Remedial Action Plan

249-271 RAILWAY TERRACE, SCHOFIELDS, NSW 2762

Prepared for Provincial Investments (NSW) Pty Ltd

09 November 2022

Ref: 10791EV.P.323-R02

Document Information	
Prepared for	Provincial Investments (NSW) Pty Ltd
Report Name	249-271 Railway Terrace, Schofields, NSW 2762
File Reference	10791EV.P.323-R02.docx
Job Reference	10791EV.P.323
Date	09 November 2022
Version Number	Final

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DOCUMENT HISTORY

Version	Effective Date	Author	Reviewer
Draft	21/10/2022	Joshua Nito	Abanish Nepal
Final	09/11/2022	Joshua Nito	Abanish Nepal / Nathan Watson

INFORMATION ABOUT THIS REPORT

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Interpretation of Data: Data obtained from nominated discrete locations, subsequent laboratory testing and empirical or external sources are interpreted by trained professionals in order to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions in accordance with any relevant industry standards, guidelines or procedures.

Soil and Rock Descriptions: Soil and rock descriptions are based on AS 1726 – 1993, using visual and tactile assessment except at discrete locations where field and / or laboratory tests have been carried out. Refer to the accompanying soil and rock terms sheet for further information.

Further Advice: CS would be pleased to further discuss how any of the above issues could affect a specific project. We would also be pleased to provide further advice or assistance including:

- Assessment of suitability of designs and construction techniques;
- Contract documentation and specification;
- Construction control testing (earthworks, pavement materials, concrete);
- Construction advice (foundation assessments, excavation support).

Executive Summary

Construction Sciences Pty Ltd (CS) was engaged by Provincial Investments Pty Ltd, to prepare a remedial action plan (RAP) for land located at 249-271 Railway Terrace, Schofields NSW 2762 (the site).

At the commencement of this work, CS understood:

> The site is currently owned by the client;

> The site occupies an approximate area of 6.3 hectares (ha);

> The site is proposed for subdivision and subsequent redevelopment into a land use scenario comprising residential with minimal opportunities for soil access including dwellings with fully and permanently paved yard space such as high rise buildings and flats;

> The proposed land use scenario assumes a reticulated potable water supply will be available at the site;

> A combined Stage 1 preliminary and Stage 2 detailed site investigation was conducted by CS in October 2022 (CS (2022a)). CS (2022a) indicated that the site is not yet considered suitable for the proposed land use;

> CS (2022a) recommended remediation/management of ten areas of environmental concern (AEC) due to the presence of asbestos and/or presence of bulky aesthetically unsuitable material and further assessment of nine data gaps that were identified for the site;

> The data gaps relate to the presence of existing building footprints, shed footprints, driveways and septic tanks onsite;

> The remedial action plan (RAP) is required to:

- Address the presence of friable asbestos onsite at test pit locations:
  - TP06;
  - TP18; and
  - TP36
- Address the presence of bonded asbestos onsite at test pit locations:
  - TP18;
  - TP25;
  - TP33;
  - TP36;
  - TP37;
  - TP44;
  - TP54; and
  - TP56;

The concentration of friable and bonded asbestos were considered to pose an unacceptable land contamination exposure risk to the future residents;

  - Address the presence of elevated concentrations of microbial contaminants at test pit locations TP31 and TP32;
  - Address aesthetics impact due to the presence of construction and demolition waste and/or large/bulky items of waste in AEC06, AEC09, AEC10, AEC15, AEC24 and AEC28;
  - Provide methodology to undertake further assessment to address the identified data gaps for AEC02, AEC03, AEC04, AEC05, AEC16, AEC17, AEC19, AEC23, AEC24 and AEC32; and
  - Satisfy planning decision making processes referred to in State Environmental Planning Policy (Resilience and Hazards) 2021.

> The client's preferred outcome at the completion of remedial works, is to not have:
  - a notation on a planning certificate for the site;
  - a covenant registered on the title to the land; or
  - a long term environmental management plan (EMP).

The objectives of this project was to prepare a RAP to address unacceptable land contamination exposure risks identified for the site in previous contamination assessments, in the context of the proposed land use scenario.

The scope of work undertaken to address the project and objective included:

> A desktop review of CS (2022a) and site history; and

> Data assessment and reporting.

The scope of works was undertaken with reference to the relevant sections of NEPC (2013), NSW EPA (2020b) and WA DOH (2009).

The identified AEC and the COPC associated with those AEC are presented in Table 6.2.1.

> The remedial goal for this project is to remediate identified land contamination exposure risks to a level that does not present an unacceptable human health or ecological exposure risk, based on the proposed land use scenario.

> The preliminary inferred extent of remedial works required to address the remedial goal, is set out in the Table 6.2.1 and Figure 3. However, the inferred extents are based on limited data, and may be subject to change based on further results of supplementary contamination assessment works proposed in this RAP.

> The supplementary assessment may also remove the need for management and/or remediation in one or more areas of concern (based on statistical analysis of additional data and/or site specific risk assessment). Should there be a need to change the inferred extents based on supplementary assessment works, these changes would be presented in an addendum to the RAP.

> Based on the current understanding of the inferred extent of remedial works required, the proposed land use scenario for the site, and the client's preferred remedial outcomes for the site, the preferred remedial options for the site are presented in Table 9.2.1 and in Section 9 of the RAP.

Based on CS' assessment on the information presented in the available historical contamination assessment reports, CS considers that the remedial goal can be achieved and the site made suitable for the proposed land use, subject to:

- The implementation of the strategies and methodologies set out in this remedial action plan, including the supplementary contamination assessment works; and
- Preparation of a site validation report.

This report must be read in conjunction with the ***Information About This Report*** page at the front of this report.

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1 Introduction

1.1 Background

Construction Sciences Pty Ltd (CS) was engaged by Provincial Investments Pty Ltd, to prepare a remedial action plan (RAP) for land located at 249-271 Railway Terrace, Schofields, NSW 2762 (the site).

At the commencement of this work, CS understood:

> The site is currently owned by the client;

> The site occupies an approximate area of 6.3 hectares (ha);

> The site is proposed for subdivision and subsequent redevelopment into a land use scenario comprising residential with minimal opportunities for soil access including dwellings with fully and permanently paved yard space such as high rise buildings and flats;

> The proposed land use scenario assumes a reticulated potable water supply will be available at the site;

> A combined Stage 1 preliminary and Stage 2 detailed site investigation was conducted by CS in October 2022 (CS (2022a)). CS (2022a) indicated that the site is not yet considered suitable for the proposed land use;

> CS (2022a) recommended remediation/management of ten areas of environmental concern (AEC) due to the presence of asbestos and/or presence of bulky aesthetically unsuitable material and further assessment of nine data gaps that were identified for the site;

> The data gaps relate to the presence of existing building footprints, shed footprints, driveways and septic tanks onsite;

> This remedial action plan (RAP) is required to:

  - Address the presence of friable asbestos onsite at test pit locations:
    - TP06;
    - TP18; and
    - TP36
  - Address the presence of bonded asbestos onsite at test pit locations:
    - TP18;
    - TP25;
    - TP33;
    - TP36;
    - TP37;
    - TP44;
    - TP54; and
    - TP56;

The concentration of friable and bonded asbestos were considered to pose an unacceptable land contamination exposure risk to the future residents;

- Address the presence of elevated concentrations of microbial contaminants at test pit locations TP31 and TP32;
- Address aesthetics impact due to the presence of construction and demolition waste and/or large/bulky items of waste in AEC06, AEC09, AEC10, AEC15, AEC24 and AEC28;
- Provide methodology to undertake further assessment to address the identified data gaps for AEC02, AEC03, AEC04, AEC05, AEC16, AEC17, AEC19, AEC23, AEC24 and AEC32; and
- Satisfy planning decision making processes referred to in State Environmental Planning Policy (Resilience and Hazards) 2021.

> The client's preferred outcome at the completion of remedial works, is to not have:

- A notation on a planning certificate for the site;
- A covenant registered on the title to the land; or
- A long term environmental management plan (EMP).

1.2 Objective

The objective of this project was to prepare a RAP to address:

> The presence of friable asbestos onsite at test pit locations:

- TP06;
- TP18; and
- TP36

> The presence of bonded asbestos on the surface and/or at depth in test pits:

- TP18;
- TP25;
- TP36;
- TP37;
- TP44;
- TP54; and
- TP56;

> Address the presence of elevated concentrations of microbial contaminants at test pit locations TP31 and TP32;

> Address aesthetics impact due to the presence of construction and demolition waste and/or large/bulky items of waste in AEC06, AEC09, AEC10, AEC15, AEC24 and AEC28; and

> Provide methodology to undertake further assessment to address the identified data gaps for AEC02, AEC03, AEC04, AEC05, AEC16, AEC17, AEC19, AEC23, AEC24 and AEC32.

1.3 Scope of Work

The scope of work undertaken to address the project objective included:

> A desktop review of CS (2022a) and site history; and

> Data assessment and reporting.

The scope of works was undertaken with reference to the relevant sections of NEPC (2013), NSW EPA (2020b) and WA DOH (2009).

2 Site Identification

2.1 Site Locality

The locality of the site is presented in Figure 1.

2.2 Site Layout

The site covers an area of approximately 6.3 hectares (ha).

The general layout of the site, prior to remedial works being undertaken, is present in Figure 2. The layout plan also includes locations on site of:

> Established site access points;

> Current and historical buildings / structural extents and driveways; and

> Surface water bodies on site and immediately adjacent to the site.

2.3 Lot Number and Deposited Plan

The site is identified under multiple lots and DP's:

> Lot 3 and 4 in DP1268701; and

> Lot 5 in DP26987.

2.4 Current Land Use

The site is currently being used for rural residential land use comprising residential dwellings, driveways, sheds and open paddock for cattle grazing.

2.5 Local Government Authority

The local government authority for the site is Blacktown City Council.

2.6 Zoning

Three Section 10.7 (2) planning certificates pertaining to the site indicates that the site is currently zoned:

> R3 – Medium Density Residential and SP2 – Infrastructure for Lots 3 and Lot 4 in DP1268701; and

> R3 – Medium Density Residential for Lot 5 in DP26987.

2.7 Geographic Coordinates

The geographic coordinates of the general centre of the site obtained from Google Earth were 33°42'28.8" S and 150°52'36.7" E.

2.8 Detail and Level Survey

A copy of a detail and level survey was not provided to CS at the time of preparing this report.

2.9 Site History

Review of site historical information undertaken by CS as part of this report indicated the following:

- Site was vacant and unoccupied until 1947;
- Site was used as rural residential land comprising residential dwellings, a number of sheds and a market garden from prior to 1978 until sometime between 1986 and 1998, when market garden operation was ceased;
- Site has remained largely unchanged since 1998;
- The site (and land located immediately adjacent to the site) has not been the subject of:
  - Orders made under Part 3 of the Contaminated Land Management Act 1997;
  - Notices available to the public under section 58 of the CLM Act;
  - An approved voluntary management proposal under the CLM Act that has not been fully carried out and where NSW EPA approval has not been revoked;
  - Site audit statements provided to the NSW EPA under section 53B of the CLM Act that relate to significantly contaminated land;
  - Copies of anything formerly required to be part of the public record;
  - Actions taken by NSW EPA (or the previous State Pollution Control Commission) under section 35 or 361 of the Environmentally Hazardous Chemicals Act 1985.
  - A list of sites notified to NSW EPA as being potentially contaminated; or
  - A licence, application, notice, audit, pollution study or reduction program.
- There was no evidence provided to CS during the project, regarding historical complaints about the site;
- There was no evidence provided to CS during the project, regarding historical incidents at the site;
- There was no anecdotal information regarding the site provided to CS during the project;
- There was no evidence provided to CS during the project, regarding description of manufacturing processes, raw materials, chemical and fuels associated with site use; and
- There was no evidence to suggest potential for PFAS to have been used onsite.

[1] Sections 35 and 36 of the Environmentally Hazardous Chemicals Act 1985 have been repealed. Notices under these sections are treated by the CLM Act as management orders.

3 Geology, Topography, Elevation, Hydrogeology, Hydrology and Acid Sulfate Soils

3.1 Geology

The Department of Mineral Resources Geological Survey of NSW Penrith 1:100,000 Geological Series Sheet 9130 (Edition 1) 1983, indicated that the site is mapped under the Wianamatta Group (undifferentiated) as Bringelly Shale in Minchinbury Sandstone, comprising shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.

3.2 Topography and Elevation

A detail and level survey plan of the site indicated that:

> The topography of the site is sloping gently from north-east to the south-west; and

> The surface of the site was located at an elevation of approximately 36m Australian Height Datum (AHD) in the north-east and 30m AHD in the south-west.

3.3 Hydrogeology and Hydrology

CS (2022a) reported that there are no registered groundwater features located onsite or within a 500m radius of the site.

A review of www.nearmap.com, indicated that surface water bodies near the site included:

> A dam located within Lot 1 in DP1268701; and

> Eastern Creek located approximately 800m to the west.

Based on the location of the identified surface water body and site topography, the inferred groundwater flow and direction at the site is considered likely to be towards the west or south-west.

Based on site surface topography and elevation, the inferred general surface water flow direction on the site is considered likely to be towards the south-west.

3.4 Acid Sulfate Soils

A review of https://environment.nsw.gov.au/eSpade2WebApp indicated that the site is located in an area mapped as – *N: No known occurrence*.

Further assessment of acid sulfate soils, in the context of this project is considered not warranted.

4 Previous Contamination Assessments

The following previous contamination assessment report was reviewed for the preparation of this RAP:

> CS (2022a), 'Stage 1 Preliminary and Stage 2 Detailed Site Assessment, 249-271 Railway Terrace, Schofields, NSW 2762, ref: 10791EV.P.323-R01, dated: 09 November 2022.

4.1 CS (2022a)

The objectives of CS (2022a) were to:

> Assess the potential for contamination to be present at the site, arising from past and present land use activities;

> Provide advice on whether the site is suitable, in the context of land contamination, for the proposed land use scenario; and

> Provide recommendations for supplementary investigations, contamination management, or remedial works.

The scope of work undertaken to address the project objectives included:

> A desktop review of site history;

> A walkover of the site;

> Fieldwork including soil sampling;

> Laboratory analysis; and

> Data assessment and reporting.

Based on the scope above, CS (2022a) made the following conclusions:

> There was a potential for contamination to be present at the site, arising from past land use activities, specifically:

  - The presence of bonded asbestos within AEC06, AEC08, AEC20, AEC24, AEC25 and AEC28;
  - The presence of friable asbestos within AEC13 and AEC24; and
  - Elevated concentrations of microbes in AEC24.

