event (ERM, 2021b) represents the baseline understanding of groundwater conditions within the Western Area at the time of Detailed RAP preparation. The following conclusions were made regarding groundwater conditions within the Western Area:

- The direction of groundwater flow in the Western Area is generally consistent with previous GMEs and flows to the south east towards the bounding Duck River. Localised radial flow towards the south-west has been identified in the south-west portion of the Western Area (AEC-4) following recent investigation;

- LNAPL observed within the monitoring well network is considered to be consistent in spatial extent with previous groundwater monitoring undertaken. Lateral delineation of LNAPL to within the site boundary has been achieved via gauging and sampling of down gradient wells;
- No exceedances of risk-based SSTLs were reported for on-site receptors in any groundwater monitoring wells sampled as part of the Q4 2020 GME;
- No exceedances of offsite ecological criteria were reported at the site boundary;
- Evidence of stable groundwater conditions and natural attenuation processes continue to be identified as per previous monitoring events, including:
 - No statistically significant increasing trends of key petroleum hydrocarbon contaminants of concern identified during the Q4 2020 GME;
 - The presence of a high proportion of polar compounds in groundwater samples, as indicated by widespread detections of TRH C10-C40 fractions versus non-detect following silica gel clean-up analysis. Polar metabolites are formed via microbial degradation of petroleum hydrocarbon source areas;
- Potential for adverse changes in groundwater conditions (migration or increased contaminant concentrations) are considered to be low given the removal of primary sources from the site and that sources of groundwater impacts are limited to residual impacted soils and highly weathered and immobile LNAPL in the subsurface; and
- The nature and extent of LNAPL and dissolved phase hydrocarbon impacts are currently considered to be stable, well characterised in the context of the current approved land use and the monitoring well network is considered suitable to assess potential changes in environmental conditions as well as source/pathway/receptor linkages.

Groundwater monitoring undertaken as part of the Q4 2020 GME was focused on petroleum hydrocarbons and demonstration of stable to decreasing trends. However, the following was noted with regard to other COPCs during the Q4 2019 GME:

- Concentrations of heavy metals were reported within the Western Area exceeding adopted ecological screening criteria for copper, lead, mercury, nickel and zinc. The distribution of metals exceedances did not appear to be confined to a particular portion of the Western Area, and were considered likely to be related to regional background water quality, associated with imported fill materials across the camellia peninsula.
- Based on the groundwater dataset for Per- and Polyfluoroalkyl Substances (PFAS) in groundwater in the Western Area, ecological exceedances for PFAS (specifically PFOS) in individual wells were considered consistent with the findings of previous sampling events and were not considered to alter the existing findings of the CSM and mass flux assessment previously undertaken (ERM, 2018). Specifically:
 - Recreational water quality criteria for PFOS + PFHxS were also exceeded in monitoring wells in the following areas of the Western Area:
 - Nearby Former AFFF foam storage Tank 24, (north of AEC-3);
 - Ecological direct toxicity trigger values were exceeded for PFOS in the following areas of the Western Area:
 - At the up-gradient site boundary (AEC-1) and within AEC-3; and
 - MW12/23 on the southern site boundary.

3. GROUNDWATER MONITORING PROGRAM

Existing groundwater monitoring wells have been selected for gauging and sampling based on the following objectives:

- **Monitoring during remediation** – to demonstrate remediation works do not have short-term adverse effects on localised groundwater quality or the Duck River and implement contingency actions (if required); and
- **Monitoring post-remediation** – To demonstrate ongoing stability of groundwater conditions and that residual groundwater impacts do not present a risk to the ecological values of receptors, specifically the Duck River.

3.1 Monitoring During Remediation

Project activities identified in the EIS which have potential to cause impacts on groundwater include:

- Excavations which penetrate the impermeable silty clay layer leading to increased infiltration of surface water and therefore increased groundwater volumes and potential migration of contamination off-site;
- Dewatering of excavations potentially leading to mobilisation of contaminated groundwater or LNAPL;
- Spills and leaks during the Project which could contaminate the ground and groundwater;
- dewatering activities which result in PASS being exposed, oxidising and generating acidic conditions which have the potential to impact the Duck River and cause ecological harm (either directly or indirectly eg via mobilisation of metals).

While potential for ASS/PASS is considered to be low based on recent assessment, collection of pH readings will be used to demonstrate no acidification of groundwater to have occurred from the works.

Groundwater within the Western Area is present at depths generally between 1 – 3 m bgl.

Remediation works may require excavation and/or in-situ remediation to a maximum depth of 2 m bgl in AEC-3A and 3D and will be less than 2m bgl in other excavations completed across the Western Area.

Excavations proposed to extend below the water table may require management of groundwater which will be limited to excavations of depths greater than 1 m bgl.

Based on hydraulic testing data summarised in Section 3.2, hydraulic conductivity values for wells within the vicinity of proposed excavations AEC-3A and AEC-3D, including MW11/18 (6×10^{-3} m/day) and MW11/19 (9×10^{-4} m/day) indicate low potential for groundwater infiltration into excavations associated with clay lithologies.

Although there has been identified low potential for infiltration, due to excavation below the minimum depth of measured groundwater table, these excavations represent highest potential for altered groundwater flow regimes which may lead to mobilisation of contaminants in the subsurface. As such, groundwater monitoring during remediation works will focus on monitoring wells within or adjacent to the following excavations:

- AEC-3A (Former Laboratory Area) – proposed remediation depth of 2 m bgl;
- AEC-3D (Former Contractor Warehouse) - proposed remediation depth of 2 m bgl; and

While excavation AEC-14A has a proposed remediation depth of 1.8 m bgl, the overall footprint of this excavation is minor at 50m² and anticipated to have no notable affect on overall groundwater conditions at the Site which may be measured by the existing monitoring well network.

The proposed extent of these excavations is shown on Figure 1, Appendix A.

Viva Energy and an appropriately qualified validation consultant will be responsible for ensuring the completion of groundwater monitoring requirements during execution of remediation.

Specific groundwater monitoring wells selected for monitoring during remediation are shown on Figure 1, Appendix A.

3.2 Monitoring Post Remediation

Monitored natural attenuation of petroleum hydrocarbon impacts in groundwater has been proposed as a passive management strategy following the active remediation of source areas at the site which have been identified as driving risk to receptors. It is anticipated that groundwater conditions are likely to improve further prior to, during and following remediation works based on the following:

- Primary sources (e.g. above ground storage tanks) have been removed prior to the soil remediation commencing as part of the Clyde Terminal Conversion Project (SSD 5147). Remnant subsurface infrastructure (such as below ground pipework) has been decontaminated and decommissioned, with residual impacts assessed as providing negligible risk to groundwater when managed under an LTEMP;
- Shallow and Light Non-Aqueous Phase Liquid (LNAPL) impacts within the soil profile would be addressed as part of the remediation works by the excavation of LNAPL impacted soil to the extent practicable where potential risks are identified. As part of these works, impacted water may accumulate in these excavations and may be removed via pumping from excavations. LNAPL impacted water would be required to be disposed offsite;
- LNAPL and dissolved phase hydrocarbon impacts which are proposed to be managed in-situ have been assessed as stable and having no current or future migration or exposure pathways when managed passively in accordance with a future LTEMP; and
- The source removal and soil remediation process itself is likely to significantly improve groundwater conditions over the long term, assisted by natural attenuation (this process involves allowing naturally occurring micro-organisms in the ground to biodegrade hydrocarbon contamination).

Viva Energy will remain responsible for ensuring the completion of ongoing groundwater monitoring requirements. The requirement for future occupiers of portions of the Western Area to provide access for ongoing monitoring following completion of remediation will be outlined within relevant Long-Term Environmental Management Plans prepared following completion of remediation activities.

The objectives of the post remediation groundwater monitoring program are as follows:

- Provide confirmation of no ongoing risk to receptors, including future site users and Duck River by residual groundwater impacts following remediation;
- Demonstrate natural attenuation processes via continued stable to decreasing concentrations of petroleum hydrocarbons in groundwater.

Given the current assessment that hydrocarbon concentrations are stable to decreasing, it is expected that the remediation works proposed will enhance the current natural attenuation processes.

3.3 Groundwater Assessment Criteria

The groundwater assessment criteria outlined below represent trigger levels for the contingency actions outlined within Section 3.7 of this GWMP.

Assessment Criteria to be utilised as part of this GWMP are provided in Appendix C. The rationale for selection of assessment criteria is provided in the following subsections.

3.3.1 On-Site Monitoring

Groundwater data obtained as part of this GWMP will primarily be assessed against the Tier 2 Site Specific Target Levels (SSTLs) for groundwater, which were developed within the HHERA (ERM, 2020b) to target COPCs which exceeded tier 1 screening values for human health based on the consolidated historical dataset. Specific assumptions and input parameters used in development of these values are provided within the HHERA (ERM, 2020b). Adopted Groundwater SSTLs are provided as Appendix C.

In lieu of SSTLs for a particular COPC, groundwater data will be assessed against the 'Tier 1' investigation criteria published in *Schedule B1 Guideline on the Investigation Levels for Soil and Groundwater* of the ASC NEPM, which references the following guidance for protection of human health receptors:

- Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE), *Technical Report No. 10: Health Screening Levels in Soil and Groundwater (2011)*. Health Screening Levels (HSLs) for vapour intrusion – Commercial/Industrial 'D' and HSLs for Intrusive Maintenance Workers (shallow trench).

The human health assessment criteria adopted assumes no future beneficial groundwater use, potable or non –potable, based on the saline nature of groundwater generally encountered and the low yields expected. As such, drinking water guidelines are not relevant for tier 1 screening of groundwater.

3.3.2 Boundary Monitoring

Assessment Criteria protective off-site ecological and recreational users of the Duck and Parramatta River systems have been sourced from the below guidance:

- National Health and Medical Research Council (NHMRC), *Guidelines for Managing Risk in Recreational Waters (2008)*, to assess potential direct contact risks to recreational users of the Parramatta and Duck Rivers; and
- Australian and New Zealand Governments (ANZG) (2018), Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Trigger values for marine water, level of protection 95% species and trigger values for marine water.
- The PFAS National Environmental Management Plan, Version 2.0 ('the NEMP'), prepared by the Heads of EPA (HEPA, 2020) for Tier 1 screening values for offsite human health and ecological receptors for groundwater.

It is noted that PFAS assessment for groundwater has been undertaken within the Western Area and was not identified as a target contaminant of concern for remediation within the Auditor endorsed RSI report (ERM, 2020a). As such, further PFAS assessment is limited to monitoring within and around AEC-4, given detections in soils identified to remain in-situ. Ongoing monitoring outside of this area is not proposed to be undertaken to meet the objectives of this GWMP given the existing CSM which indicates negligible risk from the flux assessment undertaken (ERM, 2018).

A summary of Tier 1 screening criteria for PFAS is provided below in Table 3-1.

Table 3-1 Adopted Groundwater Screening Criteria (PFAS)

Receptor	Adopted Screening Criteria	Source	Comments
Off-site recreational users of the Parramatta and Duck River (via direct contact)	Recreational Water Quality Guideline	Guidance on Per and Polyfluoroalkyl Substances (PFAS) in Recreational Water (NHMRC, 2019)	The recreational values are conservative for the activities down gradient of the site (primarily boating and rowing). The recreational values assume swimming activities with much higher direct contact rates.
On-site and offsite Ecological receptors (via direct contact)	Freshwater Trigger Values (95% Species Protection – slightly to moderately disturbed systems)	ANZECC – technical draft guideline values (as referenced in PFAS NEMP (HEPA, 2020))	Freshwater values used in lieu of regulator endorsed Marine Criteria, as per the guidance in the NEMP.
Indirect exposure for off-site ecological receptors (via consumption of PFAS containing biota (bioaccumulation)).	Freshwater Trigger Values (99% Species Protection – high conservation value systems)	ANZECC – technical draft guideline values (as referenced in PFAS NEMP (HEPA, 2020))	The ANZG (2018) Water quality guidelines advise the use of the 99% trigger value for slightly to moderately disturbed systems for chemicals which bio accumulate and bio magnify in wildlife. It is noted that the 99% protection value for PFOS is below the laboratory limit of reporting.

ERM has adopted the above ecological guidelines based on the assumption that the upper Parramatta River catchment is a moderately disturbed ecosystem, as it receives road and storm water runoff from adjacent industry and residential properties. Additionally, the rivers within this area are considered to be within an upper estuarine environment, therefore receiving ecosystem is considered marine.

The boundary monitoring assessment criteria adopted are consistent with routine groundwater monitoring undertaken (formerly under the requirements of EPL570).

3.4 Data Quality Objectives

3.4.1 Step 1 - State the Problem

Collection of appropriate groundwater monitoring data is required to evaluate the following in accordance with the conditions of consent for the Clyde Western Area Remediation Project (SSD 9302):

- groundwater levels and quality during remediation works and following demobilisation;
- verify that natural attenuation of groundwater contamination is occurring over time following demobilisation.

A GWMP is required to:

- include trigger levels for investigating potential adverse impacts to the Duck River, including triggers for indicating if further remediation of groundwater is required;
- outline contingency actions to be implemented if monitoring indicates that natural attenuation is not occurring, or groundwater is having an adverse impact on the Duck River;
- monitor the effectiveness of management measures and contingency actions for reducing impacts;
- Document procedures for reporting changes to groundwater conditions that have the potential to create unacceptable risks to the Duck River.

3.4.2 Step 2 – Identify the Decisions/Goal of the Study

The data is required to enable a decision to be made that:

- mitigation measures for protection of groundwater during remediation are effective in preventing adverse effects to groundwater;
- concentrations of contaminants of concern continue to not represent a risk to human health or ecological receptors;
- concentrations of contaminants of concern continue to not represent unacceptable risks to sensitive receptors following remediation;
- Ongoing management of groundwater via natural attenuation remains an appropriate long term strategy, such that contingency measures, including groundwater remediation are not required; and
- no further groundwater monitoring is necessary.

This point will be reached when the groundwater assessment criteria are met.

3.4.3 Step 3 – Identify Inputs to the Decisions

The inputs required to make the above decisions are as follows:

- appropriate groundwater gauging data including water levels and LNAPL (if identified);
- appropriate groundwater analytical data (including obtaining data from appropriate monitoring wells and appropriate analysis);
- concentration trend analysis (Mann-Kendall) for relevant COCs, where an appropriate dataset is available;
- analytical results assessed against the assessment criteria;
- establishment of a monitoring and assessment schedule; and

- information, comments or advice provided by the relevant stakeholders, including Viva Energy, the Site Auditor, and the Planning Secretary.

3.4.4 Step 4 – Define the Study Boundaries

The study boundary is the Stage 2 Area, which forms a portion of the Clyde Western Area. The extent of the Stage 2 Area is shown on Figure 1, Appendix A.

Previous investigations and groundwater monitoring events have indicated soil and groundwater impacts are limited to the surficial water bearing unit and remedial excavations will be limited to the upper 2m. As such, groundwater monitoring will be limited to the shallow water bearing unit.

This GWMP applies to monitoring works conducted during remediation works, and biannual ongoing sampling events completed post-remediation a review of the monitoring schedule and potential for discontinuing monitoring will be undertaken at least annually.

The ability for completion of ongoing monitoring is expected to be limited by the sale and redevelopment of the Stage 2 Area. Should these limitations inhibit completion of future ongoing monitoring, the requirement will be assessed by the Site Auditor.

3.4.5 Step 5 – Develop a Decision Rule (or Analytical Approach)

The initial analytical approach proposed is semi-annual (6 monthly) groundwater monitoring events of a selection of groundwater monitoring wells within the study area. Trend and natural attenuation analysis is initially proposed to be conducted annually.

Following completion of two rounds of groundwater data collection, the analytical program should be reviewed. A scaling back of the frequency and number of monitoring locations required is envisaged progressively, contingent upon the monitoring results.

Monitoring of sufficient wells to provide representation of the areas surrounding areas where source removal has been undertaken must be maintained until such time as the groundwater assessment criteria are met or via consultation with the Site Auditor.

Relevant COPCs in groundwater are limited to BTEX, naphthalene and TRH C₆-C₄₀.

Groundwater quality during and following remediation will be evaluated primarily via comparison of groundwater analytical data with the relevant assessment criteria to assess potential for ongoing risk to receptors. In addition to dissolved phase concentrations, the occurrence of visible or measurable LNAPL in wells where not previously identified would trigger the implementation of contingency actions outlined in Section 3.7.

Demonstration of continued natural attenuation and stability of dissolved phase groundwater impacts is occurring over time will include evaluation of primary and secondary lines of evidence presented within *CRC Care Technical Report 15: A technical guide for demonstrating monitored natural attenuation of petroleum hydrocarbons in groundwater* (Beck & Mann, 2010). It is noted that tertiary lines of evidence (microcosm studies) are currently not considered necessary given primary and secondary lines of evidence have already demonstrated natural attenuation processes to have occurred at the Western Area.

Statistical Trend Analysis (Mann Kendall) will be utilised to evaluate spatial and temporal trends of COPC concentrations over time. Generally, stable to decreasing trends of COPCs will be a primary indicator that natural attenuation processes are occurring. Where statistically significant trends are unable to be established, results will be considered in the context of risk to receptors and/or mass flux.

In addition to establishing trends for dissolved phase COPCs, collection of natural attenuation indicators (dissolved oxygen, oxidation reduction potential, nitrate, sulfate, ferrous iron and methane) at selected up gradient, plume centre and plume edge locations will enable a secondary line of evidence of the occurrence of natural attenuation.

It is likely that in some wells statistically significant trends will prove impossible to establish, even when other assessment criteria are met. If this occurs, a critical evaluation of the dataset for particular monitoring wells will be undertaken using a 'lines of evidence' approach. Potential reasons for inability to establish statistically significant trends include the below:

- TRH concentrations include breakdown compounds that develop as natural attenuation proceeds. As a result, concentrations in some fractions (particularly the lower carbon chain lengths) can increase. The effect is a long period of low but fluctuating TRH concentrations without a clear trend. It is noted that TRH >C10 fractions in groundwater have been demonstrated to be heavily influenced by the presence of polar metabolites during recent monitoring events, which have been interpreted to be a product of natural biodegradation processes. As such, trend analysis will utilise results following silica gel cleanup as an indicator of petroleum hydrocarbon concentrations in the >C10- C40 range;
- Some wells will have limited datasets (particularly TRH silica gel analysis). Monitoring data was unable to be collected within former operational areas which were inaccessible for several years during demolition;
- Some wells may experience a change in conditions as a result of the source remediation work, such that post-remediation concentrations are significantly different from pre-remediation concentrations. In most instances this will be a reduction, however increases may occur. In these cases the long term dataset may be unsuitable to represent the current trend. Where considered appropriate, use of a post remediation period as a time frame for trend analysis will be considered;
- COC concentrations at some wells will be close to the laboratory Limit of Reporting (LOR), and a statistically significant trend is unlikely for results fluctuating around a LOR. This should be taken into account when assessing trends.

