Remedial Action Plan

Project

Proposed Commercial / Industrial Subdivision
290-308 Aldington Road and 59-63 Abbotts Road
Kemps Creek NSW

Prepared for

ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1

Date

2/05/2023

Report No

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Document Control

Revision	Date	Author	Technical Reviewer	Project Manager
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1	2/05/2023	S. Jones	C. Cowper	T. Park-Ross

Report 13546-ER-2-2_Rev1 dated 2 May 2023 reviewed
for and on behalf of Alliance Geotechnical Pty Ltd

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The findings presented in this report are based on specific data and information made available during the course of this project. To the best of Alliance's knowledge, these findings represent a reasonable interpretation of the general condition of the site at the time of report completion.

No warranties are made as to the information provided in this report. All conclusions and recommendations made in this report are of the professional opinions of personnel involved with the project and while normal checking of the accuracy of data has been conducted, any circumstances outside the scope of this report or which are not made known to personnel and which may impact on those opinions is not the responsibility of Alliance.

Logs, figures, and drawings are generated for this report based on individual Alliance consultant interpretations of nominated data, as well as observations made at the time fieldwork was undertaken.

Data and/or information presented in this report must not be redrawn for its inclusion in other reports, plans or documents, nor should that data and/or information be separated from this report in any way.

Should additional information that may impact on the findings of this report be encountered or site conditions change, Alliance reserves the right to review and amend this report.

Executive Summary

Alliance Geotechnical Pty Ltd (Alliance) was engaged by ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1 to prepare a remedial action plan (RAP) for 290-308 Aldington Road and 59-63 Abbotts Road Kemps Creek NSW (refer **Figure 1,** with the 'site' boundaries outlined in **Figure 2**).

At the commencement of the project, Alliance had the following project appreciation:

- The site is currently owned by ESR Investment Management 3 (Australia) Pty Ltd as trustee for ESR LVH Asset Trust ABN 46 808 844 248;
- Each lot was previously being used for residential purposes;
- The buildings at the site have been demolished and the site is currently vacant;
- The site is proposed for redevelopment, including demolition of current onsite structures and dewatering/removal of onsite dams, and a subdivision consisting of seven industrial warehouses with associated awnings and ground level carparks, as well as a detention basin in the south western of the site, with an arterial roadway separating the structures. It is understood that the majority of the site will be covered by structures & hardstand materials, with very limited landscaping and open space areas. In the context of NEPC (2013a), this is considered to be a land use scenario[1] comprising:
    - Commercial / industrial such as shops, offices, factories, and industrial sites.
- The proposed redevelopment of the site has been identified as state significant development (SSD), and that development consent is being sought from NSW Department of Planning (rather than Penrith City Council as was Alliance's understanding at the time the client's Services Agreement was executed);
- A preliminary site investigation (PSI) for 59-63 Abbotts Road was reported in Douglas Partners (2019). The PSI identified a number of potential land contamination risks at the site, and further assessment of those risks was recommended;
- A due diligence PSI with limited sampling for 290-308 Aldington Road was reported in Alliance (2019). The PSI concluded that the site was deemed unlikely to pose a significant contamination risk for future development;
- A detailed site investigation (DSI) of the site was reported in Alliance (2021b). The DSI identified a number of data gaps, which require assessment, and unacceptable land contamination risks at the site, which require management and/or remediation, in order for the site to be suitable for the proposed land use scenario;
- A remedial action plan (RAP) for the site was reported in Alliance (2022). The RAP included a sampling, analytical and quality plan (SAQP) for identified data gaps and remediation strategies for known contamination;
- A supplementary contamination assessment (SCA) of the site was reported in Alliance (2023). The SCA was undertaken with reference to the SAQP in the RAP (Alliance, 2022) to address data gaps and delineate areas of known unacceptable land contamination risks previously identified in the DSI (Alliance, 2021b); and

[1] Adopted from Section 2.2 of NEPC (2013a) and Section 3 of NEPC (2013f)

- This RAP (which is an amended version of Alliance (2022) is required to assist the client to address:
    - the identified unacceptable land contamination risks in Alliance (2021b) and Alliance (2023);
    - to address data gaps in Alliance (2023; and
    - development consent decision making processes set out in State Environmental Planning Policy (SEPP) Resilience and Hazards 2021[2] and the NSW Department of Planning.
- The client's preference at the completion of the remedial works set out in the RAP, is to not have a:
    - a covenant registered on the land title;
    - a notation on a planning certificate for the site; and
    - an environmental management plan (EMP) for the site.

The objective of this project was to prepare a remedial action plan (RAP) for the site that contains:

- a remediation objective for the site to facilitate making the site suitable for the proposed land use scenario;
- a methodology for supplementary contamination assessment (SCA) works to address the identified data gaps;
- a remediation and validation strategy that addresses the identified unacceptable land contamination risks at the site; and
- a conceptual remediation and validation strategy to address unacceptable land contamination risks at the site that could reasonably be identified during SCA works.

The following scope of works was undertaken address the project objectives:

- A desktop review of previous reports;
- A data gap analysis; and
- Data assessment and reporting.

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

The remediation objective is to remediate identified land contamination exposure risks to levels that do not present an unacceptable human health or ecological exposure risk, based on the proposed land use scenario for the site.

A preliminary conceptual inferred extent of remedial works that may be required to address the remedial objective (subject to the results of supplementary contamination assessment works), is set out in the table below.

[2] SEPP55 – Remediation of Land' was repealed on 1 March 2022

ID	AEC	Contamination Risk	Indicative Volume	Assumptions
AEC01a	Soil within vicinity of TP09	Bonded asbestos	10m^3	~80m^2, nominal depth of ~0.1m
AEC09b	Dam 5 Sediments (Lot 12 north)	Bonded asbestos	6m^3	~60m^2, nominal thickness of ~0.1m
AEC13	Commercial paint warehouse footprint curtilage (Lot 12 southern building)	Friable and bonded asbestos	60m³	~200m², nominal thickness of ~0.3m
AEC14	Gully between northern dams in Lot 12	Friable and bonded asbestos Aesthetics	2,090m^3	~950m^2, nominal thickness of ~2.2m
AEC16	Septic tank	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	5m^3	~3m^2, nominal thickness of 1.5m
AEC18	Construction material storage area near TP61 (north-west corner Lot 11)	Bonded asbestos	3m^3	~30m^2, nominal thickness of ~0.1m
AEC19a	North-west fill soils (Lot 11 north west)	Bonded asbestos	unknown	Unknown lateral extent, nominal thickness of ~0.3-4m thick
AEC21	Septic absorption pit (Lot 11 north-east of AEC23)	Bonded asbestos, aesthetics, and e. coli	100m³	~100m², nominal thickness of ~1m
AEC22	Septic tank	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, pathogens	5m^3	~3m^2, nominal thickness of 1.5m
AEC23	Former residential premises (Lot 11 west)	Bonded asbestos Aesthetics	unknown	Unknown lateral extent, nominal thickness of ~0.1m
AEC23a	ACM in wheelie bins (~~~2,500 m²~~ 3 wheelie bins containing ACM, Lot 11 west)	Bonded asbestos	750L	Three wheelie bins, approx. 250L each
AEC24a	Shallow filling(Lot 11 north-west of residence)	Friable asbestos	3m^3	~25m^2, nominal thickness of ~0.1m
AEC32	Area surrounding TP201 (Lot 13 north-east residence)	Bonded asbestos	8m³	~80m², nominal thickness of ~0.1m thick
AEC32a	Area surrounding TP207 (Lot 13 north-east residence)	Bonded asbestos	Unknown	Unknown lateral extent, nominated thickness of ~0.1m
AEC39	Septic tank	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	5m^3	~3m^2, nominal thickness of 1.5m

ID	AEC	Contamination Risk	Indicative Volume	Assumptions
Concrete stockpiles SP1 to SP10	Stockpiles of concrete	Aesthetics and potential for asbestos	200m^3	-
Concrete stockpiles SP11 to SP12	Stockpiles of concrete	Aesthetics and potential for asbestos	30m^3	-
Concrete stockpiles SP13 and SP14	Stockpiles of concrete	Aesthetics and potential for asbestos	7m^3	-
Concrete stockpiles SP15 and SP16	Stockpiles of concrete	Aesthetics and potential for asbestos	50m^3	-

It is noted that these inferred extents are based on a limited set of data that does not include soils underlying these AECs, and so plausible unacceptable contamination has been assumed. One or more of the extents may be subject to change, as a result of:

- Latent subsurface conditions;
- Temporal or seasonal fluctuations (particularly water content in dams / creeks / streams / ponds); and
- Supplementary contamination assessment works (as proposed in Section 8.3 of this RAP).

It is also noted that the results of the supplementary assessment may also require a change to the preferred management / remediation strategy, or even potentially remove the need for management / remediation. Should the inferred extents, preferred strategy or need for management / remediation change, based on supplementary assessment works, these changes would be presented in either an addendum to this RAP, or in the site remediation and validation report (SRVR) prepared at the completion of the site remedial works.

Based on the Alliance's understanding of the potential inferred extent of unacceptable land contamination risks to be addressed during the supplementary assessment, the proposed land use scenario for the site, and the client's preferred remedial outcomes for the site, and the results of the potential options assessment presented in **Section 10.2**, the conceptual preferred remedial options for the site are presented in the table below.

AEC	Potential Contamination Risk	Remedial Option and Method
AEC01a, AEC19a, & AEC32a	Bonded asbestos in fill soils >0.1m below surface	Onsite treatment to remove ACM
AEC09b, AEC18, AEC23, & AEC32	Bonded asbestos in surface soils ≤0.1m below surface	Onsite treatment to remove ACM
AEC13, AEC14, & AEC24a	Asbestos fines in surface and/or fill soils	Excavate soils and offsite disposal
AEC21	Bonded asbestos, aesthetics and e. coli	Excavate soils and offsite disposal
AEC16, AEC22 and AEC39	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	Excavate septic tank and absorption area and offsite disposal
AEC23a	Bonded asbestos	Offsite disposal
Concrete stockpiles (SP1 to SP16)	Aesthetics and potential for asbestos	Offsite disposal

It is also noted that the results of the supplementary assessment may also require a change to the preferred remedial options. Should this scenario arise, that change would be presented in either an addendum to this RAP, or in the site remediation and validation report (SRVR) prepared at the completion of the site remedial works.

Based on the assessment undertaken by Alliance of site history information, fieldwork observations and data, and laboratory analytical data, in the context of the proposed land use scenario and objectives of this project, Alliance considers that the remediation objective can be achieved and the site made suitable for the proposed land use scenario, subject to the:

- Implementation of the strategies, methodologies, plans and procedures set out in this remediation action plan, including those set out in the proposed supplementary contamination assessment works; and
- Preparation of a site remediation and validation report.

Specific assumptions that apply to the adopted land use scenario, are presented in **Section 6** of this report.

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

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1 Introduction

1.1 Background

Alliance Geotechnical Pty Ltd (Alliance) was engaged by ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1 to prepare a remedial action plan (RAP) for 290-308 Aldington Road and 59-63 Abbotts Road Kemps Creek NSW (refer **Figure 1,** with the 'site' boundaries outlined in **Figure 2**).

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[3] Adopted from Section 2.2 of NEPC (2013a) and Section 3 of NEPC (2013f)

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    - a covenant registered on the land title;
    - a notation on a planning certificate for the site; and
    - an environmental management plan (EMP) for the site.

1.2 Objectives

The objective of this project was to prepare a remedial action plan (RAP) for the site that contains:

- a remediation objective for the site to facilitate making the site suitable for the proposed land use scenario;
- a methodology for supplementary contamination assessment (SCA) works to address the identified data gaps;
- a remediation and validation strategy that addresses the identified unacceptable land contamination risks at the site; and
- a conceptual remediation and validation strategy to address unacceptable land contamination risks at the site that could reasonably be identified during SCA works.

1.3 Scope of Work

The following scope of works was undertaken address the project objectives:

- A desktop review of previous reports;
- A data gap analysis; and

[4] SEPP55 – Remediation of Land' was repealed on 1 March 2022

- Data assessment and reporting.

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

2 Site Identification

2.1 Site Details

Site identification details are presented in **Table 2.1**.

Table 2.1 Site Identification Details

Cadastral Identification	Lots 11, 12, & 13 in DP253503
Geographic Coordinates (Google Earth)	33.857311, 150.799091
Site Area	Approximately 32 ha
Local Government Authority	Penrith City Council
Current Zoning	IN1: General Industrial

2.2 Site Layout

The layout of the site is presented in **Figure 2**. The layout plan also includes locations on site of:

- Site access points;
- Demolished residential buildings and site features; and
- Existing lot boundaries and site boundaries.

3 Site Environmental Setting

3.1 Geology

The Department of Minerals and Energy Geological Survey of NSW Penrith 1:100,000 Geological Series Sheet 9030 (Edition 1) 1991, indicated that the site is likely to be underlain by Bringelly Shale, comprising shale, carbonaceous claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff.

3.2 Site Topography and Elevation

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

- the topography of the site is undulating with a significant overall east to west slope; and
- the surface of the site ranges in elevation from approximately 15m Australian Height Datum (AHD) in the west and 60m AHD in the east.

3.3 Acid Sulfate Soils

A review of https://www.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.

3.4 Hydrogeology and Hydrology

A review of Nearmap, indicated that surface water bodies located on or near the site included:

- Kemps Creek, located approximately 800 m to the south-west of the site.

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

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

A search of https://www.environment.nsw.gov.au/eSpade2WebApp was undertaken by Alliance and information considered relevant and related to the hydrogeological landscape for the locality of the site is presented in **Table 3.4**.

Table 3.4 Site Locality Hydrogeological Landscape

Aquifer Types	Unconfined in unconsolidated alluvial sediments Unconfined to semi-confined in fractured rock along structures Vertical and lateral flow components Local perching above clay-rich layers (seasonal)
Hydraulic Conductivity	Moderate Range: 10^{-2}m – 10m per day

Aquifer Transmissivity	Low to moderate Range: <2-20^{-2} m per day
Specific Yield	Moderate Range: 5-15%
Hydraulic Gradient	Gentle to intermediate Range: <10–30%
Groundwater Salinity	Marginal Range: 0.8–1.6 dS/m
Depth to Water Table	Intermediate Range: 2 – 6 m

A search of https://realtimedata.waternsw.com.au/water.stm reported in Alliance (2021b) indicated that there are no registered groundwater features located within a 500m radius of the site.

4 Previous Contamination Assessments and Results

A copy of:

- Douglas Partners 2019, 'Preliminary Environmental Site Investigation with Limited Intrusive Investigation, 59 – 63 Abbotts Road, Kemps Creek, NSW' dated 08 August 2019, ref: 92352.00.
- Alliance Geotechnical 2019, 'Stage 1 Preliminary Site Investigation (with Limited Sampling), 290-308 Aldington Road, Kemps Creek NSW' dated 18 October 2019, ref: 9687-ER-1-1.
- Alliance 2021a, 'Hazardous Building Materials (HAZMAT) Report, 290-308 Aldington Road, 59 – 63 Abbotts Road, Kemps Creek, NSW', ref: 13546-ER-1-1 Rev 1.
- Alliance 2021b, 'Detailed Site Investigation, 290-308 Aldington Road, Kemps Creek NSW' dated 17 December 2021, ref: 13546-ER-2-1.
- Alliance 2023, 'Supplementary Contamination Assessment Report', 290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW, dated 20 April 2023, ref: 13546-ER-2-3.

was provided to Alliance for review.

4.1.1 Douglas Partners (2019)

The objectives of Douglas Partners (2019) were to:

- Review available current and historical site information to identify key past or present potential contaminating activities: and
- To provide a preliminary assessment of the contamination status of the site with respect to the proposed development.

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

- Review of local topographic, soil, geological, salinity and acid sulfate soils mapping;
- Search of the NSW EPA Land Information records for any statutory notices or licences current on any parts of the site or nearby surrounds under the Contaminated Land Management Act 1997 and the Protection of the Environment Operations Act 1997 of relevance to the site;
- Search for groundwater bores on or adjacent to the site registered with the NSW Office of Water;
- Review of historical aerial photographs and Nearmap aerial imagery to identify past/present land uses and potential areas of environmental concern (PAEC);
- Review of current title deeds;
- Review of available council records;
- Undertake a site walkover and mapping of PAEC;
- Sampling of 21 test pits targeting PAEC and the general site area. Two surface samples adjacent to power poles were also collected, using hand tools. Two bore holes were also completed as part of the geotechnical investigation and reported under separate cover. Select soil samples were analyses for a range of potential contaminants and assessed against relevant NEPC (2013) guideline values;
- Preparation of a preliminary conceptual site model (CSM); and

- Preparation of a PSI report outlining the methodology and findings of the investigation, and an assessment of potential contamination at the site.

Based on the observations made during the site walkover and information obtained during the interviews, Douglas Partners (2019) made the following conclusions and recommendations:

- Localised filling impacted with metals and asbestos was recorded in the western portion of Lot 11 and filling impacted with asbestos in a gully on Lot 12 which will require further investigation and/or remediation prior to bulk earthworks. Notwithstanding the observed localised impact, based on the findings of this PSI, DP concludes that the potential for the presence of significant contamination constraints at the site with respect to the proposed industrial subdivision is considered to be generally low.
- DP recommends that an intrusive investigation in the form of a Detailed Site Investigation (DSI) including delineation of metal and asbestos impact observed in this investigation is undertaken prior to bulk earthworks to ascertain whether or not each identified PAEC require further management and/or remediation prior to commencement of the development.
- A hazardous building materials survey should be conducted for structures at the site prior to demolition. Demolition of structures containing hazardous building materials should be carried out by a licenced asbestos removal contractor (if required). After removal of existing structures, an inspection of the footprint should be conducted and (if considered to be required based on inspection) targeted soil sampling and analysis conducted to confirm the contamination status of the footprint.
- Inert materials observed during the walkover associated with fly tipping are assumed to be surficial and therefore can be removed by earthworks contractors prior to the commencement of bulk earthworks.
- A Remediation Action Plan (RAP) should be prepared by a suitably qualified environmental consultant to document how remediation and validation works will be carried out. If remediation is required, subsequent remediation and validation of any identified contamination (if any) should be carried out with reference to the RAP and the findings documented in a Validation Report. It is considered that the site could be rendered suitable for the proposed industrial subdivision, subject to further investigation and remediation, as required.

4.1.2 Alliance Geotechnical (2019)

The objectives of Alliance Geotechnical (2019) were to:

- Assess the potential for contamination to be present on the site as a result of past and current land use activities;
- Provide advice on whether the site would be suitable (in the context of land contamination) for the proposed land use setting;
- Provide advice on salinity hazards and risks for the site; and
- Provide recommendations for further investigation, management and/or remediation (if warranted).

The scope of works undertaken to address the investigation objectives, included:

- A desktop review of relevant information pertaining to the site;
- A site walkover to understand current site conditions;

- The preparation of a sampling and analysis quality plan (SAQP);
- Conduct a targeted intrusive site investigation to establish ground conditions and to facilitate the collection of representative soil samples;
- Laboratory analysis of selected samples collected during the field investigation; and
- An assessment of the contamination status of the site and the recommendation of any further remedial requirements associated with the redevelopment of the site (if necessary).