> The presence of large amount of construction and demolition waste as well as the presence of disused cars presents an aesthetics impact;

> There are data gaps associated with the contamination status of soils underneath the buildings and driveways onsite as well as the presence of septic tanks onsite; and

> The site is not yet considered to be suitable for land use scenario comprising residential with minimal opportunities for soil access including dwellings with fully and permanently paved yard space such as high rise buildings and flats.

CS (2022a) made the following recommendations:

> A remedial action plan (RAP) be prepared by a suitably experienced environmental consultant to address the identified contamination risks onsite and to address the identified data gaps onsite;

- The RAP should:
  - Include a methodology to remediate/manage identified contamination onsite;
  - Include a methodology for undertaking a supplementary contamination assessment (SCA) to assess the contamination risks associated with the identified data gaps onsite; and
  - include conceptual remedial strategies to address and remediate identified contamination onsite associated with the data gap.
- A site remediation and validation report should be prepared at the completion of all management and remedial works as outlined in the RAP and the SCA, confirming that the site has been made suitable for the proposed land use scenario.

5 Reported Data Gaps

CS (2022a) reported the following data gaps to be present onsite, in the context of site contamination characterisation and management:

- AEC02: Soils underneath the existing residential dwelling south-west of the site. Contamination status of soils underneath the building was not assessed as part of CS (2022a).
- AEC03 and AEC04: Soils underneath the existing driveways adjacent to the south-west residential dwelling. Contamination status of soils underneath the driveways was not assessed as part of CS (2022a).
- AEC05: Soils underneath the existing granny flat located to the south-west of the site. Contamination status of soils underneath this building was not assessed as part of CS (2022a).
- AEC16: Soils underneath the existing driveway to the north-west of the site, connecting a second residential dwelling to Railway Terrace. Contamination status of soils underneath this building was not assessed as part of CS (2022a).
- AEC17: Soils underneath the second residential dwelling to the north-west of the site, adjacent to AEC16. Contamination status of soils underneath the building was not assessed as part of CS (2022a).
- AEC19: Septic tank and associated infrastructure located 10m south of AEC17. Septic tank could not be decommissioned and soils around the tank was not validated as part of CS (2022a).
- AEC23: Soils underneath the collapsed shed identified as 'Collapsed northern shed' in Section 8.5 in CS (2022a). Contamination status of soils underneath this building was not assessed as part of CS (2022a).
- AEC24: Soils underneath existing buildings within an area historically used for pigsty. Contamination status of soils underneath these buildings was not assessable as part of CS (2022a).
- AEC32: Septic tank and associated infrastructure located 10m south of AEC17. Septic tank could not be decommissioned and soils around the tank was not validated as part of CS (2022a).

Provision for addressing these data gaps is presented in Section 10 of this RAP.

A figure showing where the data gaps are located is presented in Figure 3.

6 Pre-Remediation Conceptual Site Model

The findings of CS (2022a) were assessed within the objective of this project and in the context of the proposed land use setting. The findings of the assessment were used to develop a pre-remediation conceptual site model (CSM) for the site.

6.1 Sources of Contamination

A number of sources of contamination have been identified for the site. These include:

> Uncontrolled filling;

> Stockpiling;

> Uncontrolled demolition;

> Termite treatment;

> Use of hazardous building materials; and

> Former market gardens;

6.2 Land Use Scenario

6.2.1 Adopted Land Use Scenario

For the purpose of these remedial works, CS understands that the proposed land use scenario for the site includes residential with minimal opportunities for soil access including dwellings with fully and permanently paved yard space such as high rise buildings and flats.

6.2.2 Assumptions for Adopted Land Use Scenario

Section 3 of NEPC (2013e) advises that the residential with minimal access to soil land use scenario includes high-density residential, not including a private garden. This land use scenario assumes typical residential unit blocks, consisting of multistorey buildings where living areas are on the ground floor (constructed on a ground level slab or above subsurface structures including basement car parks or storage areas).

Occupants of the buildings would have access to yard spaces that are largely covered by permanent paving, with some small areas of landscaping or lawns. Opportunities for direct access to soil by residents of these buildings are therefore minimal but there may be some potential for residents to inhale, ingest or come into direct dermal contact with dust (particulates) derived from the soil on the site.

The scenario does not include landscaped/playground (including sandpit) areas used for recreation within a high-density development. These are considered a 'public open space' land use scenario.

6.3 Receptors

6.3.1 Identified Receptors

Based on the adopted land use scenario, CS considers receptors at the site may include residents, intrusive maintenance workers and other workers and terrestrial ecosystems.

6.3.2 Assumptions for Identified Receptors

The human receptors at a residential with minimal access to soils site, would typically include adults, children and infants who spend the majority of their time indoors within the residential properties, with some limited use of communal outdoor areas on site. The residents that are considered to be most susceptible to health risks associated with soil contaminants are the residents of ground floor units, due to the greatest potential for outdoor soil to be tracked indoors and vapour intrusion occurring with residences immediately overlying contaminated soil.

6.4 Exposure Pathways

Based on the information presented in CS (2022a), the following exposure pathways are considered 'complete'.

6.4.1 Human Health

6.4.1.1 Dermal Contact / Ingestion / Dust Inhalation

CS (2022a) indicated a potential for contaminants to be present in soils at the site, which may present a dermal contact, ingestion or dust inhalation risk to human health.

The proposed land use scenario is likely to include unsealed and open space areas, where a pathway between identified receptors and direct contact / ingestion contaminant sources, may be complete.

Further assessment of dermal contact, ingestion, and dust inhalation risk is considered warranted.

6.4.1.2 Asbestos

Bonded asbestos containing materials (ACM) comprises asbestos which is in sound condition, although possibly broken or fragmented, and where the asbestos is bound in a matrix such as cement or resin.

Fibrous asbestos (FA) comprises friable asbestos material and includes severely weathered cement sheet, insulation products and woven asbestos material, which can be broken or crumbled by hand pressure.

Asbestos fines (AF) include free fibres, small fibre bundles and small fragments of bonded ACM that can pass through a 7mm x 7mm sieve.

Asbestos poses a risk to human health when asbestos fibres are made airborne and inhaled. The assessment of sites contaminated with asbestos in soil should aim to describe the nature and quantity of asbestos in soil in sufficient detail to enable a risk management plan to be developed for the proposed land use scenario.

CS (2022a) indicate a potential for bonded ACM, FA and/or AF to be present in soils at the site. Laboratory data assessment for the overall site also confirms the presence of bonded ACM, FA and AF to be present in soils at the site, above the maximum criteria outlined in Table 7 in NEPC (2013a).

The proposed land use scenario is likely to include unsealed and open space areas, where a pathway between identified receptors and asbestos in soils, may be complete.

6.4.2 Aesthetics

CS (2022a) indicated a presence of large and bulky items of waste as well as construction and demolition onsite. These items are considered likely to restrict the proposed development and may also impact the future residents.

Further assessment of aesthetic risks on site, is considered warranted.

6.4.3 Management Limits for Petroleum Hydrocarbons

Section 2.9 of NEPC (2013a) indicates that there are a number of policy considerations which reflect the nature and properties of petroleum hydrocarbons:

- Formation of observable light non-aqueous phase liquids (LNAPL);
- Fire and explosive hazards; and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons.

Section 2.9 of NEPC (2013a) notes that CME (2008) includes management limits to avoid or minimise these potential effects. Application of management limits requires consideration of site specific factors such as depth of building basements and services, and depth to groundwater, to determine the maximum depth to which the limits should apply. NEPC (2013a) also states that:

- Management limits may have less relevance at operating industrial sites (including mine sites) which have no or limited sensitive receptors in the area of potential impact.
- The presence of site total petroleum hydrocarbon (TPH) contamination at the levels of the management limits does not imply that there is no need for administrative notification or controls in accordance with jurisdiction requirements.

CS (2022a) indicated a potential these policy considerations to be associated with relevant AEC's at the site, in the context of the proposed future land use scenario. On that basis, further assessment of petroleum hydrocarbons is considered warranted.

Further assessment of management limits for petroleum hydrocarbons, is considered warranted.

6.4.4 Terrestrial Ecosystems

CS (2022a) indicated a potential for contaminants, which may present an ecological risk, may be present on site.

Section 3.4.2 of NEPC (2013a) indicates that:

- A pragmatic risk-based approach should be taken when assessing ecological risk in residential and commercial / industrial land use settings;
- In existing residential and urban development sites, there are often practical considerations that enable soil properties to be improved by addition of ameliorants with a persistent modifying effect or by the common practice of backfilling or top dressing with clean soil;
- In other cases, all of the site soils will be removed during site development works or relocated for the formation of new land forms;
- Sites may also be backfilled with clean soil/fill and the fate of any excavated contaminated soil should be considered in process; and
- Commercial and industrial sites may have large building structures and extensive areas covered with concrete, other pavement or hardstand materials and may have limited environmental values requiring consideration while in operational use.

The proposed land use scenario is likely to include unsealed, open space and landscaped areas, where an ecological exposure pathway may be complete. On that basis, further assessment of terrestrial ecosystem exposure risks is considered warranted.

6.5 Source, Receptor and Pathway Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources and receptors, and exposure pathways between those sources and receptors. The CSM adopted for the site at the commencement of remedial works, is presented in Table 6.5.1, and considers contamination identified in CS (2022a), which presents an unacceptable exposure risk to human health and/or the environment.

Table 6.5.1 Pre-Remediation Conceptual Site Model

ID	AEC	Source	COPC	Exposure Pathway	Receptor
AEC02	Footprint of residential building and backyard within the south-western portion of site (~850m^2 and ~0.5m depth)	Uncontrolled filling	Hydrocarbons, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems
AEC03	Asphalt driveway to the front of residential building (~50m long and ~0.5m depth)	Uncontrolled filling	Hydrocarbons, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems
AEC04	Gravel driveway adjacent to residential building (~30m long and ~0.5m depth)	Uncontrolled filling	Hydrocarbons, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Terrestrial Ecosystems

ID	AEC	Source	COPC	Exposure Pathway	Receptor
AEC05	Footprint of granny flat 1 (~150m^2 and ~0.5m depth)	Uncontrolled filling, demolition and stockpiling Termite treatment Use of hazardous building materials	Hydrocarbons, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems
AEC06	Footprint of collapsed metal roof shed adjacent to granny flat 1 (~100m^2 and ~0.5m depth)	Bonded asbestos in surface soils	Bonded asbestos	Dust Inhalation Aesthetics	Residents Intrusive Workers
AEC08	Area surrounding cattle drinking trough (~25m^2 and ~0.5m depth)	Visible fragments of PACM on the surface	Bonded asbestos	Dust Inhalation	Residents Intrusive Workers
AEC09	Disused cars (~950m^2 and ~0.5m depth)	Disused parked cars	-	Aesthetics	Residents
AEC10	Waste Area 1 comprised of metal, concrete, brick and tile fragments (~400m^2 and ~0.5m depth)	Items of waste	-	Aesthetics	Residents
AEC13	Stockpile of construction and demolition rubble covered with vegetation (stockpile 1) (~50m^3)	Uncontrolled filling and stockpiling Fibrous asbestos / asbestos fines in surface soils	Fibrous asbestos / asbestos fines, bonded asbestos	Dermal Contact Dust Inhalation Aesthetics	Residents Intrusive Workers

ID	AEC	Source	COPC	Exposure Pathway	Receptor
AEC15	Stockpile of demolition waste covered with vegetation (stockpile 2) (~120m^3)	Items of waste	--	Aesthetics	Residents
AEC16	Residential building 2 driveway (~60m long and ~0.5m depth)	Uncontrolled filling	Hydrocarbons, PAH, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems
AEC17	Footprint of residential building 2 (~950m^2 and ~0.5m depth)	Uncontrolled filling Termite treatment Use of hazardous building materials	Hydrocarbons, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems
AEC19	Septic tank 1 (~10m^2)	Septic waste	Hydrocarbons, pathogens, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Terrestrial Ecosystems

ID	AEC	Source	COPC	Exposure Pathway	Receptor
AEC20	Footprint of historical building 2 from 1978-1998 (~50m^2 and ~0.5m depth)	Bonded asbestos in surface soils and at depth down to 0.3m below ground level	Bonded asbestos	Dust Inhalation	Residents
AEC23	Footprint of collapsed northern shed (~150m^2 and ~0.5m depth)	Uncontrolled filling, demolitions and stockpiling Termite treatment Use of hazardous building materials	Hydrocarbons, PAH, pesticides, PCB, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems
AEC24	Footprint of former pigsty (~1,850m^2 and ~0.5m depth)	Uncontrolled filling, demolitions and stockpiling Termite treatment Use of hazardous building materials Former market gardens Former pigsty use	Asbestos, microbes	Dermal Contact Soil Ingestion Dust Inhalation Aesthetics	Residents Terrestrial Ecosystems
AEC25	Footprint of historical building 3 from 1978-1986 (~2,400m^2 and ~0.5m depth)	Bonded asbestos in surface soils	Bonded asbestos	Dust Inhalation	Residents Intrusive Workers

ID	AEC	Source	COPC	Exposure Pathway	Receptor
AEC28	Stockpile of soil comprising metal wastes, concrete and brick and covered in vegetation (stockpile 3) (~175m^3)	Bonded asbestos fragments observed at surface and base of stockpile Items of waste	Bonded asbestos	Dust Inhalation Aesthetics	Residents Intrusive Workers
AEC32	Septic tank 2 (~10m^2)	Septic waste	Hydrocarbons, pathogens, metals, asbestos	Dermal Contact Soil Ingestion Dust Inhalation Direct Uptake Aesthetics Management Limits	Residents Intrusive Workers Terrestrial Ecosystems

The AECs are presented graphically in Figure 3 and Figure 4..

7 Remedial Goal and Criteria

7.7 Remedial Goal

The remedial goal for this project is to remediate:

- The presence of friable asbestos onsite at test pit locations:
  - TP06;
  - TP18; and
  - TP36
- The presence of bonded asbestos on the surface and/or at depth in test pits:
  - TP18;
  - TP25;
  - TP33;
  - TP36;
  - TP37;
  - TP44;
  - TP54; and
  - TP56;
- The presence of elevated concentrations of microbial contaminants at test pit locations TP31 and TP32; and
- The aesthetics impact due to the presence of construction and demolition waste and/or large/bulky items of waste in AEC06, AEC09, AEC10, AEC15, AEC24 and AEC28

To levels that do not present an unacceptable human health exposure risk, based on the proposed high-density residential land use scenario.

The proposed development is considered to be consistent with 'HIL B' land use scenario as outlined in NEPC (2013a) comprising residential with minimal opportunities for soil access including dwellings with fully and permanently paved yard space such as high rise buildings and flats.