In order to provide a case for reduction or cessation of monitoring, concentrations within individual wells (or based on flux assessment) must be compliant with risk-based assessment criteria provided in Section 3.3 at the boundary with the Duck River and not exceed SSTLs within on-site areas throughout a period of post remediation monitoring. If rebound is recorded during post-remediation monitoring rounds, it may be necessary to extend the duration of post-remediation monitoring.

3.4.6 Step 6 – Specify Limits on Decision Errors

A decision error would be an incorrect determination on whether groundwater assessment criteria have been met, or an incorrect assessment of statistical trends.

The acceptable limits on decision errors applied during the review of the results will be based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness (PARCC) in accordance with the *ASC NEPM Schedule B (3) - Guidelines on Laboratory Analysis*.

The potential for significant decision errors will be minimised by:

- completing a robust QA/QC assessment of the assessment data and application of the probability that 95% of data will satisfy the DQIs, therefore a limit on the decision error would be 5% that a conclusive statement may be incorrect;
- assessing whether appropriate sampling and analytical density (both laterally and vertically throughout the fill and soil profiles) has been achieved for the purposes of meeting the Project objectives; and
- ensuring that the criteria set was appropriate for continuing use consistent with current and proposed usage under the Site's zoning (IN3 – Heavy Industrial) and the receiving environment of the Duck River;

- Mann Kendall trend analysis will be conducted on data using a significance level of 0.05, (or 95% confidence) which is considered suitable for sensitive land use.

3.4.7 Step 7 – Optimise the Plan

Review of the data set and concentration trends, and consideration of the appropriateness of the monitoring schedule will be undertaken annually. Revisions to the monitoring schedule (if required) should be made on the basis of the interpretation of the results. Outliers should be identified and contingency measures implemented if needed.

3.5 Sampling, Analysis and Quality Plan

3.5.1 Sampling Locations and Rationale

Table 1 and 2 of Appendix B presents the rationale for monitoring of specific existing groundwater monitoring wells.

Existing groundwater monitoring wells have been selected for gauging and sampling based on the following objectives:

- **Monitoring during remediation** – to demonstrate remediation works do not have short-term adverse effects on localised groundwater quality or the Duck River and implement contingency actions (if required). The monitoring program during the remediation phase is presented as Table B1, Appendix B; and
- **Monitoring post-remediation** – To demonstrate ongoing stability of groundwater conditions and that residual groundwater impacts do not present a risk to the ecological values of receptors, specifically the Duck River. The monitoring program to be implemented post-remediation is presented as Table B2, Appendix B.

Monitoring wells selected in Tables 1 and 2 of Appendix B form part of the existing monitoring well network. Should these monitoring wells be damaged, or unable to be located on site, an assessment of the adequacy of the remaining monitoring well network to meet the objectives of this GWMP will be undertaken. The re-installation of monitoring wells will only be considered if the existing network becomes unsuitable for its intended purpose.

Selected monitoring locations to be monitored during the remediation phase and the proposed analytical suite are listed in Table B1, Appendix B along with the rationale for their selection. The locations of these monitoring wells are shown on *Figure 1, Appendix A*. It is noted that wells designated for monitoring during remediation will only be applicable to where active remediation is being undertaken. For instance, only wells within the Stage 1 monitoring network will be monitored throughout the duration of Stage 1 remediation works.

Table 3-2 Groundwater Monitoring Requirements – During Remediation

Monitoring Area	Rationale	Frequency	Data Collected
Excavation Areas (nearby wells)	■ Sampling for adverse changes in dissolved phase COPC concentrations from remediation activities ■ Although considered unlikely to occur, an indication of potential ASS issues created during remediation may be assessed via collection of field parameters.	■ Baseline sampling prior to commencement of remediation works ■ Within 3 months following completion of remediation works	■ laboratory analysis for target COPCs (excavation specific), ■ collection of field parameters (including pH)
Excavation Areas (nearby wells)	■ Gauging to monitor potential alteration to groundwater levels/ flow regime;	■ Gauging weekly during excavation and/or dewatering	■ Gauging Data (water levels,

Monitoring Area	Rationale	Frequency	Data Collected
	Monitor potential for LNAPL mobilisation		LNAPL presence/ thickness);
Down-gradient boundary	- Demonstrate groundwater at the boundary is not adversely impacted by remediation works or causing environmental harm to the Duck River; - Monitor potential for LNAPL mobilisation from remediation works	monthly during active remediation conducted up-gradient;	- Gauging data (water levels, LNAPL presence/ thickness); - grab sample for collection of field parameters (including pH)

It is noted that wells designated for monitoring during remediation will only be applicable to where active remediation is being undertaken. For instance, only wells nominated within AEC-3A will be monitored throughout the duration of excavation works in this area.

Selected monitoring locations to be monitored post-remediation and the proposed analytical suite are listed in Table B2, Appendix B, along with the rationale for selection. The locations of these monitoring wells are shown on *Figure 2, Appendix A*.

Table 3-3 Groundwater Monitoring Requirements - Post remediation

Monitoring Area	Rationale	Frequency	Data collected
Excavation Areas (nearby wells)	Gauging to monitor potential for alteration to groundwater levels/ flow regime or LNAPL mobilisation	Completion of a single post-remediation sampling event (within 3 months of completion of remediation work)	- laboratory analysis for TRH, BTEXN and MNA parameters - collection of field parameters - Gauging Data (water levels, LNAPL presence/ thickness).
Downgradient boundary	- Demonstrate groundwater at the boundary is not impacted by remediation works or causing environmental harm to the Duck River; - Monitor potential for LNAPL mobilisation from remediation works	- Biannually (every 6 months) following completion of post remediation sampling event - Requirement for ongoing sampling is to be reviewed at least annually (ie every two GMEs) based on trend analysis and reported concentrations	- laboratory analysis for TRH, BTEXN and MNA parameters - collection of field parameters; - Gauging Data (water levels, LNAPL presence/ thickness); - collection of field parameters (including pH)
Downgradient boundary (AEC-4)	- Demonstrate groundwater at the site boundary does not present an unacceptable risk to offsite receptors (Duck River) via mobilisation of contaminants from by in-situ managed buried waste material; - Monitor potential for LNAPL mobilisation and groundwater flow alteration following installation of surface capping.	- Biannually (every 6 months) following completion of post remediation sampling event - Requirement for ongoing sampling is to be reviewed annually (ie every two GMEs) based on trend analysis and reported concentrations	- Laboratory analysis for Contaminants of concern specific to AEC-4: - TRH C6-C40, BTEXN and MNA parameters - PAHs - Hexavalent Chromium - PFAS - Collection of field parameters

Monitoring Area	Rationale	Frequency	Data collected
			Gauging Data (water levels, LNAPL presence/ thickness)

3.5.2 Groundwater Sampling Method

Consistent with recent sampling methodologies employed since 2014, sampling via the use of no-purge 'Hydrasleeve' groundwater samplers is proposed.

To facilitate collection of representative groundwater samples, Hydrasleeve samplers will be installed a minimum of 24 hours prior to sample collection to allow for equilibration of the water column.

Water quality parameters, including pH, conductivity, dissolved oxygen (DO), temperature and redox potential (redox) will be measured during the groundwater sampling activities immediately following collection of groundwater samples from no purge samplers.

Where routine sampling of a well is required, samplers will be deployed for the next groundwater monitoring event following collection of samples.

3.5.3 Quality Assurance/Quality Control Plan

Appropriate quality assurance measures such as use of equipment that is calibrated and appropriately decontaminated between each sample location will be implemented. Samples will be placed in appropriate sample containers that are clearly labelled and stored in insulated boxes on ice.

Field quality control (QC) samples shall be collected including field duplicates, trip blanks, trip spikes and equipment rinsates. The number of field QC samples proposed is indicated in *Tables 1 and 2, Appendix B*.

Laboratory QA/QC procedures will be undertaken in accordance with *Schedule B(3) - Guidelines on Laboratory Analysis of Potentially Contaminated Soils* of the ASC NEPM (NEPC 2013) and will comprise matrix spikes, method blanks and surrogate recoveries. The results of the quality control testing will be presented in the laboratory reports. Duplicate testing will also be undertaken by the laboratories to compare the results obtained in analysing samples.

A comprehensive QA/QC assessment will be included within the annual summary report. However, the data quality will be evaluated after each event such that non-compliances are identified and resolved in a timely manner.

3.6 Data Evaluation and Reporting

Field and laboratory data collected as part of the groundwater monitoring program will be reviewed and evaluated continuously throughout the delivery of the Project to monitor compliance during and following completion of remediation works. Groundwater Monitoring reporting requirements are as follows:

Report	Timing	Description
Remediation Phase – Annual Groundwater compliance report	Annually throughout completion of remediation works	Factual presentation of groundwater data collected during remediation for demonstration of compliance. Report will summarise the results of monthly reporting and be incorporated into the Annual Report for the Development Consent (Section 6.2 of the REMP)

Report	Timing	Description
Remediation Phase – Monthly Factual Reporting	Monthly following completion of monitoring events during each stage of the remediation	Factual presentation of groundwater data collected during remediation for demonstration of compliance to the regulator throughout the duration of remediation works.
Ongoing Monitoring – Event 1 Factual Report	Following completion of first GME	Factual GME Report presenting laboratory results and field data
Ongoing Monitoring Event 2 and Annual Summary	Annual. The ongoing monitoring event 2 and annual summary report will be reported within 3 months of the completion of monitoring and provided to NSW EPA and Local Council (Parramatta City Council) in accordance with the requirements of the relevant LTEMPs	Interpretive GME report including: ■ Interpretation of dataset collected over the preceding year in relation to the historical dataset ■ Concentration and trend analysis and assessment of the progress of natural attenuation ■ Review of GWMP and provide amendment as necessary, including any proposed changes to monitoring (as appropriate) ■ Completion of interpretive QA/QC assessment for the preceding year's dataset

Based on the extensive existing dataset, which is demonstrating the occurrence of pre-existing natural attenuation processes, it is anticipated that ongoing groundwater monitoring of boundary monitoring wells will be required to be conducted for a minimum 1-2 years after the completion of remediation works to establish a sufficient post-remediation dataset for statistical purposes. Any reduction in the monitoring program will be reviewed in consultation with the Site Auditor in the context of the DQOs outlined in Section 3.4.

3.6.1 Non-Compliance Reporting

A non-compliance is defined within the REMP as “an occurrence, set of circumstances or development that is a breach of the requirements of the REMP, Development Consent, EPL or associated management plans, including exceedance of monitoring limits...”.

Non-compliances (i.e. exceedances of monitoring limits which present risks to receptors) may be identified via the groundwater monitoring program and should be reported to the NSW DPIE, along with corrective actions in accordance with the procedure provided within Section 6.4 of the REMP.

3.7 Contingency Plan

If mobilisation of LNAPL or a spike in contaminant concentrations indicated via groundwater monitoring wells, the following actions should be taken:

- check whether concentrations are within the historical range, conducting re-analysis or additional sampling to confirm concentrations;
- Sample LNAPL to determine if composition of COPCs constitutes a risk to human health;
- evaluate surrounding wells to determine if there are pockets of groundwater in which attenuation does not appear to be occurring, or whether the situation appears isolated to one well. Monitor additional locations if needed to determine this;

- Revisit risk assessment in the context of mass flux to assess potential contaminant contributions to receptors;

If a risk to receptors is identified through the above actions or poses an immediate risk to the environment, consideration of short-term active LNAPL remediation solutions, such as mobile Multi-Phase Vacuum Extraction and/or in-situ chemical oxidation (ISCO) would be made in consultation with the Site Auditor.

3.8 Monitoring Well Decommissioning

When monitoring wells have been identified as being no longer required, decommissioning of these wells is recommended. Recommendations for the decommissioning of specific monitoring wells will be included in the Q4 reports.

Monitoring well decommissioning should be completed in accordance with the decommissioning requirements set out within the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC, 2012).

3.9 GWMP Evaluation, Review and Completion

The monitoring program outlined within *Table 1 and 2 of Appendix B* should be reviewed at least annually (following completion of each Annual GME Summary report).

The requirements of the GWMP will be met for ongoing monitoring, enabling monitoring to cease when concentrations of contaminants of concern shown to have met the groundwater assessment criteria and are demonstrating statistically decreasing or stable trends following remediation.

A case for the reduction or cessation of monitoring will be provided to the Site Auditor for consideration and endorsement in consideration of the DQOs outlined in Section 3.4.

Complete cessation of monitoring may be presented in the same way, or may be prepared as a separate report for consideration by the Site Auditor.

3.10 Amendments

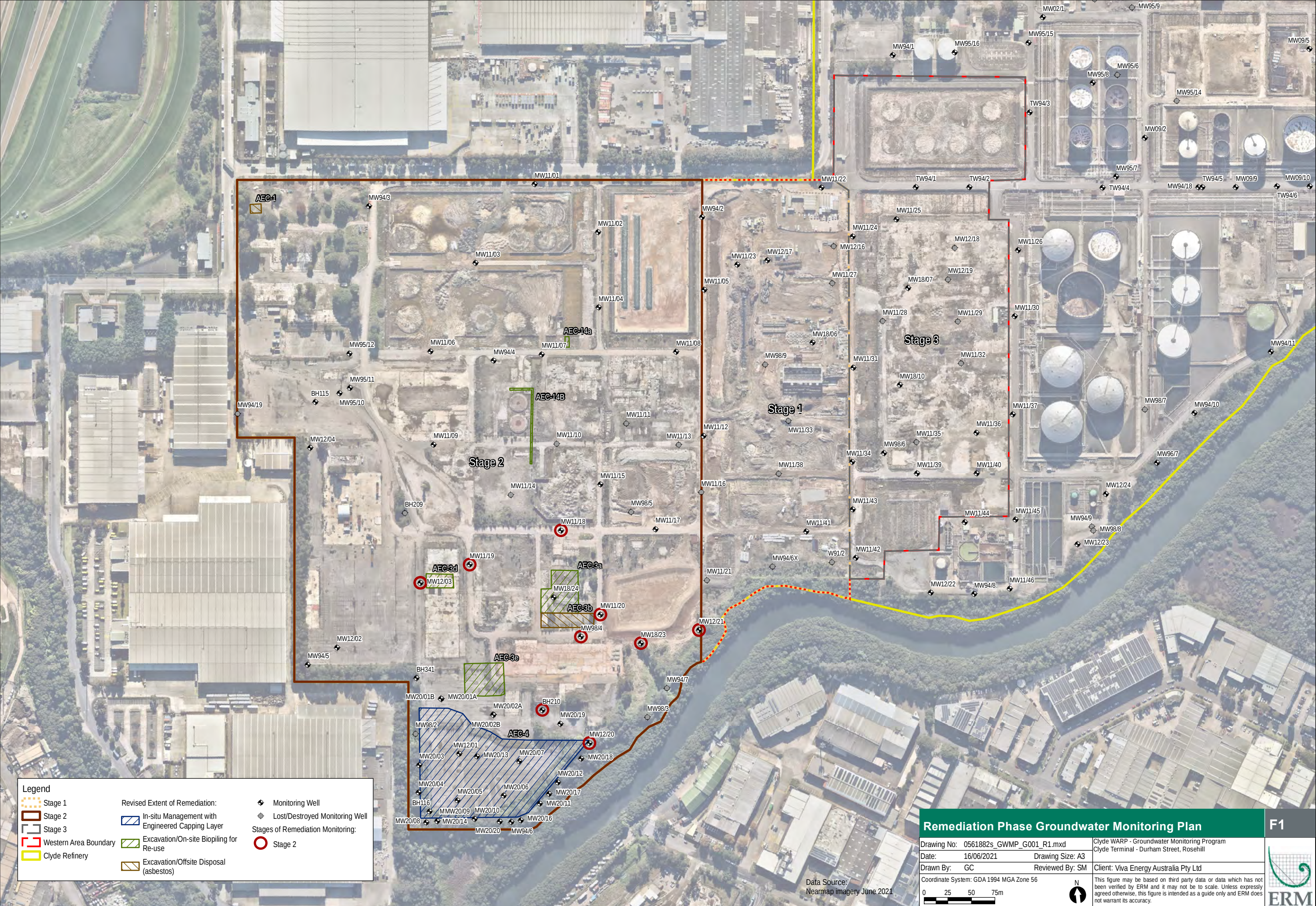
If the reviews described above recommend amendments, then this GWMP must be amended and re-issued. Any amendments must be reviewed by Viva Energy and the Site Auditor and documented within the Amendment Register at the front of this GWMP.