Based on Alliance's assessment of the desktop review information, fieldwork data and laboratory analytical data, in the context of the proposed redevelopment scenario, Alliance made the following conclusions:

- The detected concentrations of identified contaminants of potential concern in the soils assessed are considered unlikely to present an unacceptable human health or ecological risk;
- The detected concentrations of nutrients in the soils assessed are considered to be similarly low across the site;
- Soils assessed onsite (up to a depth of 1.0m below ground surface) are considered to be:
    - non-saline to very saline;
    - non-aggressive to concrete piles;
    - non-aggressive to steel piles; and
    - non-sodic to sodic.
- The soil materials were considered suitable for the proposed land use setting; and
- The site was deemed unlikely to pose a significant contamination risk to for future development.

Based on the above conclusions, Alliance made the following recommendations:

- The soil materials are considered suitable for the proposed land use (in the context of contamination), no further investigation, management and/or remediation is deemed warranted.

A copy of the sampling point layout plan, logs, and laboratory summary tables from Alliance Geotechnical (2019), is presented in Appendix E.

4.1.3 Alliance Geotechnical (2021a)

The objectives of Alliance (2021) were to:

- Identify hazardous building materials within the accessible areas of the structures(s);
- Detail the survey methodology;
- Provide a qualitative risk assessment of the identified hazardous materials an provide information regarding health risks;
- Provide recommendations for control measures and management strategies;
- Prepare a hazardous materials register for the site to ensure legislative compliance;
- Outline the responsible persons and details those persons responsibilities in relation to managing on site asbestos containing materials (ACM)
- Detail the principles of hazardous materials management;

- Detail the management strategies for in-situ asbestos and other hazardous materials;
- Provide information about safe working practices for work involving asbestos and other hazardous materials;
- Detail the requirements for removal of ACM
- Provide a template for emergency response procedures; and
- Outline asbestos training and awareness.

The scope of works undertaken to address the investigation objectives, included:

- Development of a task specific safe work method Statement (SMMS);
- Walkthrough inspection of the site building(s);
- Risk assessment and identification of all visible and accessible hazardous materials including asbestos, lead, ODS, and SMF;
- Sampling and laboratory analysis of suspect materials where necessary/possible;
- Preparation of a hazardous materials register and management plan in accordance with all relevant legislatures.

Summary of Assessment
Location: 59-62 Abbotts Rd (Lot 12)

1 x Residential Dwelling, 3 x Sheds, 1 x Swimming Pool *(External inspections conducted to occupied structures)*

- Asbestos Containing Materials (ACM)
    - At the time of inspection, ACM was identified within externally accessible building areas.
- Lead Based Paint (LBP)
    - At the time of inspection, No LBP was identified within accessible building areas.
- Lead Containing Dust (LCD)
    - At the time of inspection, No LCD was identified within accessible building areas.
- Polychlorinated Biphenyls (PCBs)
    - At the time of inspection, fluorescent light fittings were observed which may contain PCBs.
- Synthetic Mineral Fibres (SMF)
    - At the time of inspection, SMF was identified within externally accessible building areas.
- Ozone Depleting Substances (ODSs)
    - At the time of inspection, No ODS were identified within accessible building areas.
- Hazardous Chemicals
- At the time of the inspection, hazardous chemicals were identified within accessible building areas.

Location: 63 Abbotts Road (Lot 11)

1 x Residential Dwelling, 4 x Sheds *(External inspections conducted to occupied structures)*

- Asbestos Containing Materials (ACM)
    - At the time of inspection, ACM was identified within externally accessible building areas.

- Lead Based Paint (LBP)
    - At the time of inspection, No LBP was identified within accessible building areas.
- Lead Containing Dust (LCD)
    - At the time of inspection, No LCD was identified within accessible building areas.
- Polychlorinated Biphenyls (PCBs)
    - At the time of inspection, No PCB was identified within accessible building areas.
- Synthetic Mineral Fibres (SMF)
    - At the time of inspection, SMF was identified within externally accessible building areas.
- Ozone Depleting Substances (ODSs)
    - At the time of inspection, No ODS was identified within accessible building areas.

Location: 290-308 Aldington Road (Lot 13)

2 x Residential Dwelling, 5 x Sheds, 4 GHG Structures *(External inspections conducted to occupied structures)*

- Asbestos Containing Materials (ACM)
    - At the time of inspection, ACM was identified within accessible building areas.
- Lead Based Paint (LBP)
    - At the time of inspection, LBP was identified within accessible building areas.
- Lead Containing Dust (LCD)
    - At the time of inspection, No LCD was identified within accessible building areas.
- Polychlorinated Biphenyls (PCBs)
    - At the time of inspection, fluorescent light fittings were observed which may contain PCBs.
- Synthetic Mineral Fibres (SMF)
    - At the time of inspection, SMF was identified within accessible building areas.
- Ozone Depleting Substances (ODSs)
    - At the time of inspection, No ODS were identified within accessible building areas.

Summary of Assessment

Due to the public health rules and guidelines in place at the time this survey was undertaken, which did not allow access into resident occupied buildings and structures, a general assumption of the location of possible incidents of hazardous building materials was made.

These assumptions were made based on but not limited to the following:

- Age of building/structure
- Incidences of hazardous materials on the external structure implies potential incidences on the internal structure

The general assumption of the location of hazardous materials within the internal structure of the buildings are:

- 4 x residential dwellings

- Asbestos – wall linings to wet areas (bathrooms, toilets, kitchens, laundry rooms, sauna rooms), floor tiles, ceilings, storerooms
- Lead based paint – paint system to walls (where flaking mostly)
- Lead contained dust – roof/ceiling voids, underground voids etc
- PCBs – light fittings throughout building
- SMF – roof insulation, wall lining insulations, pipe insulations etc.

4.1.4 Alliance Geotechnical (2021b)

The objectives of Alliance (2021b) were to:

- Assess the potential for land contamination to be present in the areas of environmental concern (AEC) identified in the preliminary site investigations prepared for the site;
- Assess whether identified potential land contamination would present an unacceptable human health or ecological exposure risk, based on the proposed land use scenario;
- Assess whether the site is suitable, in the context of land contamination, for the proposed land use scenario;
- Make a preliminary assessment of concentrations of contaminants (considered to be relevant to the site) to be present within the dam water and sediments (for the purpose of informing dam decommissioning procedures to be prepared by others); and
- Provide recommendations for further investigations, and management or remediation of land contamination (if warranted).

The following scope of works was undertaken address the project objectives:

- A desktop review of previous reports;
- Preparation of a sampling and analysis quality plan;
- Intrusive investigations on site;
- Laboratory analysis; and
- Assessment of data and reporting.

Multiple areas of environmental concern (AEC) and contaminants of potential concern (COPC) associated with potential land contaminating activities undertaken at the site, have been identified as part of this project. The AEC, land contaminating activity and COPC are presented in the **Table 4.1.4** below.

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC01a	Western poultry farming area, 3 sheds (~1.2 hectares, ~0.5m in depth)	Poultry waste, hazardous buildings materials, shallow uncontrolled filling, termite and poultry parasite pesticides	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, pathogens, metals, & asbestos.
AEC01b	Eastern poultry farming area, 1 shed on fill pad (~4,500m^2, ~3.0m to ~0.5m in depth)	Poultry waste, hazardous buildings materials, uncontrolled filling, termite and poultry parasite pesticides	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, pathogens, metals, & asbestos.
AEC02	Aboveground fuel storage tank labelled as liquid petroleum gas (Lot 13 between poultry sheds, ~5,000L)	Fuel spills/leaks	Petroleum hydrocarbons, BTEX, PAH, lead
AEC03a	Dam 1 Wall (Lot 13 west, ~50m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC03b	Dam 1 Sediments (Lot 13 west, ~180m^2, ~0.1m in thickness)	Poultry shed wastes	Organochlorine pesticides, metals, & asbestos, pathogens
AEC03c	Dam 1 Surface Water (Lot 13 west, ~180m^2, ~0.5m in depth)	Effluent from poultry sheds.	Pesticides, pathogens, nutrients, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC04a	Dam 2 Wall (Lot 13 north, ~150m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC04b	Dam 2 Sediments (Lot 13 north, ~900m^2, ~0.1m in thickness)	Waste disposal, poultry shed wastes.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC04c	Dam 2 Surface Water (Lot 13 north, ~900m^2, ~1.5m in depth)	Waste disposal and effluent from poultry sheds.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC05a	Dam 3 Wall (Lot 13 east, ~25m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC05b	Dam 3 Sediments (Lot 13 east, ~90m^2, ~0.1m in thickness)	waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC05c	Dam 3 Surface Water (Lot 13 east, ~90m^2, ~0.5m in depth)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC06	Stockpile (~50 m^3, near east dam in Lot 13)	Uncontrolled dumping or stockpiling of poultry manure	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, pathogens, nutrients & asbestos.
AEC07	Fill material (~200m^2, ~0.5m in thickness, south of eastern poultry shed in Lot 13)	Uncontrolled soil filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, , BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC08a	Dam 4 Wall (Lot 12 west, ~250m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC08b	Dam 4 Sediments (Lot 12 west, ~2,800m^2, ~0.1m in thickness)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC08c	Dam 4 Surface Water (Lot 12 west, ~2,800m^2, ~2.0m in depth)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC09a	Dam 5 Wall (Lot 12 north, ~70m^2, ~2m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC09b	Dam 5 Sediments (Lot 12 north, ~300m^2, ~0.1m in thickness)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC09c	Dam 5 Surface Water (Lot 12 north, ~300m^2, ~1.0m in depth)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC10a	Dam 6 Wall (Lot 12 south, ~100m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC10b	Dam 6 Sediments (Lot 12 south, ~700m^2, ~0.1m in thickness)	Waste disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC10c	Dam 6 Surface Water (Lot 12 south, ~700m^2, ~1.0m in depth)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC11a	Dam 7 Wall (Lot 12 south east, ~40m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC11b	Dam 7 Sediments (Lot 12 south east, ~190m^2, ~0.1m in thickness)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC12	Fill material (~50 m², ~0.5m in thickness, west of Lot 12 south structure)	Uncontrolled soil filling/	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC13	Commercial paint warehouse (~2,000m², central southern portion of Lot 12)	Hazardous buildings materials, chemical and fuel storage/spills/leaks	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, VOC, BTEX, polychlorinated biphenyl, metals, & asbestos
AEC14	Gully between northern dams in Lot 12 (~500m², ~0.5m in thickness)	Uncontrolled soil filling/	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, , BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC15	Residential premises (~3,000 m² Lot 12 east)	hazardous buildings materials, termite treatment	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, , BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC16	Septic tank (~3m^2, ~1.5m deep, Lot 12 east property)	Domestic effluent disposal	Pathogens, petroleum hydrocarbons and metals

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC17	Stockpile (~5 m³, north-west corner Lot 11)	Uncontrolled soil dumping	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, , BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC18	Construction material storage area, including metal sheeting, piping and lumber (~1,000 m², north-west corner Lot 11)	Deterioration of exposed ageing materials, heavy vehicle use.	Petroleum hydrocarbons, BTEX, metals, asbestos.
AEC19a	Dam 8 Wall (Lot 11 north west smaller dam, ~40m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC19b	Dam 8 Sediments (Lot 11 north west smaller dam, ~120m^2, ~0.1m in thickness)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC19c	Dam 8 Surface Water (Lot 11 north west smaller dam, ~120m^2, ~0.5m in depth)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC20a	Dam 9 Wall (Lot 11 north west larger dam, ~100m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC20b	Dam 9 Sediments (Lot 11 north west larger dam, ~600m^2, ~0.1m in thickness)	Waste disposal.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC20c	Dam 9 Surface Water (Lot 11 north west larger dam, ~600m^2, ~0.5m in depth)	Waste disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC21	Stockpile (~50 m³, north-west Lot 11, south of AEC18)	Uncontrolled soil dumping	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, & asbestos.

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC22	Septic tank (~3m^2, ~1.5m deep, Lot 11 north of residence)	Domestic effluent disposal	Pathogens, petroleum hydrocarbons and metals
AEC23	Residential premises (~2,500 m² Lot 11 west)	hazardous buildings materials, termite treatment	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, , BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC24	Aboveground fuel storage tank unlabelled, likely diesel petroleum ~5,000L (Lot 11 north-west of residence)	Fuel spills/leaks	Petroleum hydrocarbons, BTEX, PAH, lead
AEC25	Storage shed (~40 m², centre-west Lot 11)	hazardous buildings materials, chemical and fuel storage/spills/leaks, termite treatment	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC26	Market Gardens (~5.2ha, ~0.5m in thickness, Central portion of Lot 11)	Application of pesticides	organochlorine pesticides, metals.
AEC27	Storage shed (~40 m², centre-east Lot 11)	hazardous buildings materials, termite treatment, chemical/fuel leaks and spills	Petroleum hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC028	Storage shed (~15 m², centre-south Lot 11)	hazardous buildings materials, termite treatment, chemical/fuel leaks and spills	Petroleum hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, & asbestos.
AEC29a	Dam 10 Wall (Lot 11 south east larger dam, ~220m^2, ~1m in height)	Potential uncontrolled filling.	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC29b	Dam 10 Sediments (Lot 11 south east larger dam, ~2600m^2, ~0.1m in thickness)	Waste disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC29c	Dam 10 Surface Water (Lot 11 south east larger dam, ~2600m^2, ~2.0m in depth)	Waste disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC30a	Dam 11 Wall (Lot 11 south east smaller dam, ~200m^2, ~1m in thickness)	Potential uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, & asbestos
AEC30b	Dam 11 Sediments (Lot 11 south east smaller dam, ~1,300m^2, ~2.0m in depth)	Waste disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, heavy metals, & asbestos
AEC30c	Dam 11 Surface Water (Lot 11 south east larger dam, ~2600m^2, ~2.0m in depth)	Waste disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, metals, temperature, turbidity, dissolved oxygen, biological oxygen demand
AEC31	Power poles (12 poles across Lot 11 and 12)	Copper chrome arsenate treatment	Arsenic, chromium, copper
AEC32	Residential premises (<2,000 m² Lot 13 north – not within scope)	Deterioration of hazardous buildings materials, application of pesticides	Organochlorine pesticides, polychlorinated biphenyl, metals, & asbestos.
AEC33	Residential premises (<2,000 m² Lot 13 west – not within scope)	Deterioration of hazardous buildings materials, application of pesticides	Organochlorine pesticides, polychlorinated biphenyl, metals, & asbestos.
AEC34	Concrete driveway along the northern boundary to residential dwelling within Lot 13 (~100m in length)	Potential uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, BTEX, heavy metals, & asbestos
AEC35	Asphalt and gravel driveway leading to the commercial paint shed and residential dwelling within Lot 12 (~360m in length)	Potential uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, BTEX, heavy metals, & asbestos
AEC36	Gravel driveway leading to the residential dwelling within Lot 11 (~130m in length)	Potential uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, BTEX, heavy metals, & asbestos

Table 4.1.4 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC37	Gravel driveway leading to the eastern residential dwelling and poultry sheds within Lot 13 (~750m in length)	Potential uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, BTEX, heavy metals, & asbestos

Based on the assessment undertaken by Alliance of site history information, fieldwork observations and data, and laboratory analytical data, in the context of the proposed land use scenario and objectives of this project, Alliance made the following conclusions:

- Detected concentrations of friable asbestos in soil present an unacceptable human health risk at TP70, and ASB12;
- Detected concentrations of bonded asbestos in soil present an unacceptable human health risk at TP09, TP51, ASB12, and DW23;
- Field observations and laboratory analysis warrant further assessment for aesthetics risks at the location of AEC14 (demolition waste, asbestos, and tyres), AEC09 (demolition waste and asbestos), AEC22 (asbestos and potential septic system), and AEC18 (surficial asbestos near TP61).
- Potential contamination risks in AEC13, AEC15, AEC16, AEC22, AEC23, AEC32, AEC33, and AEC34 have not yet been assessed. The presence of existing hardstands is constraining adequate access to assess underlying soils. This is a data gap that needs addressing in order to draw conclusions regarding site suitability in the context of land contamination;
- In the context of preparing a dam dewatering procedure for the site, in addition to information on the proposed disposal methods, the dam water data would need to be supplemented with further assessment of likely receptors during dewatering, in order to potentially derive less conservative assessment criteria, based on a preferred dam water disposal method, some additional dam water sampling and analysis to support the preliminary data obtained, that is consistent with site specific criteria
- The site is not yet considered to be suitable for the following land use scenario:
    - Commercial / industrial such as shops, offices, factories, and industrial sites.
- Specific assumptions that apply to the adopted land use scenario, are presented in Section 6 of this report.
- Further assessment, management, and remedial planning works for the identified unacceptable exposure risks is required.

Based on those conclusions, Alliance makes the following recommendations:

- An interim management plan should be implemented to mitigate potential human health exposure risks to asbestos in AEC14, TP70, TP09, and DW23. As some of those activities may result in disturbance of soils impacted with asbestos, a class A licensed asbestos contractor should undertake the recommended works where necessary. Prior to entry, site workers and other personnel on site should be made aware of the areas impacted with friable and bonded asbestos, and the controls in place to mitigate risk of exposure to human health;

- A supplementary contamination assessment should be undertaken to address the data gaps associated with AEC13, AEC15, AEC16, AEC22, AEC23, AEC32, AEC33, and AEC34, as well as assessing the extent of identified unacceptable risks onsite, to inform future remedial works. The supplementary contamination assessment should be undertaken following controlled demolition and removal of the structures and pavements.
- The recommended data gap assessment should also address the extent of asbestos contamination at AEC14, TP09, TP61, DS13, TP71, and TP141, as well as the aesthetics risk observed within AEC14, TP141 and TP142 (AEC21) and DS13 (AEC09);
- A remedial action plan (RAP) should be prepared to address the identified unacceptable human health exposure risks upon completion and consideration of the aforementioned data gap assessment; and
- Further assessment, management or remedial planning works for the site, be undertaken by a suitably experienced environmental consultant.

4.1.5 Alliance Geotechnical (2023)

The objectives of this project were to:

- Assess the potential for land contamination to be present in AEC13, AEC15, AEC16, AEC21, AEC22, AEC23, AEC32, AEC33, and AEC34;
- Assess whether identified potential land contamination in AEC13, AEC15, AEC16, AEC21, AEC22, AEC23, AEC32, AEC33, and AEC34 would present an unacceptable human health exposure risk;
- Assess the likely lateral and vertical extent of contamination in AEC01a, AEC09, AEC14, AEC18, AEC21, and AEC24a; and
- Provide recommendations for further investigations, and management or remediation of land contamination (if warranted).

The following scope of works was undertaken address the project objectives:

- A desktop review of previous reports;
- Preparation of a sampling and analysis quality plan;
- Intrusive investigations on site;
- Laboratory analysis; and
- Assessment of data and reporting.

A number of areas of environmental concern (AEC) and contaminants of potential concern (COPC) associated with potential land contaminating activities undertaken at the site, have been identified as part of this project. The AEC, land contaminating activity and COPC are presented in the **Table 4.1.5**.