It is noted that the client's preferred outcome at the completion of remedial works, is to not have:

- A notation on a planning certificate for the site;
- A covenant registered on the title to the land; or
- A long term environmental management plan (EMP).

7.8 Remedial Criteria

The remediation acceptance criteria adopted for this project, and the references that those criteria were adopted from, are outlined in Table 7.8.1, which will be based on proposed land use scenario[2] and identified receptors.

The rationale for the selection of the criteria including any assumptions and limitations used have been presented in Section 5.2 and Section 5.3.

Table 7.8.1 Remediation Acceptance Criteria and References

Exposure Pathway	Land Use Setting[3]	Reference
Human health (asbestos)	Residential B	Table 7 in NEPC (2013a)[4]
Human health (aesthetics)	All	Section 3.6.2 and 3.6.3 in NEPC (2013a)

[2] The land use scenarios in Section 2.2 of NEPC (2013a) will be considered when adopting human health assessment criteria. The land use scenarios in Section 2.5 of NEPC (2013a) will be considered when adopting ecological assessment criteria.
[3] Consideration will be given to soil type, soil texture, soil depth, groundwater depth and appropriate species protection levels.
[4] A depth of down to 10cm below ground level is adopted to define 'surface soil'.

8 Remedial Extent and Options Assessment

8.1 Inferred Remedial Extent

The inferred extent of remedial works required to address the remedial goal, is set out in Table 8.1.1.

However, CS notes that the data available at the time of preparing this report will need to be supplemented to characterise some of the AEC that have not been previously assessed. As such, the inferred extents are based on limited data, and may be subject to change following the completion of supplementary contamination assessment works proposed in Section 10 of this RAP.

The supplementary assessment may also remove the need for management and/or remediation in one or more AEC (based on statistical analysis of additional data and/or site specific risk assessment). Should there be a need to change the inferred extents based on supplementary assessment works, these changes would be presented in an addendum to this RAP.

Table 8.1.1 Inferred Remedial Extent

ID	AEC	Indicative In-situ Quantities	Assumptions[5]
AEC02	Footprint of residential building and backyard within the south-western portion of site (~850m^2 and ~0.5m depth)	-	*Refer to Section 10*
AEC03	Asphalt driveway to the front of residential building (~50m long and ~0.5m depth)	-	*Refer to Section 10*
AEC04	Gravel driveway adjacent to residential building (~30m long and ~0.5m depth)	-	*Refer to Section 10*
AEC05	Footprint of granny flat 1 (~150m^2 and ~0.5m depth)	-	*Refer to Section 10*
AEC06	Footprint of collapsed metal roof shed adjacent to granny flat 1 (~100m^2 and ~0.5m depth)	10m^3	100m^2, to depths down to 0.1m
AEC08	Area surrounding cattle drinking trough (~25m^2 and ~0.5m depth)	-	*Refer to Section 10*
AEC09	Disused cars (~950m^2 and ~0.5m depth)	--	Disused cars
AEC10	Waste Area 1 comprised of metal, concrete, brick and tile fragments (~400m^2 and ~0.5m depth)	--	Items of waste
AEC13	Stockpile of construction and demolition rubble covered with vegetation (stockpile 1) (~50m^3)	30m^3	50m^2, to base of stockpile (0.6m)

[5] Surface soils as defined down to 0.1m, based on confirmed presence of bonded and friable asbestos at depth range of 0.0-0.1m below ground level (bgl).

ID	AEC	Indicative In-situ Quantities	Assumptions[5]
AEC15	Stockpile of demolition waste covered with vegetation (stockpile 2) (~120m^3)	--	Items of waste
AEC16	Residential building 2 driveway (~60m long and ~0.5m depth)	-	*Refer to Section 10*
AEC17	Footprint of residential building 2 (~950m^2 and ~0.5m depth)	-	*Refer to Section 10*
AEC19	Septic tank 1 (~10m^2)	-	*Refer to Section 10*
AEC20	Footprint of historical building 2 from 1978-1998 (~50m^2 and ~0.5m depth)	15m^3	50m^2, to depths down to 0.3m
AEC23	Footprint of collapsed northern shed (~150m^2 and ~0.5m depth)	-	*Refer to Section 10*
AEC24	Footprint of former pigsty (~1,850m^2 and ~0.5m depth)	160m^3	1,600m^2, to depths down to 0.1m Also refer to Section 10
AEC25	Footprint of historical building 3 from 1978-1986 (~2,400m^2 and ~0.5m depth)	95m^3	950m^2, to depths down to 0.1m
AEC28	Stockpile of soil comprising metal wastes, concrete and brick and covered in vegetation (stockpile 3) (~175m^3)	175m^3	175m^2, to base of stockpile (1.0m)
AEC32	Septic tank 2 (~10m^2)	-	*Refer to Section 10*

The inferred extent of remedial works is also presented graphically in Figure 4.

8.2 Remedial Options Assessment

The preferred hierarchy of remedial options for site clean-up and/or management, as set out in s.6 (6) Assessment of Site Contamination Policy Framework of Schedules A and B of NEPC (1999) is as follows:

1. On-site treatment of contamination, so that it is destroyed or the associated risk is reduced to an acceptable level;
2. Off-site treatment of excavated soil so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which the soil is returned to the site;

If the above are not practicable;

3. Consolidation and isolation of the soil by on-site containment with a properly designed barrier; and
4. Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material; or
5. Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

CRC CARE (2018) provides additional guidance on other remedial options available for consideration. These are (among others):

6. Chemical immobilisation and solidification;
7. Bioremediation;
8. Soil washing;
9. Thermal desorption; and
10. Soil vapour remediation.

For the purpose of assessing remedial options, a selection of qualitative remedial option ranking criteria have been adopted. These criteria and the ranking system are presented in Table 8.2.1.

Table 8.2.1 Remedial Option Assessment Ranking Criteria

Score					
Criteria	**0**	**1**	**2**	**3**	**4**
Applicability	Not applicable	◄	----------	►	Widely available
Technical Feasibility	Unfeasible	◄	----------	►	Feasible
Effectiveness	Limited effectiveness for intended purpose	◄	----------	►	Highly effective for intended purpose
Stakeholder Acceptance	Unlikely acceptable to stakeholders (EPA, Council and community)	◄	----------	►	Highly likely to be acceptable to stakeholders
Cost	Likely highest	◄	----------	►	Likely lowest
Sustainability	Unsustainable	◄	----------	►	Sustainable in terms of environmental management and corporate / social responsibility
Duration	Long term	◄	----------	►	Short term

Based on CS' discussion with the client and nature and extent of likely remedial works, the following remedial options have been selected for further assessment:

> Onsite treatment
> Containment
> Excavation and disposal

The options considered, along with a qualitative ranking, are presented in Table 8.2.2.

Table 8.2.2 Remedial Options

Criteria	Onsite Treatment	Containment	Excavation and Disposal	Comment
Applicability	2	2	4	Onsite treatment option not available for the remediation of friable asbestos or the large quantities of aesthetically unsuitable material. However, onsite treatment option available only for the remediation of bonded asbestos and microbial contaminants. Containment solution could integrate well with proposed development design. Excavation and disposal integrates well with proposed development work.
Technical Feasibility	2	2	4	Industry accepted onsite treatment methods readily available for the remediation of bonded asbestos and microbial contaminants with some limitations based on soil type/structure. Onsite treatment option not available for the remediation of friable asbestos. Potential constraints during site construction and long-term site maintenance with containment. Containment option not suitable for large quantities of aesthetically unsuitable material. May require some relocation of impacted materials elsewhere onsite, to achieve a suitable containment solution. Excavation and disposal methods readily available.

Criteria	Onsite Treatment	Containment	Excavation and Disposal	Comment
Effectiveness	3	1	4	Onsite treatment effective if implemented correctly, with some limitations based on soil type/structure. Onsite treatment option not available for the remediation of friable asbestos. Containment not effective at managing all unacceptable risks such as large/bulky aesthetically unsuitable material. Excavation is highly effective as potential unacceptable risks are removed from site.
Stakeholder Acceptance	3	1	3	Onsite treatment acceptable. Onsite treatment option not available for the remediation of friable asbestos. Containment may not be acceptable if not consistent with local Council contaminated land policy. Excavation and disposal would be acceptable – risk removed from site, however, may be considered as not sustainable by some stakeholders.
Cost	4	2	1	Onsite treatment option is cost effective wherever applicable. Containment short term costs acceptable, but long term cost (future land value) may be unacceptable. Excavation and disposal costs are significantly higher.
Sustainability	4	2	1	Onsite treatment considered sustainable, given relatively minor quantities of waste generated. However, onsite treatment option is not possible for the remediation of friable asbestos. A capping solution is likely to require longer term passive maintenance. Excavation not considered to be consistent with sustainability principles.

Criteria	Onsite Treatment	Containment	Excavation and Disposal	Comment
Duration	1	1	4	Onsite treatment would likely impact project timeframe. Capping design and implementation, would likely impact project time. Excavation and offsite disposal comparatively faster; therefore remediation is unlikely to significantly impact project timeframe.
Score	**19**	**11**	**21**	

9 Preferred Remedial Options

9.1 Known Site Issues

Based on the current understanding of the inferred extent of remedial works required, the proposed land use scenario for the site, and the client's preferred remedial outcomes for the site, the preferred remedial options for the site are presented in Table 9.1.

Table 9.1 Preferred Remedial Option – Soils (known site issues)

AEC	Contamination Risk	Preferred Remedial Option
AEC06	Surface soils (down to 0.1m) impacted with friable asbestos Aesthetics	Impacted soils down to 0.1m will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC08	Inferred presence of bonded asbestos in surface soils	The surface of the AEC will be scraped to expose the underlying soil. A walkover of the surface will be undertaken by an environmental consultant. If no visual evidence to suggest the presence of asbestos is noted, validation will be undertaken in accordance with Section 12.7. If visual evidence to suggest presence of asbestos is observed, the soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Validation of the excavation footprint will be in accordance with Section 12.7.1.
AEC09	Aesthetics	Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal will be in accordance with Section 12.7.1.
AEC10	Aesthetics	Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal will be in accordance with Section 12.7.1.
AEC13	Stockpile impacted with friable asbestos Aesthetics	Stockpile will be disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.

AEC	Contamination Risk	Preferred Remedial Option
AEC15	Aesthetics	Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal will be in accordance with Section 12.7.1.
AEC19 and AEC32	Septic structure	If there are contents inside the pit, arrange for the pump-out and de-sludge of the pit in a method acceptable to local council (referred below) Hose down the sides, lid and partition walls of the pit with water. Excavation and offsite disposal of the pit and associated pipe works. All works to be undertaken in accordance with guidance provided in NSW Health (2017) and Blacktown City Council (2014). Validation of the excavation base and walls will be in accordance with Section 12.7.1.
	Content inside the pit and soils around the pit with unacceptable concentrations of contaminants (all contaminants).	Pump and de-sludge the content/residual liquids in the pit. Excavate the soils from around the pit. Excavation of soils from beneath the pit is only applicable if the pit is removed. Dispose the content of the pit and the excavated soil to a licensed facility suited to receiving such waste. Validation of the excavation base and walls will be in accordance with Section 12.7.1.
AEC20	Surface soils (down to 0.3m) impacted with bonded asbestos	Impacted soils down to 0.1m will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Validation of the excavation footprint will be in accordance with Section 12.7.1.
AEC24	Surface soils (down to 0.1m) impacted with pathogens, bonded and friable asbestos Aesthetics	Impacted soils down to 0.1m will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC25	Surface soils (down to 0.1m) impacted bonded asbestos	Impacted soils down to 0.1m will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Validation of the excavation footprint will be in accordance with Section 12.7.1.

AEC	Contamination Risk	Preferred Remedial Option
AEC28	Soils (down to 1.0m) impacted with bonded asbestos Aesthetics	Impacted soils down to 0.1m will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.

9.2 Unknown Site Issues

Based on the current understanding of the conceptual extent of remedial works required, the proposed land use scenario for the site, and the client's preferred remedial outcomes for the site, the preferred conceptual remedial options for the unknown site issues are presented in Table 9.2.

However, the preferred conceptual remedial options are based on limited data, and may be subject to the results of supplementary contamination assessment (SCA) works proposed in Section 10 of this RAP. Results from the SCA may identify the need for additional management and/or remediation in one or more areas of concern.

The supplementary assessment may also remove the need for management and/or remediation in one or more areas of concern (based on statistical analysis of additional data and/or site specific risk assessment). Should there be a need to change the inferred extents based on supplementary assessment works, these changes would be presented in an addendum to this RAP.

Table 9.2 Preferred Conceptual Remedial Option – Soils (unknown site issues)

AEC	Likely Contamination Risk	Preferred Conceptual Remedial Option
AEC02	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC03	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC04	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC05	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC16	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.

AEC	Likely Contamination Risk	Preferred Conceptual Remedial Option
AEC17	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC23	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.
AEC24	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	Impacted soils will be excavated using an excavator, and disposed offsite to a suitably licensed facility, with an appropriate waste classification. Aesthetically unsuitable material will be removed from the site. Validation of the aesthetics removal and excavation footprint will be in accordance with Section 12.7.1.

10 Supplementary Contamination Assessment Works

10.1 Background

Based on a desktop review of CS (2022a), a number of data gaps were identified in the context of site contamination characterisation and management. Those data gaps were presented in Section 5 of this RAP. These data gaps need to be addressed to further characterise the contamination status of the site. Given the presence of hardstand material and structures in these areas, the collection of additional data will occur following the completion of the demolition works set out in Section 11.4 of this RAP.

10.2 Site Walkover

A site walkover will be undertaken by the environmental consultant. The walkover will be grid based using transects (generally in a north-south orientation, then perpendicular to those transects in an east-west orientation). The walkover will focus on making observations of potential contamination, including the presence of staining, discolouration, anthropogenic materials (including building and demolition waste) and potential asbestos containing materials.

A written and photographic record of the transect pattern and observations made, will be kept by the environmental consultant, and relevant information presented in the supplementary contamination assessment report. The results of the inspection may result in amendments being made to the sampling point density, sampling point pattern and schedule of sample analysis proposed for the supplementary contamination assessment.

10.3 Step 1: State the problem

The reason the project is being undertaken, is set out in Section 5 of this RAP.

The project team and technical support experts identified for the project include the CS project director, CS project manager, CS field staff and CS' subcontractors.

The design and undertaking of this project will be constrained by the client's financial and time budgets.

The regulatory authorities associated with this project include NSW EPA and the local planning authority.

10.4 Step 2: Identify the decision/goal of the study

The decisions that need to be made during this project, to address the project objectives, include:

> Is the data collected for the project, suitable for assessing land contamination exposure risks?