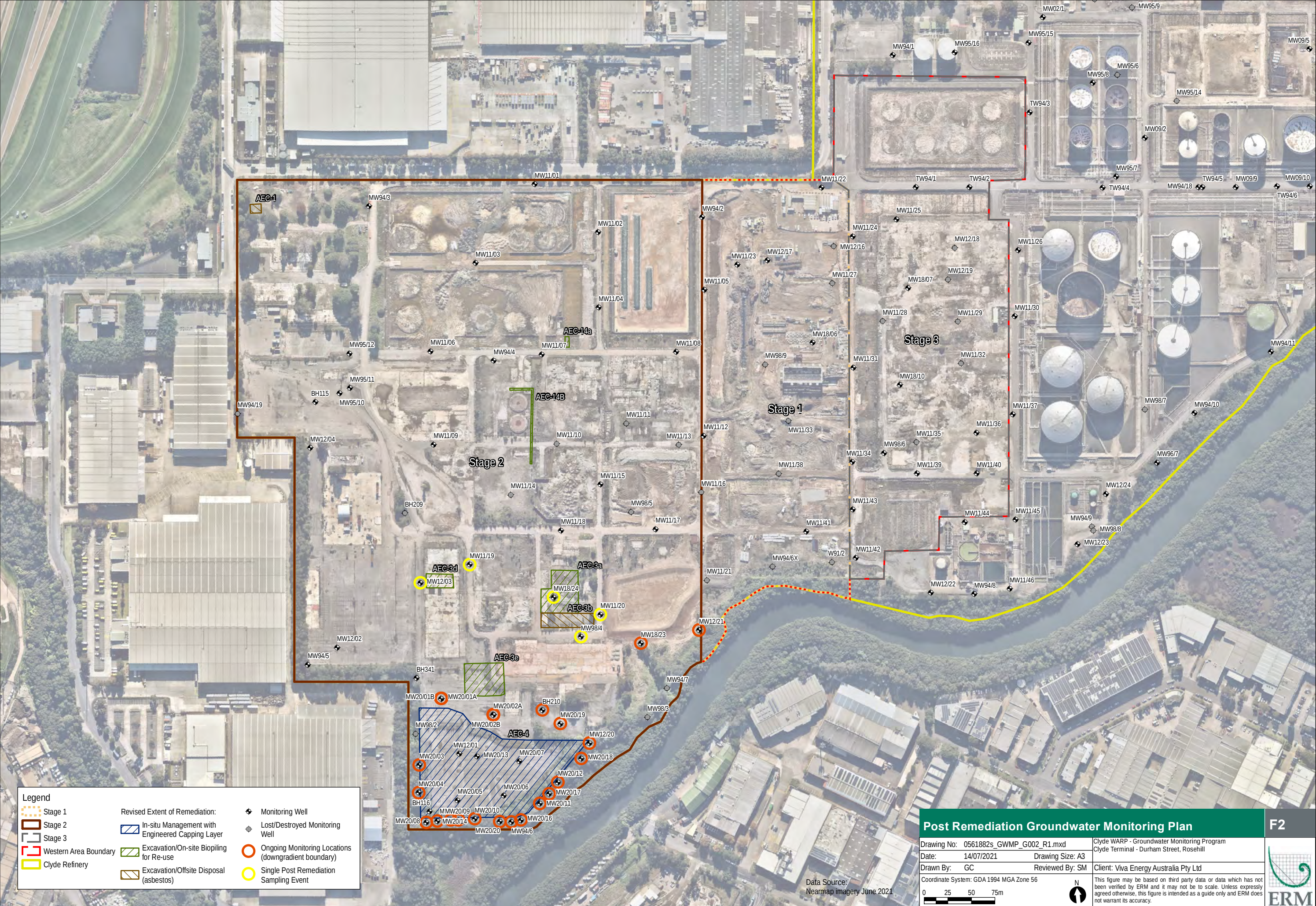
Amendments to the GMP and this GWMP must be documented in accordance with the requirements specified in Section 6.5 of the REMP and will be undertaken in consultation with the Site Auditor

4. REFERENCES

- AECOM 2019a. Clyde Western Area Remediation Project, Environmental Impact Statement.
- AECOM 2019b. Clyde Western Area Remediation Project, Conceptual RAP.
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- ANZAST (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality
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- Department of Land & Water Conservation (1998) *The NSW Groundwater Quality Protection Policy*
- ERM 2018. *PFAS Conceptual Site Model and Flux Assessment* (0466133_Clyde PFAS PSI_FINAL) Clyde Terminal, Durham Street, Rosehill, NSW. December 2018.
- ERM 2020a. Clyde Western Area Remediation Project – *Remediation Site Investigation*. Final V3. February 2020.
- ERM 2020b. Clyde Western Area Remediation Project – *Human Health and Ecological Risk Assessment*. Final V3. February 2020.
- ERM 2020c. Quarter 4 (2019) Groundwater Monitoring Event, Clyde and Parramatta Terminal. Final. February 2020.
- ERM 2021a. Clyde Western Area Remediation Project – *Groundwater Monitoring Program*. Final Rev04. February 2021.
- ERM 2021b. Clyde Western Area Remediation Project – *Stage 2 Detailed Remediation Action Plan*. Final Draft. May 2021.
- ERM 2021c. Clyde Western Area Remediation Project – *Quarter 4 2020 Groundwater Monitoring Event*. Final. March 2021.
- Environmental Planning and Assessment Act 1979
- NSW EPA (2020) *Consultants Reporting on Contaminated Land. Contaminated Land Guidelines*
- National Health and Medical Research Council (2011). Australian Drinking Water Guidelines ADWG [updated August 2018].
- Heads of EPA Australia and New Zealand (HEPA 2020). *PFAS National Environmental Management Plan Version 2.0*.
- National Environment Protection Council (2013). National Environment Protection (Assessment of site Contamination) Amendment Measure (No.1). This is hereafter referred to as ‘the NEPM, 2013’.
- National Health and Medical Research Council/National Resource Management Ministerial Council, Commonwealth of Australia, Canberra (2011). Australian drinking water guidelines paper 6 national water quality management strategy.
- NSW Environment Protection Authority (2017). Guidelines for the NSW Site Auditor Scheme (3rd edition).

APPENDIX A FIGURES





APPENDIX B

GROUNDWATER MONITORING PROGRAM SUMMARY TABLES

				Baseline Monitoring (prior to remediation commencement) Completion Monitoring (<3 months following completion of remediation excavation)				During Remediation		
Sample ID	Remediation Stage	Purpose/ Rationale	Remediation Excavation Area	Gauging	Sampling	Analysis ²	Field Parameters ¹	Frequency	Gauging	Field Parameters ¹
BH210	Stage 2	Excavation Area Monitoring	AEC-3a	Y	Y	TRH C6-C40, BTEXN	Y	Weekly during excavation and dewatering	Y	Y
MW98/4	Stage 2	Excavation Area Monitoring	AEC-3a	Y	Y	TRH C6-C40, BTEXN	Y	Weekly during excavation and dewatering	Y	Y
MW11/18	Stage 2	Excavation Area Monitoring	AEC-3a	Y	Y	TRH C6-C40, BTEXN	Y	Weekly during excavation and dewatering	Y	Y
MW11/19	Stage 2	Excavation Area Monitoring	AEC-3d	Y	Y	TRH C6-C40, BTEXN	Y	Weekly during excavation and dewatering	Y	Y
MW11/20	Stage 2	Excavation Area Monitoring	AEC-3a	Y	Y	TRH C6-C40, BTEXN	Y	Weekly during excavation and dewatering	Y	Y
MW12/03	Stage 2	Excavation Area Monitoring	AEC-3d	Y	Y	TRH C6-C40, BTEXN	Y	Weekly during excavation and dewatering	Y	Y
MW12/20	Stage 2	Boundary Monitoring	-	Y	Y	TRH C6-C40, BTEXN	Y	Monthly during active remediation conducted up-gradient	Y	Y
MW18/23	Stage 2	Boundary Monitoring	-	Y	Y	TRH C6-C40, BTEXN	Y	Monthly during active remediation conducted up-gradient	Y	Y
MW12/21	Stage 2	Boundary Monitoring	-	Y	Y	TRH C6-C40, BTEXN	Y	Monthly during active remediation conducted up-gradient	Y	Y

QA/QC Samples	
Sample Type	Required Frequency
Intra-laboratory duplicates	1 per 10 primary samples
Inter-laboratory duplicates	1 per 20 primary samples
Trip Blanks	1 per laboratory batch
Trip Spikes	1 per laboratory batch
Rinsate Blanks	1 per day of sampling

Notes:
1) Field Parameters include pH, conductivity, dissolved oxygen (DO), temperature and redox potential (redox)
2) All TRH analysis to include Silica Gel Cleanup results in addition to regular analysis

				Ongoing monitoring (biannual)						
Sample ID	Remediation Stage	Purpose/ Rationale	Remediation Excavation Area	Gauging	Sampling	Field Parameters ¹	TRH C6-C40 (SGC ²), BTEXN	MNA Parameters ³	PAH / Speciated Cr (ultra trace ⁴)	PFAS (28)
MW11/21	Stage 2	Boundary Monitoring	-	1	1	1	1	1	-	-
MW12/21	Stage 2	Boundary Monitoring	-	1	1	1	1	1	-	-
MW18/23	Stage 2	Boundary Monitoring	-	1	1	1	1	1	-	-
MW20/01A	Stage 2	Upgradient Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/01B	Stage 2	Upgradient Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/02A	Stage 2	Upgradient Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/02B	Stage 2	Upgradient Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/03	Stage 2	Source Area (north)	AEC-4	1	1	1	1	1	1	1
MW20/04	Stage 2	Source Area (south)	AEC-4	1	1	1	1	1	1	1
MW20/08	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/09	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/10	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/11	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/12	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/14	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/15	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/16	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/17	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/18	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW20/19	Stage 2	Upgradient Monitoring	AEC-4	1	1	1	1	1	1	1
BH210	Stage 2	Upgradient Monitoring	AEC-4	1	1	1	1	1	1	1
MW12/20	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
MW94/6	Stage 2	Downgradient Boundary Monitoring	AEC-4	1	1	1	1	1	1	1
TOTAL				23	23	23	23	23	20	20

QA/QC Samples

Sample Type	Required Frequency
Intra-laboratory duplicates	1 per 10 primary samples
Inter-laboratory duplicates	1 per 20 primary samples
Trip Blanks	1 per laboratory batch
Trip Spikes	1 per laboratory batch
Rinsate Blanks	1 per day of sampling

Notes:
1) Field Parameters include pH, conductivity, dissolved oxygen (DO), temperature and redox potential (redox)
2) All TRH analysis to include Silica Gel Cleanup results in addition to regular analysis
3) Monitored Natural Attenuation (MNA) parameters include nitrate, ferrous iron, methane and sulphate
4) Ultra Trace PAH required below ANZG (2018) Marine Trigger Values. Laboratory Limit of Reporting <4.4 ug/L required for hexavalent chromium)

APPENDIX C

GROUNDWATER SITE SPECIFIC LEVELS

COPC	Groundwater		
	VI (mg/L)		
	Commercial (1.8mbgl)	IMW	Construction
Benzene	5.0	NL	NL
Naphthalene	13	NL	NL
Benzo(a)pyrene TEQ	-	-	-
Total Chromium ^a	-	-	-
Chromium VI	-	-	-
TRH C6-C10 (less BTEX)	6.2	NL	NL
TRH C6-C10	-	-	-
TRH C10-C16 (less N)	NL	NL	NL
TRH C10-C16	-	-	-
TRH C16-C34	-	-	-
TRH C34-C40	-	-	-
TPH (EC5-6) aliphatic	-	-	-
TPH (>EC6-8) aliphatic	NL	NL	NL
TPH (>EC8-10) aliphatic	4	NL	NL
TPH (>EC10-12) aliphatic	NL	NL	NL
TPH (>EC12-16) aliphatic	NL	NL	NL
TPH (>EC16-21) aliphatic	-	-	-
TPH (>EC21-34) aliphatic	-	-	-
TPH (>34) aliphatic	-	-	-
TPH (>EC8-10) aromatic	NL	NL	NL
TPH (>EC10-12) aromatic	NL	NL	NL
TPH (>EC12-16) aromatic	NL	NL	NL
TPH (>EC16-21) aromatic	-	-	-
TPH (>EC21-34) aromatic	-	-	-
TPH (>34) aromatic	-	-	-
Trimethylbenzene, 1,2,4-			
Trimethylbenzene, 1,3,5-			
Cyclohexane			
Heptane, N-			
Hexane, N-			
Isooctane			
Propene			
Notes:			
NL = Non-Limiting			

ChemName	MatrixType	ActionLevelSource	ActionLevel	Units	Comments
1,1-dichloroethene	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
1,2-dichlorobenzene	water	NHMRC (2008) Recreational Water - Health	15	mg/L	
1,2-dichloroethane	water	NHMRC (2008) Recreational Water - Health	0.03	mg/L	
1,2-dichloroethene	water	NHMRC (2008) Recreational Water - Health	0.6	mg/L	
1,3-Dichloropropene	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
1,4-dichlorobenzene	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
2,2-DPA	water	NHMRC (2008) Recreational Water - Health	5	mg/L	
2,4,5-T	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
2,4,6-trichlorophenol	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
2,4-D [(2,4-Dichlorophenoxy) acetic acid]	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
2,4-dichlorophenol	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
2-chlorophenol	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Acephate	water	NHMRC (2008) Recreational Water - Health	0.08	mg/L	
Acrylamide	water	NHMRC (2008) Recreational Water - Health	0.002	mg/L	
Aldicarb	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Aldrin & Dieldrin	water	NHMRC (2008) Recreational Water - Health	0.003	mg/L	
Ametryn	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Amitraz	water	NHMRC (2008) Recreational Water - Health	0.09	mg/L	
Amitrole	water	NHMRC (2008) Recreational Water - Health	0.09	mg/L	
Antimony	water	NHMRC (2008) Recreational Water - Health	0.03	mg/L	
Arsenic	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Asulam	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Atrazine	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Azinphos-methyl	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Barium	water	NHMRC (2008) Recreational Water - Health	20	mg/L	
Benomyl	water	NHMRC (2008) Recreational Water - Health	0.9	mg/L	
Bentazone	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Benzene	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Benzo-(a)-pyrene	water	NHMRC (2008) Recreational Water - Health	0.0001	mg/L	
Beryllium	water	NHMRC (2008) Recreational Water - Health	0.6	mg/L	
Bioresmethrin	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Boron	water	NHMRC (2008) Recreational Water - Health	40	mg/L	
Bromacil	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Bromate	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Bromophos-ethyl	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Bromoxynil	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Cadmium	water	NHMRC (2008) Recreational Water - Health	0.02	mg/L	
Captan	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Carbaryl	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Carbendazim	water	NHMRC (2008) Recreational Water - Health	0.9	mg/L	
Carbofuran	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Carbon tetrachloride	water	NHMRC (2008) Recreational Water - Health	0.03	mg/L	
Carbophenothion	water	NHMRC (2008) Recreational Water - Health	0.005	mg/L	
Carboxin	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Carfentrazone-ethyl	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Chlordane	water	NHMRC (2008) Recreational Water - Health	0.02	mg/L	
Chlorfenvinphos	water	NHMRC (2008) Recreational Water - Health	0.02	mg/L	
chloroacetic acid	water	NHMRC (2008) Recreational Water - Health	1.5	mg/L	
Chlorobenzene	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Chlorothalonil	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Chloroxuron	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Chlorpyrifos	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Chlorsulfuron	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
Chromium (as Cr(VI))	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Clopyralid	water	NHMRC (2008) Recreational Water - Health	20	mg/L	
Copper	water	NHMRC (2008) Recreational Water - Health	20	mg/L	
Cyanide	water	NHMRC (2008) Recreational Water - Health	0.8	mg/L	
Cyanogen chloride (as cyanide)	water	NHMRC (2008) Recreational Water - Health	0.8	mg/L	
Cyfluthrin, Beta-cyfluthrin	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Cypermethrin isomers	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
Cyprodinil	water	NHMRC (2008) Recreational Water - Health	0.9	mg/L	
DDT	water	NHMRC (2008) Recreational Water - Health	0.09	mg/L	
Deltamethrin	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
di(2-ethylhexyl) phthalate	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Diazinon	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Dicamba	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Dichlobenil	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
dichloroacetic acid	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Dichloromethane (methylene chloride)	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Dichloroprop / Dichlorprop-P	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Dichlorvos	water	NHMRC (2008) Recreational Water - Health	0.05	mg/L	
Difenzquat	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Diflubenzuron	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Dimethoate	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Diphenamid	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Diuron	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
EDB	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Endosulfan	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Endothal	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Epichlorohydrin	water	NHMRC (2008) Recreational Water - Health	0.005	mg/L	
EPTC	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Esfenvalerate	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Ethion	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Ethoprophos	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Ethylbenzene	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Ethylenediamine tetraacetic acid (EDTA)	water	NHMRC (2008) Recreational Water - Health	2.5	mg/L	
Etridiazole	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Fenamiphos	water	NHMRC (2008) Recreational Water - Health	0.005	mg/L	
Fenarimol	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
Fenitrothion	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Fenoprop	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Fensulfothion	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Fenthion	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Fenvalerate	water	NHMRC (2008) Recreational Water - Health	0.6	mg/L	

ChemName	MatrixType	ActionLevelSource	ActionLevel	Units	Comments
Fipronil	water	NHMRC (2008) Recreational Water - Health	0.007	mg/L	
Flamprop-methyl	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Fluometuron	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Fluoride	water	NHMRC (2008) Recreational Water - Health	15	mg/L	
Fluproponate	water	NHMRC (2008) Recreational Water - Health	0.09	mg/L	
Formaldehyde	water	NHMRC (2008) Recreational Water - Health	5	mg/L	
Formothion	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Fosamine	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Glyphosate	water	NHMRC (2008) Recreational Water - Health	10	mg/L	
Haloxypop	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Heptachlor	water	NHMRC (2008) Recreational Water - Health	0.003	mg/L	
Hexachlorobutadiene	water	NHMRC (2008) Recreational Water - Health	0.007	mg/L	
Hexaflurate	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Hexazinone	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Imazapyr	water	NHMRC (2008) Recreational Water - Health	90	mg/L	
Iodide	water	NHMRC (2008) Recreational Water - Health	5	mg/L	
Iprodione	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Lead	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Lindane	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Malidison (Malathion)	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Mancozeb	water	NHMRC (2008) Recreational Water - Health	0.09	mg/L	
Manganese	water	NHMRC (2008) Recreational Water - Health	5	mg/L	
MCPA	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
Mercury	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Metalddehyde	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Metham	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Methidathion	water	NHMRC (2008) Recreational Water - Health	0.06	mg/L	
Methiocarb	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Methomyl	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Methyl bromide	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Metiram	water	NHMRC (2008) Recreational Water - Health	0.09	mg/L	
Metolachlor/s- Metolachlor	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Metribuzin	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Metsulfuron-methyl	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
Mevinphos	water	NHMRC (2008) Recreational Water - Health	0.05	mg/L	
Microcystins	water	NHMRC (2008) Recreational Water - Health	13	µg/L	
Molinate	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Molybdenum	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Monochloramine	water	NHMRC (2008) Recreational Water - Health	30	mg/L	
Monocrotophos	water	NHMRC (2008) Recreational Water - Health	0.02	mg/L	
Napropamide	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Nicarbazin	water	NHMRC (2008) Recreational Water - Health	10	mg/L	
Nickel	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Nitrate (as nitrate)	water	NHMRC (2008) Recreational Water - Health	500	mg/L	
Nitritoltriacetic acid	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
Nitrite (as nitrite)	water	NHMRC (2008) Recreational Water - Health	30	mg/L	
N-Nitrosodimethylamine (NDMA)	water	NHMRC (2008) Recreational Water - Health	0.001	mg/L	
Norflurazon	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Omethoate	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Oryzalin	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Oxamyl	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Paraquat	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Parathion	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Parathion-methyl	water	NHMRC (2008) Recreational Water - Health	0.007	mg/L	
Pebulate	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Pendimethalin	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Pentachlorophenol	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Permethrin	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
Picloram	water	NHMRC (2008) Recreational Water - Health	3	mg/L	
Piperonyl butoxide	water	NHMRC (2008) Recreational Water - Health	6	mg/L	
Pirimicarb	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Pirimiphos methyl	water	NHMRC (2008) Recreational Water - Health	0.9	mg/L	
Pirimiphos-ethyl	water	NHMRC (2008) Recreational Water - Health	0.005	mg/L	
Polihexanide	water	NHMRC (2008) Recreational Water - Health	7	mg/L	
Profenofos	water	NHMRC (2008) Recreational Water - Health	0.003	mg/L	
Propachlor	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Propanil	water	NHMRC (2008) Recreational Water - Health	7	mg/L	
Propargite	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Propazine	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Propiconazole	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Propyzamide	water	NHMRC (2008) Recreational Water - Health	0.7	mg/L	
Pyrasulfotole	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
Pyrzophos	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Pyroxulam	water	NHMRC (2008) Recreational Water - Health	40	mg/L	
Quintozene	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Selenium	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Silver	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Simazine	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Spirotetramat	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
Styrene (vinylbenzene)	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Sulprofos	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Temephos	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Terbacil	water	NHMRC (2008) Recreational Water - Health	2	mg/L	
Terbufos	water	NHMRC (2008) Recreational Water - Health	0.009	mg/L	
Terbutylazine	water	NHMRC (2008) Recreational Water - Health	0.1	mg/L	
Terbutryn	water	NHMRC (2008) Recreational Water - Health	4	mg/L	
Tetrachloroethene	water	NHMRC (2008) Recreational Water - Health	0.5	mg/L	
Tetrachlorvinphos	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Thiobencarb	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
Thiometon	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Thiophanate	water	NHMRC (2008) Recreational Water - Health	0.05	mg/L	
Thiram	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Toltrazuril	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Toluene	water	NHMRC (2008) Recreational Water - Health	8	mg/L	