Table 4.1.5 AEC and COPC in Alliance Geotechnical (2021b)

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC01a	Surface soil within vicinity of TP09	Uncontrolled filling	Bonded asbestos

ID	AEC	Land Contaminating Activity (Source)	COPC
	(~80m², ~0.1m thick).		
AEC09b	Dam 5 Sediments (Lot 12 north, ~~300m², ~0.1m~~ ~60m², ~0.1m thick)	Waste disposal.	Bonded asbestos
AEC13	Commercial paint warehouse fill (~~~2,000m², 200m², ~0.3 m thick fill)	Hazardous buildings materials and demolition Termite treatment chemical and fuel storage/spills/leaks	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, BTEX, polychlorinated biphenyl, metals, VOCs & friable and bonded asbestos
AEC14	Gully between northern dams in Lot 12 (~950m², ~2.2m thick)	Uncontrolled filling	Friable & bonded asbestos
AEC15	Residential premises (~150m³, Lot 12 east)	Hazardous buildings materials, termite treatment Demolition	polychlorinated biphenyl Pesticides, heavy metals, and asbestos
AEC16	Septic tank (~3m², ~1.5m deep, Lot 12 east property)	Domestic effluent disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens
AEC18	Construction material storage area, including metal sheeting, piping and lumber (~~~1,000 m² ~30m², ~0.1m thick, north-west corner Lot 11)	Uncontrolled filling	Bonded asbestos
AEC19a	Dam 8 Wall and Lot 11 north west fill soils (~3,200m², ~4m thick).	Uncontrolled filling	Bonded asbestos

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC21	Septic absorption pit (~100m² ~1m thick, north-east of AEC23)	Uncontrolled soil dumping Septic discharge Uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, OCP, BTEX, heavy metals, & asbestos and pathogens
AEC22	Septic tank (~3m^2, ~1.5m deep, Lot 11 north of residence)	Domestic effluent disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, pathogens
AEC23	Residential premises (~~~2,500 m²~~ lateral extent unknown, ~0.1m depth, Lot 11 west)	Hazardous buildings materials deterioration and demolition, termite treatment	Organochlorine pesticides, polychlorinated biphenyl, metals, and bonded asbestos
AEC23a	ACM in wheelie bins (~~~2,500 m²~~ 3 wheelie bins containing ACM, Lot 11 west)	Hazardous buildings materials deterioration and demolition, termite treatment	Organochlorine pesticides, polychlorinated biphenyl, metals, and bonded asbestos
AEC24a	Shallow filling (~25m², ~0.1 m thick) Lot 11 north-west of residence)	Shallow uncontrolled filling	Friable asbestos
AEC32	Residential premises (~~<2,000 m²~~ ~80m² at TP201, ~0.1m thick, Lot 13 north)	Deterioration of hazardous buildings materials, application of pesticides Demolition of hazardous building materials	Organochlorine pesticides, polychlorinated biphenyl, metals, & bonded asbestos
AEC32a	Residential premises (lateral extent unknown, ~0.1m thick)	Deterioration of hazardous buildings materials, application of pesticides Demolition of hazardous building materials	Organochlorine pesticides, polychlorinated biphenyl, metals, & bonded asbestos
AEC33	Residential premises (<2,000 m), Lot 13 west)	Deterioration of hazardous buildings materials, application of pesticides Demolition	Organochlorine pesticides, polychlorinated biphenyl, metals, & asbestos.

ID	AEC	Land Contaminating Activity (Source)	COPC
AEC34	Concrete driveway along the northern boundary to residential dwelling within Lot 13 ~~(~100m in length, ~0.4m thick fill)~~	Potential uncontrolled filling Demolition	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, BTEX, heavy metals, & asbestos
AEC38	Poultry sheds (~8,200m^2)	Demolition	-
AEC39	Septic tank (~3m^2, ~1.5m deep, Lot 13 north-east property)	Domestic effluent disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens
Concrete stockpiles (SP1 to SP16)	Stockpiles of concrete observed at various locations	Demolition	Asbestos

Note: Strikethroughs are initial dimensions, COPC, and exposure pathways that have since been investigated and revised.

Based on the assessment undertaken by Alliance of site history information, fieldwork observations, data, and laboratory analytical data, in the context of the proposed land use scenario and objectives of this project, Alliance made the following conclusions:

- Detected concentrations of bonded asbestos in AEC01a, AEC09b, AEC13, AEC14, AEC18, AEC19a, AEC21, AEC23, AEC23a, AEC24a, AEC32 and AEC32a may present an unacceptable human health risk;
- Detected concentrations of friable asbestos in AEC13, AEC14, and AEC24a may present an unacceptable human health risk;
- Detected concentrations of E.coli and buried demolition waste within AEC21 may present an unacceptable human health and aesthetic risk, respectively;
- Septic systems at AEC16, AEC21, AEC22 and AEC39 may present unacceptable aesthetic risks;
- Stockpiled concrete on the site may present an unacceptable aesthetics risk and have not been subject to intrusive investigations;
- Surficial and buried tyres, as well as a demolition waste stockpile within AEC14 may present an unacceptable aesthetics risk;
- The extent of soils requiring management and/or remediation is shown in **Figure 4A** to **4G** and presented in **Table 6.6.1**;

- The extent of bonded asbestos in soil at AEC19a and AEC23 is uncertain and requires further assessment;
- Visual assessment for surficial ACM could not be completed due to overgrown vegetation at AEC13, AEC14, AEC15, AEC23, AEC18, AEC19a, AEC21, AEC23, AEC24a, AEC32, AEC33, AEC34 and AEC38;
- The western portion of AEC15 beneath the former residence requires further assessment as conformance with published guidance on sampling point pattern and density was not able to be achieved, for the purpose of making human health related land contamination status decisions;
- The site is not yet considered to be suitable for the following land use scenario:
    - Commercial / industrial such as shops, offices, factories and industrial sites.
- Management or remedial planning works for the identified unacceptable exposure risks is required.

Based on those conclusions, Alliance made the following recommendations:

- An interim management plan (IMP) for identified asbestos in soils risks, should be prepared that outlines mitigation measures to be implemented onsite to adequately manage the identified asbestos risks onsite, prior to further assessment, management or remediation of the site;
- The remedial action plan (RAP) should be amended to:
    - incorporate the findings of this SCA;
    - provide a methodology to address data gaps identified in this SCA,
    - address unacceptable land contamination risks identified for the site, as well as to address risks that may arise during the addressing of the identified data gaps;
- A site remediation and validation report (SRVR) should be prepared following implementation of the RAP, to demonstrated whether the site has been made suitable for the proposed land use scenario; and
- Remedial planning and validation work for the site, should be undertaken by a suitably experienced environmental consultant.

5 Results and Site Characterisation

The results of the previous assessments (refer **Section 4**) have been reviewed. Characterisation of site contamination risks, in a tabular and plan format, is discussed below.

A plan showing the location of historical sampling point locations at the site, is presented in **Figure 3A to Figure 3K**.

Sample descriptions of the media assessed on the site, including soil, sediment, and surface water, are presented in copies of logs and field sampling records presented in **Appendix A**.

A copy of tabulated results from previous contamination assessments that include:

- sample identification numbers and sampling depths;
- adopted contamination assessment criteria;
- highlighted results that exceeded those adopted criteria,

is presented in **Appendix B**.

A plan showing the locations, vertical and lateral extent of soil contaminant concentrations that exceeded the adopted contamination assessment criteria, is presented in **Figure 4A** to **Figure 4G**.

Alliance notes that the aforementioned plans, descriptions, tables and inferred lateral/vertical extent of soil concentration exceedances of criteria do not include data which may be obtained during the second round of supplementary contamination assessment works proposed **Section 8**.

6 Conceptual Site Model

The conceptual site mode takes into consideration the results of previous investigations reported in **Section 4** and the data gaps present in **Section 7**.

6.1 Preamble

A conceptual site model (CSM) is a representation of site related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The initial CSM is constructed from the information obtained during the preliminary site investigation (PSI), detailed site investigation (DSI), and supplementary contamination assessment (SCA).

The CSM identifies complete and potential pathways between the known or potential source(s) and the receptors. Where a pathway between a source and a receptor is incomplete, the exposure to chemical substances via that pathway cannot occur, but the potential for that pathway to be completed (for example, by abstraction of groundwater or a change in land use) should be considered in the assessment.

6.2 Land Use

6.2.1 Adopted Land use Scenario

For the purpose of this project, Alliance understands that the proposed land use scenario for the site includes:

- Commercial / industrial such as shops, offices, factories and industrial sites.

6.2.2 Assumptions for Adopted Land Use Scenario

Section 3 of NEPC (2013i) advises that the commercial/industrial land use scenario, which assumes typical commercial or light industrial properties, consisting of single or multistorey buildings where work areas are on the ground floor (constructed on a ground level slab) or above subsurface structures (such as basement car parks or storage areas).

The dominant users of commercial / industrial sites are adult employees who are largely involved in office-based or light industrial activities.

The outdoor areas of the commercial/industrial facilities are largely covered by hardstand, with some limited areas of landscaping or lawns and facilities. Opportunities for direct access to soil by employees using these facilities are likely to be minimal, but there may be potential for employees to inhale, ingest or come into direct dermal contact with dust particulates derived from the soil on the site.

The land use scenario does not include more sensitive uses that may be permitted under relevant commercial or industrial zonings. These more sensitive uses include childcare, educational facilities, caretaker residences and hotels and hostels, etc. Information on uses permitted under local council zoning schemes for commercial/industrial land use can be obtained from local council planning zones/schemes. Should these more sensitive uses be permitted, then ‘residential with accessible soil’, ‘residential with minimal access to soil’, or ‘public open space’ land use scenarios should be considered.

6.3 Sources of Contamination

A number of potential land contaminating activities have been identified for the site, based on previous contamination assessments. These include:

- Uncontrolled demolition;
- Uncontrolled filling;
- Use of septic tanks for waste water disposal;
- Stockpiling;
- Use of hazardous building materials.

Table J1 in Appendix J of AS 4482.1-2005[5] and Section 3 of WA DoE (2004) provides guidance on chemicals associated with land uses activities. That guidance provides a basis for deciding on contaminants of potential concern (COPC) for each relevant land use activity. Information on COPC adopted for this project is presented in **Section 6.6** of this report.

6.4 Receptors

6.4.1 Identified Receptors

Based on the adopted land use scenario in **Section 6.2**, receptors at the site may include commercial / industrial workers and intrusive maintenance workers, as outlined in **Section 6.4** in Alliance (2021b).

6.4.2 Assumptions for Identified Receptors

The receptors at a commercial/industrial site are predominantly adult employees, who are largely involved in office-based or light indoor industrial activities. The employees who are most susceptible to health risks associated with volatile soil contaminants are the employees who work in offices on the ground floor, as the greatest potential for vapour intrusion occurs with workspaces immediately overlying contaminated soil.

Employees may make use of outdoor areas of a commercial/industrial premises for activities such as meal breaks. Opportunities for direct access to soil by employees using these facilities are likely to be minimal, but there may be potential for employees to inhale, ingest or come into direct dermal contact with dust particulates derived from the soil on the site.

[5] Alliance understands this standard has been withdrawn, however, guidance on the Aged Standards Review process at https://www.standards.org.au/standards-development/aged-standards, indicates that it is still possible for a withdrawn standard to be used within an industry or reference by a government if chosen to do so. On the basis that this standard is referenced in NEPC (2013b), it is considered reasonable to still refer to it, within the context of this project.

Intrusive maintenance workers are assumed to be adult workers who carry out work in shallow trenches (maximum depth of 1m). The work may include work related to telephone, electricity, gas, water and sewer. It is also assumed that the workers will follow industry accepted procedures in relation to health and safety. The assumptions do not extend to work in deep trenches (such as deep sewers), on the basis that deep trench work would usually require confined space health and safety procedures to be followed, including the use of personal protective equipment.

In the context of petroleum hydrocarbons, exposure[6] may occur through:

- inhalation of volatiles from contaminants at any depth (soil and groundwater); and
- direct contact (dust inhalation, ingestion and dermal contact) for contaminated soils from surface to 2m below ground surface (i.e. trench walls for surface to 1m, trench floor 1 to 2m below ground surface).

Potential acute exposure risks or explosion hazards associated with very high concentrations of vapours are not considered in this scenario.

6.5 Exposure Pathways

6.5.1 Human Health

6.5.1.1 Dermal Contact / Ingestion / Dust Inhalation

Site history information and observations made during the site walkover, indicated a potential for contaminants to be present in soils at the site, which could 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, and dust inhalation contaminant sources, may be complete.

Based on the results of the SCA (Alliance, 2023), further assessment of dermal contact, dust inhalation and ingestion risk in AEC15 is considered warranted.

6.5.1.2 Vapour Intrusion / Inhalation

A vapour intrusion / inhalation exposure risk to human health can be present when a vapour source (either primary or secondary[7]) is present.

Site history information and observations made during the site walkover, indicated a potential for a source of vapour to be present on the site, including:

- Historical commercial painting within a warehouse near the central southern portion of Lot 12.

[6] Section 2.1.4 of Friebel, E & Nadebaum, P 2011
[7] Primary sources typically include underground storage tanks. Secondary sources typically include significantly contaminated soil or groundwater.

The proposed land use scenario is likely to include building footprints as well as limited unsealed and open space areas, where a vapour intrusion / inhalation exposure pathway between identified receptors and these identified primary and secondary sources, may be complete.

Based on the results of the SCA (Alliance, 2023), further assessment of vapour intrusion / inhalation risks associated with the aboveground storage tank and painting warehouse is considered not warranted.

Site history information and observations made during the site walkover, indicated a potential for a historical uncontrolled filling to be present at the site. However, Alliance notes that the activity of transporting, placement and spreading of uncontrolled fill soils would typically include significant disturbance of those soils, that can result in the volatilisation of those contaminants that could normally present a vapour intrusion / inhalation risk (e.g. light fraction petroleum hydrocarbons, naphthalene, and chlorinated hydrocarbons); and

On that basis, Alliance considers that the potential for contaminants to be present in the uncontrolled filling, at concentrations which could present a vapour intrusion / inhalation risk, would be low.

Further assessment of vapour intrusion / inhalation risks associated with the uncontrolled filling, is considered not warranted.

6.5.1.3 Asbestos

Bonded asbestos containing material (ACM) is comprised of asbestos bound in a matrix (including cement or resin), which is in sound condition, although possibly broken or fragmented.

Fibrous asbestos (FA) comprises friable asbestos material and includes severely weathered cement sheeting, insulation products and woven asbestos material. This type of friable asbestos is defined here as asbestos material that is in a degraded condition such that it can be broken or crumbled by hand pressure. This material is typically unbonded or was previously bonded and is now significantly degraded (crumbling).

Asbestos fines (AF) include free fibres, small fibre bundles and small fragments of ACM[8] that would pass through a 7mm x 7mm aperture sieve.

FA and AF are considered to be ‘friable’ asbestos, which is material that is in a powder form or that can be crumbled, pulverised or reduced to powder by hand pressure when dry.

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.

Site history information and observations made during the site walkover, indicated a potential for ACM, FA, and AF to be present in soils at the site.

[8] For bonded ACM fragments to pass through a 7mm x 7mm sieve implies a substantial degree of damage which increases the potential for fibre release.

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

Based on the results of the SCA (Alliance, 2023), further assessment and management/remediation of asbestos exposure risk is considered warranted.

6.5.2 Management Limits for Petroleum Hydrocarbons

Section 2.9 of NEPC (2013a) states 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;
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services by hydrocarbons;
- Effects on buried infrastructure e.g., penetration of, or damage to, in-ground services by hydrocarbons;
- Aesthetic considerations and
- Technological factors.

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.
- 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.

Site history information and walkover observations indicated a potential for these policy considerations to be associated with relevant identified areas of environmental concern (AEC) at the site, in the context of the proposed future land use scenario. Based on the results of the SCA (Alliance, 2023), further assessment of petroleum hydrocarbons in soils in the context of those policy considerations, is considered not warranted.

6.5.3 Hazardous Ground Gases

NSW EPA (2020a) provides advice that if present in the pore space of soils and rocks, ground gas can adversely impact human health and safety or the integrity of structures. The ground gases that are generally of concern in this context are:

- Bulk ground gases, including methane, carbon dioxide, carbon monoxide, hydrogen, hydrogen sulphide, and petroleum vapours; and
- Trace ground gases including radon, volatile organic compounds and mercury vapour.

Alliance has reviewed site history information review and site walkover observations in the context of sources and origins of hazardous ground gases in Table 1 and Table 2 of NSW EPA (2020a). Based on that review, Alliance considers that further assessment of hazardous ground gases in the context of this project, is considered not warranted.

6.5.4 Aesthetics

Aesthetic issues generally relate to the presence of low-concern or non-hazardous inert foreign material (refuse) in soil or fill resulting from human activity. Sites that are assessed as being acceptable from a human health and environmental perspective may still contain foreign material[9]. Sites may have some soil discolouration from relatively inert chemical waste (e.g. ferric metals) or residual odour (e.g. natural sulfur odour).

Assessment should be undertaken in the context of the sensitivity of the proposed land use scenario (e.g. higher expectations apply to residential properties with gardens compared with industrial settings). General assessment considerations should include:

- That chemically discoloured soils or large quantities of various types of inert refuse, particularly if unsightly, may cause ongoing concern to site users;
- The depth of the materials, including chemical residues, in relation to the final surface of the site;
- The need for, and practicality of, any long term management of foreign material;
- The presence of small quantities of non-hazardous material and low odour residue (e.g. weak petroleum odours) that will decrease over time should not be a cause of concern in most circumstances
- Sites with large quantities of well-covered known inert material that present no health hazard such as brick fragments and cement wastes, are usually of low concern for non-sensitive and sensitive land uses; and
- Caution should be used when assessing sensitive land uses, such as residential, when large quantities of various fill types and demolition rubble are present.

Alliance has adapted guidance in Section 3.6.2 and Section 3.6.3 of NEPC (2013a) to facilitate a preliminary assessment of potential aesthetic risks, identified during review of site history information and site walkover observations. The results of the preliminary assessment are presented in **Table 6.5.4**, and they are used to assess whether the need for further assessment to be undertaken, has been triggered.

[9] Geotechnical issues related to the presence of fill should be treated separately to assessment of site contamination.

Table 6.5.4 Preliminary Aesthetics Screening

Preliminary Aesthetics Screening Question	Assessment
Is there potential for highly malodorous soils or extracted groundwater (e.g. strong residual petroleum hydrocarbon odours, hydrogen sulphide in soil or extracted groundwater, organosulfur compounds) to be present on site?	No
Is there hydrocarbon sheen on surface waters at site?	No
Is there potential for discoloured chemical deposits or soil staining with chemical waste other than of a very minor nature, to be present in site soils;	No
Is there potential for large monolithic deposits of otherwise low risk material, e.g. gypsum as powder or plasterboard or cement kiln dust, to be present in site soils;	No
Is there potential for putrescible refuse including material that may generate hazardous levels of methane such as a deep fill profile of green waste or large quantities of timber waste, to be present in site soils?	No
Is there potential for residue from animal burial (e.g. former abattoir sites) to be present in site soils.	No
Is there potential for large quantities of non-hazardous inert material to be present in site soils?	Yes
Is there potential for high odour residue material to be present in site soils?	No
Is there potential for large quantities of various fill types and demolition rubble to be present in site soils proposed for residential land use?	No

Site history information and observations made during the DSI (Alliance, 2021b) and SCA (Alliance, 2023) site walkovers and fieldwork, and considered during the aesthetics risk assessment, indicated the following potential aesthetics risks for the site:

- Use of uncontrolled fill within the rubble pit at AEC21;
- Large deposits of building waste and tyres within the gully between dams within Lot 12 in AEC14;
- Sixteen (16) concrete stockpiles across the site identified as SP01 to SP16.

6.5.5 Terrestrial Ecosystems

Site history information and observations made during the DSI site walkover, indicated a potential for contaminants, which may present a risk to terrestrial ecosystems, may be present on site.