> Do the detected concentrations of contaminants of potential concern identified in the CSM, present an unacceptable exposure risk to the receptors identified in the CSM, based on the proposed land use scenario?

> Is the data collected for the project, suitable for assessing the likely extent of contamination requiring management and/or remediation?

10.5 Step 3: Identify the information inputs

The information inputs required to make the decisions for the project set out in Section 12.2, include:

> Data obtained during the site history review and site walkover;

- Identification of sample media that needs to be collected, as set out in Section 10.9;
- Parameters that will be measured in each relevant sample, as set out in Section 10.9;
- The analytical methods required for each identified COPC, so that assessment can be made relative to adopted site criteria. These are set out in Section 10.9 of this report;
- The basis for decisions to be made from field screening, including photo-ionisation detector (PID) data, and what action is to be taken if a defined concentration is attained, as set out in Section 12.7; and
- The site criteria for the media of concern. These criteria are set out in Table 10.5.1 and will be adopted based on the proposed land use scenario[6] and identified receptors.

Table 10.5.1 Adopted Supplementary Contamination Assessment Criteria

Exposure Pathway	Land Use Setting[7]	Reference
Human health direct contact	HIL B - Residential with minimal access to soils	Table 1A(1) in NEPC (2013a) Table B4 in Friebel, E & Nadebaum P (2011) Table 3-5 in NSW EPA (2000)
Human health (asbestos)	Residential B	Table 7 in NEPC (2013a)[8]
Human health (aesthetics)	All	Characteristics and processes in Section 3.6.2 and 3.6.3 in NEPC (2013a)
Ecological	Urban residential space	Table 1B(1) in NEPC (2013a) Table 1B(2) in NEPC (2013a) Table 1B(3) in NEPC (2013a) Table 1B(4) in NEPC (2013a) Table 1B(5) in NEPC (2013a) Table 1B(6) in NEPC (2013a)
Management Limits (petroleum hydrocarbons)	Residential space	Table 1B(7) in NEPC (2013a)

10.6 Step 4: Define the boundaries of the study

The geographical and spatial extent of the project will be limited to:

- The AEC where data gaps exist, as set out in Section 5 and Section 6.5; and
- Any physical constraints or existing infrastructure on site that prevents safe and reasonable access by the project team and/or typical industry equipment used for projects of this nature.

The time and budget constraints of the project will be as per those set out in the contract (and subsequent variations) between CS and the client.

The temporal boundaries of the project will include:

[6] The land use scenarios in Section 2.2 of NEPC (2013a) will be considered when adopting human health assessment criteria. The land use scenarios in Section 2.5 of NEPC (2013a) will be considered when adopting ecological assessment criteria.
[7] Consideration will be given to soil type, soil texture, soil depth, groundwater depth and appropriate species protection levels.
[8] A depth of down to 10cm below ground level is adopted to define 'surface soil'.

- Weather conditions including rain, wind, heat and cold, which may adversely affect execution of fieldwork tasks and/or data quality;
- Availability of the site for access to execute fieldwork tasks; and
- Availability of project team members to execute the project.

The lateral and vertical intervals in which contamination distribution is believed to be distributed, based on the CSM, will be:

- The inferred lateral boundaries of each AEC, including groundwater down gradient of primary / secondary sources (where applicable);
- The inferred vertical extent of each AEC, likely to be to 0.3m into natural soil, to the base of stockpiled material, to ~1m below the base of belowground infrastructure, and to ~2m below inferred standing water level (where applicable).

The scale of the decisions required will be based on the site, as defined by its boundaries.

10.7 Step 5: Develop the analytical approach

10.7.7.1 Duplicates and Triplicates

Field duplicates and triplicates will be collected at a rate of one set per 20 samples collected (an equivalent of 5%), and one set per 10 samples collected (an equivalent of 10%) where PFAS is a contaminant of concern. Sample collection will include splitting of one bulk sample across three separate sample containers. Soil samples will not be homogenised, particularly where the COPC are volatile or semi volatile in nature.

Analysis of the duplicate and triplicates will be based on at least one of the analytes that the parent sample is being analysed for (excluding asbestos).

The relative percent difference (RPD) of the detected concentrations in the parent and duplicate, and the parent and triplicate, will be calculated.

10.7.7.2 Trip Blanks and Trip Spikes

One trip blank and trip spike will be used for each day of sampling[9]. A minimum of one trip blank and one trip spike will be scheduled for BTEX analysis, during the project, provide sample handling, preservation and storage procedures the same for each day of sampling.

10.7.7.3 Rinsate Blanks

One rinsate blank will be used for each day of sampling[10].

Analysis of the rinsate blank will be based on at least one of the analytes that the parent sample is being analysed for (excluding asbestos).

[9] Only where samples being collected on that day are expected to be analysed for BTEX and/or TRH C6-C10.
[10] Only where non-disposable sampling equipment is being used on that day.

10.7.7.4 Field Blanks

One field blank will be used for each day of sampling[11]. A minimum of one field blank will be scheduled for PFAS analysis, during the project, provided sample handling, preservation and storage procedures the same for each day of sampling.

10.7.7.5 Laboratory Quality Assurance and Quality Control

The quality assurance and quality control (QA/QC) program of the primary analytical laboratory will typically include analysis of method blanks, matrix spikes, surrogate spikes, laboratory control samples and laboratory duplicates. The laboratory will report on whether the QA/QC analysis meets the laboratory's adopted data quality objectives.

10.7.7.6 Data Quality Indicators

Data quality indicators (DQI) will be adopted to facilitate an assessment of the completeness, comparability, representativeness, precision and accuracy (bias) of the field and laboratory data collected. These DQI are set out in Table 10.7.7.6.

Table 10.7.7.6 Data Quality Indicators

Completeness			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Experienced sampling team used	Yes	Complete SRA and COA attached	Yes
Sampling devices and equipment set out in sampling plan were used (refer Section 10.9).	Yes	Critical samples identified in sampling plan, analysed	Yes
Critical locations in sampling plan, sampled (refer Section 10.9).	Yes	Analysis undertaken addresses COPC in sampling plan (refer Section 10.9)	Yes
Critical samples in sampling plan, collected (refer Section 10.9).	Yes	Analytical methods reported in laboratory documentation and appropriate LOR used	Yes
Completed field and calibration logs attached	Yes	Sample holding times met (refer Section 10.9)	Yes
Completed COC attached	Yes		

Comparability			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Same sampling team used for all work.	Yes	Same laboratory used for all analysis (refer Section 10.9).	Yes

[11] Only where PFAS is a contaminant of concern for samples collected on that day.

Comparability			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Weather conditions suitable for sampling.	Yes	Comparable methods if different laboratories used (refer Section 10.9).	Yes
Same sample types collected and preserved in same way (refer Section 10.9).	Yes	Comparable LORs if different laboratories used.	Yes
Relevant samples stored in insulated containers and chilled (refer Section 10.9).	Yes	Comparable units of measure if different laboratories used (refer Section 10.9).	Yes

Representativeness			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Media identified in sampling plan, sampled (refer Section 10.9).	Yes	Samples identified in sampling plan, analysed.	Yes
Samples required by sampling plan, collected (refer Section 10.9).	Yes		

Precision			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Minimum 5% duplicates and triplicates collected and analysed (refer Section 10.9).	Yes	All laboratory duplicate RPDs within laboratory acceptance criteria (refer Section 10.9).	Yes
Minimum 10% duplicates and triplicates collected and analysed where PFAS is a contaminant of concern (refer Section 10.9).	Yes		
RPD unlimited where detected concentrations are <10 times the LOR.	Yes		
RPD within 50% where detected concentrations are 10-20 times the LOR.	Yes		
RPD within 30% where detected concentrations are >20 times the LOR.	Yes		

Accuracy (bias)			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Trip blank analyte results less than LOR (refer Section 10.9).	Yes	Laboratory method blank results within laboratory acceptance limits (refer Section 10.9).	Yes
Trip spike analyte results less between 60% and 140% (refer Section 10.9).	Yes	Laboratory control sample results within laboratory acceptance limits (refer Section 10.9).	Yes
Rinsate blank analyte results less than LOR (refer Section 10.9).	Yes	Laboratory spike sample results within laboratory acceptance limits.	Yes
Field (PFAS) blank analyte results less than LOR (refer Section 10.9).	No		

10.7.7.7 If/Then Statements

If field and laboratory analytical dataset is within the DQI assessment parameters, then the data may be considered to be adequately complete, comparable, representative, precise and accurate, for decision making within the objectives of this project.

If field and laboratory analytical dataset is outside the DQI assessment parameters, then additional data may be collected to address identified data gaps.

If field and laboratory analytical results are within adopted contamination assessment criteria, then the site may be considered suitable for the proposed land use scenario.

If field and laboratory analytical results are outside adopted contamination assessment criteria, then the site may be considered unsuitable for the proposed land use scenario, or additional data collected to further inform the decision making process.

10.8 Step 6: Specify the performance or acceptance criteria

10.8.1 If / Then Decisions

There are two types of decision error:

- Sampling errors occur when the sampling program does not adequately detect the variability of a contaminant from point to point across the site. That is, the samples collected are not representative of site conditions (e.g. an appropriate number of representative samples have not been collected from each stratum to account for estimated variability); and
- Measurement errors occur during sample collection, handling, preparation, analysis and data reduction.

In the assessment of land contamination, these errors can result in either:

- A Type I error, where contamination exposure risks are considered to be acceptable, when they are not; or
- A Type II error, where contamination exposure risks are considered to be not acceptable, when they are.

In order for decision rules to be sound, they should be designed to minimise decision errors. The risk of decision error will be mitigated by:

> Ensuring fieldwork tasks are undertaken by suitably experienced field staff and sub-contractors, with reference to the DQO presented in this report;

> Ensuring laboratory analyses are undertaken by NATA accredited laboratories; and

> Ensuring interpretation of data is undertaken by suitably experienced environmental consultants and/or outsourcing interpretation to technical experts (if warranted).

10.9 Step 7: Develop the plan for obtaining data

10.9.1 Sampling Point Density

Table 2 in NSW EPA Part 1 (2022) includes guidance on minimum sampling point densities required characterising a site, based on detecting circular hot spots by using a systematic sampling pattern. Application of this guidance is recommended when:

> There is little knowledge about the probable locations of the contamination;

> The distribution of the contamination is expected to be random (e.g. landfill sites); or

> The distribution of the contamination is expected to be fairly homogenous (e.g. agricultural lands).

Section 5 of NSW EPA Part 1 (2022) states that judgemental or stratified sampling methods can be used if there is sufficient information about the probable distribution of the contamination. Additionally, Section 6.2.1 in NEPC (2013b) states that judgemental sampling, the selection of samples (number, location, timing, etc) is based on knowledge of the site and professional judgement. Sampling would be expected to be localised to known or potentially contaminated areas identified from knowledge of the site either from the site history or an earlier phase of site assessment. Judgemental sampling can be used to investigate sub-surface contamination issues in site assessment.

Section 7.5 of NEPC (2013b) and VIC EPA (2009) provides guidance on sampling methods and sample numbers for stockpiles.

Section 4.1 and Table 1 of WA DOH (2009) provides guidance on asbestos in soil sampling densities, relative to the likelihood of asbestos being present on the site.

The scope of this project has included collection of data that provides an understanding of:

> Site history;

> The locations of potentially contaminated areas;

> The identified COPC;

> Laydown mechanisms for COPC in each AEC;

> The likely lateral and vertical extent of potential contamination in each AEC; and

> Constraints on site which may restrict the use of certain sampling techniques.

On that basis, it is considered reasonable to adopt a mix of grid based / judgemental sampling pattern, using the sampling point densities set out in Table 10.9.1 and sampling point locations set out in Figure 5.

Table 10.9.1 Sampling Point Densities and Locations

ID	AEC	Sampling Point ID	Method	Target Depth (mbgs)
AEC02	Footprint of residential building and backyard within the south-western portion of site (~850m^2 and ~0.5m depth)	TP101-TP108	Test pits x 8	0.5m, 0.3m into natural or refusal
AEC03	Asphalt driveway to the front of residential building (~50m long and ~0.5m depth)	TP109-TP110	Test pits x 2	0.5m, 0.3m into natural or refusal
AEC04	Gravel driveway adjacent to residential building (~30m long and ~0.5m depth)	TP111-TP112	Test pits x 2	0.5m, 0.3m into natural or refusal
AEC05	Footprint of granny flat 1 (~150m2 and ~0.5m depth)	TP113-TP114	Test pits x 2	0.5m, 0.3m into natural or refusal
AEC16	Residential building 2 driveway (~60m long and ~0.5m depth)	TP115-TP116	Test pits x 2	0.5m, 0.3m into natural or refusal
AEC17	Footprint of residential building 2 (~950m^2 and ~0.5m depth)	TP117-TP124	Test pits x 8	0.5m, 0.3m into natural or refusal
AEC23	Footprint of collapsed northern shed (~150m^2 and ~0.5m depth)	TP125-TP126	Test pits x 2	0.5m, 0.3m into natural or refusal
AEC24	Footprint of former pigsty (~1,850m^2 and ~0.5m depth)	TP127-TP134	Test pits x 8	0.5m, 0.3m into natural or refusal

10.9.2 Sampling Method – Soils

Soil samples will be collected from relevant sampling points at the surface, and at regular intervals thereafter, or where there is a change in lithology, or where there is visual/olfactory evidence of potential contamination.

When identified COPC include volatiles (e.g. BTEX, TRH or VOC), collected soil samples will be screening for ionisable volatile organic compounds using a photo-ionisation detector (PID). A sub sample from each sample collected at each sampling point will be placed in a zip lock bag, sealed, and shaken. Each zip lock bag will then be pierced with the tip of a PID and the results recorded on the relevant sampling point log.

Samples collected from stockpiles, will be collected from a minimum of 0.3m below the surface of the stockpile.

Samples requiring asbestos gravimetric screening will be 10L in volume, and will be collected and screened with reference to Table 5 in WA DOH (2009).

Samples requiring calculation of asbestos fines (AF) and fibrous asbestos (FA), will be collected as separate samples to the 10L bulk samples.

10.9.3 Field and Laboratory Quality Assurance / Quality Control

The relevant procedures for sample identification, preservation, handling and transport, field screening, decontamination, duplicates and triplicates, rinsate blanks, field blanks, laboratory QA and data quality indicators (DQI) set out in Section 12.5 and 12.7 of this RAP, will be adopted for the supplementary contamination assessment.

10.9.4 Decontamination

Non-disposable sampling equipment will be decontaminated between sampling points to mitigate potential for cross contamination of samples. The decontamination method to be used will be:

- Wash off the non-disposable sampling equipment with a solution of potable water and phosphate free detergent (e.g. Decon 90), noting that Decon 90 will not be used on equipment used for collection of samples that will be analysed for PFAS compounds;
- Rinse the washed equipment with distilled or de-ionised water; and
- Air dry the rinsed equipment.