ChemName	MatrixType	ActionLevelSource	ActionLevel	Units	Comments
Triadimefon	water	NHMRC (2008) Recreational Water - Health	0.9	mg/L	
tributyltin oxide	water	NHMRC (2008) Recreational Water - Health	0.01	mg/L	
Trichlorfon	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
trichloroacetic acid	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Trichlorobenzenes (total)	water	NHMRC (2008) Recreational Water - Health	0.3	mg/L	
Triclopyr	water	NHMRC (2008) Recreational Water - Health	0.2	mg/L	
Trifluralin	water	NHMRC (2008) Recreational Water - Health	0.9	mg/L	
Trihalomethanes (THMs) (Total)	water	NHMRC (2008) Recreational Water - Health	2.5	mg/L	
Uranium	water	NHMRC (2008) Recreational Water - Health	0.17	mg/L	
Vernolate	water	NHMRC (2008) Recreational Water - Health	0.4	mg/L	
Vinyl chloride	water	NHMRC (2008) Recreational Water - Health	0.003	mg/L	
Xylene	water	NHMRC (2008) Recreational Water - Health	6	mg/L	
Chloral hydrate (Trichloroacetaldehyde)	water	NHMRC (2008) Recreational Water - Health	1	mg/L	
Chlorite	water	NHMRC (2008) Recreational Water - Health	8	mg/L	
Dicofol	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Disulfoton	water	NHMRC (2008) Recreational Water - Health	0.04	mg/L	
Chlorine	water	NHMRC (2008) Recreational Water - Health	50	mg/L	
Diclofop-methyl	water	NHMRC (2008) Recreational Water - Health	0.05	mg/L	
Diquat	water	NHMRC (2008) Recreational Water - Health	0.07	mg/L	
Chromium	water	NEPM (1999) GIL - Marine Water	4.4	µg/L	
Mercury	water	NEPM (1999) GIL - Marine Water	0.1	µg/L	
Cadmium	water	NEPM (1999) GIL - Marine Water	0.7	µg/L	
Copper	water	NEPM (1999) GIL - Marine Water	1.3	µg/L	
Nickel	water	NEPM (1999) GIL - Marine Water	7	µg/L	
Zinc	water	NEPM (1999) GIL - Marine Water	15	µg/L	
2,4-Dichlorophenol	water	NEPM (1999) GIL - Marine Water	160	µg/L	
1,1,2-Trichloroethane	water	NEPM (1999) GIL - Marine Water	1900	µg/L	
1,2,4-Trichlorobenzene	water	NEPM (1999) GIL - Marine Water	20	µg/L	
2,4,6-Trichlorophenol	water	NEPM (1999) GIL - Marine Water	20	µg/L	
Lead	water	NEPM (1999) GIL - Marine Water	4.4	µg/L	
Phenol	water	NEPM (1999) GIL - Marine Water	400	µg/L	
2-Chlorophenol	water	NEPM (1999) GIL - Marine Water	490	µg/L	
Naphthalene	water	NEPM (1999) GIL - Marine Water	50	µg/L	
Benzene	water	NEPM (1999) GIL - Marine Water	500	µg/L	
1,1,2-Trichloroethane	water	NEPM (1999) GIL - Marine Water	6500	µg/L	
Zinc	water	NEPM (1999) GIL - Marine Water	8	µg/L	
Arsenic	water	NEPM (1999) GIL - Marine Water	2.3	µg/L	
Anthracene	water	NEPM (1999) GIL - Marine Water	0.01	µg/L	
Fluoranthene	water	NEPM (1999) GIL - Marine Water	1.4	µg/L	
Toluene	water	NEPM (1999) GIL - Marine Water	180	µg/L	
1,2-Dichloroethane	water	NEPM (1999) GIL - Marine Water	1900	µg/L	
Phenanthrene	water	NEPM (1999) GIL - Marine Water	2	µg/L	
Carbon tetrachloride	water	NEPM (1999) GIL - Marine Water	240	µg/L	
1,1-Dichloroethane	water	NEPM (1999) GIL - Marine Water	250	µg/L	
1,1,1-Trichloroethane	water	NEPM (1999) GIL - Marine Water	270	µg/L	
meta- & para-Xylene	water	NEPM (1999) GIL - Marine Water	275	µg/L	
Trichloroethene	water	NEPM (1999) GIL - Marine Water	330	µg/L	
ortho-Xylene	water	NEPM (1999) GIL - Marine Water	350	µg/L	
Chloroform	water	NEPM (1999) GIL - Marine Water	370	µg/L	
1,1,2,2-Tetrachloroethane	water	NEPM (1999) GIL - Marine Water	400	µg/L	
Dichloromethane	water	NEPM (1999) GIL - Marine Water	4000	µg/L	
Tetrachloroethene	water	NEPM (1999) GIL - Marine Water	70	µg/L	
1,1-Dichloroethene	water	NEPM (1999) GIL - Marine Water	700	µg/L	
Pentachloroethane	water	NEPM (1999) GIL - Marine Water	80	µg/L	
Benzene	water	NEPM (1999) GIL - Marine Water	950	µg/L	
Selenium	water	NEPM (1999) GIL - Marine Water	3	µg/L	
Ethylbenzene	water	NEPM (1999) GIL - Marine Water	5	µg/L	
Benzo(a)pyrene	water	NEPM (1999) GIL - Marine Water	0.2	µg/L	
Benzo(a)pyrene TEQ	water	NEPM (1999) GIL - Marine Water	0.2	µg/L	
Benzene	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
Ethylbenzene	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
Naphthalene	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
Toluene	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
TRH >C10-C16 excluding naphthalene (F2)	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
TRH C6 - C10 excluding BTEX (F1)	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
Xylene Total	water	CRC Care (2011) Intrusive Maint. Worker - Sar	NL	µg/L	
Ammonia	water	ANZG (2018) TV - Marine water (95%)	910	µg/L	Moderate Reliability
Cadmium	water	ANZG (2018) TV - Marine water (95%)	5.5	µg/L	High Reliability
Chlorpyrifos	water	ANZG (2018) TV - Marine water (95%)	0.009	µg/L	Low Reliability
Chromium (CrVI)	water	ANZG (2018) TV - Marine water (95%)	4.4	µg/L	Very high Reliability
Cobalt	water	ANZG (2018) TV - Marine water (95%)	1	µg/L	High Reliability
Endosulfan	water	ANZG (2018) TV - Marine water (95%)	0.01	µg/L	Moderate Reliability
Endrin	water	ANZG (2018) TV - Marine water (95%)	0.008	µg/L	Moderate Reliability
Lead	water	ANZG (2018) TV - Marine water (95%)	4.4	µg/L	Low Reliability
Mercury (inorganic)	water	ANZG (2018) TV - Marine water (95%)	0.4	µg/L	Very high Reliability
Naphthalene	water	ANZG (2018) TV - Marine water (95%)	70	µg/L	Moderate Reliability
Nickel	water	ANZG (2018) TV - Marine water (95%)	70	µg/L	High Reliability
Phenol	water	ANZG (2018) TV - Marine water (95%)	400	µg/L	Low Reliability
Silver	water	ANZG (2018) TV - Marine water (95%)	1.4	µg/L	Moderate Reliability
Zinc	water	ANZG (2018) TV - Marine water (95%)	15	µg/L	Very high Reliability
1,1,1-Trichloroethane	water	ANZG (2018) TV - Marine water (95%)	270	µg/L	Unknown level of species protection; Unknown Reliability
1,1,2,2-Tetrachloroethylene	water	ANZG (2018) TV - Marine water (95%)	70	µg/L	Unknown level of species protection; Unknown Reliability
1,1,2-Trichloroethylene	water	ANZG (2018) TV - Marine water (95%)	330	µg/L	Unknown level of species protection; Unknown Reliability
1,2,3,4-Tetrachlorobenzene	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
1,2,3,5-Tetrachlorobenzene	water	ANZG (2018) TV - Marine water (95%)	3	µg/L	Unknown level of species protection; Unknown Reliability
1,2,3-Trichlorobenzene	water	ANZG (2018) TV - Marine water (95%)	3	µg/L	Unknown level of species protection; Unknown Reliability
1,2,4,5-Tetrachlorobenzene	water	ANZG (2018) TV - Marine water (95%)	5	µg/L	Unknown level of species protection; Unknown Reliability
1,2-Dichlorobenzene	water	ANZG (2018) TV - Marine water (95%)	160	µg/L	Unknown level of species protection; Unknown Reliability
1,2-Dichloroethane	water	ANZG (2018) TV - Marine water (95%)	1900	µg/L	Unknown level of species protection; Unknown Reliability
1,2-Dinitrobenzene	water	ANZG (2018) TV - Marine water (95%)	0.6	µg/L	Unknown level of species protection; Unknown Reliability
1,3,5-Trichlorobenzene	water	ANZG (2018) TV - Marine water (95%)	8	µg/L	Unknown level of species protection; Unknown Reliability
1,3-Dichloropropane	water	ANZG (2018) TV - Marine water (95%)	1100	µg/L	Unknown level of species protection; Unknown Reliability
1,3-Dichloropropene	water	ANZG (2018) TV - Marine water (95%)	0.8	µg/L	Unknown level of species protection; Unknown Reliability
1,3-Dinitrobenzene	water	ANZG (2018) TV - Marine water (95%)	13	µg/L	Unknown level of species protection; Unknown Reliability

ChemName	MatrixType	ActionLevelSource	ActionLevel	Units	Comments
1,4-Dichlorobenzene	water	ANZG (2018) TV - Marine water (95%)	60	µg/L	Unknown level of species protection; Unknown Reliability
1-Chloro-2-nitrobenzene	water	ANZG (2018) TV - Marine water (95%)	15	µg/L	Unknown level of species protection; Unknown Reliability
1-Chloro-3-nitrobenzene	water	ANZG (2018) TV - Marine water (95%)	12	µg/L	Unknown level of species protection; Unknown Reliability
1-Chloro-4-nitrobenzene	water	ANZG (2018) TV - Marine water (95%)	1	µg/L	Unknown level of species protection; Unknown Reliability
1-Chloronaphthalene	water	ANZG (2018) TV - Marine water (95%)	0.7	µg/L	Unknown level of species protection; Unknown Reliability
2,3,4,5-Tetrachlorophenol	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
2,3,4,6-Tetrachlorophenol	water	ANZG (2018) TV - Marine water (95%)	10	µg/L	Unknown level of species protection; Unknown Reliability
2,3,4-Trichlorophenol	water	ANZG (2018) TV - Marine water (95%)	4	µg/L	Unknown level of species protection; Unknown Reliability
2,3,5,6-Tetrachlorophenol	water	ANZG (2018) TV - Marine water (95%)	1.4	µg/L	Unknown level of species protection; Unknown Reliability
2,3,5-Trichlorophenol	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
2,3,6-Trichlorophenol	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
2,4,5-Trichlorophenol	water	ANZG (2018) TV - Marine water (95%)	4	µg/L	Unknown level of species protection; Unknown Reliability
2,4-Dichloroaniline	water	ANZG (2018) TV - Marine water (95%)	7	µg/L	Unknown level of species protection; Unknown Reliability
2,4-Dichlorophenol	water	ANZG (2018) TV - Marine water (95%)	120	µg/L	Unknown level of species protection; Unknown Reliability
2,4-Dimethylphenol	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
2,4-Dinitrophenol	water	ANZG (2018) TV - Marine water (95%)	45	µg/L	Unknown level of species protection; Unknown Reliability
2,4-Dinitrotoluene	water	ANZG (2018) TV - Marine water (95%)	16	µg/L	Unknown level of species protection; Unknown Reliability
2,5-Dichlorophenol	water	ANZG (2018) TV - Marine water (95%)	3	µg/L	Unknown level of species protection; Unknown Reliability
2,6-Dichlorophenol	water	ANZG (2018) TV - Marine water (95%)	34	µg/L	Unknown level of species protection; Unknown Reliability
2-Chlorophenol	water	ANZG (2018) TV - Marine water (95%)	340	µg/L	Unknown level of species protection; Unknown Reliability
2-Nitrophenol	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
2-Nitrotoluene	water	ANZG (2018) TV - Marine water (95%)	110	µg/L	Unknown level of species protection; Unknown Reliability
4-Nitrophenol	water	ANZG (2018) TV - Marine water (95%)	58	µg/L	Unknown level of species protection; Unknown Reliability
4-Nitrotoluene	water	ANZG (2018) TV - Marine water (95%)	120	µg/L	Unknown level of species protection; Unknown Reliability
Acetonitrile	water	ANZG (2018) TV - Marine water (95%)	160	µg/L	Unknown level of species protection; Unknown Reliability
Acrylonitrile	water	ANZG (2018) TV - Marine water (95%)	8	µg/L	Unknown level of species protection; Unknown Reliability
Aldrin	water	ANZG (2018) TV - Marine water (95%)	0.003	µg/L	Unknown level of species protection; Unknown Reliability
Amitrole	water	ANZG (2018) TV - Marine water (95%)	22	µg/L	Unknown level of species protection; Unknown Reliability
Aniline	water	ANZG (2018) TV - Marine water (95%)	8	µg/L	Unknown level of species protection; Unknown Reliability
Anthracene	water	ANZG (2018) TV - Marine water (95%)	0.1	µg/L	Unknown level of species protection; Unknown Reliability
Antimony	water	ANZG (2018) TV - Marine water (95%)	270	µg/L	Unknown level of species protection; Unknown Reliability
Aroclor 1242	water	ANZG (2018) TV - Marine water (95%)	0.3	µg/L	Unknown level of species protection; Unknown Reliability
Aroclor 1254	water	ANZG (2018) TV - Marine water (95%)	0.01	µg/L	Unknown level of species protection; Unknown Reliability
Atrazine	water	ANZG (2018) TV - Marine water (95%)	13	µg/L	Unknown level of species protection; Unknown Reliability
Azinphos methyl	water	ANZG (2018) TV - Marine water (95%)	0.01	µg/L	Unknown level of species protection; Unknown Reliability
Benzo[a]pyrene	water	ANZG (2018) TV - Marine water (95%)	0.1	µg/L	Unknown level of species protection; Unknown Reliability
Bromacil	water	ANZG (2018) TV - Marine water (95%)	180	µg/L	Unknown level of species protection; Unknown Reliability
Carbofuran	water	ANZG (2018) TV - Marine water (95%)	0.06	µg/L	Unknown level of species protection; Unknown Reliability
Carbon disulfide	water	ANZG (2018) TV - Marine water (95%)	20	µg/L	Unknown level of species protection; Unknown Reliability
Carbon tetrachloride	water	ANZG (2018) TV - Marine water (95%)	240	µg/L	Unknown level of species protection; Unknown Reliability
Chlordane	water	ANZG (2018) TV - Marine water (95%)	0.001	µg/L	Unknown level of species protection; Unknown Reliability
Chlorobutylene	water	ANZG (2018) TV - Marine water (95%)	100	µg/L	Unknown level of species protection; Unknown Reliability
Chloroform	water	ANZG (2018) TV - Marine water (95%)	370	µg/L	Unknown level of species protection; Unknown Reliability
Cumene (isopropylbenzene)	water	ANZG (2018) TV - Marine water (95%)	30	µg/L	Unknown level of species protection; Unknown Reliability
DDE	water	ANZG (2018) TV - Marine water (95%)	0.0005	µg/L	Unknown level of species protection; Unknown Reliability
DDT	water	ANZG (2018) TV - Marine water (95%)	0.0004	µg/L	Unknown level of species protection; Unknown Reliability
Deltamethrin	water	ANZG (2018) TV - Marine water (95%)	0.0001	µg/L	Unknown level of species protection; Unknown Reliability
Demeton-S	water	ANZG (2018) TV - Marine water (95%)	0.3	µg/L	Unknown level of species protection; Unknown Reliability
Demeton-S-methyl	water	ANZG (2018) TV - Marine water (95%)	4	µg/L	Unknown level of species protection; Unknown Reliability
Di(2-ethylhexyl)phthalate	water	ANZG (2018) TV - Marine water (95%)	1	µg/L	Unknown level of species protection; Unknown Reliability
Diazinon	water	ANZG (2018) TV - Marine water (95%)	0.01	µg/L	Unknown level of species protection; Unknown Reliability
Dichloromethane	water	ANZG (2018) TV - Marine water (95%)	4000	µg/L	Unknown level of species protection; Unknown Reliability
Dicofol	water	ANZG (2018) TV - Marine water (95%)	0.1	µg/L	Unknown level of species protection; Unknown Reliability
Dieldrin	water	ANZG (2018) TV - Marine water (95%)	0.01	µg/L	Unknown level of species protection; Unknown Reliability
Dimethoate	water	ANZG (2018) TV - Marine water (95%)	0.15	µg/L	Unknown level of species protection; Unknown Reliability
Dimethylformamide	water	ANZG (2018) TV - Marine water (95%)	1000	µg/L	Unknown level of species protection; Unknown Reliability
Diphenylnitrosamine	water	ANZG (2018) TV - Marine water (95%)	6	µg/L	Unknown level of species protection; Unknown Reliability
Diquat	water	ANZG (2018) TV - Marine water (95%)	1.4	µg/L	Unknown level of species protection; Unknown Reliability
Diuron	water	ANZG (2018) TV - Marine water (95%)	1.8	µg/L	Unknown level of species protection; Unknown Reliability
Esfenvalerate	water	ANZG (2018) TV - Marine water (95%)	0.001	µg/L	Unknown level of species protection; Unknown Reliability
Ethanol	water	ANZG (2018) TV - Marine water (95%)	1400	µg/L	Unknown level of species protection; Unknown Reliability
Ethylbenzene	water	ANZG (2018) TV - Marine water (95%)	5	µg/L	Unknown level of species protection; Unknown Reliability
Ethylene glycol	water	ANZG (2018) TV - Marine water (95%)	50000	µg/L	Unknown level of species protection; Unknown Reliability
Fenitrothion	water	ANZG (2018) TV - Marine water (95%)	0.001	µg/L	Unknown level of species protection; Unknown Reliability
Fluoranthene	water	ANZG (2018) TV - Marine water (95%)	1	µg/L	Unknown level of species protection; Unknown Reliability
Heptachlor	water	ANZG (2018) TV - Marine water (95%)	0.0004	µg/L	Unknown level of species protection; Unknown Reliability
Hexachlorobenzene	water	ANZG (2018) TV - Marine water (95%)	0.05	µg/L	Unknown level of species protection; Unknown Reliability
Hexachlorocyclopentadiene	water	ANZG (2018) TV - Marine water (95%)	0.05	µg/L	Unknown level of species protection; Unknown Reliability
Hexachloroethane	water	ANZG (2018) TV - Marine water (95%)	290	µg/L	Unknown level of species protection; Unknown Reliability
Isophorone	water	ANZG (2018) TV - Marine water (95%)	130	µg/L	Unknown level of species protection; Unknown Reliability
Lindane	water	ANZG (2018) TV - Marine water (95%)	0.007	µg/L	Unknown level of species protection; Unknown Reliability
Malathion	water	ANZG (2018) TV - Marine water (95%)	0.05	µg/L	Unknown level of species protection; Unknown Reliability
Manganese	water	ANZG (2018) TV - Marine water (95%)	80	µg/L	Unknown level of species protection; Unknown Reliability
MCPA	water	ANZG (2018) TV - Marine water (95%)	1.4	µg/L	Unknown level of species protection; Unknown Reliability
Methomyl	water	ANZG (2018) TV - Marine water (95%)	3.5	µg/L	Unknown level of species protection; Unknown Reliability
Methoxychlor	water	ANZG (2018) TV - Marine water (95%)	0.004	µg/L	Unknown level of species protection; Unknown Reliability
Mirex	water	ANZG (2018) TV - Marine water (95%)	0.04	µg/L	Unknown level of species protection; Unknown Reliability
Molinate	water	ANZG (2018) TV - Marine water (95%)	3.4	µg/L	Unknown level of species protection; Unknown Reliability
Monochlorobenzene	water	ANZG (2018) TV - Marine water (95%)	55	µg/L	Unknown level of species protection; Unknown Reliability
m-Xylene	water	ANZG (2018) TV - Marine water (95%)	75	µg/L	Unknown level of species protection; Unknown Reliability
Nitrobenzene	water	ANZG (2018) TV - Marine water (95%)	550	µg/L	Unknown level of species protection; Unknown Reliability
o-Xylene	water	ANZG (2018) TV - Marine water (95%)	350	µg/L	Unknown level of species protection; Unknown Reliability
Paraquat	water	ANZG (2018) TV - Marine water (95%)	0.5	µg/L	Unknown level of species protection; Unknown Reliability
Parathion	water	ANZG (2018) TV - Marine water (95%)	0.004	µg/L	Unknown level of species protection; Unknown Reliability
Pentachlorobenzene	water	ANZG (2018) TV - Marine water (95%)	1.5	µg/L	Unknown level of species protection; Unknown Reliability
Pentachloroethane	water	ANZG (2018) TV - Marine water (95%)	80	µg/L	Unknown level of species protection; Unknown Reliability
Phenanthrene	water	ANZG (2018) TV - Marine water (95%)	0.6	µg/L	Unknown level of species protection; Unknown Reliability
Profenofos	water	ANZG (2018) TV - Marine water (95%)	0.002	µg/L	Unknown level of species protection; Unknown Reliability
p-Xylene	water	ANZG (2018) TV - Marine water (95%)	200	µg/L	Unknown level of species protection; Unknown Reliability
Tebuthiuron	water	ANZG (2018) TV - Marine water (95%)	2.2	µg/L	Unknown level of species protection; Unknown Reliability
Thallium	water	ANZG (2018) TV - Marine water (95%)	17	µg/L	Unknown level of species protection; Unknown Reliability
Thiobencarb	water	ANZG (2018) TV - Marine water (95%)	2.8	µg/L	Unknown level of species protection; Unknown Reliability
Thiram	water	ANZG (2018) TV - Marine water (95%)	0.01	µg/L	Unknown level of species protection; Unknown Reliability
Toluene	water	ANZG (2018) TV - Marine water (95%)	180	µg/L	Unknown level of species protection; Unknown Reliability