Section 3.4.2 of NEPC (2013a) states 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 landforms;
- 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.

Alliance has considered the potential for sensitive ecological receptors to be present at the site, in the context of site history information, site walkover observations and the proposed land use scenario.

Alliance notes that:

- Observations of flora onsite were limited to a limited number of scattered trees at the boundaries of the site, with some along the driveway of Lot 13. Observed native herbaceous flora species across the site were minimal;
- The proposed land use scenario will include soil excavation and removal across the site and covering the majority of the site with hardstand pavements and building footprints;
- Mammals are unlikely to access the site following construction of proposed buildings and hardstand areas;
- Invertebrates currently present at the site (including soil fauna, earthworms, and insects) are likely to be removed during excavation works;
- Birds are unlikely to remain onsite following removal of the scattered trees at the site boundary and along the Lot 13 driveway, and construction of the new buildings and hardstand areas;
- Reptiles unlikely to remain onsite following removal of the scattered trees at the site boundary, and along the Lot 13 driveway, excavation works, and construction of the new buildings and hardstand areas;

On the basis that, further assessment of terrestrial ecosystem risks is considered not warranted.

6.5.6 Groundwater

Section 2.2 of NSW DEC (2007) provides guidance on the need for the potential for groundwater contamination to be assessed, for the purposes of evaluating whether it may pose an unacceptable risk to human health and/or the environment.

Section 3.2 of NEPC (2013h) provides guidance on the environmental values (that are conducive to public benefit, welfare, safety or health) and that require protection from the effects of pollution, waste discharge and deposits. These values include:

- Ecosystem protection;
- Aquaculture and human consumers of food;
- Agricultural water (irrigation and stock water);
- Recreation and aesthetics;
- Drinking water; and
- Industrial water.

Each of these values is considered in sub-sections **6.5.6.1** to **6.5.6.6**.

6.5.6.1 Aquatic Ecosystem Protection

In the context of aquatic ecosystems, ANZG (2018) defines level of protection is the degree of protection afforded to a water body based upon its ecosystem condition (current or desired health status of an ecosystem relative to the human degree of disturbance). Selecting a level of protection should consider:

- Maintaining the existing ecosystem condition, or
- Enhancing a modified ecosystem by targeting the most appropriate level of condition.

ANZG (2018) recognises three categories of current or desired ecosystems:

- High conservation or ecological value systems
- Slightly to moderately disturbed ecosystems; and
- Highly disturbed ecosystems.

Alliance has undertaken an assessment of the likely nearest aquatic ecosystem to the site (refer Section 3.4) and considers that is it a freshwater system. Following review of site-specific attributes, and in the context of guidance provided in ANZG (2018) [10], Alliance considers that the nearest aquatic ecosystem is:

- highly disturbed system, on the basis that the aquatic ecosystem is measurably degraded and of lower ecological value (e.g. urban streams receiving road and stormwater runoff, and rural streams receiving runoff from intensive horticulture).

Groundwater at the site is considered likely to discharge to the nearest downgradient surface water body identified for the site (refer **Section 3.4**). That surface water body is considered likely to be polluted and be of a quality that is not consistent with natural background water quality.

Geology at the site is likely to include low permeability clays, which would limit vertical migration of soil contaminants (if present) into groundwater.

The shallowest groundwater at the site is likely to be transient perched groundwater generally present at the soil-bedrock interface, after heavy rain events. Data on natural background water quality for transient groundwater is generally not available. Subsequently, comparison of site specific shallow transient groundwater data against background quality is therefore not practical.

Given the distance between the site and the nearest downgradient surface water body, it is considered that diffusion and dilution of potential contaminants on site, if they were to migrate into groundwater, would unlikely result in an unacceptable aquatic ecosystem risk to that surface water body.

Based on this, Alliance considers that further assessment of aquatic ecosystem protection as a groundwater value, is not warranted.

[10] https://www.waterquality.gov.au/anz-guidelines/resources/key-concepts/level-of-protection

6.5.6.2 Aquaculture and Human Consumers of Food

Groundwater at the site is considered likely to discharge to the nearest surface water body identified for the site (refer **Section 3.4**).

The nearest surface water body to the site is not located on or adjacent to the site and is located a significant distance (~700 m) from the site. Alliance considers it unlikely that occupants of the site would frequent that surface water body for the collection and consumption of aquatic based foods, at a rate that the intake would present an unacceptable risk to human health.

The nearest surface water body identified for the site (refer **Section 3.4**) appears to be a drainage/creek line and is likely to be shallow in nature. Alliance considers it unlikely that the surface water body would contain an aquatic food source suitable for human consumption.

Given the distance between the site and the nearest downgradient surface water body, it is considered that diffusion and dilution of potential contaminants on site, if they were to migrate into groundwater, would unlikely result in an unacceptable aquaculture and human consumption risk to that surface water body.

Based on this, Alliance considers that further assessment of aquaculture and human consumers of food as a groundwater value, is not warranted.

6.5.6.3 Agricultural (Irrigation and Stock Water)

The groundwater bore search in Section 3.4 did not identify any registered groundwater bores within a 500m radius of the site, that were authorised for irrigation or stock watering purposes.

The shallowest groundwater at the site is likely to be transient perched groundwater generally present at the soil-bedrock interface, after heavy rain events, and therefore, unlikely to be a reliable groundwater abstraction source for irrigation and stock watering purposes.

Commercial/industrial development on the site is considered likely to prevent agricultural land use activities from being undertaken, which would mitigate the potential for abstraction of groundwater for irrigation and stock watering.

Given the distance between the site and the nearest downgradient surface water body, it is considered that diffusion and dilution of potential contaminants on site, if they were to migrate into groundwater, would unlikely result in an unacceptable agricultural use risk to that surface water body.

Based on this, Alliance considers that further assessment of agricultural water as a groundwater value, is not warranted.

6.5.6.4 Recreation and Aesthetics

Section 3.4 of this report did not identify licensed recreational water abstraction bores within a 500m radius of the site. Further to this McNally (2009) advises that:

- deeper regional groundwater present in the fractures of the Ashfield / Bringelly shales (in western Sydney) is generally saline, typically in the range of 5,000-50,000mg/L (due to their sea salt content); and
- the Ashfield / Bringelly shales (in western Sydney) are also considered to have no value as sources of groundwater.

The future land use scenario for the site includes a reticulated drinking water system. Development surrounding the site is also considered likely to include a reticulated drinking water system. Alliance considers use of reticulated water as a recreational water source (e.g. filling up swimming pools or ponds on site) is considered a more plausible scenario.

On that basis, installation of groundwater wells on site for the purpose of groundwater abstraction and use as a recreational water source (e.g. filling up swimming pools or ponds on site) is considered unlikely.

Groundwater at the site is considered likely to discharge to the nearest surface water body identified for the site (refer **Section 3.4**).

The nearest surface water body identified for the site (refer **Section 3.4**) appears to be a drainage / creek line, is likely to be shallow in nature, and has limited access to the general public. Alliance considers it is unlikely that the surface water body would be used for:

- sports in which the user comes into frequent direct contact with water, either as part of the activity or accidentally, for example, swimming or surfing (primary contact);
- sports that generally have less-frequent body contact with the water, for example, boating or fishing (secondary contact); or
- visual passive recreational use, for example, pleasant places to be near or to look at (no body contact).

Given the distance between the site and the nearest downgradient surface water body, it is considered that diffusion and dilution of potential contaminants on site, if they were to migrate into groundwater, would unlikely result in an unacceptable recreation or aesthetics risk to that surface water body.

Based on this, Alliance considers that further assessment of recreation and aesthetics as a groundwater value, is not warranted.

6.5.6.5 Drinking Water

The groundwater bore search in **Section 3.4** did not identify any registered groundwater bores within a 500m radius of the site, that were authorised for drinking water purposes.

The shallowest groundwater at the site is likely to be transient perched groundwater generally present at the soil-bedrock interface, after heavy rain events, and therefore, unlikely to be a reliable groundwater abstraction source for drinking water purposes.

McNally (2009) advises that:

- deeper regional groundwater present in the fractures of the Ashfield / Bringelly shales (in western Sydney) is generally saline, typically in the range of 5,000-50,000mg/L (due to their sea salt content), and therefore not suitable for drinking purposes; and
- the Ashfield / Bringelly shales (in western Sydney) are also considered to have no value as sources of groundwater.

The future land use scenario for the site includes a reticulated drinking water system. development surrounding the site is also considered likely to include a reticulated drinking water system. Alliance considers use of reticulated water as a drinking water source onsite is a more plausible scenario.

Installation of rainwater collection tanks on site (for use as a secondary source of drinking water is also considered a more plausible scenario).

Given the distance between the site and the nearest downgradient surface water body, it is considered that diffusion and dilution of potential contaminants on site, if they were to migrate into groundwater, would unlikely result in an unacceptable drinking water risk to that surface water body.

On that basis, further assessment of drinking water as a groundwater value, is considered not warranted.

6.5.6.6 Industrial Use

The groundwater bore search in **Section 3.4** did not identify any registered groundwater bores within a 500m radius of the site, that were authorised for industrial purposes.

The shallowest groundwater at the site is likely to be transient perched groundwater generally present at the soil-bedrock interface, after heavy rain events, and therefore, unlikely to be a reliable groundwater abstraction source for industrial purposes.

Development on the site and on land down gradient of the site, is considered likely to prevent industrial land use activities from being undertaken, which would mitigate the potential for abstraction of groundwater for industrial purposes.

The future land use scenario for the site includes a reticulated drinking water system. Development surrounding the site is also considered likely to include a reticulated drinking water system. Use of reticulated water for industrial purposes (if industrial activities were undertaken) is considered a more plausible scenario.

Given the distance between the site and the nearest downgradient surface water body, it is considered that diffusion and dilution of potential contaminants on site, if they were to migrate into groundwater, would unlikely result in an unacceptable industrial use risk to that surface water body.

Based on this, Alliance considers that further assessment of industrial water as a groundwater value, is not warranted.

6.6 Source, Pathway and Receptor Links

Based on:

- The identified sources of contamination associated with the locations of where potential land contaminating activities have been undertaken at the site (areas of environmental concern or AEC);
- The identified contaminants of potential concern (COPC) associated with those land contaminating activities;
- The receptors identified for the site, based on the proposed land use scenario;
- The exposure pathways between the identified sources and receptors that have been assessed as being potentially or actually complete; and
- The results of contamination assessment works presented in Alliance Geotechnical (2021b),

a conceptual site model (CSM) that identifies plausible south-pathway-receptor linkages for the site, is presented **Table 6.6.1**.

The inferred extents of unacceptable contamination risks based on the CSM, are presented in **Figure 4A to Figure 4G**. Alliance notes that the inferred extent of unacceptable contamination risks do not include data which may be obtained during the supplementary contamination assessment works proposed **Section 8**.

Table 6.6.1 Source, Pathway and Receptor Links

ID	AEC	Land Contaminating Activity (Source)	COPC	Exposure Pathway	Receptor
AEC01a	Surface soil within vicinity of TP09 (~80m², ~0.1m thick).	Uncontrolled filling	Bonded asbestos	Inhalation (asbestos)	Commercial / industrial workers
AEC09b	Dam 5 Sediments (Lot 12 north, ~60m², ~0.1m thick)	Waste disposal.	Bonded asbestos	Inhalation (asbestos)	Commercial / industrial workers
AEC13	Commercial paint warehouse fill (200m², ~0.3 m thick fill)	Hazardous buildings materials and demolition	Friable and bonded asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC14	Gully between northern dams in Lot 12 (~950m², ~2.2m thick)	Uncontrolled filling	Friable & bonded asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC15	Residential premises (~150m³, Lot 12 east)	Hazardous buildings materials, termite treatment Demolition	Polychlorinated biphenyl, pesticides, heavy metals, and asbestos	Dermal contact Soil Ingestion Dust inhalation Inhalation (asbestos) Management limits Aesthetics	Commercial / industrial workers
AEC16	Septic tank (~3m^2, ~1.5m deep, Lot 12 east property)	Domestic effluent disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	Dermal contact Soil Ingestion Dust inhalation Management limits Aesthetics	Commercial / industrial workers

ID	AEC	Land Contaminating Activity (Source)	COPC	Exposure Pathway	Receptor
AEC18	Construction material storage area, including metal sheeting, piping and lumber (~30m², ~0.1m thick, north-west corner Lot 11)	Uncontrolled filling	Bonded asbestos	Inhalation (asbestos)	Commercial / industrial workers
AEC19a	Dam 8 Wall and Lot 11 north west fill soils (~3,200m², ~4m thick).	Uncontrolled filling	Bonded asbestos	Inhalation (asbestos)	Commercial / industrial workers
AEC21	Septic absorption pit (~100m² ~1m thick, north-east of AEC23)	Septic discharge Uncontrolled filling	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, OCP, BTEX, heavy metals, & asbestos and pathogens	Dermal contact Soil Ingestion Dust inhalation Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC22	Septic tank (~3m^2, ~1.5m deep, Lot 11 north of residence)	Domestic effluent disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, pathogens	Dermal contact Soil Ingestion Dust inhalation Management limits Aesthetics	Commercial / industrial workers
AEC23	Residential premises (lateral extent unknown, ~0.1m depth, Lot 11 west)	Hazardous buildings materials deterioration and demolition	Bonded asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC23a	ACM in wheelie bins (3 wheelie bins containing ACM, Lot 11 west)	Hazardous buildings materials deterioration and demolition	Bonded asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers

ID	AEC	Land Contaminating Activity (Source)	COPC	Exposure Pathway	Receptor
AEC24a	Shallow filling (~25m², ~0.1 m thick) Lot 11 north-west of residence)	Shallow uncontrolled filling	Friable asbestos	Inhalation (asbestos)	Commercial / industrial workers
AEC32	Residential premises (~80m² at TP201, ~0.1m thick, Lot 13 north)	Demolition of hazardous building materials	Bonded asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC32a	Residential premises (lateral extent unknown, ~0.1m thick)	Demolition of hazardous building materials	Bonded asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC33	Residential premises (<2,000 m), Lot 13 west)	Demolition	Asbestos.	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC34	Concrete driveway along the northern boundary to residential dwelling within Lot 13	Potential uncontrolled filling Demolition	Asbestos	Inhalation (asbestos) Aesthetics	Commercial / industrial workers
AEC38	Poultry sheds (~8,200m^2)	Demolition	-	Aesthetics	Commercial / industrial workers
AEC39	Septic tank (~3m^2, ~1.5m deep, Lot 13 north-east property)	Domestic effluent disposal	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	Dermal contact Soil Ingestion Dust inhalation Management limits Aesthetics	Commercial / industrial workers

ID	AEC	Land Contaminating Activity (Source)	COPC	Exposure Pathway	Receptor
Concrete stockpiles (SP1 to SP16)	Stockpiles of concrete observed at various locations	Demolition	Asbestos	Aesthetics Inhalation (asbestos)	Commercial / industrial workers

7 Data Gap Analysis and Uncertainty

Based on a desktop review of previous reports referred to in **Section 4** and the development of the conceptual site model (CSM) presented in **Section 6**, Alliance has assessed that that the following data gaps, in the context of site contamination characterisation and management, are present and need to be addressed:

- Visual assessment for surficial ACM following the slashing and removal of vegetation at AEC13, AEC14, AEC15, AEC23, AEC18, AEC19a, AEC21, AEC23, AEC24a, AEC32, AEC33, AEC34 and AEC38;
- The extent of bonded asbestos in soil at AEC19a, AEC23, & AEC32 is uncertain and requires further assessment;
- The western portion of AEC15 beneath the former residence requires further assessment as conformance with published guidance on sampling point pattern and density was not able to be achieved in the SCA, for the purpose of making human health related land contamination status decisions; and
- The concrete stockpiles (SP01 to SP16) require intrusive investigation to assess for the potential presence of asbestos.

Provision for addressing these data gaps is presented in **Section 8** of this RAP.

8 Supplementary Contamination Assessment (SCA)

8.1 Preamble

Supplementary contamination assessment (SCA) works will be undertaken, to address the data gaps identified in **Section 7** of this RAP. It is noted that vegetation within the relevant AECs will need to be slashed and removed prior to further assessment work.

8.2 Objectives

The objectives of the SCA are to:

- Assess the potential for visible asbestos to be present in surface soils (following the slashing and removal of vegetation) in AEC13, AEC14, AEC15, AEC23, AEC18, AEC19a, AEC21, AEC23, AEC24a, AEC32, AEC33, AEC34 and AEC38;
- Assess the likely extent of bonded asbestos in soil at AEC19a, AEC23, & AEC32a;
- Further assess the potential for land contamination to be present in the western portion of AEC15 beneath the former residence;
- Assess the potential for asbestos to be present in concrete stockpiles identified as SP01 to SP16 on site; and
- Provide recommendations for further investigations, and management or remediation of land contamination (if warranted).

The work required to address these objectives, will be undertaken in the context of the proposed land use scenario adopted for the site, and is subject to completion of vegetation slashing and removal within AEC13, AEC14, AEC15, AEC23, AEC18, AEC19a, AEC21, AEC23, AEC24a, AEC32, AEC33, AEC34 and AEC38.

8.3 SCA Data Quality Objectives

The data quality objectives (DQO) and associated sampling and analysis quality plan (SAQP) for the SCA are presented in the following sub sections.

8.3.1 SCA - Step 1: State the problem

The reason the SCA works are being undertaken, is set out in **Section 8.1** of this report.

The objective of these SCA works is set out in **Section 8.2** of this report.

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

The design and undertaking of these SCA works will be constrained by the client's financial and time budgets.

The regulatory authorities associated with these SCA works include NSW EPA, the planning authority, and SafeWork NSW.

8.3.2 SCA - Step 2: Identify the decision / goal of the study

The decisions that need to be made during these SCA work, to address the project objectives, include:

- Is the data collected for the SCA works, 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 suitable for assessing the likely extent of contamination requiring remediation?

8.3.3 SCA - Step 3: Identify the information inputs

The information inputs required to make the decisions for the project set out in **Section 8.3.2**, include:

- Data obtained during the site history review and site walkover;
- Field and laboratory analytical data from previous contamination assessments at site;
- Identification of sample media that needs to be collected, as set out in **Section 8.3.7.2**;
- Parameters that will be measured in each relevant sample, as set out in **Section 8.3.7.7**;
- 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 13.7** of this report; and
- The site criteria for the media of concern. These criteria are set out in **Table 13.3** and will be adopted based on the proposed land use scenario[11], identified receptors, and site-specific soil and groundwater conditions (where relevant).

8.3.4 SCA - Step 4: Define the boundaries of the study

The spatial extent of the project will be limited to:

- The boundaries of the site as set out in **Section 2**; and
- Physical constraints or infrastructure on site or on land adjacent to the site, that prevents safe and reasonable access for project team members and/or typical and readily available equipment used for projects of this nature.

The scale of the decisions required (as set out in **Section 8.3.2**) will be based on the boundaries of the site set out in **Section 2**.

The extents of SCA works will be limited to the distribution of contamination assessed in the CSM in **Section 6** (associated with the data gaps identified in **Section 7**), which are likely to be:

- The inferred vertical extent of AECs, likely to be to the base of fill material or the soil surface, or the base of stockpiles, or the top 10cm of surface soils, in relevant AECs; and

[11] 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.

- The inferred lateral boundaries of each identified AEC (where applicable).