10.9.5 Sample Identification, Preservation, Handling and Transport

Soil samples will be identified using the CS project number, sampling point identification number and sampling depth interval (e.g. TP101/0.0-0.1), and date the sample was collected.

Samples will be placed in laboratory prepared containers (containing preservatives as appropriate), bulk sample bags and zip lock bags.

Soil samples will be stored in insulated containers with ice.

Samples will be transported to the analytical laboratory by CS field staff or a third party courier, using the analytical laboratory's chain of custody (COC) documentation.

10.9.6 Laboratory Selection

Analytical laboratories used for this project will be NATA accredited for the analytical methods used.

10.9.7 Laboratory Analytical Schedule

Samples scheduled for laboratory analysis will be selected based on:

- The COPC identified for the AEC the sample was collected from;
- Observations made of the sample when collected (including staining, odour and discolouration); and
- The results of PID headspace screening (if applicable).

The proposed laboratory analytical schedule (including upper limiting sample quantities) for the project is set out in Table 10.9.7.

Table 10.9.7 Laboratory Analytical Schedule

ID	AEC	Sampling Point ID	TRH / BTEX	PAH	OCP/ OPP	PCB	Metals (8)	Asbestos (Material ID)	Asbestos (0.001%)	Microbes	pH/ CEC
AEC02	Footprint of residential building and backyard within the south-western portion of site (~850m^2 and ~0.5m depth)	TP101-TP108	3	8	5	3	8	2	16	-	1
AEC03	Asphalt driveway to the front of residential building (~50m long and ~0.5m depth)	TP109-TP110	1	2	1	1	2	1	4	-	-
AEC04	Gravel driveway adjacent to residential building (~30m long and ~0.5m depth)	TP111-TP112	1	2	1	1	2	1	4	-	-
AEC05	Footprint of granny flat 1 (~150m2 and ~0.5m depth)	TP113-TP114	1	2	1	1	2	-	4	-	-
AEC16	Residential building 2 driveway (~60m long and ~0.5m depth)	TP115-TP116	1	2	1	1	2	1	4	-	-
AEC17	Footprint of residential building 2 (~950m^2 and ~0.5m depth)	TP117-TP124	3	8	5	3	8	2	16	-	1
AEC23	Footprint of collapsed northern shed (~150m^2 and ~0.5m depth)	TP125-TP126	1	2	1	1	2	-	4	-	-
AEC24	Footprint of former pigsty (~1,850m^2 and ~0.5m depth)	TP127-TP134	3	8	5	3	8	2	16	4	1
	Total	TP101-TP134	14	34	20	14	34	9	70	4	3

10.9.8 Laboratory Holding Times, Analytical Methods and Limits of Reporting

Sample holding times, laboratory analytical methods and limits of reporting applicable to this project, are set out in Table 10.9.8.

Table 10.9.8 Laboratory Holding Times, Analytical Methods and Limits of Reporting

Analyte	Holding Time	Method	LOR (mg/kg)
BTEX and TRH C6-C10	14 days	USEPA 5030, 8260B and 8020	0.2-0.5
TRH C10-C40	14 days	USEPA 8015B & C	20-100
PAH	14 days	USEPA 8270	0.1-0.2
OCP	14 days	USEPA 8081	0.2
PCB	14 days	USEPA 8270	0.2
Metals	6 months	USEPA 8015B & C	0.05-2
pH	On receipt	APHA 4500 pH	-
E.Coli	24 hours	AS 4276.5:2007	-
Faecal Coliforms	24 hours	AS 4276.7:2007	-
Asbestos ID	No limit	AS4926	Absence / presence
Asbestos (WA DOH)	No limit	Inhouse	0.001% w/w

10.10 Supplementary Contamination Assessment Reporting

The findings of the supplementary contamination assessment will be presented as an addendum to this RAP. The RAP addendum report will include:

- An executive summary;
- The scope of reporting work undertaken;
- Site identification details;
- Information on supplementary contamination assessment works undertaken;
- Field and laboratory analytical data and QA/QC assessment;
- Supplementary site characterisation;
- Information on the revised inferred remedial extent;
- Information on the revised remedial strategy (if any);
- Information on revised validation strategy (if any);
- Information on revised site monitoring requirements (if any); and
- Conclusions and recommendations.

11 Remedial Strategy

11.1 Schedule of Remediation

Schedule of remediation has not yet been determined at the time of writing this report. This timeframe will be refined following appointment of a remediation contractor.

11.2 Approvals and Notifications

A notification of intent to undertake remedial works will be submitted to the relevant planning authority, 30 days prior to the intended commencement date of remedial works.

The proposed remedial works are considered likely to class as Category 2 under State Environmental Planning Policy (Resilience and Hazards) 2021. It is understood that Category 2 remedial works do not require consent from the planning authority.

The following information will be provided to the relevant planning authority, with the notice of intent to undertake remedial works:

> A copy of previous contamination assessment reports;

> A copy of this RAP;

> The contact details of the party responsible for ensuring remedial works comply with relevant regulatory requirements; and

> The contact details of the remediation contractor.

Development consent or a construction certificate will be obtained (if required) from the planning authority for demolition, excavation or shoring works.

Demolition works (if required) will be undertaken by a contractor holding an appropriate SafeWork NSW demolition licence. That licence will hold a chemical endorsement, in the event that demolition works includes underground service tanks.

Approvals will be obtained (if required) from Roads and Maritime Services (RMS) for remedial works being undertaken adjacent to (or on) RMS assets.

A notification of asbestos removal work will be submitted to SafeWork NSW by the remediation contractor. The remediation contractor will hold:

> A Class A licence for removal of friable asbestos / asbestos fines; and

> A Class B licence for removal of bonded asbestos.

Within seven days of completion of underground storage tank abandonment / decommissioning / removal works (if applicable), a notification will be sent to SafeWork NSW by the remediation contractor.

Within 30 days of completion of remediation and validation works, a notice of completion of the remedial works will be submitted to the relevant planning authority by the client's project manager.

11.3 Stability of Structures

The stability of structures (including, but not necessarily limited to footings, walls, buildings and roads), which may be impacted by the proposed remedial works) will be assessed by a suitably experienced structural

consultant before commencing remedial works. Recommendations made by the structural consultant will be incorporated by the remediation contractor, into the execution of all relevant site works.

11.4 Demolition Works

A hazardous materials survey (if required), will be prepared prior to demolition of structures (if required). The survey will identify the location, nature and extent of all hazardous materials (including asbestos, lead, PCB and synthetic mineral fibres) in those structures.

Identified hazardous materials will be treated (where appropriate), removed from site, and a clearance certificate obtained from a licensed asbestos assessor, prior to commencing demolition of the structures.

The remediation contractor will retain records of the transport and disposal of demolition wastes (including hazardous materials), removed from the site.

11.5 Remedial Works

The preferred and conceptual remedial strategies to be adopted for each of the identified AEC or potential contamination risks, are presented in Section 9 of this the RAP.

Remedial works will be undertaken by the remediation contractor with guidance provided by the appointed environmental consultant. The environmental consultant will assist the remediation contractor in setting out the inferred extents of remediation required, based on refined remedial extents set out in the supplementary contamination assessment report referred to in Section 10 of this RAP. The environmental consultant will provide guidance to the remediation contractor on:

- Where to extend remedial works beyond the inferred extent (if observations indicate a need for 'chasing out' additional contamination); and
- When to stop remedial works, to allow validation works to be undertaken.

The remediation contractor will be responsible for:

- Coordinating right of way access through third party properties (as required) with the site owner and owners/tenants of third party properties;
- Site establishment, including stabilising of site access entry/exit points;
- Provision of worker amenities on site;
- Establishment of sediment and erosion controls;
- Establishing soil / sediment treatment areas, which may require localised minor earthworks to create cleared and 'flat' treatment pads;
- Disposal of wastes to appropriately licensed facilities; and
- Retaining records of the transport and disposal of all wastes generated during remedial works.

11.6 Backfilling of Remedial Excavations

Should backfilling of remedial excavations be required, then backfill material will be limited to:

- Virgin excavated natural material (VENM);
- Excavated natural material (ENM); and

- Other materials that:
  - Have been certified as compliant with a NSW EPA issued resource recovery exemption; and
  - The placement on the site is within the constraints of the resource recovery exemption; and
  - Do not present an unacceptable human health or ecological exposure risk, in the context of the proposed land use scenario.

Material proposed for importing will be compatible with existing soil characteristics for site drainage purposes. Nominating engineering properties (compaction, density and moisture content) is not within the scope of this RAP and will be specified by others.

Certification of VENM, ENM or other resource recovery material, will be reviewed by the environmental consultant, before the remediation contractor commences importation.

The remediation contractor will be responsible for:

- Inspecting every load of imported material for consistency with the material described in the relevant certification, including that the material is free of anthropogenic materials, odours or staining;
- Maintaining a record of inspection of each load;
- Maintaining detailed records of all material imported to site, including details of the supplier/s, source of the material, quantity of the material, importing vehicle registration numbers, and dates/times the material is received on site; and
- The remediation contractor will be responsible for retaining records of the certification, importation and placement of all remedial excavation backfill materials.

11.7 Unexpected Finds and Contingency Plans

There is a degree of uncertainty inherent in site assessment and remediation works. Based on the site history information made available to CS prior to preparing this RAP, it is considered the unexpected scenarios presented in Table 11.7 could occur during remedial works.

Contingency plans and protocols to be implemented, should those scenarios arise, are also presented in Table 11.7.

Table 11.7 Contingency Plan

Scenario	Contingency Plan
Unexpected buried contamination or underground structures encountered during remedial works (e.g. buried waste, underground storage tank, underground sump/pit).	Cease remedial works. Consider undertaking intrusive soil investigations into and around the unexpected find, to assess the potential nature and extent of the contamination / structure. Consider undertaking groundwater assessment works, if groundwater is encountered and the potential nature and extent of the contamination / structures suggest a risk to groundwater. Prepare an amendment to the remediation and/or validation strategy in the RAP (if required), pending

Scenario	Contingency Plan
	the outcomes and of the soil and/or groundwater assessment works. Remediate the unexpected contamination. Undertake validation of the remedial works.
Potential asbestos containing materials encountered beyond the inferred extent of remediation.	Cease remedial works. Consider undertaking intrusive soil investigations into and around the potential asbestos identified beyond the inferred remedial extent, and assess whether the asbestos is bonded and/or friable. Submit notification to SafeWork NSW for asbestos removal works (if not already addressed in an existing notification). Prepare an amendment to the remediation and/or validation strategy in the RAP. Remediate the unexpected contamination. Undertake validation of the remedial works.

12 Validation Sampling, Analytical and Quality Plan

Appendix B in NEPC (2013b) provides guidance on the data quality objective (DQO) process, which is a seven step iterative planning approach that can be used to define the type, quantity and quality of data needed to inform decisions relating to the environmental condition of a site.

12.1 Step 1: State the problem

The reason the project is being undertaken, is set out in Section 1.1 of this report.

The objective of this project is set out in Section 1.2 of this report.

The project team and technical support experts identified for the project include the CS project director, CS project manager, CS field staff and CS' subcontractors.

The design and undertaking of this project will be constrained by the client's financial and time budgets.

The regulatory authorities associated with this project include NSW EPA, the local planning authority, and SafeWork NSW.

12.2 Step 2: Identify the decision/goal of the study

The decisions that need to be made during this project, to address the project objectives, include:

> Has the site been remediated in accordance with appropriate remedial acceptance criteria?

> Is the data collected for the project, suitable for assessing land contamination exposure risks?

> Do the detected concentrations of contaminants of potential concern identified in the CSM, present an unacceptable exposure risk to the receptors identified in the CSM, based on the proposed land use scenario?

> Has the site been suitably remediated and made suitable for the intended land use?

12.3 Step 3: Identify the information inputs

The information inputs required to make the decisions for the project set out in Section 12.2, include:

> Data obtained during the site history review and site walkover;

> Data obtained during the remediation and validation works, as set out in Section 12.7;

> Identification of sample media that needs to be collected, as set out in Section 12.7;

> Parameters that will be measured in each relevant sample, as set out in Section 12.7;

> The analytical methods required for each identified COPC, so that assessment can be made relative to adopted site criteria. These are set out in Section 12.7 of this report; and

> The site criteria for the media of concern. These criteria are set out in Table 7.8.1 and will be adopted based on the proposed land use scenario[12] and identified receptors.

[12] The land use scenarios in Section 2.2 of NEPC (2013a) will be considered when adopting human health assessment criteria. The land use scenarios in Section 2.5 of NEPC (2013a) will be considered when adopting ecological assessment criteria.

12.4 Step 4: Define the boundaries of the study

The geographical and spatial extent of the project will be limited to:

> The site as defined by the boundaries set out in Section 2; and

> Any physical constraints or existing infrastructure on site that prevents safe and reasonable access by the project team and/or typical industry equipment used for projects of this nature.

The time and budget constraints of the project will be as per those set out in the contract (and subsequent variations) between CS and the client.

The temporal boundaries of the project will include:

> Weather conditions including rain, wind, heat and cold, which may adversely affect execution of fieldwork tasks and/or data quality;

> Availability of the site for access to execute fieldwork tasks; and

> Availability of project team members to execute the project.

The lateral and vertical intervals in which contamination distribution is believed to be uniformly distributed, based on the CSM, will be:

> The inferred lateral boundaries of each AEC; and

> The inferred vertical extent of each AEC, as indicated in Section 8.1.

The scale of the decisions required will be based on the site, as defined by its boundaries.

12.5 Step 5: Develop the analytical approach

12.5.1 Duplicates and Triplicates

Field duplicates and triplicates will be collected at a rate of one set per 20 samples collected (an equivalent of 5%), and one set per 10 samples collected (an equivalent of 10%) where PFAS is a contaminant of concern. Sample collection will include splitting of one bulk sample across three separate sample containers. Soil samples will not be homogenised, particularly where the COPC are volatile or semi volatile in nature.

Analysis of the duplicate and triplicates will be based on at least one of the analytes that the parent sample is being analysed for (excluding asbestos).

The relative percent difference (RPD) of the detected concentrations in the parent and duplicate, and the parent and triplicate, will be calculated.

12.5.2 Trip Blanks and Trip Spikes

One trip blank and trip spike will be used for each day of sampling[13]. A minimum of one trip blank and one trip spike will be scheduled for BTEX analysis, during the project, provide sample handling, preservation and storage procedures the same for each day of sampling.

[13] Only where samples being collected on that day are expected to be analysed for BTEX and/or TRH C6-C10.