ChemName	MatrixType	ActionLevelSource	ActionLevel	Units	Comments
Toxaphene	water	ANZG (2018) TV - Marine water (95%)	0.0006	µg/L	Unknown level of species protection; Unknown Reliability
Xylene (m & p)	water	ANZG (2018) TV - Marine water (95%)	275	µg/L	Unknown level of species protection; Unknown Reliability
1,1,2-Trichloroethane	water	ANZG (2018) TV - Marine water (95%)	1900	µg/L	Very Low Reliability
1,2,4-Trichlorobenzene	water	ANZG (2018) TV - Marine water (95%)	80	µg/L	Moderate Reliability
3,4-Dichloroaniline	water	ANZG (2018) TV - Marine water (95%)	150	µg/L	Low Reliability
Benzene	water	ANZG (2018) TV - Marine water (95%)	700	µg/L	Moderate Reliability
Chromium (CrIII)	water	ANZG (2018) TV - Marine water (95%)	27.4	µg/L	Low Reliability
Copper	water	ANZG (2018) TV - Marine water (95%)	1.3	µg/L	Very high Reliability
Cyanide	water	ANZG (2018) TV - Marine water (95%)	4	µg/L	Very Low Reliability
Pentachlorophenol	water	ANZG (2018) TV - Marine water (95%)	22	µg/L	
Poly(acrylonitrile-co-butadiene-co-styrene)	water	ANZG (2018) TV - Marine water (95%)	250	µg/L	Low Reliability
Temephos	water	ANZG (2018) TV - Marine water (95%)	0.05	µg/L	Moderate Reliability
Tributyltin (as µg Sn/L)	water	ANZG (2018) TV - Marine water (95%)	0.006	µg/L	High Reliability
Vanadium	water	ANZG (2018) TV - Marine water (95%)	100	µg/L	High Reliability
1,1-Dichloroethylene	water	ANZG (2018) TV - Marine water (95%)	700	µg/L	Unknown level of species protection; Unknown Reliability
1,2-Dichloropropane	water	ANZG (2018) TV - Marine water (95%)	900	µg/L	Unknown level of species protection; Unknown Reliability
1,2-Diphenylhydrazine	water	ANZG (2018) TV - Marine water (95%)	2	µg/L	Unknown level of species protection; Unknown Reliability
1,3,5-Trinitrobenzene	water	ANZG (2018) TV - Marine water (95%)	4	µg/L	Unknown level of species protection; Unknown Reliability
1,3-Dichlorobenzene	water	ANZG (2018) TV - Marine water (95%)	260	µg/L	Unknown level of species protection; Unknown Reliability
1,4-Dinitrobenzene	water	ANZG (2018) TV - Marine water (95%)	0.6	µg/L	Unknown level of species protection; Unknown Reliability
2,3-Dichlorophenol	water	ANZG (2018) TV - Marine water (95%)	31	µg/L	Unknown level of species protection; Unknown Reliability
2,4,5-T	water	ANZG (2018) TV - Marine water (95%)	36	µg/L	Unknown level of species protection; Unknown Reliability
2,4,6-Trichlorophenol	water	ANZG (2018) TV - Marine water (95%)	3	µg/L	Unknown level of species protection; Unknown Reliability
2,4,6-Trinitrotoluene	water	ANZG (2018) TV - Marine water (95%)	140	µg/L	Unknown level of species protection; Unknown Reliability
3-Chloropropene	water	ANZG (2018) TV - Marine water (95%)	3	µg/L	Unknown level of species protection; Unknown Reliability
3-Nitrotoluene	water	ANZG (2018) TV - Marine water (95%)	75	µg/L	Unknown level of species protection; Unknown Reliability
4-Chlorophenol	water	ANZG (2018) TV - Marine water (95%)	220	µg/L	Unknown level of species protection; Unknown Reliability

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APPENDIX F GROUND GAS MONITORING PROGRAM

Post Remediation Ground Gas Monitoring Plan

Clyde Western Area Remediation
Project – Proposed Lot 64

PREPARED FOR
Viva Energy Pty Ltd

DATE
7 May 2024

REFERENCE
0561882



DOCUMENT DETAILS

DOCUMENT TITLE	Post Remediation Ground Gas Monitoring Plan
DOCUMENT SUBTITLE	Clyde Western Area Remediation Project – Proposed Lot 64
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Date	7 May 2024
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Author	Indiana Strachan
Client name	Viva Energy Pty Ltd

DOCUMENT HISTORY

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SIGNATURE PAGE

Post Remediation Ground Gas Monitoring Plan

Clyde Western Area Remediation Project – Proposed Lot 64

0561882



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ACRONYMS AND ABBREVIATIONS

Acronyms	Description
ACM	Asbestos Containing Material
AEC-4	Area of Environmental Concern 4
Ave	Average
BOM	Bureau of Meteorology
BTEXN	Benzene, toluene, ethylbenzene, xylene and naphthalene
Costin Roe	Costin Roe Consulting
CS	Characteristic Situation
CSM	Conceptual Site Model
EPS	EnviroPacific Services
ERM	Environmental Resources Management Australia Pty Ltd
ESA	Environmental Site Assessment
GGMP	Ground Gas Monitoring Plan
GSV	Gas Screening Values
Ha	Hectare
LLDPE	Linear low density polyethylene
LNAPL	Light, non-aqueous phase liquid
LTEMP	Long-term Environmental Management Plan
m BGL	Metres below ground level
Max	Maximum
Min	Minimum
NSW EPA	New South Wales Environmental Protection Agency
PAH	Polycyclic aromatic hydrocarbons
PFAS	Per- and poly- fluoroalkyl substances
QAQC	Quality assurance and quality control
RAP	Remedial Action Plan
SPR	Source-pathway-receptor
SSTLs	Site Specific Target Levels
Stage 2 RAP	ERM (2021a) <i>Stage 2 Detailed Remediation Action Plan</i> . Clyde Western Area Remediation Project
SVOC	Semi-volatile organic compounds
TRH	Total recoverable hydrocarbons
Viva Energy	Viva Energy Australia Pty Ltd
WARP	Western Area Remediation Project

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Viva Energy Australia Pty Ltd (Viva Energy) to prepare this Ground Gas Monitoring Plan (GGMP) for a portion of the Clyde Western Area, referred to as 'Proposed Lot 64' to outline the required ongoing gas monitoring requirements as described in the Long Term Environmental Management Plan (LTEMP) for Proposed Lot 64 (ERM, 2024¹).

Proposed Lot 64 is proposed subdivision of the former under State Significant Development (SSD-10459), and forms a portion of the the 'Stage 2 Area' of the Clyde Western Area Remediation Project (WARP) (SSD-9302). The site location of the WARP, Proposed Lot 64 and Proposed Lot 64 is presented as *Figure 1, Appendix A*.

The extent of Proposed Lot 64 subject this monitoring plan is shown on *Figure 2, Appendix A*. The extent is defined by the boundaries of those parts of Lot 1, DP1271927 forming Proposed Lot 64, as authorised for subdivision under State Significant Development Consent 10459.

The LTEMP for Proposed Lot 64 describes the requirement for monthly gas monitoring of Proposed Lot 64 for a period of six months, post-remediation of the area by encapsulation. The purpose of the ongoing monitoring is to verify the stability of ground gases and efficacy of the constructed capping surface at Proposed Lot 64 in mitigating the vertical and lateral migration of hazardous ground gases within Proposed Lot 64.

1.1 OBJECTIVES

The purpose of this monitoring plan are to provide an appropriate monitoring program and management controls for Proposed Lot 64, post-remediation by encapsulation of AEC-4.

The objectives of this monitoring plan are to:

- Provide monitoring and controls for the ongoing management of Proposed Lot 64 to identify migration of associated ground gases of the buried waste area to other on-site areas;
- Verify assumption that there is no additional ongoing gas accumulation potential within enclosed spaces within the capped extent; and
- Provide action requirements for exceedances of criteria and trigger levels of ground gases, if identified.

1.2 MONITORING SCOPE

The scope of monitoring is based on assessment of existing historical dataset obtained from within Proposed Lot 64, the requirements of the New South Wales Environmental Protection Agency (NSW EPA) (2016) *Solid Waste Landfills* guidelines, and the monitoring requirements specified in the LTEMP (ERM, 2024). The scope includes:

- Monitoring of sub-surface gas in the perimeter gas monitoring wells;
- Monitoring of sub-surface gas within identified enclosed structures installed above the capping liner (stormwater pits); and
- Monitoring of surface gas emissions from the capped surface and immediate surrounding areas.

¹ ERM (2024a) *Proposed Lot 64 – Long Term Environmental Management Plan, Clyde Western Area Remediation Project*. Preliminary Draft 21 March 2024.

2. SITE OVERVIEW

2.1 SITE DETAILS

The Site is located at Devon Street, Rosehill NSW as shown on *Figure 1, Appendix A*. Site details have been included in *Table 2-1* below. The site is suitable for commercial / industrial land uses, however infrastructure for occupation (without appropriate mitigations), basement structures or beneficial re-use of groundwater is precluded following remediation works. The environmental setting of Proposed Lot 64 has been detailed in the Supplementary Environmental Site Assessment Further details are provided within the LTEMP.

2.2 OVERVIEW OF REMEDIATION (2023 – 2024)

Remediation of Proposed Lot 64 took place between 2023 to 2024. Proposed Lot 64 has been subject to remediation activities as prescribed in the Stage 2 RAP, which involved *in-situ* management of residual soil contamination under an engineered capping. Details of the design and engineering and construction of the cap is detailed in the Proposed Lot 64 – AEC-4 Capping Construction Technical Specification (ERM 2024b). Remediation activities were conducted between December 2023 and May 2024, and included the following scope of works:

- Decommissioning of monitoring wells;
- Vegetation clearing and grubbing;
- Landforming and surface grading;
- Subgrade preparation;
- Excavation of shared anchor / service trenches;
- Installation of cushion geotextile;
- Installation of linear low-density polyethylene (LLDPE) geomembrane;
- Installation of a marker layer; and
- Laying of covering material and finishing with asphalt.

2.2.1 REFINED CONCEPTUAL SITE MODEL SUMMARY

The Refined Conceptual Site Model (CSM), provided in *Table 2-1* below, has been further refined to reflect the risks associated with the current nature of Proposed Lot 64, post-remediation.

Due to the nature and extent of contaminants of concern identified in AEC-4 and the chosen remediation option (in-situ management under engineered cap), the post-remediation use of the land will be a concrete slab predominantly used for outdoor storage under commercial / industrial land-use. It is noted that at this stage, no enclosed buildings exist or are proposed within Proposed Lot 64. However, should any future buildings be proposed, the design must include appropriate management controls and measures assessed consistent with the *Hazardous Ground Gas Guidelines*².

² NSW EPA (2020) *Assessment and Management of Hazardous Ground Gases*. May 2020.

TABLE 2-1 REFINED CONCEPTUAL SITE MODEL – AEC-4

Residual Contamination Contained within the Capped Extent	Potentially Complete SPR Linkages Without LTEMP Controls	
	Human Health	Ecological
SOIL - LNAPL - visual evidence of free-phase petroleum hydrocarbons in unsaturated soils, - TRH C₁₀-C₃₄, - Benzene, - Asbestos (ACM and fibres within fill), - Metals (hexavalent chromium), - Carcinogenic PAHs, - PFAS. GROUNDWATER - LNAPL (contained within AEC-4). GROUND GASES - Methane	SOIL No potentially complete SPR linkages through soil contamination were identified for on-site commercial/industrial or intrusive maintenance workers following completion of remediation. GROUNDWATER No potentially complete SPR linkages were identified for on-site or off-site human health receptors via groundwater under the current and proposed commercial/industrial land-use. GROUND GASES A detailed assessment of ground gas in relation to AEC-4 is summarised as follows: - There are no identified potential exposure pathways for receptors, given a well-ventilated open-air environment (i.e. no buildings, service trenches and pits within the entirety of Proposed Lot 64). - The presence of buildings and sub-surface structures and confined spaces are precluded within the remediated Proposed Lot 64. The preclusion of buildings and sub-surface structures within this area mitigates potential risks associated with confined spaces (i.e. asphyxiation from carbon dioxide rich, oxygen depleted atmospheres or generation of hazardous/flammable atmospheres). - Given the presence of the Duck River downgradient (south) and drainage infrastructure located to the west and south of the capped area, lateral migration of bulk ground gases is considered unlikely. Existing drainage infrastructure provide a barrier between Proposed Lot 64 to off-site receptors through restriction of flow and pore space below the ground surface.	No potentially complete SPR linkages to ecological receptors identified (limited to offsite - Duck River), noting the below incomplete exposure pathways for exceedances of offsite groundwater criterion: - Concentrations of PAHs exceeding ecological criteria in groundwater have been delineated to the boundary of Proposed Lot 64 - Concentrations of PFAS (including PFOS) exceeding ecological direct toxicity criteria in downgradient wells from AEC-4 are considered consistent with the magnitude of concentrations assessed via mass flux estimates of groundwater at the site boundary for other areas of Stage 2 (ERM 2018). Previous assessments have concluded: - potential direct toxicity risks to offsite receptors were unlikely considering low mass contribution and overall volume of receiving water body. - Indirect human exposure via consumption of PFAS containing seafood is unlikely given existing fishing bans. - Offsite assessment of bioaccumulative effects of PFAS in waterways are unlikely to provide meaningful input into site-based PFAS management given magnitude of other offsite contributions to these systems.

3. GROUND GAS MONITORING PLAN

The ongoing GGMP, post-remediation of Proposed Lot 64, is detailed in the following sub-sections. The monitoring plan has been summarised for ease interpretation and use as *Appendix B*.

3.1 DATA QUALITY OBJECTIVES

Required Information	Requirements
Step 1: State the problem	Define the problem: Collection of appropriate gas monitoring data is required to evaluate the effectiveness of the engineered capping layer, and to verify that gas accumulation is not occurring at a level that may pose risks to commercial/industrial receptor in and around the capping layer. The GGMP is required to: - include trigger levels for assessing the efficacy of the engineered capping layer; - monitor for potential adverse impacts of vertical migration of hazardous ground gasses in Lot 64; - outline contingency actions to be implemented if monitoring indicates that ground gas accumulation and/or migration is occurring; - outline contingency actions for reducing risks; and - document procedures for reporting changes to gas conditions that have the potential to create unacceptable risks to commercial/industrial receptors. AEC-4 is considered to be remediated by the construction of an engineered cap, and implementation of the LTEMP. The LTEMP describes the requirement for ongoing monthly monitoring of gas at Proposed Lot 64 for a period of six months, in order to identify any risk of gas migration and accumulation beneath the capped area. This GGMP has been prepared to demonstrate the efficacy of the remedial strategy i.e. the engineered cap remedial per the requirements of the LTEMP. Identify the project team: The project team related to the monitoring plan consist of the landowners of Proposed Lot 64 (Viva Energy), the Validation Consultant (ERM), and the Site Auditor (Andrew Kohlrusch, GHD).
Step 2: Identify the decision/goal of the study	Goal of the study: The objectives of this GGMP are to provide an appropriate monitoring program and controls for Proposed Lot 64 in order to satisfy the LTEMP and generate data for an assessment of the efficacy of the engineered cap construction. Primary study question(s): - Has any migrating or accumulating gas within Proposed Lot 64 been identified? - Is an assessment of the efficacy of the engineered cap construction required?
Step 3: Identify the information inputs	Information inputs: Monthly collection of gas monitoring data for a period of six months, consisting of: - Sub-surface gas accumulation monitoring of 12 monitoring well locations situated around the perimeter of the capped area; - Sub-surface gas accumulation monitoring of three stormwater pit locations; and - Surface gas emissions survey (25m grid) of the surface of Proposed Lot 64. The sampling locations described above are presented in <i>Figure 3, Appendix A</i>.
Step 4: Define the boundaries of the study	Study area: The study area is approximately 2.35 ha in size. The extent of AEC-4, within Proposed Lot 64 is defined in <i>Section 2</i> of this plan and presented as <i>Figure 2, Appendix A</i>. Temporal limits: The monitoring plan will collect data for a period of six months, upon the completion of the remediation and validation works in May 2024. The requirement for further monitoring will be assessed in consultation with the Site Auditor beyond the 6 month period.