The time and budget constraints of the SCA works will be as per those set out in the contract (and any subsequent variations to that contract) between the client and Alliance.

The temporal boundaries of the SCA works will include:

- Availability of project team members (including subcontractors and subconsultants) to collect and assess relevant project data;
- The availability of site access to undertake fieldwork; and
- Meteorological conditions including heat, cold, wind, rain and snow, which may constrain undertaking of fieldwork, or may affect the quality of the data being collected.

8.3.5 SCA - Step 5: Develop the analytical approach

8.3.5.1 Field Duplicates and Triplicates

Field duplicates and triplicates will be collected and assessed in accordance with the procedures set out in **Section 13.5**.

8.3.5.2 Trip Spikes and Trip Blanks

Trip spikes and trip blanks used and assessed in accordance with the procedures set out in **Section 13.5**.

8.3.5.3 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected and assessed in accordance with the procedures set out in **Section 13.5**.

8.3.5.4 Field Blanks

Field blanks will be collected and assessed in accordance with the procedures set out in **Section 13.5**.

8.3.5.5 Analytical Laboratory Quality Assurance and Quality Control

The primary analytical laboratory will:

- be NATA accredited for the methods used; and
- use a quality assurance and quality control (QA/QC) program that will typically include analysis of method blanks, matrix spikes, surrogate spikes, laboratory control samples and laboratory duplicates.

The primary analytical laboratory will report on whether the analytical results of the QA/QC program are within the criteria set out in the laboratory's adopted data quality objectives.

8.3.5.6 Data Quality Indicators

A set of data quality indicators (DQI) will be adopted for assessing the completeness, comparability, representativeness, precision and bias (accuracy) of data collected during fieldwork, the analytical data produced by the laboratory. Each of these DQI are set out in **Table 8.3.5.6**.

Table 8.3.5.6 Data Quality Indicators and Target Criteria

Completeness			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Experienced sampling team used	Yes	Complete sample receipt advice and chain of custody attached	Yes
Sampling devices and equipment set out in sampling plan were used (refer **Section 8.3.7.2**).	Yes	Critical samples identified in sampling plan, analysed	Yes
Critical locations in sampling plan, sampled (refer **Section 8.3.7.1**).	Yes	Analysis undertaken addresses COPC in sampling plan (refer **Section 8.3.7.7**)	Yes
Critical samples in sampling plan, collected (refer **Section 8.3.7.1**).	Yes	Analytical methods reported in laboratory documentation and appropriate limit of reporting used	Yes
Completed field and calibration logs attached	Yes	Sample holding times met (refer **Section 8.3.7.8**)	Yes
Completed chain of custody attached	Yes		

Comparability			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Same sampling team used for all work.	Yes	Same laboratory used for all analysis (refer **Section 8.3.7.6**).	Yes
Weather conditions suitable for sampling.	Yes	Comparable methods if different laboratories used (refer **Section 8.3.7.8**).	Yes
Same sample types collected and preserved in same way (refer **Section 8.3.7.2**).	Yes	Comparable limits of reporting if different laboratories used.	Yes
Relevant samples stored in insulated containers and chilled (refer **Section 8.3.7.5**).	Yes	Comparable units of measure if different laboratories have been used (refer **Section 8.3.7.8**).	Yes

Representativeness			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Media identified in sampling plan, sampled (refer **Section 8.3.7.2**).	Yes	Samples identified in sampling plan, analysed.	Yes
Samples required by sampling plan, collected (refer **Section 8.3.7.1**).	Yes		

Precision			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Minimum 5% duplicates and triplicates collected and analysed (refer **Section 8.3.5**).	Yes	All laboratory duplicate RPDs within laboratory acceptance criteria (refer **Section 8.3.5**).	Yes

RPD unlimited where detected concentrations are <10 times the limit of reporting.	Yes		
RPD within 50% where detected concentrations are 10-20 times the limit of reporting.	Yes		
RPD within 30% where detected concentrations are >20 times the limit of reporting.	Yes		

Bias (Accuracy)			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Trip blank analyte results less than limit of reporting (refer **Section 8.3.5**).	Yes	Laboratory method blank results within laboratory acceptance limits (refer **Section 8.3.5**).	Yes
Trip spike analyte results less between 60% and 140% (refer **Section 8.3.5**).	Yes	Laboratory control sample results within laboratory acceptance limits (refer **Section 8.3.5**).	Yes
Rinsate blank analyte results less than limit of reporting (refer **Section 8.3.5**).	Yes	Laboratory spike sample results within laboratory acceptance limits.	Yes

8.3.5.7 If / Then Statements

If the SCA field and laboratory analytical dataset meets the DQI target assessment criteria, then the data may be considered adequately complete, comparable, representative, precise and unbiased, for the purpose of addressing the decisions / goals of this project as set out in **Section 8.3.2**.

If the SCA field and laboratory analytical dataset does not meet the DQI target assessment criteria, then additional data may need to be collected to address gaps identified in the data.

If the SCA field and laboratory analytical results are within the adopted land contamination assessment criteria (refer **Section 13.3**), then it may be assessed that identified land contamination at the site does not present an unacceptable human health exposure risk.

If the SCA field and laboratory analytical results are outside adopted land contamination assessment criteria (refer **Section 13.3**), then it may be assessed that identified land contamination at the site presents an unacceptable human health exposure risk, or that supplementary site specific qualitative / quantitative risk assessment may be required.

If the statistical assessment of the relevant previous contamination assessment and SCA data indicate that the arithmetic average concentration of a specified contaminant, is unlikely to exceed an adopted screening criterion, then it may be assessed that the identified land contamination does not present an unacceptable human health exposure risk.

8.3.6 SCA Step 6: Performance and Acceptance Criteria

8.3.6.1 If / Then Decisions

There are two types of decision error:

- Sampling errors – these occur when the sampling program does not adequately detect variability of a contaminant from point to point across a 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 in that contaminant); and
- Measurement errors - these occur during sample collection, preparation, analysis and reduction of data.

During land contamination assessment, these errors can result in either:

- a Type I error, where land contamination human health exposure risks are considered to be acceptable, when they are not acceptable; or
- a Type II error, where land contamination human health exposure risks are considered to be unacceptable, when they are acceptable.

For decision rules to be sound, they should be designed to mitigate risk of decision errors occurring. The risk of decision error on this project will be mitigated by:

- Ensuring fieldwork is undertaken by suitably experienced field staff and sub-contractors, with reference to the DQO adopted for this project;
- Ensuring laboratory analysis is undertaken by NATA accredited laboratories; and
- Ensuring assessment of field and laboratory analytical data is undertaken by suitably experienced environmental consultants and/or outsourcing assessment to technical experts (if warranted).

8.3.7 SCA Step 7: Develop the plan for obtaining data

8.3.7.1 Sampling Point Densities and Locations

Section 5.1 in NSW EPA (2022) provides guidance regarding probabilistic sampling and judgemental sampling.

A probabilistic sampling design uses random selection that when properly applied, results in unbiased and independent data. For an optimal design, using probabilistic sampling, an accurate CSM is required, including a clear definition of the population to be sampled. Systematic grid based sampling is a probabilistic method.

A judgemental sampling design requires decisions on where and/or when to collect samples, and relies on good site histories and/or site features being clear and distinct. The method can be efficient for assessing areas of worse case impacts and can be useful where site history is inadequate or the features of concern are obscured or not discernible. Targeted sampling is a judgemental method. Section 6.2.1 in NEPC (2013b) advises that judgemental sampling and the selection of samples (number, location, timing, etc) should be based on knowledge of the site and professional judgement. In these instances, 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 laned contamination assessment. Judgemental sampling can be used to investigate sub-surface contamination issues in site assessment.

Stratified sampling comprises a combination of systematic and judgemental sampling, for sites with different uses, features and complex contaminant distributions, where a site is divided into various non-overlapping sub areas, according to geological and geographical features. Each sub area can then be treated as an individual decision area with different sampling patterns and sampling densities applied. For example, on area might require targeted sampling while a neighbouring one might need systematic sampling.

A stratified sampling strategy requires reliable prior knowledge of the site. NEPC (2013b) notes that stratified sampling can provide:

- potential for achieving greater precision in estimates of the mean and variance where the measurement of interest is strongly correlated with the variable used to define the strata; and
- calculation of reliable estimates for subgroups of special interest.

Table 2 in NSW EPA (2022) provides guidance on minimum sampling point densities required for characterising a site, based on detecting circular hot spots, by using a systematic sampling pattern.

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

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 mixture of systematic and judgemental sampling patterns, using the sampling point densities set out in **Table 8.3.7.1** and **Figure 6A to 6G.**

In the event observations are made during sampling fieldwork that suggest the nature and/or extent of contamination will not be adequately assessed by the proposed sampling point densities and depths, then consideration will be given to amending those densities or depths, in consultation with the client.

Table 8.3.7.1 SCA Works Sampling Point Densities and Locations

ID	AEC	Sampling Point ID	Method	Target Depth (m bgl)
AEC13	Commercial paint warehouse (~200m², 0.3m thick)	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC14	Gully between northern dams in Lot 12 (~950m², ~2.2m thick)	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC15	Residential premises (~800m²[3], 0.4m thick Lot 12 east)	TP236 to TP240	Test pit Systematic walkover of the AEC to make surface observations for ACM	0.5m, 0.3m into natural, or practical refusal
AEC18	Construction material storage area, curtilage (~30m², ~0.1m thick, north-west corner Lot 11)	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC19a	Lot 11 north west fill soils (~3,200m², ~0.3-4m thick).	TP241 to TP56	Test pits Systematic walkover of the AEC to make surface observations for ACM	4m, 0.3m into natural, or practical refusal
AEC21	Septic absorption pit (~100m², north-east of AEC23)	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC23	Residential premises footprint and curtilage (lateral extent unknown, ~0.1m depth, Lot 11 west)	TP257 to TP261	Test pits Grid based systematic walkover of the AEC to make surface observations for ACM	0.5m, 0.3m into natural, or practical refusal
AEC23a	ACM in wheelie bins (3 wheelie bins containing ACM, Lot 11 west)	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC24a	Shallow filling (~25m², Lot 11 north-west of former residence)	Grid based systematic walkover of the AEC to make surface observations for ACM		

Table 8.3.7.1 SCA Works Sampling Point Densities and Locations

ID	AEC	Sampling Point ID	Method	Target Depth (m bgl)
AEC32	Residential premises (~2,000m², Lot 13 north)	Grid based systematic walkover of the AEC to make surface observations for ACM		
AEC32a	Residential premises (lateral extent unknown, ~0.1m thick)	TP262 to TP264	Test pits Grid based systematic walkover of the AEC to make surface observations for ACM	0.5 m, 0.3m into natural
AEC33	Residential premises (<2,000 m), Lot 13 west)	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC34	Concrete driveway curtilage to former western premises, (~150m²), Lot 13	Grid based systematic walkover of the AEC to make surface observations for ACM and aesthetic impacts		
AEC38	Poultry sheds (~8,200m^2)	Grid based systematic walkover of the AEC to make surface observations for aesthetic impacts		
Concrete stockpiles SP1 to SP10	Stockpiles of concrete (~200m^3)	TP265 to TP267	Test pits	Base of stockpile
Concrete stockpiles SP11 to SP12	Stockpiles of concrete (~30m^3)	TP268 and TP269	Test pits	Base of stockpile
Concrete stockpiles SP13 and SP14	Stockpiles of concrete (~7m^3)	TP270 and TP271	Test pits	Base of stockpile
Concrete stockpiles SP15 and SP16	Stockpiles of concrete (~50m^3)	TP272 and TP273	Test pits	Base of stockpile

8.3.7.2 Sampling Methods

8.3.7.2.1 Walkover

A grid based walkover of AEC13, AEC14, AEC15, AEC23, AEC18, AEC19a, AEC21, AEC23, AEC24a, AEC32, AEC33, AEC34 and AEC38, will be undertaken for the purpose of assessing the presence of visible asbestos in surface soils. The walkover will be undertaken on 5m transects with at least one pass in a north/south direction and one in an east/west direction, in each individual AEC.

8.3.7.2.2 Soils

Soil sampling points will be established onsite, at the locations nominated in **Figure 5A** to **Figure 5C**.

Soil samples will be collected from each relevant sampling point, 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.

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 asbestos fines (AF) and fibrous asbestos (FA) analysis, will be collected as separate samples to the aforementioned 10L bulk samples.

Samples will be submitted to a NATA accredited laboratory for analysis.

8.3.7.3 Decontamination

Non-disposable sampling equipment will be decontaminated using the procedures set out in **Section 13.7** of this report.

8.3.7.4 Headspace Screening

Collected relevant soil samples will be subjected to headspace screening for ionisable volatile organic compounds, using the procedures set out in Section 13.7 of this report.

8.3.7.5 Sample Identification, Handling, Storage and Transport

Soil samples will be identified, handled, stored and transported using the procedures set out in **Section 13.7** of this report.

8.3.7.6 Selection of Laboratory

The analytical laboratories used for this project will reputable industry recognised environmental laboratories, that are NATA accredited for the analytical methods used.

8.3.7.7 Scheduling of Laboratory Analysis

Collected samples will be scheduled for laboratory analysis based on:

- The COPC identified for the AEC the sample was collected from;
- Observations made of the sample when collected (including staining, odour, presence of anthropogenic materials, and presence of potential asbestos containing materials);

- The results of sample headspace screening (if applicable); and
- The need for specific qualitative or quantitative data to inform assessment of risk associated with other laboratory analytical data (e.g. pH, cation exchange capacity, clay content, organic carbon content).

The laboratory analytical schedule (including upper limiting sample quantities) adopted for this project, is set out in **Table 8.3.7.7**.

ID	AEC	Sampling Point ID	OCP	PCB	Metals (8)	Asbestos (0.001%)	10L asbestos screening(Gravimetric) only)
AEC15	Residential premises (~800m³, 0.4m thick Lot 12 east)	TP236 to TP240	5	5	5	5	5
AEC19a	Lot 11 north west fill soils (~3,200m², ~0.3-4m thick).	TP241 to TP256	-	-	-	64	64
AEC23	Residential premises footprint and curtilage (lateral extent unknown, ~0.1m depth, Lot 11 west)	TP257 to TP261	-	-	-	-	10
AEC32a	Residential premises (lateral extent unknown, ~0.1m thick)	TP262 to TP264	-	-	-	-	3
Concrete stockpiles SP1 to SP10	Stockpiles of concrete (~200m³)	TP265 to TP267	-	-	-	3	3
Concrete stockpiles SP11 to SP12	Stockpiles of concrete (~30m³)	TP268 and TP269	-	-	-	2	2
Concrete stockpiles SP13 and SP14	Stockpiles of concrete (~7m³)	TP270 and TP271	-	-	-	2	2
Concrete stockpiles SP15 and SP16	Stockpiles of concrete (~50m³)	TP272 and TP273	-	-	-	2	2

Note: asbestos assessment will only be undertaken on concrete stockpiles if a fines fraction is present.

8.3.7.8 Analytical Methods, Limits of Reporting and Holding Times

The analytical methods, limits of reporting and sample holding times adopted for this project, are set out in **Table 13.7.8.**

8.4 SCA - Data Assessment and Reporting

The findings of the supplementary contamination assessment will be presented as either an addendum to this RAP if contamination is found, or a site validation report if no unacceptable contamination risks are found. The RAP addendum report will include:

- An executive summary;
- The scope of work undertaken;
- Site identification details;
- Information on supplementary contamination assessment works undertaken;
- Field and laboratory analytical data;
- Field and laboratory data QA/QC assessment;
- Supplementary site contamination assessment and characterisation;
- Information on revised inferred unacceptable contamination extents (if any);
- Information on revised inferred remediation extents (if any);
- 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.

9 Remediation Objectives and Criteria

CRC CARE (2019c) defines a remediation objective as a site specific objective that relates solely to the reduction or control of unacceptable risks associated with one or more pollutant linkage.

The remediation objective is to remediate identified land contamination exposure risks to levels that do not present an unacceptable human health or ecological exposure risk, based on the proposed land use scenario for the site, which comprises:

- Commercial / industrial such as shops, offices, factories, and industrial sites.

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

- a covenant registered on the land title;
- a notation on a planning certificate for the site; and
- an environmental management plan (EMP) for the site.

It is acknowledged that Section 2.1.2 of NEPC (2013a) advises that:

- investigation and screening levels are not clean up levels or response levels nor are they desirable soil or water quality criteria; and
- the use of investigation and screening levels as default remediation criteria may result in unnecessary remediation and increased development costs, unnecessary disturbance to the site and local environment, and potential waste of landfill space.

However, in practice, the investigation and screening levels in NEPC (2013a) are often used as clean up / remediation targets, because the assumptions on which the those levels are based, can have general applicability for protection of certain land uses and there may not be a reason for varying from them.

The remediation assessment criteria that have been adopted for this project, and the basis/source of those criteria, are set out in **Table 13.3** of this RAP.

10 Remediation Extent and Options

10.1 Inferred Extent

The inferred extent of remediation that may be required in these AEC is set out in **Table 10.1** and **Figure 4A** to **Figure 4G**.

Table 10.1 Inferred Extent of Remediation

ID	AEC	Contamination Risk	Indicative Volume (In-situ)	Assumptions
AEC01a	Soil within vicinity of TP09	Bonded asbestos	10m^3	~80m^2, nominal depth of ~0.1m
AEC09b	Dam 5 Sediments (Lot 12 north)	Bonded asbestos	6m^3	~60m^2, nominal thickness of ~0.1m
AEC13	Commercial paint warehouse footprint curtilage (Lot 12 southern building)	Friable and bonded asbestos	60m³	~200m², nominal thickness of ~0.3m
AEC14	Gully between northern dams in Lot 12	Friable and bonded asbestos Aesthetics	2,090m^3	~950m^2, nominal thickness of ~2.2m
AEC16	Septic tank	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	5m^3	~3m^2, nominal thickness of 1.5m
AEC18	Construction material storage area near TP61 (north-west corner Lot 11)	Bonded asbestos	3m^3	~30m^2, nominal thickness of ~0.1m
AEC19a	North-west fill soils (Lot 11 north west)	Bonded asbestos	unknown	Unknown lateral extent, nominal thickness of ~0.3-4m thick
AEC21	Septic absorption pit (Lot 11 north-east of AEC23)	Bonded asbestos, aesthetics, and e. coli	100m³	~100m², nominal thickness of ~1m
AEC22	Septic tank	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, pathogens	5m^3	~3m^2, nominal thickness of 1.5m
AEC23	Former residential premises (Lot 11 west)	Bonded asbestos Aesthetics	unknown	Unknown lateral extent, nominal thickness of ~0.1m
AEC23a	ACM in wheelie bins (~~~2,500 m²~~ 3 wheelie bins containing ACM, Lot 11 west)	Bonded asbestos	750L	Three wheelie bins, approx. 250L each
AEC24a	Shallow filling(Lot 11 north-west of residence)	Friable asbestos	3m^3	~25m^2, nominal thickness of ~0.1m
AEC32	Area surrounding TP201 (Lot 13 north-east residence)	Bonded asbestos	8m³	~80m², nominal thickness of ~0.1m thick

Table 10.1 Inferred Extent of Remediation

ID	AEC	Contamination Risk	Indicative Volume (In-situ)	Assumptions
AEC32a	Area surrounding TP207 (Lot 13 north-east residence)	Bonded asbestos	Unknown	Unknown lateral extent, nominated thickness of ~0.1m
AEC39	Septic tank	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	5m^3	~3m^2, nominal thickness of 1.5m
Concrete stockpiles SP1 to SP10	Stockpiles of concrete	Aesthetics and potential for asbestos	200m^3	-
Concrete stockpiles SP11 to SP12	Stockpiles of concrete	Aesthetics and potential for asbestos	30m^3	-
Concrete stockpiles SP13 and SP14	Stockpiles of concrete	Aesthetics and potential for asbestos	7m^3	-
Concrete stockpiles SP15 and SP16	Stockpiles of concrete	Aesthetics and potential for asbestos	50m^3	-

It is noted that these inferred extents are based on a limited set of data that does not include soils underlying these AECs, and so plausible unacceptable contamination has been assumed. One or more of the extents may be subject to change, as a result of:

- Latent subsurface conditions;
- Temporal or seasonal fluctuations (particularly water content in dams / creeks / streams / ponds); and
- Supplementary contamination assessment works (as proposed in **Section 8.3** of this RAP).