12.5.3 Rinsate Blanks

One rinsate blank will be used for each day of sampling[14]. A minimum of one rinsate blank will be collected during the project, provided equipment decontamination procedures are the same for each day of sampling.

Analysis of the rinsate blank will be based on at least one of the analytes that the parent sample is being analysed for (excluding asbestos).

12.5.4 Field Blanks

One field blank will be used for each day of sampling[15]. A minimum of one field blank will be scheduled for PFAS analysis, during the project, provided sample handling, preservation and storage procedures the same for each day of sampling.

12.5.5 Laboratory Quality Assurance and Quality Control

The quality assurance and quality control (QA/QC) program of the primary analytical laboratory will typically include analysis of method blanks, matrix spikes, surrogate spikes, laboratory control samples and laboratory duplicates. The laboratory will report on whether the QA/QC analysis meets the laboratory's adopted data quality objectives.

12.5.6 Data Quality Indicators

Data quality indicators (DQI) will be adopted to facilitate an assessment of the completeness, comparability, representativeness, precision and accuracy (bias) of the field and laboratory data collected. These DQI are set out in Table 12.5.6.

Table 12.5.6 Data Quality Indicators

Completeness			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Experienced sampling team used	Yes	Complete SRA and COA attached	Yes
Sampling devices and equipment set out in sampling plan were used (refer Section 12.7.1).	Yes	Critical samples identified in sampling plan, analysed	Yes
Critical locations in sampling plan, sampled (refer Section 12.7.1).	Yes	Analysis undertaken addresses COPC in sampling plan (refer Section 12.7.6)	Yes
Critical samples in sampling plan, collected (refer Section 12.7.1).	Yes	Analytical methods reported in laboratory documentation and appropriate LOR used	Yes
Completed field and calibration logs attached	Yes	Sample holding times met (refer Section 1.7.7)	Yes
Completed COC attached	Yes		

[14] Only where non-disposable sampling equipment is being used on that day.
[15] Only where PFAS is a contaminant of concern for samples collected on that day.

Comparability			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Same sampling team used for all work.	Yes	Same laboratory used for all analysis (refer Section 12.7.5).	Yes
Weather conditions suitable for sampling.	Yes	Comparable methods if different laboratories used Refer Section 1.7.7).	Yes
Same sample types collected and preserved in same way (refer Section 12.7.4).	Yes	Comparable LORs if different laboratories used.	Yes
Relevant samples stored in insulated containers and chilled (refer Section 12.7.4).	Yes	Comparable units of measure if different laboratories used (refer Section 1.7.7).	Yes

Representativeness			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Media identified in sampling plan, sampled (refer Section 12.7.1).	Yes	Samples identified in sampling plan, analysed.	Yes
Samples required by sampling plan, collected (refer Section 12.7.1).	Yes		

Precision			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Minimum 5% duplicates and triplicates collected and analysed (refer Section 12.5.1).	Yes	All laboratory duplicate RPDs within laboratory acceptance criteria (refer Section 12.5.4).	Yes
RPD unlimited where detected concentrations are <10 times the LOR.	Yes		
RPD within 30% where detected concentrations are 10-20 times the LOR.	Yes		
RPD within 50% where detected concentrations are >20 times the LOR.	Yes		

Accuracy (bias)			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Trip blank analyte results less than LOR (refer Section 12.5.2).	Yes	Laboratory method blank results within laboratory acceptance limits (refer Section 12.5.4).	Yes

Accuracy (bias)			
Field Considerations	**Target**	**Laboratory Considerations**	**Target**
Trip spike analyte results less between 60% and 140% (refer Section 12.5.2).	Yes	Laboratory control sample results within laboratory acceptance limits (refer Section 12.5.4).	Yes
Rinsate blank analyte results less than LOR (refer Section 12.5.3).	Yes	Laboratory spike sample results within laboratory acceptance limits.	Yes

12.5.7 If/Then Statements

If field and laboratory analytical dataset is within the DQI assessment parameters, then the data may be considered to be adequately complete, comparable, representative, precise and accurate, for decision making within the objectives of this project.

If field and laboratory analytical dataset is outside the DQI assessment parameters, then additional data may be collected to address identified data gaps.

If field and laboratory analytical results are within adopted contamination assessment criteria, then the site may be considered suitable for the proposed land use scenario.

If field and laboratory analytical results are outside adopted contamination assessment criteria, then the site may be considered unsuitable for the proposed land use scenario, or additional data collected to further inform the decision making process.

12.6 Step 6: Specify the performance or acceptance criteria

12.6.7 If / Then Decisions

There are two types of decision error:

> Sampling errors occur when the sampling program does not adequately detect the variability of a contaminant from point to point across the site. That is, the samples collected are not representative of site conditions (e.g. an appropriate number of representative samples have not been collected from each stratum to account for estimated variability); and

> Measurement errors occur during sample collection, handling, preparation, analysis and data reduction.

In the assessment of land contamination, these errors can result in either:

> A Type I error, where contamination exposure risks are considered to be acceptable, when they are not; or

> A Type II error, where contamination exposure risks are considered to be not acceptable, when they are.

In order for decision rules to be sound, they should be designed to minimise decision errors. The risk of decision error will be mitigated by:

> Ensuring fieldwork tasks are undertaken by suitably experienced field staff and sub-contractors, with reference to the DQO presented in this report;

> Ensuring laboratory analyses are undertaken by NATA accredited laboratories; and

- Ensuring interpretation of data is undertaken by suitably experienced environmental consultants and/or outsourcing interpretation to technical experts (if warranted).

12.7 Step 7: Develop the plan for obtaining data

12.7.1 Validation Sampling

Table 2 in NSW EPA Part 1 (2022) includes guidance on minimum sampling point densities required characterising a site, based on detecting circular hot spots by using a systematic sampling pattern. Application of this guidance is recommended when:

- There is little knowledge about the probable locations of the contamination;
- The distribution of the contamination is expected to be random (e.g. landfill sites); or
- The distribution of the contamination is expected to be fairly homogenous (e.g. agricultural lands).

Section 5 of NSW EPA Part 1 (2022) states that judgemental or stratified sampling methods can be used if there is sufficient information about the probable distribution of the contamination. Additionally, Section 6.2.1 in NEPC (2013b) states that judgemental sampling, the selection of samples (number, location, timing, etc) is based on knowledge of the site and professional judgement. Sampling would be expected to be localised to known or potentially contaminated areas identified from knowledge of the site either from the site history or an earlier phase of site assessment. Judgemental sampling can be used to investigate sub-surface contamination issues in site assessment.

Section 7.5 of NEPC (2013b) and VIC EPA (2009) provides guidance on sampling methods and sample numbers for stockpiles.

Section 4.1 and Table 1 of WA DOH (2009) provides guidance on asbestos in soil sampling densities, relative to the likelihood of asbestos being present on the site.

The scope of this project has included collection of data that provides an understanding of site history and the locations of potentially contaminated areas. On that basis, it is considered reasonable to adopt a mix of grid based / judgemental sampling pattern, using the sampling point densities set out in Table 12.7.1.1 and Table 12.7.1.2.

Table 12.7.1.1 Validation Sampling Plan – Known Issues

AEC	Contamination Risk	Preferred Validation Strategy
AEC06	Surface soils (down to 0.1m) impacted with friable asbestos Aesthetics	A visual inspection of the residual remedial excavation and photographic record. Collect one 500ml sample for every 5m x 5m area on the base or a minimum of two samples. Collect one 500ml sample from each wall for every 5 linear meter for every vertical meter, or a minimum of one sample per wall. Laboratory analysis of validation samples for AF/FA % w/w. Visual validation of excavation base to confirm the removal of aesthetically unsuitable material. Photograph of removal must be taken. Clearance inspection and issuance of a clearance certificate by a licensed asbestos assessor.
AEC08	Inferred presence of bonded asbestos in surface soils	A visual inspection of the residual remedial excavation and photographic record. Collect one 10L sample per 5m x 5m scraped area. Field screening of the validation samples for the presence of bonded ACM greater than 7mm. Clearance inspection by a competent person.
AEC09	Aesthetics	A visual inspection of the remediated surface and photographic record.
AEC10	Aesthetics	A visual inspection of the remediated surface and photographic record.
AEC13	Stockpile impacted with friable asbestos Aesthetics	A visual inspection of the residual remedial excavation and photographic record. Collect one 500ml sample for every 5m x 5m area on the base or a minimum of two samples. Collect one 500ml sample from each wall for every 5 linear meter for every vertical meter, or a minimum of one sample per wall. Laboratory analysis of validation samples for AF/FA % w/w. Visual validation of excavation base to confirm the removal of aesthetically unsuitable material. Photograph of removal must be taken. Clearance inspection and issuance of a clearance certificate by a licensed asbestos assessor.
AEC15	Aesthetics	A visual inspection of the remediated surface and photographic record.

AEC	Contamination Risk	Preferred Validation Strategy
AEC19 and AEC32	Septic structure – aesthetics impact	Collect one sample for every 5m x 5m area on the base or a minimum of two samples. Collect one sample from each wall for every 5 linear meters, for every vertical meter, or a minimum of one sample per wall. Laboratory analysis of validation samples for septic COPC. Visual validation of excavation base to confirm the removal sludge/septic material. Photograph of removal must be taken.
AEC20	Surface soils (down to 0.3m) impacted with bonded asbestos	A visual inspection of the residual remedial excavation and photographic record. Collect one 10L sample per 5m x 5m scraped area. Field screening of the validation samples for the presence of bonded ACM greater than 7mm. Clearance inspection by a competent person.
AEC24	Surface soils (down to 0.1m) impacted with pathogens, bonded and friable asbestos Aesthetics	A visual inspection of the residual remedial excavation and photographic record. Collect one jar sample, one 500ml sample and one 10L sample for every 5m x 5m area on the base or a minimum of two samples. Collect one jar sample, one 500ml sample and one 10L sample from each wall for every 5 linear meter for every vertical meter, or a minimum of one sample per wall. Laboratory analysis of jar samples for microbes analysis. Laboratory analysis of 500ml validation samples for AF/FA % w/w. Field screening of 10L samples for the presence of bonded fragments of asbestos greater than 7mm. Visual validation of excavation base to confirm the removal of aesthetically unsuitable material. Photograph of removal must be taken. Clearance inspection and issuance of a clearance certificate by a licensed asbestos assessor.
AEC25	Surface soils (down to 0.1m) impacted with bonded asbestos	A visual inspection of the residual remedial excavation and photographic record. Collect one 10L sample per 5m x 5m scraped area. Field screening of the validation samples for the presence of bonded ACM greater than 7mm. Clearance inspection by a competent person.

AEC	Contamination Risk	Preferred Validation Strategy
AEC28	Soils (down to 1.0m) impacted with bonded asbestos Aesthetics	A visual inspection of the residual remedial excavation and photographic record. Collect one 10L sample for every 5m x 5m area on the base or a minimum of two samples. Collect one 10L sample from each wall for every 5 linear meter for every vertical meter, or a minimum of one sample per wall. Field screening of validation samples for the presence of bonded fragments of asbestos greater than 7mm. Visual validation of excavation base to confirm the removal of aesthetically unsuitable material. Photograph of removal must be taken. Clearance inspection by a competent person.
Remedial Excavations	Imported VENM for backfilling	One per $25m^3$ or minimum of 3 samples. Laboratory analysis of all samples for TRH, BTEX, PAH, OCP, PCB, metals and asbestos.
Remedial Excavations	Imported ENM for backfilling	Quantity dependent – refer to The Excavated Natural Material (ENM) resource recovery exemption. Laboratory analysis of all samples as per Order and Exemption.
Remedial Excavations	Imported Other for backfilling	Quantity dependent – refer to the relevant resource recovery exemption. Laboratory analysis of all samples as per Order and Exemption.

Table 12.7.1.2 Conceptual Validation Sampling Plan – Unknown Issues

AEC	Likely Contamination Risk	Preferred Validation Strategy
AEC02, AEC03, AEC04, AEC05, AEC16, AEC17, AEC23 and AEC24	Soils impacted with chemical and asbestos contamination. Presence of bulk items of waste and construction and demolition waste	A visual inspection of the residual remedial excavation and photographic record. Collect one jar sample, one 500ml sample and one 10L sample for every 5m x 5m area on the base or a minimum of two samples. Collect one jar sample, one 500ml sample and one 10L sample from each wall for every 5 linear meter for every vertical meter, or a minimum of one sample per wall. Laboratory analysis of jar samples for relevant contaminant of concern. Laboratory analysis of 500ml validation samples for AF/FA % w/w. Field screening of 10L samples for the presence of bonded fragments of asbestos greater than 7mm. Visual validation of excavation base to confirm the removal of aesthetically unsuitable material. Photograph of removal must be taken. Clearance inspection and issuance of a clearance certificate by a licensed asbestos assessor.

Samples collected from stockpiles, will be collected from a minimum of 0.3m below the surface of the stockpile.

Samples requiring asbestos gravimetric screening will be 10L in volume, and will be collected and screened with reference to Table 5 in WA DOH (2009).

Samples requiring calculation of asbestos fines (AF) and fibrous asbestos (FA), will be collected as separate samples to the 10L bulk samples.

If olfactory or visual observations of remedial works, or headspace analysis of screening samples, indicate a potential for contamination to be present, then consideration will be given to collection of additional validation samples / data.

The location of collected validation sampling data will be recorded on a site plan.

12.7.2 Field Screening

When identified COPC include volatiles (e.g. BTEX, TRH or VOC), collected soil samples will be screening for ionisable volatile organic compounds using a photo-ionisation detector (PID). A sub sample from each sample collected at each sampling point will be placed in a zip lock bag, sealed, and shaken. Each zip lock bag will then be pierced with the tip of a PID and the results recorded on the relevant sampling point log.

12.7.3 Decontamination

Non-disposable sampling equipment will be decontaminated between sampling points to mitigate potential for cross contamination of samples. The decontamination method to be used will be:

- Wash off the non-disposable sampling equipment with a solution of potable water and phosphate free detergent (e.g. Decon 90), noting that Decon 90 will not be used on equipment used for collection of samples that will be analysed for PFAS compounds;
- Rinse the washed equipment with distilled or de-ionised water; and
- Air dry the rinsed equipment.

12.7.4 Sample Identification, Preservation, Handling and Transport

Soil samples will be identified using the CS project number, date the sample was collected one, and the AEC, number of sample and depth/interval the sample was collected from (e.g. the second validation sample collected from AEC06 at a depth of 0.4m below ground level, would be identified as AEC06/02/0.4).

Samples will be placed in laboratory prepared containers (containing preservatives as appropriate), bulk sample bags and zip lock bags.

Soil samples will be stored in insulated containers with ice.