Required Information	Requirements
Step 5: Develop the analytical approach	The monitoring plan approach for the project is outlined within <i>Section 4</i> of this plan and summarised below. Monitoring will consist of; • Sub-surface gas monitoring using a GA5000 gas analyser, for monitoring of methane, carbon dioxide, oxygen, carbon monoxide, hydrogen sulphide and flow rate. • Surface gas monitoring using a portable methane laser detector, for monitoring methane. • Sub-surface gas accumulation monitoring of three stormwater pit locations using a GA5000 gas analyser, for monitoring of methane, carbon dioxide, oxygen, carbon monoxide, hydrogen sulphide and flow rate. Weather condition requirements for gas monitoring are outlined within <i>Section 4.1</i> of this plan.
Step 6: Specify performance or acceptance criteria	The LTEMP describes the requirement for ongoing monthly monitoring of gas at Proposed Lot 64 for a period of six months, in order to identify any risk of gas migration and accumulation on the surface of, beneath and in enclosed spaces of the capped area at Lot 64. If monthly monitoring during a six monthly period demonstrates a lack of exceedances of trigger levels, monitoring of ground gasses as described within this GGMP should be undertaken on a six-monthly basis. The action requirements for exceedances of compliance criteria for sub-surface gas monitoring, enclosed structure gas monitoring and surface emissions monitoring are presented in <i>Section 6</i> of this GGMP. Exceedances of trigger levels for methane require notification to the NSW EPA, while an exceedance of adopted trigger levels for carbon dioxide require investigation and corrective action to be undertaken by the occupier. Additional to notification to the NSW EPA, exceedances of compliance criterion will initiate an assessment of the efficacy of the installed cap over Proposed Lot 64, and re-evaluation of the LTEMP (ERM, 2024a) per <i>Section 5</i> of this GGMP. Data quality assessment: The method for ensuring the quality assurance and quality control (QAQC) of collected data is defined in <i>Section 3.4</i> of this plan. QAQC for the monitoring plan is limited to: • Ensuring the monitoring equipment is calibrated, zeroed and fit for use prior to monitoring; • Ensuring field staff are well trained and qualified for use of scientific equipment; • Ensuring satisfactory field note collection procedures are adhered to.
Step 7: Develop the plan for obtaining data	The DQOs have been developed based on review of existing data, the selected remedial strategy and discussions with Viva Energy and the Site Auditor.

3.2 MONITORING LOCATIONS

The current available monitoring locations at Proposed Lot 64 comprises (refer to *Figure 3, Appendix A*):

- Twelve perimeter sub-surface gas monitoring wells outs the encapsulated area;
- Three enclosed structures in the form of stormwater pits (ES01 to ES03); and
- A 25 m grid survey of the capped surface area, including a 25 m buffer from the encapsulated perimeter.

Well construction details for the sub-surface gas monitoring wells are included as *Appendix C*.

3.3 GROUND GAS MONITORING PROGRAM

A summary of the GGMP is presented in *Table 3-1* below. The full monitoring plan including analytes and reporting limits is included in *Appendix B*.

TABLE 3-1 GROUND GAS MONITORING PLAN

Type of monitoring	Frequency	Description	Proposed Monitoring Locations	Appendix B Reference
Subsurface gas	Monthly (total of six months)	- Leak test; - Measurement of gas concentrations, pressure and flow within the well; and - Standing water level measurement.	MW12/20, MW20/08, MW20/09, MW20/10, MW20/11, MW20/12, MW20/14, MW20/15, MW20/16, MW20/17, MW20/18, and MW20/20. Refer to <i>Figure 3, Appendix A</i> .	C-1
Enclosed structures	Monthly (total of six months)	Measurement of gas concentrations in enclosed structures.	ES01, ES02, and ES03. Refer to <i>Figure 3, Appendix A</i>	C-2
Surface gas emissions	Monthly (total of six months)	Measure gas concentration 50 mm above capped surface on a 25 m grid, and within a 25 m buffer from the encapsulated perimeter. Measurements should target the corner of each 25 m grid.	25 m grid survey. Refer to <i>Figure 3, Appendix A</i> .	C-3

3.4 FIELD QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Quality Assurance and Quality Control (QAQC) actions relevant to GGMP are limited to the calibration of field equipment by a certified equipment specialist prior to monitoring events, and daily in-field calibration by bump and fresh air testing directly prior to monitoring. Additionally, weather condition requirements for surface gas emissions monitoring are detailed below in *Section 4.1*.

4. MONITORING METHODOLOGY

The required methodologies for conducting monitoring of Proposed Lot 64 are summarised below.

4.1 WEATHER CONDITIONS

The Bureau of Meteorology (BOM) weather data for the nearest weather station (Sydney Olympic Park Weather Station, Station 066212) should be checked prior to the site visit to ensure conditions are appropriate for monitoring.

The following weather parameters shall be recorded and included in the report for each monitoring event:

- Wind speed (average and maximum (max)) on the days of the monitoring event;
- Temperature (max and minimum (min)) on the days of the monitoring event;
- Atmospheric pressure (max and min) on the days of the monitoring event; and
- Rainfall (daily average) on the days of the monitoring event and five days prior to the event.

Surface emissions monitoring requires low wind speeds (<10 km/hr) and stable pressure (<101.3 kPa) and is preferably conducted in dry conditions, as saturated soils impede gas flow and clay swelling would reduce the width of an cracks beneath the capped area.

Where possible, sampling events should be targeted on days of stable pressure or falling pressure.

4.2 SUBSURFACE GAS MONITORING

All sub-surface gas monitoring in wells will be conducted using a suitable hand-held landfill gas monitoring instrument, such as a GA5000. The instrument must be capable of providing the measurements and meeting the detection limits that are specified in *Appendix B-1*. Sub-surface gas monitoring shall include the following methodology:

- Landfill gas analyser is to be connected to the well, gas tap opened and analytes as per *Appendix B-1* are to be recorded, with gas readings to be taken after the pump has purged for 60 seconds, then has sampled for 60 seconds to allow gas readings to stabilise;
- Following disconnection of the monitoring instrument, standing water level in the well is to be measured and recorded using an oil-water interface probe. The measurement required is depth to water, relative to the top of the well casing (elevation provided in *Appendix C*).

A proposed field form for documenting the gas monitoring is attached as *Appendix D*.

4.3 ENCLOSED STRUCTURES GAS ACCUMULATION MONITORING

Enclosed structures at Proposed Lot 64 are limited to three stormwater pits, labelled ES01, ES02 and ES03. The pits are connected and are part of a drainage system which collects run off from Proposed Lot 64 and wider WARP.

A GA5000 or equivalent landfill gas analyser will be used for measurements of the enclosed structures (specification as per *Appendix B-2*). Tubing from the landfill gas analyser is to be fed into the stormwater pit and purged for 60 seconds before results are recorded.

4.4 CAPPED SURFACE METHANE EMISSIONS

Surface gas emissions of methane from the capped surface shall be undertaken in dry, calm conditions of relatively low, stable atmospheric pressure (wind speeds not exceeding 10 km / hr and atmospheric pressure below 101.3 kPa. If this is not possible, the actual weather conditions should be recorded, and an assessment conducted of the potential implications of collected data.

Surface monitoring shall be undertaken using a infra-red laser spectroscopy analyser or equivalent instrument with specification in accordance with that provided in *Appendix B-3*. Wind speed should be measured using a hand-held anemometer.

At each event, measurement of methane concentration at no more than 50 mm above the capped surface should be taken in each of the 25 m grid squares within the capped area and within the 25 m buffer from the perimeter of the capped area. The extent of the capped area and the 25 m buffer is presented in *Figure 4, Appendix A*. Measurements of wind speed and direction are to be recorded at each location.

A proposed field form for documenting the surface monitoring is attached as *Appendix D*.

5. ASSESSMENT CRITERIA, THRESHOLD LEVELS AND COMPLIANCE CRITERIA

The objective of this post-remediation GGMP is to utilise the collected dataset to assess the efficacy of the remediation strategy of Proposed Lot 64 by encapsulation.

The assessment criteria adopted for Proposed Lot 64 has been provided by the New South Wales Environmental Protection Agency (NSW EPA), Environmental Guidelines: Solid waste landfill (2016). The guidelines provide both threshold levels for investigation and corrective action, and compliance criteria in which requires notification to the EPA.

It is noted that Proposed Lot 64, although not defined as a landfill, has adopted these guidelines and compliance criterion due to the nature of the sub-surface contamination and historical land uses of the “buried waste area”.

The actions required in the event that monitoring results fail to meet the assessment criteria are provided in *Section 6*, and presented in *Table 5-1* below.

TABLE 5-1 ASSESSMENT CRITERIA FOR GROUND GAS MONITORING

Monitoring type	Gas	Criteria	Action Requirements	Guideline	Comment
Sub-surface gas monitoring	Methane (CH ₄)	1 % v/v	<i>Section 6.1</i>	NSW EPA 2016	Exceedance requires notification to the NSW EPA.
	Carbon dioxide (CO ₂)	1.5 % above background levels	<i>Section 6.1</i>	NSW EPA 2016	Threshold level for further investigation and corrective action.
Enclosed structures gas accumulation monitoring (stormwater pits)	Methane (CH ₄)	1 % v/v	<i>Section 6.2</i>	NSW EPA 2016	Exceedance requires notification to the NSW EPA.
	Carbon dioxide (CO ₂)	1.5 % v/v ¹	<i>Section 6.2</i>	-	-
Surface gas emissions	Methane (CH ₄)	500 ppm	<i>Section 6.3</i>	NSW EPA 2016	Threshold level for further investigation and corrective action.
	Carbon dioxide (CO ₂)	- ²	-	-	-

Notes:

1. The NSW EPA guidelines do not specify a threshold for CO₂ accumulation in enclosed structures. However, carbon dioxide is toxic at concentrations of 2-5% v/v in air, and on this basis, a threshold of 1.5% v/v is considered a reasonable assessment criterion that would indicate potential health hazard.
2. CO₂ measurements are not relevant to surface emissions monitoring, as CO₂ related risks are specific to confined spaces.

6. ACTION REQUIREMENTS

Exceedances of the adopted screening criteria for gas monitoring at Proposed Lot 64 will initiate differing action requirements as defined by the NSW EPA (2016) guidelines.

Exceedances of trigger levels for methane require notification to the NSW EPA, while an exceedance of adopted trigger levels for carbon dioxide will require investigation and corrective action to be undertaken by the occupier.

Additional to notification to the NSW EPA, exceedances of compliance criterion will initiate an assessment of the efficacy of the installed cap over Proposed Lot 64, and re-evaluation of the LTEMP (ERM, 2024a).

The action requirements for exceedances of compliance criteria for sub-surface gas monitoring, enclosed structure gas monitoring and surface emissions monitoring are presented in the following subsections.

6.1 EXCEEDANCE OF COMPLIANCE CRITERION IN PERIMETER SUB-SURFACE GAS WELLS

As per the NSW EPA (2016) guidelines, if methane is detected at concentrations above 1% v/v in sub-surface gas monitoring wells, the occupier must notify the EPA *promptly*. Within 14 days, the occupier must submit a plan to the EPA for further investigation and/or remediation of the elevated gas levels.

Specific to Proposed Lot 64, this plan may include (but is not limited to) one or more of the following corrective actions:

- An increase in monitoring frequency;
- The installation of additional monitoring wells;
- Volumetric/gas flow determinations to assess the significance of gas generation rates and the potential scale of off-site gas migration; and
- Notifications to potentially affected persons.

6.2 EXCEEDANCE OF COMPLIANCE CRITERION IN ENCLOSED STRUCTURES

Enclosed structures are limited to stormwater pits within the proposed Lot 64. As per the NSW EPA (2016) guidelines, if methane is detected at concentrations above 1% v/v in enclosed structures, the occupier must notify the EPA within *24 hours*. Within 14 days, the occupier must submit a plan to the EPA for further investigation and/or remediation of the elevated gas levels.

Specific to Proposed Lot 64, this plan may include (but is not limited to) one or more of the following corrective actions:

- Daily testing of the building or enclosed structure until ventilation or other measures have been put in place to eliminate the methane build-up; and
- Further sub-surface monitoring to delineate any potential migration of landfill gas

6.3 EXCEEDANCE OF COMPLIANCE CRITERION IN SURFACE GAS EMISSIONS

As per the NSW EPA (2016) guidelines, if methane is detected at concentrations above 500 parts per million (ppm), the occupier must implement investigation and corrective actions, specific to Proposed Lot 64.

Corrective actions may include (but not limited to):

- Flux (emissions) monitoring to quantify emission rates and help identify the extent of gas loss (surface scans give a concentration, not a flow rate); and
- The installation of additional monitoring wells.

7. REFERENCES

Environmental Resources Management Australia (ERM), 2024a. *Proposed Lot 64 – Long Term Environmental Management Plan*, Clyde Western Area Remediation Project. Preliminary Draft 21 March 2024.

ERM, 2021a – *Stage 2 – Detailed Remediation Action Plan*, Clyde Western Area Remediation Project. 8 July 2021.

ERM, 2021b. *Supplementary Environmental Site Assessment – Southern Buried Waste Area (AEC-4)*, Clyde Western Area Remediation Project. June 2021.

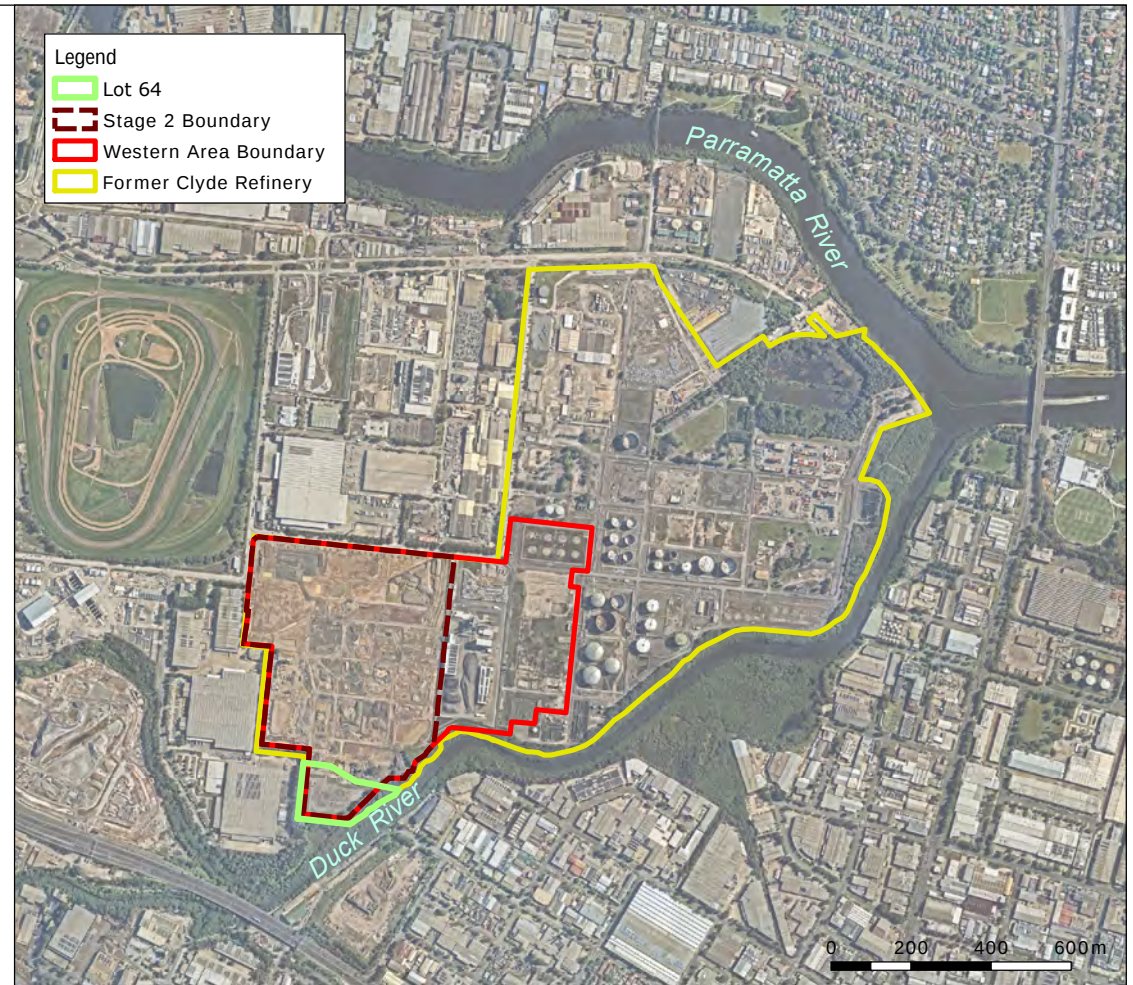
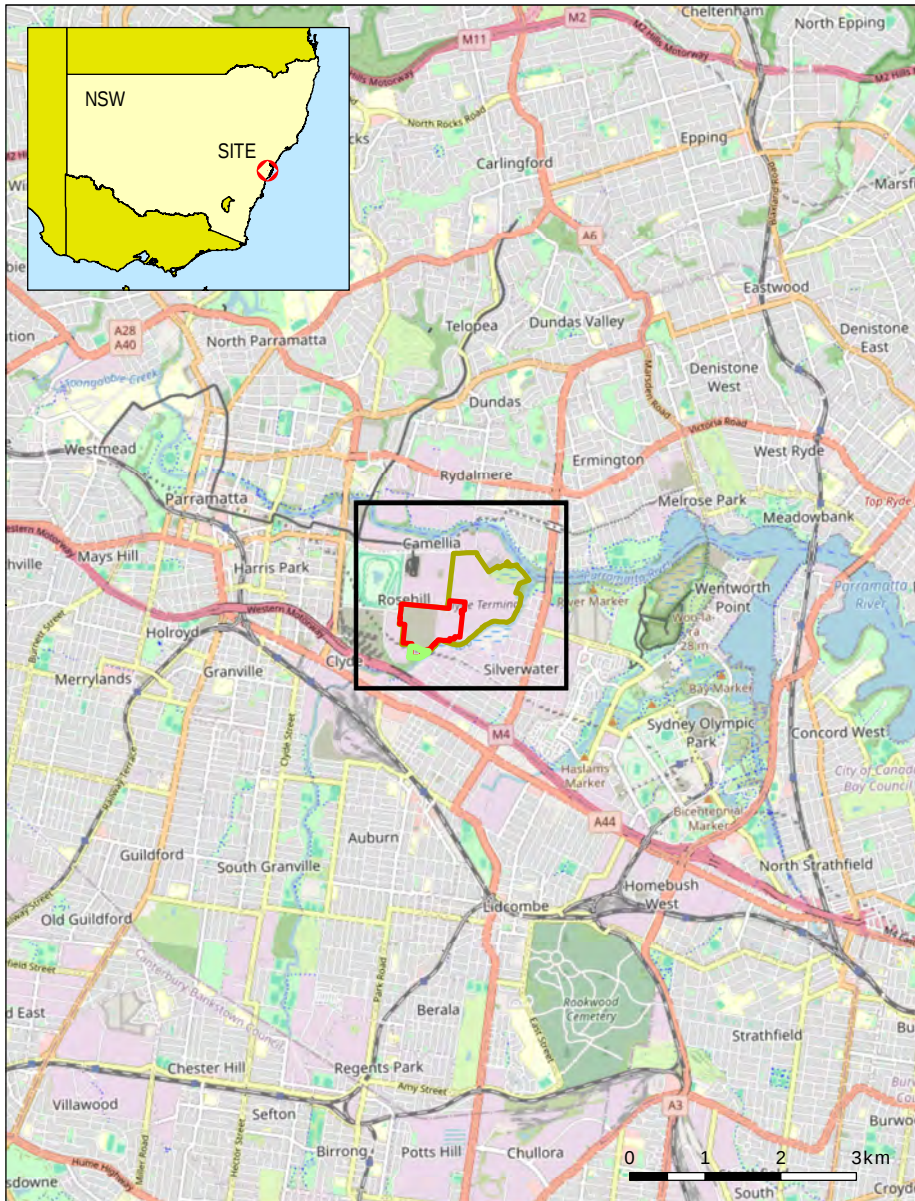
ERM, 2023. *Proposed Lot 64 – Baseline Ground Gas Monitoring Event*, Clyde Western Area Remediation Project. 14 July 2023.