It is also noted that the results of the supplementary assessment may also require a change to the preferred management / remediation strategy, or even potentially remove the need for management / remediation. Should the inferred extents, preferred strategy or need for management / remediation change, based on supplementary assessment works, these changes would be presented in either an addendum to this RAP, or in the site remediation and validation report (SRVR) prepared at the completion of the site remedial works.

10.2 Options Assessment For Known & Unknown Remedial Works

10.2.1 Preamble

When assessing management of contamination, the preferred hierarchy[12] of options for site clean-up and/or management should be considered, which includes:

- on-site treatment of the contamination so that it is destroyed, or the associated risk is reduced to an acceptable level; and
- 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; or

if the above are not practicable;

- consolidation and isolation of the soil by on-site containment with a properly designed barrier; and
- removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material; or
- 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.

10.2.2 Adopted Criterion

For the purpose of assessing the suitability of known and unknown remediation options considered appropriate for this project, Alliance has adopted a matrix that facilitates a qualitative score being assessed for each option being considered. That assessment matrix is presented in **Table 10.2.2**, in the context of the known unacceptable contamination risks onsite and unknown risks following supplementary assessments.

Table 10.2.2 Qualitative Remediation Options Assessment Criteria Matrix

ID	Performance Ranking Guidance and Scoring				
Criterion	**0**	**1**	**2**	**3**	**4**
Applicability	Not Applicable	←	→		Highly applicable
Technical Feasibility	Unfeasible	←	→		Highly feasible
Effectiveness	Not effective for desired outcome	←	→		Highly effective for desired outcome
Sustainability[13]	Unsustainable	←	→		
Stakeholder Acceptance	Not acceptable to EPA, Council or local community	←	→		Highly acceptable to EPA, Council or local community

[12] NEPC 2013, 'National Environment Protection (Assessment of Site Contamination) Measure 1999, Site Contamination Policy Framework, Section 6' dated May 2013

[13] In context of remediation, this is considered to refer to achieving an acceptable balance between the impacts of undertaking remediation activities and the benefits of those activities will deliver in terms of the environmental, economic and social indicators relevant to the site.

Table 10.2.2 Qualitative Remediation Options Assessment Criteria Matrix

ID	Performance Ranking Guidance and Scoring				
Criterion	**0**	**1**	**2**	**3**	**4**
Duration	Long term relative to redevelopment timeframe ←				→ Short term relative to redevelopment timeframe
Cost	Likely highest cost ←				→ Likely lowest cost

10.2.3 Potential Remedial Options Selection and Assessment

For the purpose of identifying remediation options for the site, consideration has been given to guidance in Section 3.1 of CRC CARE (2019c). Options considered appropriate, based on the inferred extents of remediation and nature of the contamination set out in **Section 10.1** of this RAP, are presented for bonded asbestos in **Table 10.2.3.1** & friable asbestos in **Table 10.2.3.2**.

The client advised Alliance that its preferred remediation option for septic systems, stockpiles of concrete and the ACM in the wheelie bins (AEC23a) is excavation and off-site disposal. The e. coli impacted material within AEC21 is to be disposed off-site due to the presence of bonded asbestos and demolition rubble which prevents on-site treatment.

A qualitative assessment of each relevant remediation option against the criterion adopted for this process, is also presented in **Table 10.2.3.1** & **Table 10.2.3.2**.

Table 10.2.3.1 Bonded Asbestos Remedial Option Assessment

Criterion	Excavate and Dispose	In-situ Containment	Onsite Treatment	Comments
Applicability	4	1	4	Excavation and disposal integrates well with proposed development work. Containment solution would not integrate well with proposed development design Onsite treatment of bonded ACM works well with proposed development, assuming treated soils have a purpose for the proposed development (e.g. achieving cut to fill earthworks design levels) and are not surplus to the needs of the site, noting treated soils would need to be placed below the surface (top 10cm of soil).
Technical Feasibility	4	1	4	Excavation and disposal methods readily available. Containment creates constraints for construction and related long term site management, not consistent with client preference. Onsite treatment methods available, with limitations based on soil type/structure.

Table 10.2.3.1 Bonded Asbestos Remedial Option Assessment

Criterion	Excavate and Dispose	In-situ Containment	Onsite Treatment	Comments
Effectiveness	4	2	4	Excavation is highly effective - unacceptable risks removed from site. Containment achieved by removing pathway between source and receptor. Onsite treatment effective if implemented correctly, with limitations based on soil type/structure.
Sustainability	1	3	4	Excavation not consistent with sustainability principles. Containment requires long term passive maintenance and constraints on land use. Onsite treatment is sustainable - relatively minor quantities of waste generated, and retention of soils onsite.
Stakeholder Acceptance	3	1	3	Excavation removes risk from site, however, major site disturbance and traffic impacts considered not sustainable by some stakeholders. Containment unlikely to be consistent with local Council contaminated land policy. Onsite treatment acceptable.
Duration	3	1	2	Offsite disposal comparatively fast, remediation unlikely to adversely impact project timeframe. Containment design, approval and construction likely to impact project timeframe. Onsite treatment would likely impact project timeframe.
Cost	1	3	3	Disposal costs are significantly high. Containment short term costs acceptable, but long term cost (management and future land value) may be unacceptable. Onsite treatment considered generally cost effective.
Score	**20**	**13**	**24**	

Table 10.2.3.1 Friable Asbestos Remedial Option Assessment

Criterion	Excavate and Dispose	In-situ Containment	Onsite Treatment	Comments
Applicability	4	1	0	Excavation and disposal integrates well with proposed development work. Containment solution would not integrate well with proposed development design Onsite treatment methods not available.
Technical Feasibility	4	1	0	Excavation and disposal methods readily available. Containment creates constraints for construction and related long term site management, not consistent with client preference. Onsite treatment methods not available.
Effectiveness	4	2	0	Excavation is highly effective - unacceptable risks removed from site. Containment achieved by removing pathway between source and receptor. Onsite treatment methods not available.
Sustainability	1	3	0	Excavation not consistent with sustainability principles. Containment requires long term passive maintenance and constraints on land use. Onsite treatment methods not available.
Stakeholder Acceptance	3	1	0	Excavation removes risk from site, however, major site disturbance and traffic impacts considered not sustainable by some stakeholders. Containment unlikely to be consistent with local Council contaminated land policy. Onsite treatment methods not available.
Duration	4	1	0	Offsite disposal comparatively fast, remediation unlikely to adversely impact project timeframe. Containment design, approval and construction likely to impact project timeframe. Onsite treatment methods not available.
Cost	1	3	0	Disposal costs are significantly high. Containment short term costs acceptable, but long term cost (management and future land value) may be unacceptable. Onsite treatment methods not available.
Score	**21**	**13**	**0**	

11 Preferred & Conceptual Remedial Options

Based on Alliance's understanding of a the known extent of unacceptable land contamination risks, the potential extent of unacceptable land contamination risks to be addressed during the supplementary assessment, the proposed land use scenario for the site, and the client's preferred remedial outcomes for the site, and the results of the potential options assessment presented in **Section 10.2**, the conceptual preferred remedial options for the site are presented for known land contamination risks in **Table 11.1** and currently unknown land contamination risks in **Table 11.2**.

It is noted that the conceptual remedial options are based on a qualitative assessment of a limited set of data. One or more of the preferred options may be subject to change, as a result of:

- Latent subsurface conditions, including unexpected finds;
- Temporal or seasonal fluctuations (particularly water content in dams / creeks / streams / ponds); and
- Supplementary contamination assessment works (as proposed in **Section 8.3** of this RAP).

It is also noted that the results of the supplementary assessment may also require a change to the preferred remedial options. Should this scenario arise, that change would be presented in either an addendum to this RAP, or in the site remediation and validation report (SRVR) prepared at the completion of the site remedial works.

Table 11.1 Preferred remedial options

AEC	Potential Contamination Risk	Preferred Remedial Option and Method
AEC01a, AEC19a, & AEC32a	Bonded asbestos in fill soils >0.1m below surface	Works will be undertaken in a manner that avoids further damage or burial of the ACM by the process. Establish a treatment pad area. Staged excavation of fill soils and spreading across treatment pad to a thickness no greater than 0.1m. Systematic inspection of surface of spread material and hand picking of visible ACM fragments. Rake spread soils in one direction, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. Rake spread soils in a direction 90^{o} perpendicular to the first raking direction, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. ACM fragments will be disposed to a suitably licensed waste receiving facility, with a waste classification. This method (as opposed to hand raking) is proposed, to accommodate the physical properties of soils (cohesive). Validation of the raked area will be undertaken in accordance with **Section 13**.

AEC	Potential Contamination Risk	Preferred Remedial Option and Method
AEC09b, AEC18, AEC23, & AEC32	Bonded asbestos in surface soils ≤0.1m below surface	Works will be undertaken in a manner that avoids further damage or burial of the ACM by the process. Systematic inspection of surface and hand picking of visible ACM fragments. Rake surface soils in one direction, to a depth of 0.1m below ground level, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. Rake surface soils in a direction 90° perpendicular to the first raking direction, to a depth of 0.1m below ground level, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. ACM fragments will be disposed to a suitably licensed waste receiving facility, with a waste classification. This method (as opposed to hand raking) is proposed, to accommodate the physical properties of surface soils and likely presence of anthropogenic materials in the surface soils. Validation of the raked area will be undertaken in accordance with **Section 13**.
AEC13, AEC14, & AEC24a	Asbestos fines in surface and/or fill soils	Excavate soils and dispose to suitably licensed waste receiving facility, with a waste classification. Validation of the residual excavation will be undertaken in accordance with **Section 13**. Backfill remedial excavation.
AEC21	Bonded asbestos, aesthetics and e. coli	Excavate soils and dispose to suitably licensed waste receiving facility, with a waste classification. Validation of the residual excavation will be undertaken in accordance with **Section 13**. Backfill remedial excavation.
AEC16, AEC22 and AEC39	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, & pathogens	Remove content of septic tank by suitably licensed contractor and dispose content offsite with appropriate waste classification. Demolish and excavate the tank, and dispose offsite with appropriate waste classification. Flush irrigation lines, spray head, sprinklers and drippers with potable water for 5 minutes. Validation of the residual excavation will be undertaken in accordance with **Section 13**. Backfill remedial excavation.
AEC23a	Bonded asbestos	Disposal to a suitably licensed waste receiving facility, with a waste classification.
Concrete stockpiles (SP1 to SP16)	Aesthetics and potential for asbestos	Disposal to a suitably licensed waste receiving facility, with a waste classification.

Table 11.2 Conceptual remedial options

AEC	Potential Contamination Risk	Conceptual Remedial Option and Method
Subject to supplementary contamination assessment	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyl, metals, VOC, pathogens	Excavate soils and dispose to suitably licensed waste receiving facility, with a waste classification. Validation of the residual excavations will be undertaken in accordance with **Section 13**. Backfill remedial excavation.
Subject to supplementary contamination assessment	Bonded asbestos in fill soils >0.1m below surface	Works will be undertaken in a manner that avoids further damage or burial of the ACM by the process. Establish a treatment pad area. Staged excavation of fill soils and spreading across treatment pad to a thickness no greater than 0.1m. Systematic inspection of surface of spread material and hand picking of visible ACM fragments. Rake spread soils in one direction, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. Rake spread soils in a direction 90^{o} perpendicular to the first raking direction, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. ACM fragments will be disposed to a suitably licensed waste receiving facility, with a waste classification. This method (as opposed to hand raking) is proposed, to accommodate the physical properties of soils (cohesive). Validation of the raked area will be undertaken in accordance with **Section 13**.
Subject to supplementary contamination assessment	Bonded asbestos in surface soils $\leq$0.1m below surface	Works will be undertaken in a manner that avoids further damage or burial of the ACM by the process. Systematic inspection of surface and hand picking of visible ACM fragments. Rake surface soils in one direction, to a depth of 0.1m below ground level, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. Rake surface soils in a direction 90o perpendicular to the first raking direction, to a depth of 0.1m below ground level, using an excavator fitted with a tooth bucket. Systematic inspection of raked surface and hand picking of visible ACM fragments. ACM fragments will be disposed to a suitably licensed waste receiving facility, with a waste classification. This method (as opposed to hand raking) is proposed, to accommodate the physical properties of surface soils and likely presence of anthropogenic materials in the surface soils. Validation of the raked area will be undertaken in accordance with **Section 13**.

AEC	Potential Contamination Risk	Conceptual Remedial Option and Method
Subject to supplementary contamination assessment	Asbestos fines in surface and/or fill soils	Excavate soils and dispose to suitably licensed waste receiving facility, with a waste classification. Validation of the residual excavation will be undertaken in accordance with **Section 13**. Backfill remedial excavation.
Subject to supplementary contamination assessment	Aesthetics	Establish treatment pad. Process soils using sieve bucket, mechanical screens or similar, to manage/remove anthropogenic materials to a level consistent with qualitative aesthetic criteria. Validation of the treated soils will be undertaken in accordance with **Section 13**.
Subject to supplementary contamination assessment	Bonded asbestos in concrete stockpiles (SP1 to SP16)	Excavate soils and dispose to suitably licensed waste receiving facility, with a waste classification. Validation of the residual stockpile footprints will be undertaken in accordance with **Section 13**. Backfill remedial excavation.

12 Remedial Strategy

The remedial strategy set out below, is conceptual in nature, and has been prepared as a guide on the assumption that supplementary contamination assessment works at the site, identifies unacceptable land contamination risks, and assumptions around likely remedial works, compared to similar scenarios on similar residential subdivision sites. In the event the supplementary contamination assessment works do not identify unacceptable land contamination risks, then the strategies set out in **Table 11.2** of this RAP would be obsolete.

12.1 Schedule of Remediation

Remedial works would be expected to take three to six months to complete. This timeframe would be refined following appointment of a remediation contractor.

12.2 Notifications and Approvals

A notification of intent to undertake remedial works will be submitted to the relevant planning authority, 30 days prior to the date that remedial works (excluding any supplementary contamination assessment works where proposed) are intended to commence.

Alliance understands that remedial works classified as Category 2 under State Environmental Planning Policy (SEPP) 55, do not require development consent. However, in the event that the proposed remedial works trigger the Category 1 criteria in SEPP 55, including but limited to issues related to:

- designated development under the Environmental Planning and Assessment Regulation;
- critical habitat under the Threatened Species Conservation Act;
- the works having a significant effect on threatened species, populations or ecological communities or their habitats;
- the works being located in areas of environmental significance; or
- requiring consent under another SEPP or a regional environmental plan (REP),

then development consent for the remedial works may be required.

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.

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, in accordance with **Section 15.3** of this RAP.

Development consent or a construction certificate will be obtained (if required) from the relevant planning authority for demolition, excavation and/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 include an underground and/or aboveground storage tank.

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

A water access licence will be obtained (if required) from Water NSW, in the event remediation works requires water to be taken at specified times, rates and circumstances from specified areas or locations.

A water supply work and use approval will be obtained (if required) from Water NSW, in the event remediation works requires construction and use of a specific water supply at a specified location. Water supply works may include pumps, bores, spear points and wells.

Asbestos removal works (if required) will be notified to SafeWork NSW by the remediation contractor. The asbestos removal works will be undertaken by a contractor that will hold a:

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

Within 30 days of completion of all remediation and validation works, a notice of completion of the remedial works will be submitted to the relevant planning authority.

12.3 Structural Stability

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.

12.4 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 and/or competent person, prior to commencing demolition of the structures. The clearance certificate will be prepared with reference to guidance provided in Appendix D of SafeWork NSW (2019).

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

12.5 Remedial Works

The preferred remedial options (and associated methodologies) to be adopted for each of the identified AEC or potential contamination risks, are presented in **Section 11** of this RAP, and any addenda prepared for 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**, and any subsequent addenda prepared for 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;
- Mixing treated material back into onsite soils;
- Disposal of wastes to appropriately licensed facilities; and
- Retaining records of the transport and disposal of all wastes generated during remedial works.

12.6 Unexpected Finds, Unsuccessful Remedial Strategies 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 12.6** could occur during remedial works.

Contingency plans and protocols to be implemented, should those scenarios arise, are also presented in **Table 12.6**.

Table 12.6 Unexpected Finds, Unsuccessful Remedial Strategies and Contingency Plans

Unexpected Find Scenario / Unsuccessful Remedial Strategy	Contingency Plan
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.

Table 12.6 Unexpected Finds, Unsuccessful Remedial Strategies and Contingency Plans

Unexpected Find Scenario / Unsuccessful Remedial Strategy	Contingency Plan
	Remediate the unexpected contamination. Undertake validation of the remedial works.
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 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 the outcomes and of the soil and/or groundwater assessment works. Remediate the unexpected contamination. Undertake validation of the remedial works.

12.7 Material Importation and Backfilling of Remedial Excavations

Should backfilling of remedial excavations be required, then backfill material being imported onto site will be lawful and 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, moisture content) is not within the scope of this RAP and will be specified by others.

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

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 placement location of imported material.

13 Site Validation Data Quality Objectives (DQO)

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 land contamination risks at the site.

The site validation data quality objectives (DQO) set out below, are conceptual in nature, and have been prepared as a guide on the assumption that supplementary contamination assessment works at the site, identifies unacceptable land contamination risks, and assumptions around likely remedial works, compared to similar scenarios on similar residential subdivision sites. In the event the supplementary contamination assessment works do not identify unacceptable land contamination risks, then the DQO set out in Section 13 of this RAP would be obsolete.

13.1 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 Alliance project director, Alliance project manager, Alliance field staff and Alliance's 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.

13.2 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:

- 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 remediation objective been achieved?
- Is the site suitable, in the context of land contamination, for the proposed land use scenario?

13.3 Step 3: Identify the information inputs

The information inputs required to make the decisions for the project set out in **Section 13.2**, include:

- Data obtained during the site history review, site walkover and remediation works observations;
- Records produced by the remediation contractor and other relevant 3rd parties, during the undertaking of remediation works;
- Identification of sample media that needs to be collected, as set out in **Section 13.7**;
- Parameters that will be measured in each relevant sample, as set out in **Section 13.7**;

- 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 13.7** of this report; and
- The site criteria for the media of concern. These criteria are set out in **Table 13.3** and will be adopted based on the proposed land use scenario[14], identified receptors, and site-specific soil and groundwater conditions (where relevant).