Samples will be transported to the analytical laboratory by CS field staff or a third party courier, using the analytical laboratory's chain of custody (COC) documentation.

12.7.5 Laboratory Selection

Analytical laboratories used for this project will be NATA accredited for the analytical methods used.

12.7.6 Laboratory Analytical Schedule

Samples scheduled for laboratory analysis will be selected based on:

- The COPC identified for the AEC the sample was collected from;
- Observations made of the sample when collected (including staining, odour and discolouration); and
- The results of PID headspace screening (if applicable).

The proposed laboratory analytical schedule (including upper limiting sample quantities) for the project is set out in Table 12.7.6.

Table 12.7.6 Laboratory Analytical Schedule

ID	AEC	TRH	PAH	OCP /OPP	PCB	Metals (8)	E. Coli	Faecal Coliforms	Asbestos Field Screen and 0.001%
AEC02	Footprint of residential building and backyard within the south-western portion of site (~850m^2 and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC03	Asphalt driveway to the front of residential building (~50m long and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC04	Gravel driveway adjacent to residential building (~30m long and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC05	Footprint of granny flat 1 (~150m^2 and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC06	Footprint of collapsed metal roof shed adjacent to granny flat 1 (~100m^2 and ~0.5m depth)	-	-	-	-	-			ALL
AEC08	Area surrounding cattle drinking trough (~25m^2 and ~0.5m depth)	-	-	-	-	-			-
AEC09	Disused cars (~950m^2 and ~0.5m depth)	-	-	-	-	-			-

ID	AEC	TRH	PAH	OCP /OPP	PCB	Metals (8)	E. Coli	Faecal Coliforms	Asbestos Field Screen and 0.001%
AEC10	Waste Area 1 comprised of metal, concrete, brick and tile fragments (~400m^2 and ~0.5m depth)	-	-	-	-	-			-
AEC13	Stockpile of construction and demolition rubble covered with vegetation (stockpile 1) (~50m^3)	-	-	-	-	-			ALL
AEC15	Stockpile of demolition waste covered with vegetation (stockpile 2) (~120m^3)	-	-	-	-	-			-
AEC16	Residential building 2 driveway (~60m long and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC17	Footprint of residential building 2 (~950m^2 and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC19	Septic tank 1 (~10m^2)	ALL	ALL	-	-	ALL			-
AEC20	Footprint of historical building 2 from 1978-1998 (~50m^2 and ~0.5m depth)	-	-	-	-	-			-

ID	AEC	TRH	PAH	OCP /OPP	PCB	Metals (8)	E. Coli	Faecal Coliforms	Asbestos Field Screen and 0.001%
AEC23	Footprint of collapsed northern shed (~150m^2 and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC24	Footprint of former pigsty (~1,850m^2 and ~0.5m depth)	ALL	ALL	ALL	ALL	ALL			ALL
AEC25	Footprint of historical building 3 from 1978-1986 (~2,400m^2 and ~0.5m depth)	-	-	-	-	-			-
AEC28	Stockpile of soil comprising metal wastes, concrete and brick and covered in vegetation (stockpile 3) (~175m^3)	-	-	-	-	-			-
AEC32	Septic tank 2 (~10m^2)	ALL	ALL	-	-	ALL	ALL		-
-	VENM	All samples for TRH, BTEX, PAH, OCP, PCB, metals and asbestos (absence / presence)							
-	ENM	All samples for analytical suite set out in ENM order							
-	Other material	All samples for analytical suite set out in relevant resource recovery order							

12.7.7 Laboratory Holding Times, Analytical Methods and Limits of Reporting

Sample holding times, laboratory analytical methods and limits of reporting applicable to this project, are set out in Table 12.7.7.

Table 12.7.71.7.7 Laboratory Holding Times, Analytical Methods and Limits of Reporting

Analyte	Holding Time	Method	LOR (mg/kg)	LOR (µg/L)
BTEX and TRH C6-C10	14 days	USEPA 5030, 8260B and 8020	0.2-0.5	1-2 and 50
TRH C10-C40	14 days	USEPA 8015B & C	20-100	50-500
PAH	14 days	USEPA 8270	0.1-0.2	0.5-10
OCP	14 days	USEPA 8081	0.2	-
PCB	14 days	USEPA 8270	0.2	-
Metals	6 months	USEPA 8015B & C	0.05-2	0.1-5
Faecal Coliforms	24 hours	AS 4276.5:2007	10 MPN/g	1 cfu/100mL
E. Coli	24 hours	AS 4276.7:2007	10 MPN/g	1 cfu/100mL
Asbestos ID	No limit	AS4926	Absence / presence	-
Asbestos (WA DOH)	No limit	Inhouse	0.001% w/w	-

13 Site Validation Report

At the completion of remedial works, a site validation report will be prepared with reference to the relevant sections of NSW EPA (2020b). The site validation report will include:

- An executive summary;
- The scope of reporting work undertaken;
- Site identification details;
- A summary of geology and hydrogeology;
- A summary of site condition and the surrounding environment;
- Information on supplementary contamination assessment works undertaken (if any);
- A pre-remediation conceptual site model;
- Summary of the remedial action plan;
- Remediation and validation activities undertaken;
- Information on waste management;
- Information on the remedial works undertaken;
- Information on imported material;
- An assessment of field and laboratory quality assurance / quality control data;
- Validation results and discussion;
- A post remediation conceptual site model; and
- Conclusions and recommendations.

14 Site Management Plan

14.1 Register of Contacts

A register of contact details of stakeholders considered relevant to the project, is presented in Table 14.1.

Table 14.1 Emergency Response Register of Contacts

Role	Person	Organisation	Contact
Emergency Services	-	Fire / Police / Ambulance	000
Site Owner	Felix Bigeni	Provincial Investments Pty Ltd	0414 621 000
Project Manager	*To be advised*	*To be advised*	*To be advised*
Planning Authority	-	Blacktown City Council	0298 311 961
Environmental Regulatory Authority	-	NSW EPA	131 500
WHS Regulatory Authority	-	SafeWork NSW	131 050
Remediation Contractor	*To be advised*	*To be advised*	*To be advised*
Environmental Consultant	Abanish Nepal	Construction Sciences	0436 620 611

14.2 Hours of Operation, Signage and Security

The hours of operation at the site will be limited to:

> Days and times set out in the relevant development consent conditions (if available); or

> Monday to Friday between 7:00am and 5:00pm, and Saturday between 8:00am and 1:00pm.

The 24-hour contact details of the remediation contractor will be put on a sign, and posted on the site boundary, adjacent to the site access point. The sign will be maintained by the remediation contractor until completion of remedial works.

Security of the site will be maintained for the duration of the remedial works, with appropriate boundary fencing/barricades and access point locks.

14.3 Workplace Health and Safety

14.3.7 Safe Work Method Statement

All parties intending to undertake tasks in the remediation area/s will prepare a safe work method statement (SWMS) that documents:

> The task/s to be undertaken;

> Hazards associated with undertaking those task/s;

- A risk assessment of each hazard, considering consequence and likelihood;
- Control measures to be implemented to mitigate identified risks; and
- A re-assessment of each hazard, assuming control measure implementation, and showing a demonstrable decrease to the risk.

14.3.8 Personal Protective Equipment

The following personal protective equipment (PPE) will be worn (as a minimum) by all persons working on, or visiting, the remediation work area/s:

- Long sleeves and long pants;
- A high visibility vest (or clothing);
- Hard hat;
- Protective foot wear (e.g. safety boots);
- Eye protection (e.g. safety glasses or goggles); and
- Cut resistant gloves.

Additional PPE or respiratory protective equipment (RPE) may also be required, subject to the control measures set out in the SWMS for the task.

14.3.9 Decontamination

The following decontamination procedure will apply to all persons existing the remediation work area/s:

- Cleaning of protective footwear, including removal of potentially contaminated material from the soles of the footwear;
- Washing of hands (including prior to eating, drinking or smoking).

14.3.10 Occupational Hygiene

Atmospheric monitoring will be undertaken (subject to the findings of the risk assessment in the relevant SWMS), or as may be recommended by a suitably experienced occupational hygienist. Monitoring may include airborne fibre monitoring during asbestos remedial works, vapour monitoring during hydrocarbon remediation, or gas/explosion risk monitoring during land fill remediation.

Plant and equipment will be appropriately decontaminated before leaving a remedial works zone.

14.3.11 Biological Risks

Works include the handling and treatment of materials impacted with potential biological human health risks, including E.coli and faecal coliforms. Exposure pathways for workers may include ingestion of soil/dust, inhalation of dust, and dermal contact with soil / dust.

Safe work method statements prepared for workers undertaking works where these biological risks are present, will include management controls to mitigate those risks. Controls for workers may include, but not necessarily include, disposable coveralls, gloves, respiratory protection, and showering / hand washing facilities onsite.

14.4 Waste Management

Wastes generated during remedial works will be removed from site for recycling / disposal, with reference to NSW EPA (2014) and the relevant provisions of the Protection of the Environment Operations Act 1997.

The remediation contractor will maintain detailed records of each load of waste materials generated during remedial works, including:

> The location the waste was generated from;

> The classification of the waste;

> The date and time the waste was removed from the site;

> The vehicle registration number of the waste transport vehicle;

> The quantity of the load of waste removed from site;

> Waste receipt docket from the waste receiving facility; and

> Weighbridge docket from the waste receiving facility.

14.5 Stormwater and Soil Management

14.5.1 Access and Egress

Vehicle and plant site access/egress will be managed to prevent soils being tracked onto roads and pathways external to the site (e.g. gravels, gabions, cattle grids). Soil will be broomed or washed off tyres/tracks prior to the vehicle or plant leaving the remediation work area. Broomed/washed soil will be managed onsite, depending on its likely contamination status.

In the event soils are tracked onto roads or pathways external to the site, these soils will be removed by sweeping and/or shovelling.

A sediment and erosion control plan will be prepared by the remediation contractor, to suit the nature and staging of the remedial works. Control measures will be operated and maintained by the remediation contractor, until completion of the remedial works.

Surface stormwater generated from (or travelling through) the remediation works area, will be managed using relevant measures set out in the Blue Book[16].

14.5.2 Excavation Pump Out and Groundwater

Should excavations require water to be pumped out, the water will be sampled and analysed by a suitably experienced environmental consultant, for total suspended solids (TSS), pH, metals (8) and petroleum hydrocarbons.

If the laboratory analytical results are less than the relevant[17] aquatic ecosystem groundwater investigation levels (GILs) set out in ANZG (2018), then the excavation water may be discharged to the local stormwater system.

[16] Landcom 2004, 'Managing Urban Stormwater – Soils and Construction'
[17] Freshwater or marine

If the laboratory analytical results are greater than the relevant[18] aquatic ecosystem groundwater investigation levels (GILs) set out in ANZG (2018), then other options for the excavation water will be considered, including:

> Assessment of proposed receiving waters, in the context of the contaminant concentrations found in the excavation water;

> Removal and offsite disposal by a liquid waste contractor; and

> Discharge to sewer under an approval obtained from the relevant sewerage infrastructure operator.

In the event the site requires dewatering, development consent from the relevant planning authority and/or approvals from the state water authority, will be obtained (if required).

14.5.3 Stockpiles

Stockpiles of material generated during remedial works will be:

> Generally constructed as low elongated mounds on level surfaces;

> Stored in secure areas and covered if remaining on site for more than 24 hours;

> Placed away from stormwater pits, drainage lines and gutters;

> Kept damp if containing (or suspected of containing) asbestos;

> Not located on footpaths or nature strips, unless approved by the local planning authority.

14.5.4 Rehabilitation

Areas of the site that become exposed as a result of remedial works, will be stabilised progressively, as remedial works are completed. Stabilisation methods will be maintained until such time as they are no longer required (e.g. vegetation becomes established and self-sustaining, or site development work commences).

14.6 Noise and Vibration Control

Plant and equipment being utilised for remedial works, will be fitted with noise attenuation devices (e.g. exhaust mufflers). Where possible, selection and use of reversing alarms will avoid standard tonal pulse alarms.

Vehicle access roads will be designed to mitigate the need for vehicles and mobile plant to reverse during travel (e.g. creation of turning circles in the immediate vicinity of remediation work area/s).

'Offensive noise', as defined under the Protection of the Environment Operations Act 1997, will not be emitted beyond the site boundary, during remedial works.

Vibrations generated during remedial works will be managed to mitigate risk of damage to structural assets and risk of amenity loss to adjacent land occupiers. Advice from geotechnical, structural or vibration consultants will be sought, if required.

14.7 Dust Control

Consideration will be given to the following control measures, to mitigate risk of dust emissions migrating beyond the boundary of the remediation work area/s:

> Maintaining site access / egress stabilisation methods;

[18] Freshwater or marine

- Covering loads during site access / egressing;
- Covering stockpiles of contaminated soil that remain on site for greater than 24 hours;
- Use of water sprays in areas prone to dust generation, including excavation surfaces and fill material (during offloading and spreading);
- Establishing screens around the perimeter of remediation work area/s (e.g. application of shade cloth to fencing);
- Minimising soil excavation and/or handling during windy days; and
- Sweeping of accumulated soil on hardstand areas.

14.8 Odour Control

Should odours be detected at the site boundary during remediation works, monitoring of those odours may be undertaken, using methods[19] suited to the odour type, based on recommendations from a suitably experienced odour consultant (if required).

14.9 Atmospheric Monitoring

Airborne asbestos monitoring will be undertaken on site by a licensed asbestos assessor during friable asbestos removal or handling. Monitoring during bonded asbestos removal, will be undertaken, subject to advice provided by the occupational hygienist appointed to the project.

Monitoring will be used to validate controls put in place to mitigate potential asbestos exposure.

Portable battery operated air monitors will be placed in static positions approximately 1.5m above the ground surrounding the asbestos handling / removal area.

Analysis of monitors will be undertaken by a NATA-accredited laboratory. The results of analysis will be compared to the criteria presented in Table 14.9 and the appropriate action applied.

Table 14.9 Atmospheric Monitoring Concentrations and Actions

Detected Concentration (fibres per millilitre)	Action
<0.01	Continue with established control measures
0.01 to 0.02	Review established control measures Investigate probably cause Establish additional control to mitigate further fibre release

[19] Methods could include instrumental, chemical analysis, electronic, sensory tests or olfactometry.

Detected Concentration (fibres per millilitre)	Action
>0.02	Stop works Notify the relevant regulatory authority that work has ceased Investigate probably cause Extent the works exclusion zone Establish additional control to mitigate further fibre release Do not re-commence work until detected concentrations are at or below 0.01 fibres per millilitre

14.10 Traffic

The remediation contractor will:

> Utilise suitable experienced and qualified traffic controllers (as required);

> Ensure vehicles exit the site in a forward direction; and

> Arrange for receipt and dispatch of materials during approved remedial working hours (refer Section 14.1).