ERM, 2024b. *Proposed Lot 64 – AEC-4 Capping Construction Technical Specification*, Clyde Western Area Remediation Project. 14 March 2024.

New South Wales Environmental Protection Agency (NSW EPA), 2016. *Solid Waste Landfills*, Solid Waste Guidelines. Second Edition, 2016.



APPENDIX A FIGURES



General Area Land Use:

Industrial

Aquifer Usage:

No on-site extraction

General Hydrogeology of Locality:

1. Soil Type:

Residual clay with minor silt and sand

2. Depth to aquifer:

0.5-2.5m bgs

Data Source:
Nearmap Imagery February 2024
Locality: Esri, OpenStreetMap 2023

Coordinate System:
GDA 1994 MGA Zone 56
Date: 10/04/2024
Created By: MF / FS
Drawing Size: A4

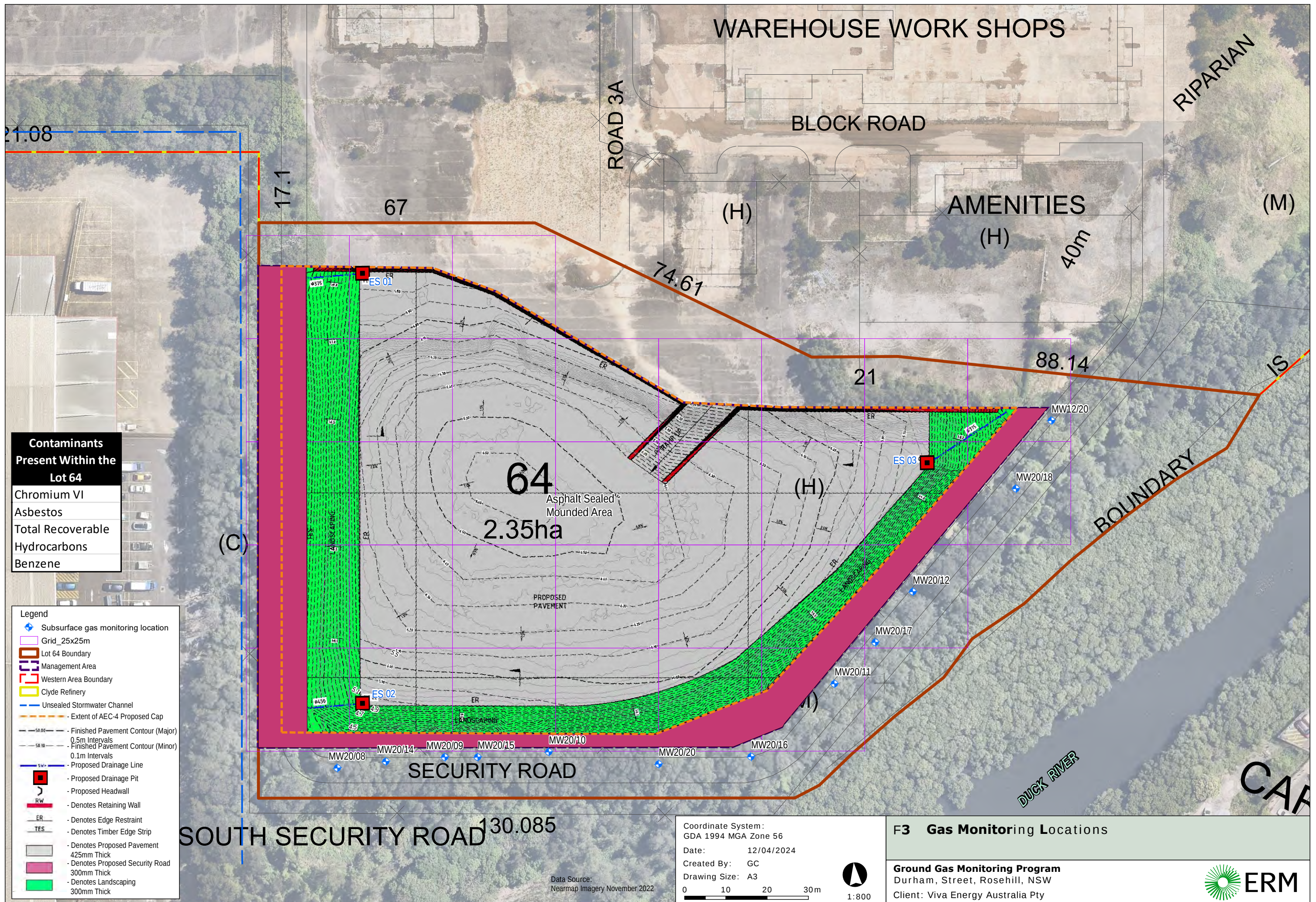


1:18,875

F1 - Site Location

Ground Gas Monitoring Program
Durham Street, Rosehill NSW
Viva Energy Australia Pty Ltd







APPENDIX B

MONITORING PLAN

Appendix C-1 - Sub-surface Gas Monitoring
Gas Monitoring Plan
Clyde Stage 2 WARP - Lot 64

Media	Frequency	Analytes	Detection Limits	Units
Ambient Air	Monthly (total of six months)	Stabilised CH4	0.1	% v/v
		Stabilised CO2	0.1	% v/v
Sub-surface gas	Monthly (total of six months)	Peak CH4	0.1	% v/v
		Stabilised CH4	0.1	% v/v
		Peak CO2	0.1	% v/v
		Stabilised CO2	0.1	% v/v
		Minimum O2	0.1	% v/v
		Stabilised O2	0.1	% v/v
		CO	1	ppm
		HS	1	ppm
		Flow Rate	0.1	L / hr
		Barometric Pressure	N/A	Mb
		Relative Pressure	N/A	Mb
Groundwater	Monthly (total of six months)	Standing Water Level	0.001	Metres below top of casing (m btoc)

Abbreviations:

CH4	Methane
CO2	Carbon dioxide
O2	Oxygen
CO	Carbon monoxide
HS	Hydrogen sulphide

Appendix C-2 - Enclosed Structures
Gas Monitoring Plan
Clyde Stage 2 WARP - Lot 64

Media	Frequency	Analytes	Detection Limits	Units
Sub-surface gas	Monthly (total of six months)	Peak CH ₄	0.1	% v/v
		Stabilised CH ₄	0.1	% v/v
		Peak CO ₂	0.1	% v/v
		Stabilised CO ₂	0.1	% v/v
		Minimum O ₂	0.1	% v/v
		Stabilised O ₂	0.1	% v/v
		CO	1	ppm
		HS	1	ppm

Abbreviations:

CH ₄	Methane
CO ₂	Carbon dioxide
O ₂	Oxygen
CO	Carbon monoxide
HS	Hydrogen sulphide

Appendix C-3 - Surface Gas Monitoring
Gas Monitoring Plan
Clyde Stage 2 WARP - Lot 64

Media	Frequency	Analytes	Detection Limits	Units
Surface Gas	Monthly (total of six months)	Methane	1	ppm
		Wind speed	N/A	km/hr
		Wind direction	N/A	N/A
Surface Gas Analyser Specifications				
Item		Value		
Response Times	TP90 standard:	4.5 seconds		
	TP10 standard:	2 seconds		
	TP90 with suction rod:	6 seconds		
	TP10 with suction rod:	<3.5 seconds		
Analytes measured		Methane by laser spectroscopy		
Measurement Range - ppm		0 - 10,000 ppm		
Measurement Range - Volume Gas		0 - 100% volume gas		
Detection Limit		1 ppm		
Certification		94/9/CE directive dated March 23, 1994		
ATEX Certification		112G Ex ib IIB T4		



APPENDIX C

WELL CONSTRUCTION DETAILS

Well ID	Date of Installation	Longitude	Latitude	Top of Casing Elevation (m AHD)	Ground Elevation (m AHD)	Screen Length (m)	Top of Screen (mb TOC)	Bottom of Screen (mb TOC)
MW12/20	2012	-33.8325951	151.033354	2.940	2.940	3.0	1.000	4.000
MW20/08	2020	-33.8331558	151.0313852	4.876	3.930	3.0	2.946	5.946
MW20/09	2020	-33.8331613	151.0316674	4.864	3.871	3.0	2.993	5.993
MW20/10	2020	-33.8331775	151.0319402	4.697	3.728	3.0	2.969	5.969
MW20/11	2020	-33.8331071	151.0327049	3.949	3.022	3.0	2.927	5.927
MW20/12	2020	-33.8329285	151.032938	4.368	2.985	3.0	3.383	6.383
MW20/14	2020	-33.8331545	151.0315129	4.810	3.836	3.0	2.974	5.974
MW20/15	2020	-33.8331697	151.0317531	4.825	3.834	3.0	2.991	5.991
MW20/16	2020	-33.8332425	151.0324642	3.482	2.656	3.0	2.826	5.826
MW20/17	2020	-33.8330284	151.0328242	4.051	3.012	3.0	3.039	6.039
MW20/18	2020	-33.8327332	151.0332393	3.629	2.589	3.0	3.040	6.040
MW20/20	2020	-33.8332338	151.0322217	4.077	2.566	3.0	3.511	6.511



APPENDIX D

EXAMPLE FIELD SHEETS

Project:

EPL Monitoring Point 1

Date:

Surface Gas

Time:

Location	CH4 (ppm)	Windspeed (m/s)	Wind Direction	Comments	NSW EPA Threshold (ppm)
A1					500
A2					500
A3					500
A4					500
A5					500
A6					500
A7					500
A8					500
A9					500
B1					500
B2					500
B3					500
B4					500
B5					500
B6					500
B7					500
B8					500
B9					500
C1					500
C2					500
C3					500
C4					500
C5					500
C6					500
C7					500
C8					500
C9					500
D1					500
D2					500
D3					500
D4					500
D5					500
D6					500
D7					500
D8					500
D9					500
E1					500
E2					500
E3					500
E4					500
E5					500
E6					500
E7					500
E8					500
E9					500
F1					500
F2					500
F3					500
F4					500
F5					500
F6					500
F7					500
F8					500
F9					500

Location	CH4 (ppm)	Windspeed (m/s)	Wind Direction	Comments	NSW EPA Threshold (ppm)
G1					500
G2					500
G3					500
G4					500
G5					500
G6					500
G7					500
G8					500
G9					500
H1					500
H2					500
H3					500
H4					500
H5					500
H6					500
H7					500
H8					500
H9					500
I1					500
I2					500
I3					500
I4					500
I5					500
I6					500
I7					500
I8					500
I9					500
J1					500
J2					500
J3					500
J4					500
J5					500
J6					500
J7					500
J8					500
J9					500
K1					500
K2					500
K3					500
K4					500
K5					500
K6					500
K7					500
K8					500
L1					500
L2					500
L3					500
L4					500
L5					500
L6					500
L7					500
M1					500
M2					500
M3					500
M4					500
M5					500

Project:
Date:
Time:
Barometric pressure (start):
Barometric pressure (finish):
Weather:
Ground conditions:

0449086

Technician: _____
Instrument: GA 5000

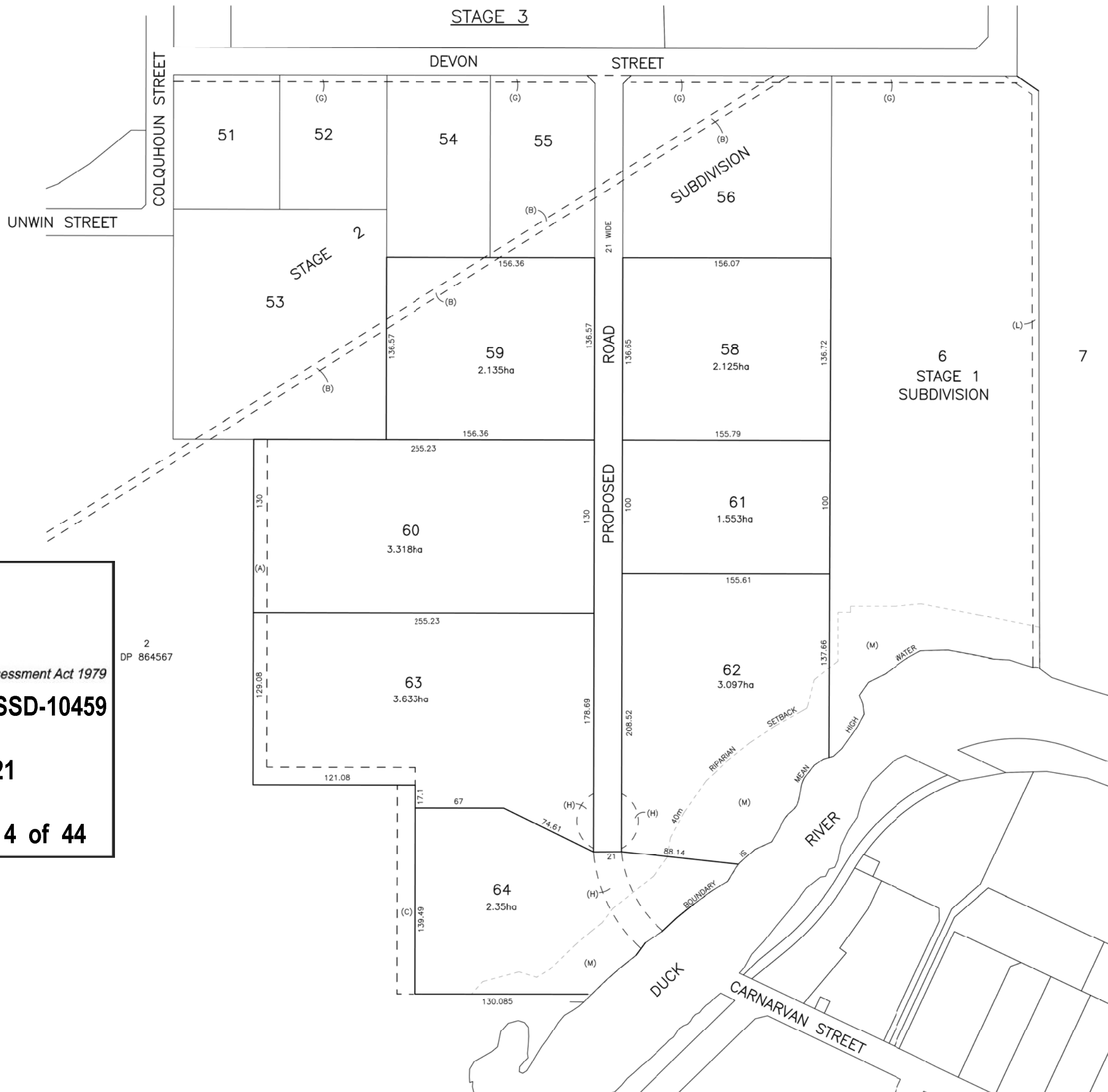
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APPENDIX E

SITE SURVEY

M.G.A.



CLIENT

VE PROPERTY PTY LTD

PROJECT

PLAN OF PROPOSED SUBDIVISION OF LOT 57 OF STAGE 2 OF SUBDIVISION OF LOT 100 IN DP1168951 STAGE 3

NOTES

The title boundaries shown hereon were not marked at the time of survey and have been determined by plan dimensions only and not by field survey.

Services shown hereon have been located where possible by field survey. If not able to be so located, services have been plotted from the records of relevant authorities where available and have been noted accordingly on the plan. Where such records do not exist or are inadequate a notation has been made hereon.

Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed locations of all services.

6	GKO	23/11/2020	LOT 61 & 62 AMENDED
7	GKO	11/11/2020	AMEND RIPARIAN SETBACK & (H)
8	GKO	02/11/2020	LANDSCAPE SETBACK REMOVED
9	GKO	29/10/2020	PLAN AMENDED
4	GKO	20/10/2020	LOT BOUNDARIES AMENDED
3	GKO	24/07/2020	EASEMENTS DETAIL ADDED
2	GKO	17/07/2020	EASEMENT AMENDED
1	GKO	22/06/2020	INITIAL ISSUE

SYM	CODE	DESCRIPTION	SYM	CODE	DESCRIPTION
BN	BN	BIN	OFM	OFM	OPTICAL FIBRE MARKER
BM	BM	BENCH MARK	OPF	OPF	OPTICAL FIBRE PIT
BO	BO	BOLLARD	TM	TM	PALM TREE
DUM	DUM	DRAINAGE MANHOLE	SE	SE	SEAT
EFP	EFP	ELEC FUSE BOX	TS	TS	SHRUB
ELP	ELP	ELEC GARDEN LIGHT	TCA	TCA	TELSTRA PIT
EL	EL	ELEC GREEN PILLAR	SLH	SLH	SEWER LAMP HOLE
LP	LP	ELEC LIGHT POLE	SMH	SMH	SEWER MANHOLE
EP	EP	ELEC SINGLE PIT	SWP	SWP	SEWER VENT PIPE
SPL	SPL	ELEC STAY POLE	SI	SI	SIGN
PP	PP	ELEC POWER POLE	BS	BS	BUS STOP SIGN
ELP	ELP	ELEC POLE/LIGHT	T	T	TREE
HWMT	HWMT	ELEC POLE/TRANSFORM	SGL	SGL	TRAFFIC LIGHT
FD	FD	FUEL DISP	SCL	SCL	TRAFFIC CONTROLLER
GM	GM	GAS MAIN	SJX	SJX	TRAFFIC JUNCTION BOX
GMR	GMR	GAS METER	US	US	UNKNOWN SERVICE
GV	GV	GAS VALVE	WAV	WAV	WATER AIR VALVE
AG	AG	GATE	WMR	WMR	WATER METER
GUL	GUL	GULLY PIT	WEP	WEP	WATER PUMP
HYD	HYD	HYDRANT	WSP	WSP	WATER STOP VALVE
BOP	BOP	BORHPOLE	WTF	WTF	WATER TAP

Symbols shown are indicative only. The symbol size and orientation does not necessarily represent the real size or orientation of the feature.