Table 13.3 Adopted Tier 1 Site Assessment Screening Criteria

Exposure Pathway	Land Use Scenario[15]	Criteria Reference
Human health dermal contact / ingestion / dust inhalation	HIL D - Commercial / industrial	Table 1A(1) in NEPC (2013a) Table B4 in Friebel, E & Nadebaum P (2011) Table 3-1 in NSW EPA (2000)
Human health (asbestos)	Commercial / industrial D	Table 7 in NEPC (2013a)[16]
Human health (aesthetics)	All	Characteristics and processes in Section 3.6.2 and 3.6.3 in NEPC (2013a)
Management Limits (petroleum hydrocarbons)	Commercial / industrial	Table 1B(7) in NEPC (2013a)

13.4 Step 4: Define the boundaries of the study

The spatial extent of the project will be limited to:

- The boundaries of the site as set out in **Section 2**; and
- Physical constraints or infrastructure on site or on land adjacent to the site, that prevents safe and reasonable access for project team members and/or typical and readily available equipment used for projects of this nature.

The scale of the decisions required (as set out in **Section 13.2**) will be based on the boundaries of the site set out in **Section 2**.

The vertical and lateral extents of validation works will be limited to the extends of remediation works undertaken on relevant AECs identified in the CSM (refer **Section 6**), which are likely to be:

- The inferred vertical extent of AECs, identified as AEC01a, AEC09b, AEC13, AEC14, AEC16, AEC19a, AEC21, AEC22, AEC23, AEC23a, AEC32, AEC32a, AEC39 and concrete stockpiles SP1 to SP16, as shown in Table 10.1 and based on the results of the SCA outlined in **Section 8**;
- The inferred lateral boundaries of each identified AEC (where applicable).

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

[14] 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.
[15] Consideration will be given to soil type, soil texture, soil depth, groundwater depth and appropriate species protection levels.
[16] A depth of up to 10cm below ground level is adopted to define 'surface soil'.

The temporal boundaries of the project will include:

- Availability of project team members (including subcontractors and subconsultants) to collect and assess relevant project data;
- The availability of site access to undertake fieldwork; and
- Meteorological conditions including heat, cold, wind, rain and snow, which may constrain undertaking of fieldwork, or may affect the quality of the data being collected.

13.5 Step 5: Develop the analytical approach

13.5.1 Field Duplicates and Triplicates

A minimum of one set of field duplicates and triplicates will be collected for each set of 20 samples collected (an equivalent of 5%), excluding asbestos samples.

Field duplicate and triplicate samples will be collected by splitting one bulk sample across three separate sample containers. Soil samples will not be homogenised, particularly where volatile or semi volatile COPC are being considered.

Analysis of the duplicate samples and triplicate samples will be scheduled based on at least one of the analytes that the relevant parent sample is being analysed for.

The relative percent difference (RPD) of the detected concentrations in the parent and duplicate, and the parent and triplicate, will be calculated, and the result compared to the relevant data quality indicator (DQI), as set out in **Section 13.5.6**.

13.5.2 Trip Spikes and Trip Blanks

One trip spike and one trip blank will be used for each day of sampling[17].

A minimum of one trip spike and one trip blank will be scheduled for BTEX analysis, during the project, provided the sample preservation, handling, transport and storage procedures used are the same for each day of sampling undertaken.

13.5.3 Equipment Rinsate Blanks

One rinsate blank will be used for each day of sampling[18].

A minimum of one rinsate blank will be scheduled for analysis for at least one of the COPC, during the project, provided sample collection and equipment decontamination procedures are the same for each day of sampling.

[17] When samples are being collected on that day, that will be analysed for BTEX and/or TRH C_6-C_{10}.
[18] Only where non-disposable sampling equipment is being used on that day.

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).

13.5.4 Field Blanks

One field blank will be used for each day of sampling[19].

13.5.5 Analytical Laboratory Quality Assurance and Quality Control

The primary analytical laboratory will:

- be NATA accredited for the methods used; and
- use a quality assurance and quality control (QA/QC) program that will typically include analysis of method blanks, matrix spikes, surrogate spikes, laboratory control samples and laboratory duplicates.

The primary analytical laboratory will report on whether the analytical results of the QA/QC program are within the criteria set out in the laboratory's adopted data quality objectives.

13.5.6 Data Quality Indicators

A set of data quality indicators (DQI) will be adopted for assessing the completeness, comparability, representativeness, precision and bias (accuracy) of data collected during fieldwork, the analytical data produced by the laboratory. Each of these DQI, and associated target criteria are set out in **Table 13.5.6**.

[19] When samples are being collected on that day, that will be analysed for PFAS.

Table 13.5.6. Data Quality Indicators and Target Criteria

Completeness			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Experienced sampling team used	Yes	Complete sample receipt advice and chain of custody attached	Yes
Sampling devices and equipment set out in sampling plan were used (refer Section 13.7).	Yes	Critical samples identified in sampling plan, analysed	Yes
Critical locations in sampling plan, sampled (refer Section 13.7).	Yes	Analysis undertaken addresses COPC in sampling plan (refer Section 13.7)	Yes
Critical samples in sampling plan, collected (refer Section 13.7).	Yes	Analytical methods reported in laboratory documentation and appropriate limit of reporting used	Yes
Completed field and calibration logs attached	Yes	Sample holding times met (refer Section 13.7)	Yes
Completed chain of custody attached	Yes		

Comparability			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Same sampling team used for all work.	Yes	Same laboratory used for all analysis (refer Section 13.7).	Yes
Weather conditions suitable for sampling.	Yes	Comparable methods if different laboratories used Refer Section 13.7).	Yes
Same sample types collected and preserved in same way (refer Section 13.7).	Yes	Comparable limits of reporting if different laboratories used.	Yes
Relevant samples stored in insulated containers and chilled (refer Section 13.7).	Yes	Comparable units of measure if different laboratories have been used (refer Section 13.7).	Yes

Representativeness			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Media identified in sampling plan, sampled (refer Section 13.7).	Yes	Samples identified in sampling plan, analysed.	Yes
Samples required by sampling plan, collected (refer Section 13.7).	Yes		

Precision			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Minimum 5% duplicates and triplicates collected and analysed (refer Section 13.5).	Yes	All laboratory duplicate RPDs within laboratory acceptance criteria (refer Section 13.5).	Yes

Table 13.5.6. Data Quality Indicators and Target Criteria

RPD unlimited where detected concentrations are <10 times the limit of reporting.	Yes		
RPD within 50% where detected concentrations are 10-20 times the limit of reporting.	Yes		
RPD within 30% where detected concentrations are >20 times the limit of reporting.	Yes		

Bias (Accuracy)			
Field Considerations	***Target Criteria***	***Laboratory Considerations***	***Target Criteria***
Trip blank analyte results less than limit of reporting (refer Section 13.5).	Yes	Laboratory method blank results within laboratory acceptance limits (refer Section 13.5).	Yes
Trip spike analyte results less between 60% and 140% (refer Section 13.5).	Yes	Laboratory control sample results within laboratory acceptance limits (refer Section 13.5).	Yes
Rinsate blank analyte results less than limit of reporting (refer Section 13.5).	Yes	Laboratory spike sample results within laboratory acceptance limits.	Yes

13.5.7 If / Then Statements

If the field and laboratory analytical dataset meets the DQI target assessment criteria, then the data may be considered adequately complete, comparable, representative, precise and unbiased, for the purpose of addressing the decisions / goals of this project as set out in **Section 13.2**.

If the field and laboratory analytical dataset does not meet the DQI target assessment criteria, then additional data may need to be collected to address gaps identified in the data.

If the field and laboratory analytical results are within the adopted land contamination assessment criteria (refer **Section 13.3**), then it may be assessed that identified land contamination at the remediation objective has been achieved, and that the site does not present an unacceptable human health and/or ecological exposure risk, based on the adopted land use scenario.

If the field and laboratory analytical results are outside adopted land contamination assessment criteria (refer **Section 13.3**), then it may be assessed that identified land contamination at the site presents an unacceptable human health and/or ecological exposure risk, or that supplementary site specific qualitative / quantitative risk assessment may be required, or that further contamination management / remediation work is required.

13.6 Step 6: Performance and Acceptance Criteria

13.6.1 If / The Decisions

There are two types of decision error:

- Sampling errors – these occur when the sampling program does not adequately detect variability of a contaminant from point to point across a 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 in that contaminant); and
- Measurement errors - these occur during sample collection, preparation, analysis and reduction of data.

During land contamination assessment, these errors can result in either:

- a Type I error, where land contamination human health exposure risks are considered to be acceptable, when they are not acceptable; or
- a Type II error, where land contamination human health exposure risks are considered to be unacceptable, when they are// acceptable.

For decision rules to be sound, they should be designed to mitigate risk of decision errors occurring. The risk of decision error on this project will be mitigated by:

- Ensuring fieldwork is undertaken by suitably experienced field staff and sub-contractors, with reference to the DQO adopted for this project;
- Ensuring laboratory analysis is undertaken by NATA accredited laboratories; and
- Ensuring assessment of field and laboratory analytical data is undertaken by suitably experienced environmental consultants and/or outsourcing assessment to technical experts (if warranted).

13.7 Step 7: Develop the plan for obtaining data

13.7.1 Sampling Point Densities and Locations

Section 5.1 in NSW EPA (2022) provides guidance regarding probabilistic sampling and judgemental sampling.

A probabilistic sampling design uses random selection that when properly applied, results in unbiased and independent data. For an optimal design, using probabilistic sampling, an accurate CSM is required, including a clear definition of the population to be sampled. Systematic grid based sampling is a probabilistic method.

A judgemental sampling design requires decisions on where and/or when to collect samples, and relies on good site histories and/or site features being clear and distinct. The method can be efficient for assessing areas of worse case impacts and can be useful where site history is inadequate or the features of concern are obscured or not discernible. Targeted sampling is a judgemental method. Section 6.2.1 in NEPC (2013b) advises that judgemental sampling and the selection of samples (number, location, timing, etc) should be based on knowledge of the site and professional judgement. In these instances, 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 laned contamination assessment. Judgemental sampling can be used to investigate sub-surface contamination issues in site assessment.

Stratified sampling comprises a combination of systematic and judgemental sampling, for sites with different uses, features and complex contaminant distributions, where a site is divided into various non-overlapping sub areas, according to geological and geographical features. Each sub area can then be treated as an individual decision area with different sampling patterns and sampling densities applied. For example, on area might require targeted sampling while a neighbouring one might need systematic sampling.

A stratified sampling strategy requires reliable prior knowledge of the site. NEPC (2013b) notes that stratified sampling can provide:

- potential for achieving greater precision in estimates of the mean and variance where the measurement of interest is strongly correlated with the variable used to define the strata; and
- calculation of reliable estimates for subgroups of special interest.

Table 2 in NSW EPA (2022) provides guidance on minimum sampling point densities required for characterising a site, based on detecting circular hot spots, by using a systematic sampling pattern.

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

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 systematic grid based and judgemental sampling patterns, using the preferred sampling point densities set out for known contamination risks in **Table 13.7.1**, and unknown contamination risks in **Table 13.7.2**.

Table 13.7.1 Preferred Validation Sampling Point Densities and Locations

ID	Contamination Risk	Preferred Validation Strategy
AEC01a & AEC19a	Bonded asbestos in fill soils >0.1m below surface	A visual assessment of the residual remediation excavation footprint and photographic record. A visual inspection of each batch of treated material. Collect one representative 10L sample per spread or per 70m^3 of treated material for bonded ACM field screening, whichever is less. Visual validation of excavation base and walls if exposed natural material, otherwise collect: • one 10L sample per 5m x 5m of excavation base; and • one 10L sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four. for bonded ACM field screening. Clearance certificate from a licensed asbestos assessor (LAA) or competent person.

Table 13.7.1 Preferred Validation Sampling Point Densities and Locations

ID	Contamination Risk	Preferred Validation Strategy
AEC09b, AEC18, AEC32, & AEC32a	Bonded asbestos in surface soils ≤0.1m below surface	A visual assessment of the residual remediation excavation footprint and photographic record. Visual inspection of surface soils for visible asbestos. Clearance certificate from a licensed asbestos assessor (LAA) or competent person.
AEC13, AEC14, & AEC24a	Asbestos fines in surface and/or fill soils	A visual assessment of the residual remediation excavation footprint and photographic record. Collect: • one 500mL sample per 5m x 5m of excavation base; and • one 500mL sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four. Clearance certificate from a licensed asbestos assessor (LAA).
AEC21	Bonded asbestos, aesthetics and e. coli	A visual assessment of the residual remediation excavation footprint and photographic record. Visual validation of excavation base and walls if exposed natural material, otherwise collect: • one 10L sample per 5m x 5m of excavation base; and • one 10L sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four. for bonded ACM field screening. Also: • one 10L sample per 5m x 5m of excavation base; and • one 10L sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four. for e. coli. Clearance certificate from a licensed asbestos assessor (LAA) or competent person.
AEC16, AEC22 & AEC39	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, E. Coli and thermotolerant coliforms	A visual assessment of the residual remediation excavation footprint and photographic record. Collect: • one jar sample per 5m x 5m of excavation base; and • one jar sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four.
AEC23a	Bonded asbestos	Confirmation of appropriate off-site disposal of ACM within the wheelie bins.
Concrete stockpiles SP1 to SP16	Aesthetics	A visual assessment of the residual remediation excavation footprint and photographic record.
-	Imported VENM for backfilling	Site specific — VENM to be validated using the procedures set out in https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/virgin-excavated-natural-material

Table 13.7.1 Preferred Validation Sampling Point Densities and Locations

ID	Contamination Risk		Preferred Validation Strategy
-	Imported ENM for backfilling	Refer The excavated natural material 2014 Order and Exemption	Quantity dependent – refer to The excavated natural material (ENM) resource recovery exemption. Laboratory analysis of all samples as per Order and Exemption.
-	Imported Other for backfilling	Refer relevant Order and Exemption	Quantity dependent – refer to the relevant resource recovery exemption. Laboratory analysis of all samples as per Order and Exemption.

In the event unacceptable contamination risks are identified in those AECs being subjected to supplementary contamination assessment works and they are remediated, then conceptual validation strategies to address the COPCs being potentially being remediated in those AECs, are presented in **Table 13.7.2**.

Table 13.7.2 Preferred Conceptual Validation Sampling Point Densities and Locations

ID	Potential Contamination Risk	Preferred Conceptual Validation Strategy
Subject to supplementary contamination assessment	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, pesticides, polychlorinated biphenyl, metals, VOC	A visual assessment of the residual remediation excavation and photographic record. Collect one sample per 5m x 5m of excavation base. Collect one sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is the greater frequency, minimum four. Laboratory analysis of all samples for relevant contaminants of concern.
Subject to supplementary contamination assessment	Bonded asbestos in fill soils >0.1m below surface	A visual assessment of the residual remediation excavation footprint and photographic record. A visual inspection of each batch of treated material. Collect one representative 10L sample per spread or per 70m^3 of treated material for bonded ACM field screening, whichever. Visual validation of excavation base and walls if exposed natural material, otherwise collect: • one 10L sample per 5m x 5m of excavation base; and • one 10L sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four. for bonded ACM field screening. Clearance certificate from a licensed asbestos assessor (LAA) or competent person.
Subject to supplementary contamination assessment	Bonded asbestos in surface soils ≤0.1m below surface	A visual assessment of the residual remediation excavation footprint and photographic record. Visual inspection of surface soils for visible asbestos. Clearance certificate from a licensed asbestos assessor (LAA) or competent person.
Subject to supplementary contamination assessment	Asbestos fines in surface and/or fill soils	A visual assessment of the residual remediation excavation footprint and photographic record. A visual inspection of each batch of treated material.

Table 13.7.2 Preferred Conceptual Validation Sampling Point Densities and Locations

ID	Potential Contamination Risk	Preferred Conceptual Validation Strategy
		Collect: • one 500mL sample per 5m x 5m of excavation base; and • one 500mL sample per ten lineal metres of excavation wall, for each relevant stratum, or per vertical metre of excavation depth, whichever is greater, minimum four. Clearance certificate from a licensed asbestos assessor (LAA).
Subject to supplementary contamination assessment	Aesthetics	A visual assessment of the residual remediation excavation and photographic record.

13.7.2 Sampling Methods

13.7.2.1 Soils

Samples collected from excavation bases and footprints, will typically be collected across a depth of 0.0-0.1m below the surface.

Samples collected from excavation walls will typically be collected across a profile 0.1 to 0.2m in thickness and will target suspect material based on visual and/or olfactory observations.

Samples collected from stockpiles, will be collected from a minimum of 0.3m below the surface of the stockpile. The sampling pattern for the stockpile will be a three- dimensional representative grid of sampling points across stockpile being assessed, taking into consideration guidance in Section 7.5.3 of NEPC (2013) and Figure 2 of EPA VIC (2009).

Samples requiring asbestos gravimetric screening will be 10L in volume, with sampling targeting suspect asbestos material or construction debris, and screened with reference to Table 5 in WA DOH (2009).

Samples requiring calculation of asbestos fines (AF) and fibrous asbestos (FA), with sampling targeting suspect asbestos material or construction debris, and 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.

Samples will be submitted to a NATA accredited laboratory for analysis.

13.7.3 Decontamination

Non-disposable sampling equipment will be decontaminated between sampling points to mitigate potential for cross contamination of samples. Decontamination will include the following procedure:

- Washing 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;
- Rinsing the washed equipment with distilled or de-ionised water; and
- Air drying of the rinsed equipment.

13.7.4 Headspace Screening

When COPC identified for the site include volatiles (e.g. BTEX, TRH or VOC), collected soil samples will be subjected to headspace screening for ionisable volatile organic compounds, using a calibrated photo-ionisation detector (PID) fitted with a 10.6 eV lamp. A sub sample from each collected sample 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 borehole or test pit log.

13.7.5 Sample Identification, Handling, Storage and Transport

Soil samples will be identified using the relevant Alliance project number, the sampling point identification number and the sampling depth interval (e.g. BH01/0.0-0.2 or TP05/0.5-0.7), 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 and water samples will be stored in insulated containers with ice.

Samples will be transported to the relevant analytical laboratory by Alliance or a third party courier, using chain of custody (COC) documentation.

13.7.6 Selection of Laboratory

The analytical laboratories used for this project will reputable industry recognised environmental laboratories, that are NATA accredited for the analytical methods used.

13.7.7 Scheduling of Laboratory Analysis

Collected samples will be scheduled for laboratory analysis based on:

- The COPC identified for the AEC the sample was collected from;
- Observations made of the sample when collected (including staining, odour, presence of anthropogenic materials, and presence of potential asbestos containing materials);
- The results of sample headspace screening (if applicable); and
- The need for specific qualitative or quantitative data to inform assessment of risk associated with other laboratory analytical data (e.g. pH, cation exchange capacity, clay content, organic carbon content).

The laboratory analytical schedule (including upper limiting sample quantities) adopted for this project, is set out in **Table 13.7.7**.