Traffic and haulage routes will be selected based on:

> Preference for state controlled roads (as opposed to local roads);

> Compliance with traffic road rules; and

> Opportunities to mitigate noise, vibration, dust and odour impacts to properties/occupants adjacent to the site.

14.11 Emergency Preparedness and Response

An emergency assembly point will be established at an appropriate location, and this location communicated to workers and visitors during the site induction process. In the event an emergency situation arises, workers and visitors will assemble at this location (if safe to do so) and await further instructions from the site supervisor, project manager or emergency services.

Spill control kits and fire extinguishers will be located at appropriate locations at the site.

14.12 Community Relations

Occupants of properties adjoining the site and located immediately across the road from the site, will be provided with a notification of intent to undertake remedial works on the site, a minimum of two business days before commencing those remedial works.

A register will be maintained on site, for the recording of remedial works related communications from the community.

Communication received from community about the remedial works, will be directed to the project manager in the first instance. The project manager will arrange for the communication to respond to, in accordance with arrangements agreed to between the remediation contractor and the principal.

15 Conclusions and Recommendations

Based on CS' assessment of the information presented in the available historical contamination assessment reports, CS considers that the remedial goal can be achieved and the site made suitable for the proposed land use, subject to:

> The implementation of the strategies and methodologies set out in this remedial action plan, including the supplementary contamination assessment works; and

> Preparation of a site validation report.

This report must be read in conjunction with the ***Information About This Report*** page at the front of this report.

16 References

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NSW EPA 1986, 'Chemical Control Order In Relation to Dioxin-Contaminated Waste Materials' dated 14 March 1986

NSW EPA 1989, 'Chemical Control Order In Relation to Organotin Wastes' dated 11 March 1989

NSW EPA 1995, 'Contaminated Sites: Sampling Design Guidelines', dated September 1995, ref: EPA 95/59.

NSW EPA 2022, 'Sampling Design Part 1 – Application' dated August 2022.

NSW EPA 2022, 'Sampling Design Part 2 – Interpretation', dated August 2022.

NSW EPA 1997, 'Polychlorinated Biphenyl Chemical Control Order' dated 20 June 1997

NSW EPA 2000, 'Environmental Guidelines: Use and Disposal of Biosolids Products' dated December 2000, ref: EPA 97/62.

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NSW EPA 2014, 'Waste Classification Guidelines'

NSW EPA 2015, 'Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997' dated September 2015, ref: EPA 2015/0164.

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NSW EPA 2020b, 'Contaminated Land Guidelines: Consultants reporting on contaminated land' dated May 2020, ref: EPA2020P2233.

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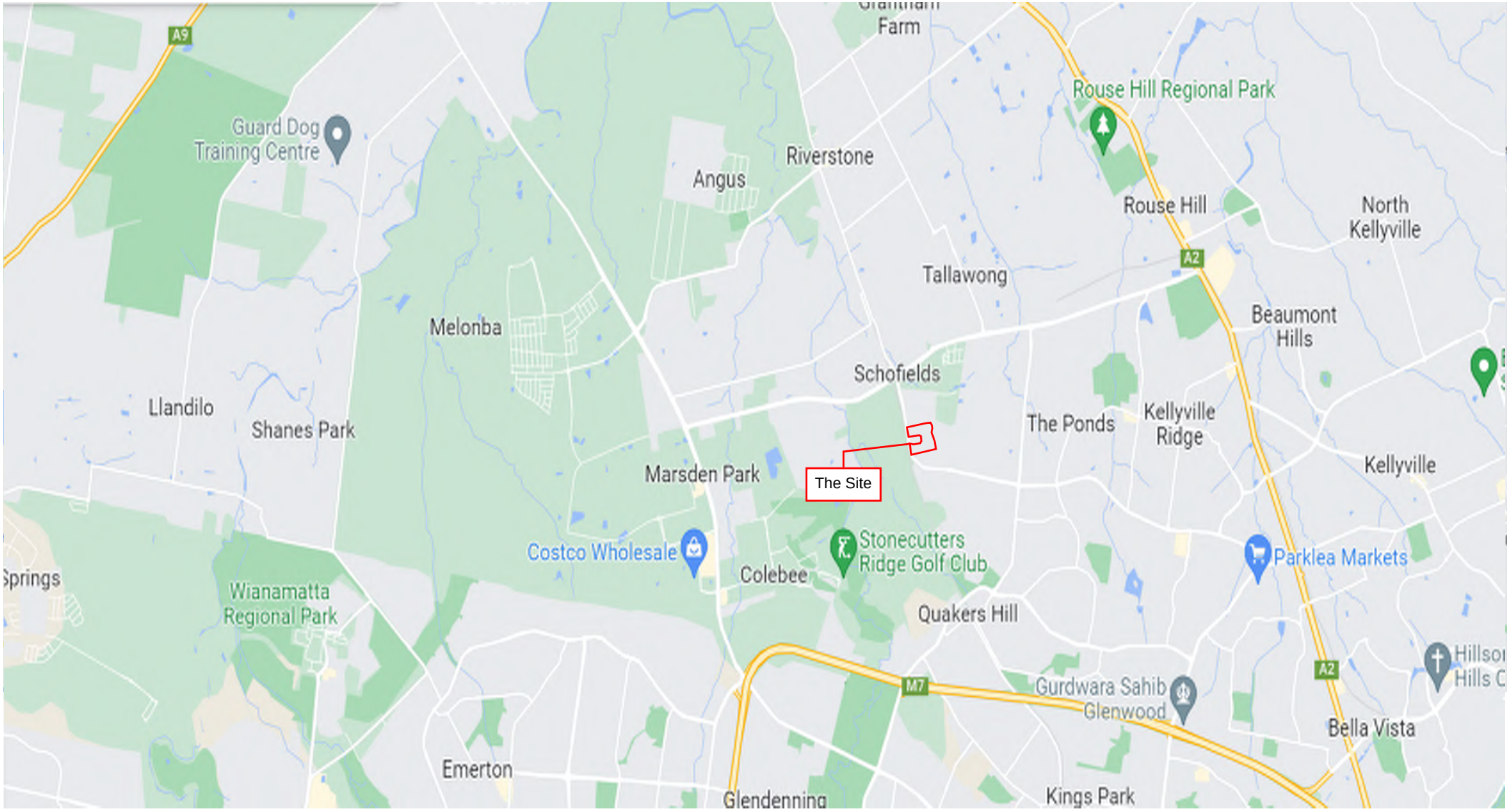
VIC EPA 2009 'Industrial Waste Resource Guidelines' dated June 2009, ref: IWRG702.

WA DOH 2009, 'Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia', dated May 2009.

FIGURES



LEGEND:

Approximate Site Boundary

N

Construction Sciences

2/4 Kellogg Road
ROOTY HILL NSW 2766
Tel: (02) 8646 2000
Fax: (02) 8646 2025
Web: www.constructionsciences.net

Scale: 0m 50m 100m	Client: Provincial Investments Pty Ltd
Date: 3 July 2022	Project: Remedial Action Plan
Drawn By: JN	Location: 249-271 Railway Terrace, Schofields NSW 2762
Drawing No: Figure 1	Sheet: 1 of 1 — Site Locality

LEGEND:

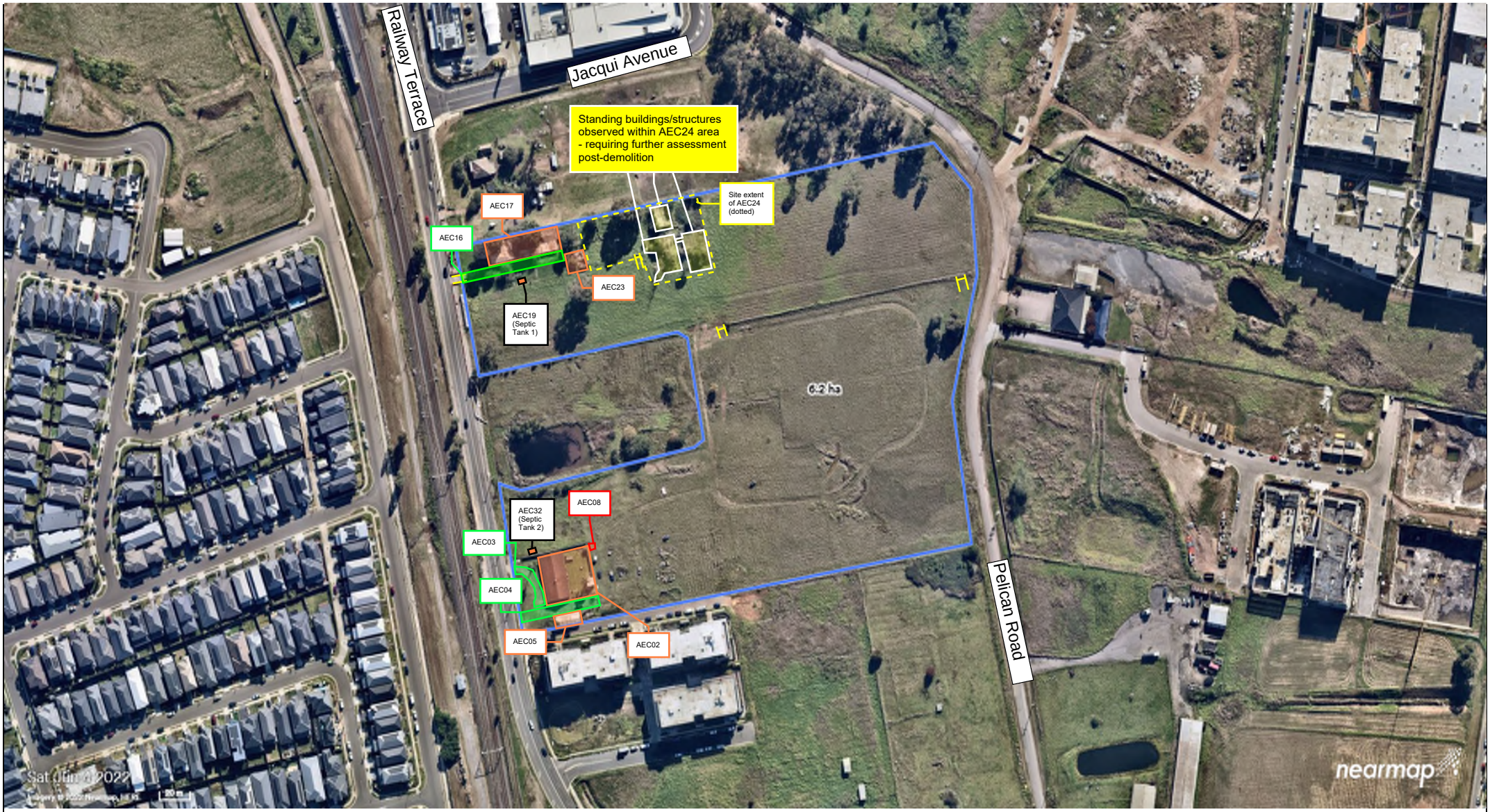
- Approximate Site Boundary
- Site Access Gates
- Onsite Buildings
- Onsite Driveways
- Dam

Construction Sciences

2/4 Kellogg Road
ROOTY HILL NSW 2766
Tel: (02) 8646 2000
Fax: (02) 8646 2025
Web: www.constructionsciences.net

Scale: 0m 50m 100m	Client: Provincial Investments Pty Ltd
Date: 15 July 2022	Project: Remedial Action Plan
Drawn By: JN	Location: 249-271 Railway Terrace, Schofields NSW 2762
Drawing No: Figure 2	Sheet: 1 of 1

Site Layout Plan



LEGEND:

- Approximate Site Boundary
- AEC's (Driveways, as data gaps)
- AEC's (Buildings, as data gaps)
- AEC's (Buildings within piggery area, as data gaps)

Construction Sciences

2/4 Kellogg Road
ROOTY HILL NSW 2766
Tel: (02) 8646 2000
Fax: (02) 8646 2025
Web: www.constructionsciences.net

Scale: 0m 50m 100m	Client: Provincial Investments Pty Ltd
Date: 12 October 2022	Project: Remedial Action Plan
Drawn By: JN	Location: 249-271 Railway Terrace, Schofields NSW 2762
Drawing No: Figure 3	Sheet: 1 of 1 — AEC Site Plan

LEGEND:

- Approximate Site Boundary
- Lateral remedial extent for offsite disposal (asbestos/chemical/pathogens)
- Lateral remedial extent for offsite disposal (aesthetics)

Construction Sciences

2/4 Kellogg Road
ROOTY HILL NSW 2766
Tel: (02) 8646 2000
Fax: (02) 8646 2025
Web: www.constructionsciences.net

Scale: 0m 50m 100m	Client: Provincial Investments Pty Ltd
Date: 6 October 2022	Project: Remedial Action Plan
Drawn By: JN	Location: 249-271 Railway Terrace, Schofields NSW 2762
Drawing No: Figure 4	Sheet: 1 of 1

Remedial Extent Plan

LEGEND:

- Approximate Site Boundary
- Test Pit (0.5m)
- Test Pit (1.0m)
- Approximate Building Extents

Construction Sciences

2/4 Kellogg Road
ROOTY HILL NSW 2766
Tel: (02) 8646 2000
Fax: (02) 8646 2025
Web: www.constructionsciences.net

Scale: 0m 50m 100m	Client: Provincial Investments Pty Ltd
Date: 04 October 2022	Project: Remedial Action Plan
Drawn By: JN	Location: 249-271 Railway Terrace, Schofields NSW 2762
Drawing No: Figure 5	Sheet: 1 of 1 — SCA Sampling Plan

Located across Australia and New Zealand

QLD
Airlie
Beenleigh
Brisbane (Acacia Ridge)
Brisbane (Beenleigh)
Brisbane (Brendale)
Brisbane (Petrie)
Cairns
Emerald
Gladstone
Gold Coast
Mackay
Moranbah
Rockhampton
Petrie
Sunshine Coast
Toowoomba
Townsville

NSW
Ballina
Coffs Harbour
Grafton
Lynwood
Newcastle
Sydney (Glendenning)
Sydney (St Peters)
Taree
Wollongong

VIC
Ararat
Bendigo
Echuca
Melbourne (Chadstone)
Melbourne (Keysborough)
Melbourne (Pakenham)
Melbourne (Oaklands Junction)
Melbourne (Sunshine West)
Traralgon

WA
Bunbury
Kalgoorlie
Newman
Perth
Port Hedland

SA
Adelaide
Port Augusta

NT
Darwin

ACT
Canberra

NZ
Wellington

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