DRAINAGE PIPE U/G	DR	DR	DR	DR	DR
DRAIN	DR	DR	DR	DR	DR
ELECT CABLE A/G	EC	EC	EC	EC	EC
ELEC CABLE U/G	EC	EC	EC	EC	EC
GAS PIPE	GP	GP	GP	GP	GP
FENCE LINE	FL	FL	FL	FL	FL
SEWERAGE PIPE	SP	SP	SP	SP	SP
TELSTRA CABLE	TC	TC	TC	TC	TC
WATER PIPE	WP	WP	WP	WP	WP

NOTES:

1. ALL DIMENSIONS SHOWN HEREON ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY

2. NO CADASTRAL SURVEY HAS BEEN UNDERTAKEN

(A) EASEMENT TO DRAIN WATER 10.2 & 13.4 WIDE (AC 424785)

(B) EASEMENT 6.095 WIDE (B309159) - SYDNEY WATER PIPELINE

(C) EASEMENT TO DRAIN WATER 13.4 WIDE (AC424784)

(G) PROPOSED EASEMENT FOR SERVICES 5 WIDE

(H) RIGHT OF ACCESS 21 WIDE AND VARIABLE WIDTH

(L) EASEMENT FOR OVERLAND FLOW 5 WIDE

(M) EASEMENT FOR PEDESTRIAN ACCESS 40 WIDE & VARIABLE WIDTH

Scale 1:1500

LANDPARTNERS built environment consultants

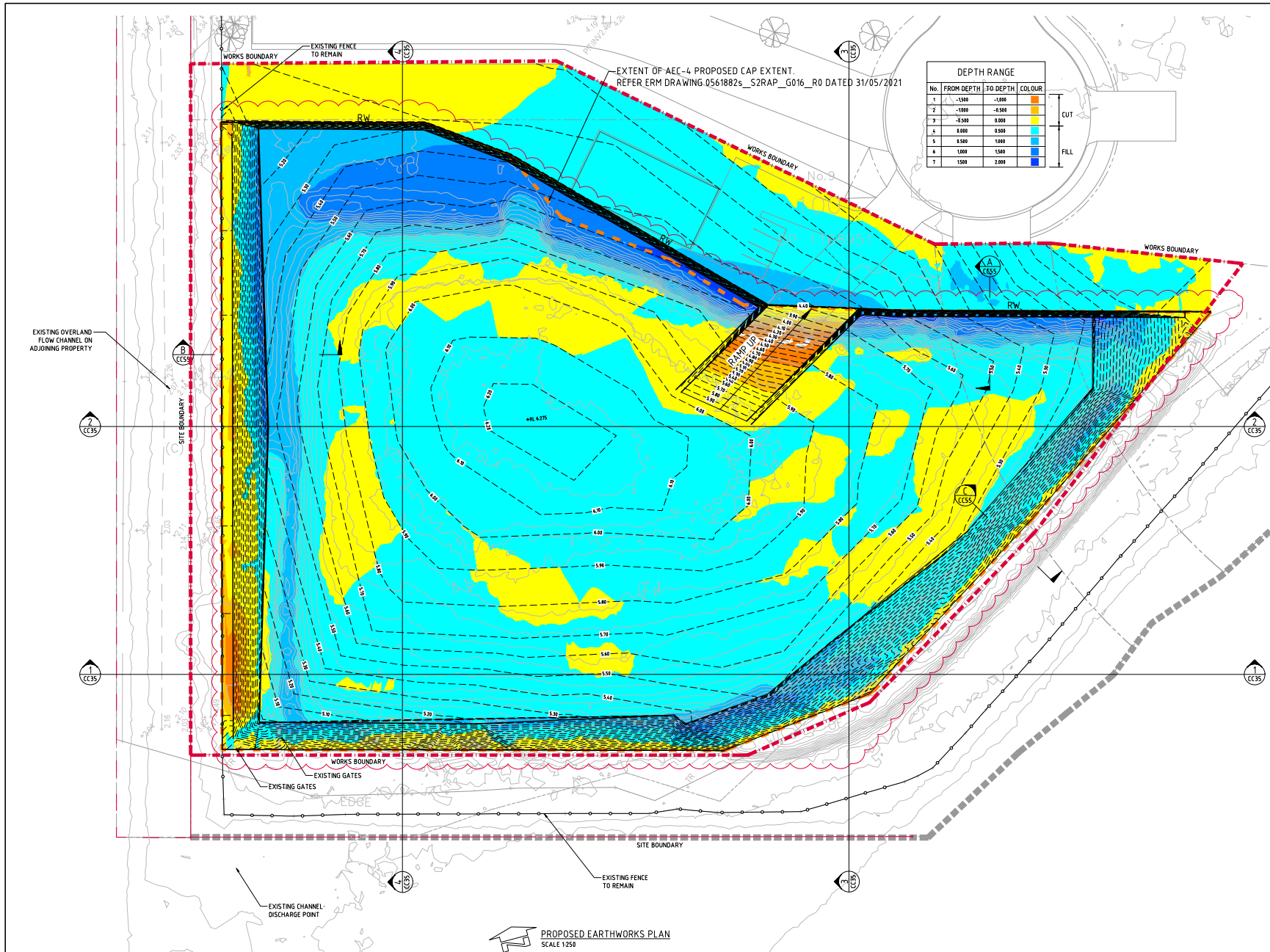
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Dundas NSW 2117

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SYDNEY OFFICE
23/11/2020

HEIGHT DATUM	LOCAL AUTHORITY	
AHD	CITY OF PARRAMATTA	
HEIGHT ORIGIN	SCALE	
N/A	1:1500 (A1)	
MERIDIAN	CONTOUR INTERVAL	
N/A	N/A	
COORD SYSTEM	SURVEYOR	DATE OF SURVEY
MGA	N/A	-
CCAD FILE	DRAWN	DATE
74707 ver 9 final subdivision	SF/CLP	23/11/2020
AUTOCAD FILE	CHECKED	DATE
SY074707.000.13.8	GKO	23/11/2020
ARCHIVE FILE	APPROVED	DATE
SY074707.000.13.6	GKO	23/11/2020
PLAN NUMBER	SHEET 1 OF 1	
SY074707.000.13.8		

APPENDIX G CIVIL DESIGN PLANS



- SITE PREPARATION NOTES:**
1. ALL EARTHWORKS SHALL BE COMPLETED GENERALLY IN ACCORDANCE WITH THE GUIDELINES SPECIFIED BY THE GEOTECHNICAL REPORT SYDGE289002-AB PROVIDED BY TETRA TECH COFFEY DATED 17 AUGUST 2021.
 2. EXISTING LEVELS ARE BASED ON INFORMATION PROVIDED BY ERM TITLED 0561882s_S2RAP_G016_R0 DATED 31 MAY 2021.
 3. STRIP ANY TOP SOIL OR DELETERIOUS MATERIAL AND DISPOSE OF FROM SITE OR STORE AS DIRECTED.
 4. COMPLETE CUT TO FILL EARTHWORKS TO ACHIEVE THE REQUIRED LEVELS AS INDICATED ON THE DRAWINGS WITHIN A TOLERANCE OF +5mm/-10mm THROUGH BUILDING PADS/PAVEMENTS AND +5mm/-20mm ELSEWHERE.
 5. PREPARE STEEP BATTERS TO RECEIVE FILL BY CONSTRUCTING BENCHING TO FACILITATE FILL PLACEMENT AND COMPACTION.
 6. AREAS TO RECEIVE FILL (THAT ARE NOT ON BENCHMARK BATTERS) AND AREAS IN CUT SHALL BE PROOF ROLLED TO IDENTIFY ANY SOFT HEAVING MATERIAL. SOFT MATERIAL SHALL BE BOXED OUT AND REMOVED PRIOR TO FILL PLACEMENT. PROOF ROLLING TO BE INSPECTED BY A GEOTECHNICAL ENGINEER OR THE EARTHWORKS DESIGNER.
 7. SITE WON FILL SHALL BE COMPACTED IN MAXIMUM 300mm LAYERS AND TO DRY OR HLF DENSITY RATIOS (STANDARD COMPACTION) OF BETWEEN 98% AND 103%. THE PLACEMENT MOISTURE VARIATION OR HLF MOISTURE VARIATION SHALL BE CONTROLLED TO BE BETWEEN 2% DRY AND 2% WET.
 8. IMPORTED FILL SHALL BE COMPACTED IN MAXIMUM 300mm LAYERS AND TO DRY OR HLF DENSITY RATIOS (STANDARD COMPACTION) OF BETWEEN 98% AND 103%. THE PLACEMENT MOISTURE VARIATION OR HLF MOISTURE VARIATION SHALL BE CONTROLLED TO BE BETWEEN 2% DRY AND 2% WET.
 9. ALL ENGINEERED FILL PARTICLES SHALL BE ABLE TO BE INCORPORATED WITHIN A SINGLE LAYER. FURTHER, LESS THAN 30% OF PARTICLES SHALL BE RETAINED ON THE 37.5 mm SIEVE. ENGINEERED FILL SHALL BE ABLE TO BE TESTED IN ACCORDANCE WITH THE STANDARD COMPACTION METHOD (AS1289.5.4.1) OR HLF TEST METHOD (AS1289.5.7). THESE METHODS REQUIRE LESS THAN 20% RETAINED ON THE 37.5 mm SIEVE. WHERE BETWEEN 20% AND 35% OF PARTICLES ARE RETAINED ON THE 37.5 mm SIEVE THE ABOVE TEST METHODS SHALL STILL BE ADOPTED AND TEST REPORTS ANNOTATED APPROPRIATELY. THESE REQUIREMENTS SHOULD BE MET BY THE MATERIAL AFTER PLACEMENT AND COMPACTION.
 10. ALL THE EARTHWORKS UNDERTAKEN AND THE SUBGRADE CONDITION IN THE CUT AREAS (IN THE STATED PERIOD) ARE DOCUMENTED IN THE REPORTS AND HAVE BEEN UNDERTAKEN IN ACCORDANCE WITH THE SPECIFICATION.
 11. PRIOR TO ANY EARTHWORKS, EROSION CONTROL AS OUTLINED IN THE EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE COMPLETED.
 12. EXISTING ROCK, IF ANY, SHALL BE REMOVED BY HEAVY ROCK BREAKING OR RIPPING.
 13. MATCH EXISTING LEVELS AT BATTER INTERFACE.
 14. CONTRACTOR TO MATCH EXISTING LEVELS AT THE INTERFACE OF EARTHWORKS AND EXISTING SURFACE AT BATTER LOCATIONS OR WHERE NO RETAINING WALLS ARE PRESENT. ANY DISCREPANCY BETWEEN DESIGN AND EXISTING LEVELS TO BE REFERRED TO THE ENGINEER FOR DIRECTION OR ADJUSTMENTS TO DESIGN LEVELS.
 15. DURING EARTHWORKS THE CONTRACTOR IS TO ENSURE ALL AREAS ARE FREE DRAINING & WILL NOT RETAIN WATER DURING RAINFALL. PROVIDE TEMPORARY MEASURES AS REQUIRED TO ENSURE FREE FLOWING RUNOFF THROUGH MANAGED DRAINAGE PATHS, DIVERSION DRAINS OR OTHER SUITABLE DISPOSAL METHOD AS AGREED DURING THE WORKS. REFER ANY CONCERNS TO THE ENGINEER. REFER TO EROSION AND SEDIMENT CONTROL DRAWINGS AND NOTES.

ALLOWANCES FOR STRUCTURE

	DEPTH OF PAVEMENT
PAVEMENT	75mm
LANDSCAPING	300mm

EARTHWORK ESTIMATES

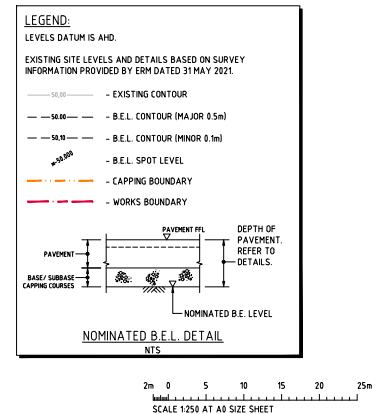
SITE AREA	= 1.65 Ha
CUT	= - 780m ³
FILL	= +3,400m ³

ALLOWANCES

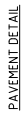
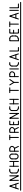
RETAINING WALLS	= -1,000m ³ (APPROX. TBC)
STORMWATER	= - 100m ³ (APPROX. TBC)
SERVICES TRENCH	= - 600m ³ (APPROX. TBC)

DIFFERENCE = +1,000m³ (i.e. FILL OVER CUT)

NOTE:
VOLUMES BASED ON NO TOPSOIL/PAVEMENT STRIP OVER THE NOMINATED AREA. EARTHWORKS VOLUMES ARE APPROXIMATE ONLY. NO ALLOWANCE HAS BEEN MADE FOR DELETERIOUS MATERIAL, EROSION AND SEDIMENT CONTROL, BUILDING OR COMPACTION OF FILLED SOILS, THE REMOVAL OF UNCONTROLLED OR CONTAMINATED MATERIAL OR ANY OTHER UNSPECIFIED EXCAVATION RELATED TO CONSTRUCTION ACTIVITIES. DETAILED EXCAVATION ALLOWANCE IS APPROXIMATE ONLY AND ACCOUNTS FOR RETAINING WALL CONSTRUCTION. THE ALLOWANCES VOLUMES ARE TO BE CONFIRMED BY THE CONTRACTOR. REFER ANY CONCERNS TO ENGINEER.



FOR CONSTRUCTION CERTIFICATE



SCALE 1:10

DESIGN TRAFFIC OF 1×10^7 ESA's

DESIGN CBR VALUE OF 3.0%
CBR OF SUBGRADE TO BE CONFIRMED TO ENGINEER FOR
FINAL PAVEMENT OPTIMISATION AND DESIGN.

NOTE:

CONFIRMATION OF PAVEMENT DESIGN SUBJECT
TO CONFIRMATION OF EXISTING SUBGRADE BY
GEOTECHNICAL ENGINEER



SCALE 110



SCALE 1:10

PAVEMENT MAINTENANCE NOTES:

DURING THE LIFE OF THE PAVEMENT, DAMAGE IN VARIOUS FORMS IS LIKELY TO OCCUR. GOOD MAINTENANCE WILL KEEP PROBLEMS TO A MINIMUM AND EXTEND THE LIFE OF PAVEMENTS. THE FOLLOWING LIKELY AREAS OF DAMAGE MAY OR MAY NOT OCCUR DURING THE LIFE OF THE PAVEMENTS:

SLAB PAVEMENTS :

1. DAMAGE TO JOINTS SUCH AS FRETTING OR BREAKING AWAY OF PIECES SHOULD BE REPAIRED USING CONCRETE REPAIR PRODUCTS AND THE JOINTING MATERIAL MUST BE GOOD QUALITY.
2. CRACKS IN THE SLAB SURFACE SHOULD BE REPAIRED AS SOON AS POSSIBLE TO PREVENT FURTHER GROUTING AS SOON AS POSSIBLE TO PREVENT LOCAL FRETTING AND BREAKING AWAY. THE DEFINITION OF A CRACK WHICH MAY BECOME A PROBLEM IS A CRACK WHICH IS DEEPER THAN 10 MM (3/8") WITH PROTRUDING NAILS OR REINFORCING RODS OR PALETS POSSIBLE WITH AN EXPOSED CONCRETE REPAIR PRODUCT.
3. CRACKS IN THE JOINTS SHOULD BE REPAIRED AS SOON AS POSSIBLE WITH AN EXPOSED CONCRETE REPAIR PRODUCT.
4. CRACKS IN THE JOINTS SHOULD BE REPAIRED AS SOON AS POSSIBLE TO DETERMINE THE BEST METHOD OF REPAIR.
5. JOINT SEALANTS WILL GENERALLY BREAKDOWN AND NEED REPLACEMENT AFTER 12 MONTHS WHEN MOST OF THE SLAB SURFACE IS CRACKED. CRACKS SHOULD BE REPAIRED AS SOON AS POSSIBLE TO ENSURE DRIVING SUPPORT IS TO SLAB EDGES.

ASPHALT PAVEMENTS :

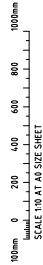
- UNLESS NOT OTHERWISE, FLEXIBLE PAVEMENTS SHOWN ON THESE DRAWINGS ARE THE MINIMUM NECESSARY TO SUPPORT LIGHT CAR PARKING FOR A MINIMUM DESIGN LIFETIME.
- CRACKING OF THE ASPHALT SURFACE AND OTHER DEFECTS SHOULD BE REPAIRED QUICKLY TO PREVENT INGRESS OF WATER TO THE SUBGRADE, WHICH WILL ACCELERATE DETERIORATION OF PAVEMENTS.
- DRAINAGE GRADES SHOULD BE MAINTAINED TO AVOID PONDING OF SURFACE WATER, WHICH MAY CONTRIBUTE TO DETERIORATION.

NOTE:

- LLDPE GEO-MEMBRANE PANELS TO BE PLACED IN ACCORDANCE WITH APPROVED PANEL LAYOUT PLAN, PREPARED BY CONTRACTOR IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS (SECTION 5.5.7.4)
- SINGLE SIDED TEXTURED GEO-MEMBRANE ON SLOPED SIZES, TEXTURED SIDE DOWN.
- MATERIALS TO MEET SPECIFICATIONS, TESTING AND APPROVAL REQUIREMENTS OUTLINED IN TECHNICAL SPECIFICATIONS.

LEGEND:

- CUSHION GEO-TEXTILE
- LLDPE - SMOOTH GEO-MEMBRANE
- LLDPE - SINGLE-SIDED TEXTURED GEO-MEMBRANE
- MARKER LAYER





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India	Taiwan
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Ireland	Thailand
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Malaysia	
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