Table 13.7.7 Schedule of Laboratory Analysis

ID	AEC	All samples collected
AEC01a	Soil within vicinity of TP09	Bonded asbestos (field screening)
AEC09b	Dam 5 Sediments (Lot 12 north)	Bonded asbestos (field screening)
AEC13	Commercial paint warehouse (Central southern portion of Lot 12)	Bonded (field screening) and friable asbestos (0.001% w/w)
AEC14	Gully between northern dams in Lot 12	Asbestos
AEC16	Septic tank and absorption area at Lot 12[20]	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, E. Coli and thermotolerant coliforms
AEC18	Construction material storage area near TP61 (north-west corner Lot 11)	Bonded asbestos (field screening)
AEC19a	North-west fill soils (Lot 11 north west)	Bonded asbestos (field screening)
AEC21	Septic absorption pit	E. Coli
AEC22	Septic tank and absorption area at Lot 11	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, E. Coli and thermotolerant coliforms
AEC23	Former residential premises (Lot 11 west)	Bonded asbestos (field screening)
AEC23a	ACM in wheelie bins (~~≈2,500 m²~~ 3 wheelie bins containing ACM, Lot 11 west)	Bonded asbestos (field screening)
AEC24a	Shallow fill (Lot 11 north-west of residence)	Asbestos (field screening)
AEC32	Area surrounding TP201 (Lot 13 north-east residence)	Bonded asbestos (field screening)
AEC32a	Area surrounding TP207 (Lot 13 north-east residence)	Bonded asbestos (field screening)
AEC39	Septic tank and absorption area at Lot 13	Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, metals, E. Coli and thermotolerant coliforms
-	Virgin excavated natural material	All samples for relevant contaminants of concern, based on guidance presented in https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/virgin-excavated-natural-material
-	Excavated natural material	All samples for the chemicals and attributes in Table 4 of the excavated natural material Order 2014.
-	Other imported material	All samples for the relevant chemicals and attributes in the relevant resource recovery order.

The laboratory analytical schedule adopted for this project for the conceptual remedial works will depend on the results of the SCA. Samples will be analysed for the relevant contaminants of concern identified in the SCA.

13.7.8 Analytical Methods, Limits of Reporting and Holding Times

The analytical methods, limits of reporting and sample holding times adopted for this project, are set out in **Table 13.7.8.**

Table 13.7.8 Analytical Methods, Limits of Reporting and Holding Times

Analyte	Method	Limit of Reporting (mg/kg)	Limit of Reporting (µg/L)	Holding Time
BTEX and TRH C_6-C_{10}	USEPA 5030, 8260B and 8020	0.2-0.5	1-2 and 50	14 days
TRH C_{10}-C_{40}	USEPA 8015B & C	20-100	50-500	14 days
PAH	USEPA 8270	0.1-0.2	0.5-10	14 days
PCB	USEPA 8270	0.2	-	14 days
OCP	USEPA 8081	0.2	-	14 days
Metals (Hg and Cr^{vi})	USEPA 8015B & C	0.05-2	0.1-5	6 months (28 days)
Asbestos ID	AS4926	Absence / presence	-	No limit
Asbestos (WA DOH)	Inhouse	0.001% w/w	-	No limit
E. Coli	AS 4276.5:2007	10 MPN/g	1 cfu/100mL	
Faecal Coliforms	AS 4276.5:2007	10 MPN/g	1 cfu/100mL	

[20] After the removal of the septic tanks and absorption areas, validation sampling will be undertaken.

14 Site Remediation and Validation Report

The remediation and validation reporting strategy set out below, is conceptual in nature, and has been prepared as a guide on the assumption that supplementary contamination assessment works at the site, identifies unacceptable land contamination risks, and assumptions around likely remedial works, compared to similar scenarios on similar residential subdivision sites. In the event the supplementary contamination assessment works do not identify unacceptable land contamination risks, then the strategies set out in Section 14 of this RAP would be obsolete.

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

15 Site Management Plan

The site management plan strategy set out below, is conceptual in nature, and has been prepared as a guide on the assumption that supplementary contamination assessment works at the site, identifies unacceptable land contamination risks, and assumptions around likely remedial works, compared to similar scenarios on similar residential subdivision sites. In the event the supplementary contamination assessment works do not identify unacceptable land contamination risks, then the strategies set out in Section 15 of this RAP would be obsolete.

15.1 Register of Contacts

A register of contact details of stakeholders considered relevant to the project, is presented in **Table 15.1**.

Table 15.1 Register of Contacts

Role	Person	Stakeholder	Contact
Emergency Services	-	Police / Fire Ambulance	000
Site Owner	Private owners and/or ESR	-	-
Project Owner	Toby Young	ESR	0422 598 431
Planning Authority	-	Penrith City Council	02 4732 7777
WHS Regulatory Authority	-	SafeWork NSW	131 050
Environmental Regulatory Authority	-	NSW EPA	131 500
Remediation Contractor	To be confirmed	To be confirmed	To be confirmed
Environmental Consultant	Thalia Park-Ross	Alliance Geotechnical	0459 261 668
Occupational Hygienist	Shambhu Shrestha	Alliance Geotechnical	0430 808 612

15.2 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.

Contact details to be used in the event of an emergency, are presented in **Table 15.1**.

15.3 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 responded to, in accordance with arrangements agreed to between the remediation contractor and the principal.

15.4 Signage, Security and Hours of Operations

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

- Monday to Friday between 7:00am and 5:00pm, and Saturday between 8:00am and 1:00pm; or
- days and times set out in the relevant development consent conditions (if available), which will take precedent over the aforementioned days and times.

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.

15.5 Workplace Health and Safety

15.5.1 Safe Work Method Statements

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.

15.5.2 Personal Protective Equipment (PPE)

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

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

15.5.3 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 landfill remediation.

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

15.5.4 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.

15.5.5 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; and
- Washing of hands (including prior to eating, drinking or smoking).

15.6 Asbestos Removal Control Plan (ARCP)

An asbestos removal control plan (ARCP) is a document that identifies the specific control measures that will be used to ensure workers and other people are not at unacceptable risk when asbestos removal work is being conducted. It is focused on the specific control measures necessary to minimise risk from exposure to asbestos.

An ARCP plan helps ensure the asbestos removal is well planned and carried out in a safe manner. An asbestos removal control plan is only required to be prepared for licensed asbestos removal work. However, one can be prepared to assist when planning asbestos removal work that does not require a licence.

Asbestos registers relevant to the asbestos to be removed and the area to be worked on, will be taken into account when preparing an ARCP.

The structure of the ARCP will address the specific requirements for each job, and will be prepared with reference to Appendix B in SafeWork NSW (2019).

For works involving the management and/or removal of asbestos, an asbestos removal control plan (ARCP) will be prepared before licensed asbestos removal work commences The ARCP will include details of:

- how the asbestos removal will be undertaken, including the method, tools, equipment and PPE to be used; and
- the asbestos to be removed, including the location, type and condition of the asbestos.

Specifications and drawings relevant to the asbestos removal work, will be attached to the ARCP, to provide additional information about the asbestos.

Preparation of the ARCP will include, as far as is practicable, consultation with the client, the person with management or control of the site, workers, and workers' health and safety representatives.

For residential asbestos removal work, the person conducting a business or undertaking (PCBU) and the owner/occupier will also be consulted.

Once prepared, copies of the ARCP will be:

- given to the person who commissioned the licensed asbestos removal work
- kept at the workplace until the completion of the asbestos removal work; and
- readily accessible on site for the duration of the licensed asbestos removal work, to:
- PCBUs at the workplace;
- workers or their health and safety representatives; and
- the occupants of the premises (if the work is carried out in residential premises).

The ARCP will also be made available for inspection under the Work Health and Safety Act.

If a notifiable incident occurs in connection with the asbestos removal work to which the ARCP relates, the licensed asbestos removalist will keep the plan for at least two years after the incident occurs.

15.7 Traffic Management

The remediation contractor will:

- ensure vehicles exit the site in a forward direction;
- arrange for receipt and dispatch of materials during approved remedial working hours (refer **Section 15.4**);
- securely cover all loads to prevent dust or odour emissions during transportation; and
- utilise suitable experienced and qualified traffic controllers (as required).

Traffic and haulage routes will be selected based on:

- compliance with traffic road rules;
- opportunities to mitigate noise, vibration, dust and odour impacts to properties/occupants adjacent to the site; and
- preference for state controlled roads (as opposed to local roads);

15.8 Soil and Stormwater Management

15.8.1 Site Access and Egress

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.

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.

Surface stormwater generated from (or travelling through) the remediation works area, will be managed using relevant measures set out in Landcom (2004).

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

15.8.2 Stockpiles

Stockpiles of material generated during remedial works will be:

- generally constructed as low elongated mounds on level surfaces;
- placed away from stormwater pits, drainage lines and gutters;
- not located on footpaths or nature strips, unless approved by the local planning authority;
- stored in secure areas and covered if remaining on site for more than 24 hours; and
- kept damp if containing (or suspected of containing) asbestos.

15.8.3 Groundwater and Excavation Pump Out

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[21] aquatic ecosystem groundwater investigation levels (GILs) set out in ANZECC (2000), then the excavation water may be discharged to the local stormwater system.

[21] Freshwater or marine, and adopted based on protection levels that consider aquatic ecosystem disturbance

If the laboratory analytical results are greater than the relevant[22] aquatic ecosystem groundwater investigation levels (GILs) set out in ANZECC (2000), 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).

15.8.4 Site 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).

15.9 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 and SafeWork NSW (2019).

The remediation contractor will maintain detailed records of each load of waste 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;
- Evidence of WasteLocate information (where applicable)
- The volume of each waste type removed from site;
- Weighbridge receipt docket from the waste receiving facility; and
- The number of the environment protection licence (EPL) authorising the receiving facility to accept that classification or waste.

[22] Freshwater or marine, and adopted based on protection levels that consider aquatic ecosystem disturbance

15.10 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:

- erection of dust screens around the perimeter of the site (e.g. fencing with shade cloth attached);
- securely covering all loads entering or exiting the site;
- use of water sprays across the site to suppress dust;
- covering stockpiles of contaminated soil remaining on site for more than 24 hours;
- keeping excavation surfaces moist;
- wetting down of placed fill material during spreading;
- sweeping of hardstand surfaces;
- minimising soil disturbance works during windy days; and
- retaining stabilised site access/egress points for vehicles.

15.11 Odour Control

Should odours be detected at the site boundary during remediation works, monitoring of those odours may be undertaken, using methods[23] suited to the odour type, based on recommendations from a suitably experienced odour consultant (if required). This may include:

- use of appropriate covering techniques such as plastic sheeting to cover excavation faces or stockpiles;
- use of fine mist sprays (which may incorporate deodorizing agents);
- use of hydrocarbon mitigating agents on impacted areas/materials; and
- adequate maintenance of equipment and machinery to minimise exhaust emissions.

15.12 Airborne Asbestos Monitoring

Airborne asbestos monitoring will be undertaken on site by a Licensed Asbestos Assessor (LAA) during friable asbestos removal or handling. Monitoring during bonded asbestos removal, will be undertaken, subject to advice provided by the occupational hygienist/competent person 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 15.12** and the appropriate action applied.

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

Table 15.12 Atmospheric Monitoring Action Criteria and Measures

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
>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

15.13 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.

16 Conclusions

Based on the assessment undertaken by Alliance of site history information, fieldwork observations and data, and laboratory analytical data, in the context of the proposed land use scenario and objectives of this project, Alliance considers that the remediation objective can be achieved and the site made suitable for the proposed land use scenario, subject to the:

- Implementation of the strategies, methodologies, plans and procedures set out in this remediation action plan, including those set out in the proposed supplementary contamination assessment works; and
- Preparation of a site remediation and validation report.

Specific assumptions that apply to the adopted land use scenario, are presented in Section 6 of this report.

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

17 References

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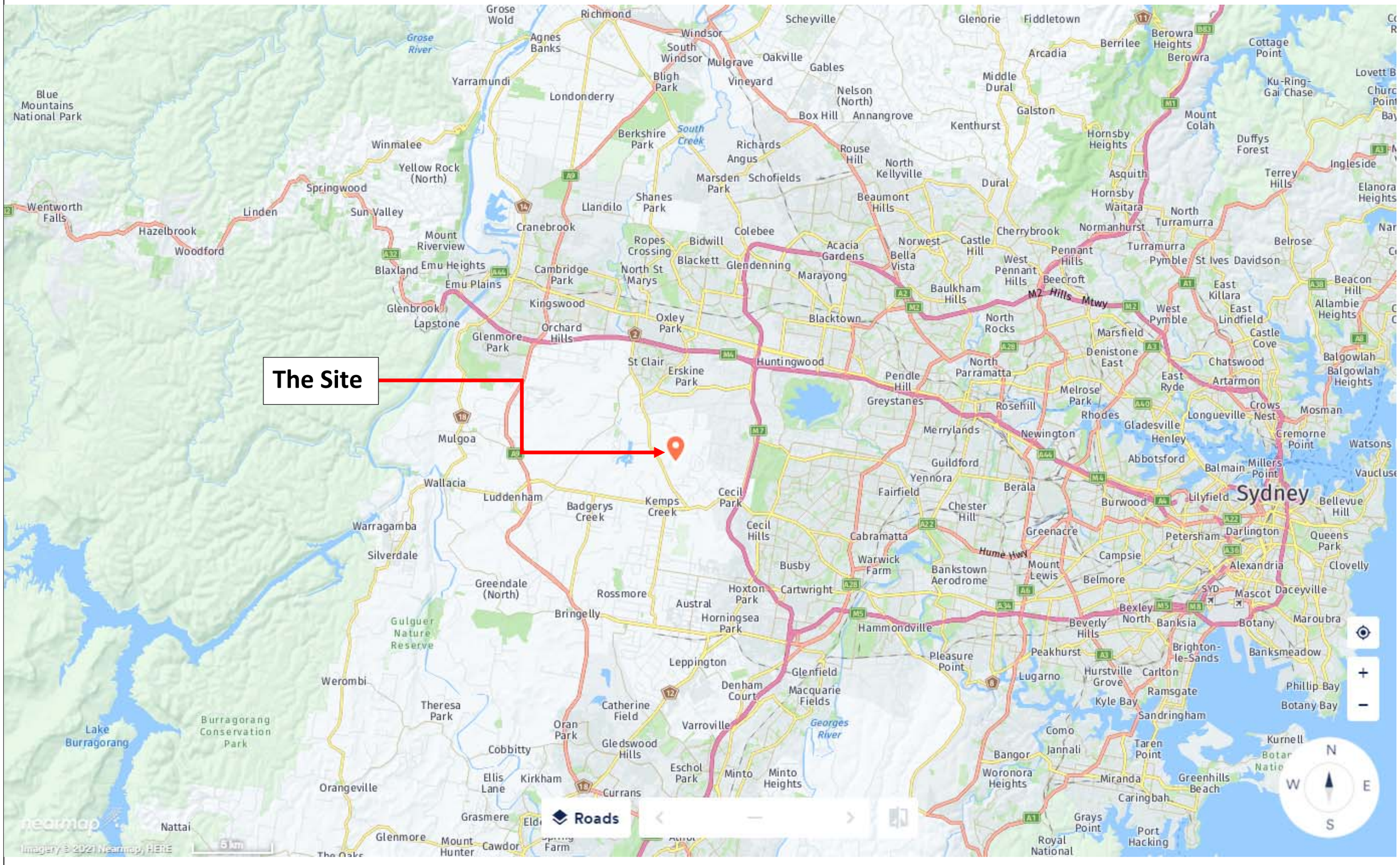
FIGURES



Site Locality

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	1
Project Name:	Remedial Action Plan	Figure Date:	24 January 2022
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

alliance

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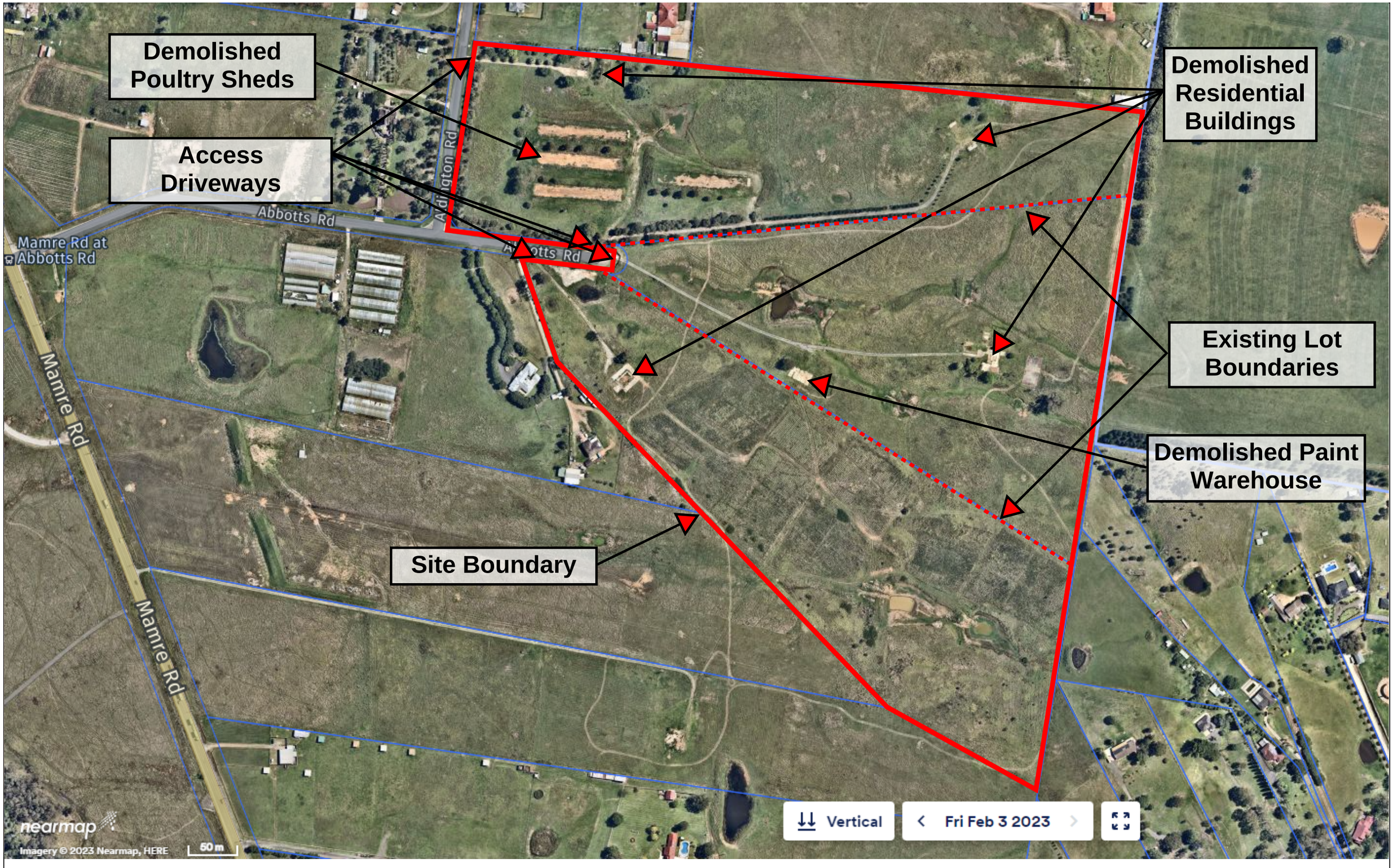

Site Boundary and Layout

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure / Drawing Number:	2
Project Name:	Remedial Action Plan	Figure / Drawing Date:	04/04/2023
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

alliance

N

Scale: 10 m

Previous Sampling Locations Lot 13 (SCA)

alliance	Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3a
	Project Name:	Remedial Action Plan	Figure Date:	2/05/23
	Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

Scale: 20 m

Previous Sampling Locations Lot 13 (DSI & SCA)

alliance	Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3b
	Project Name:	Remedial Action Plan	Figure Date:	2/05/23
	Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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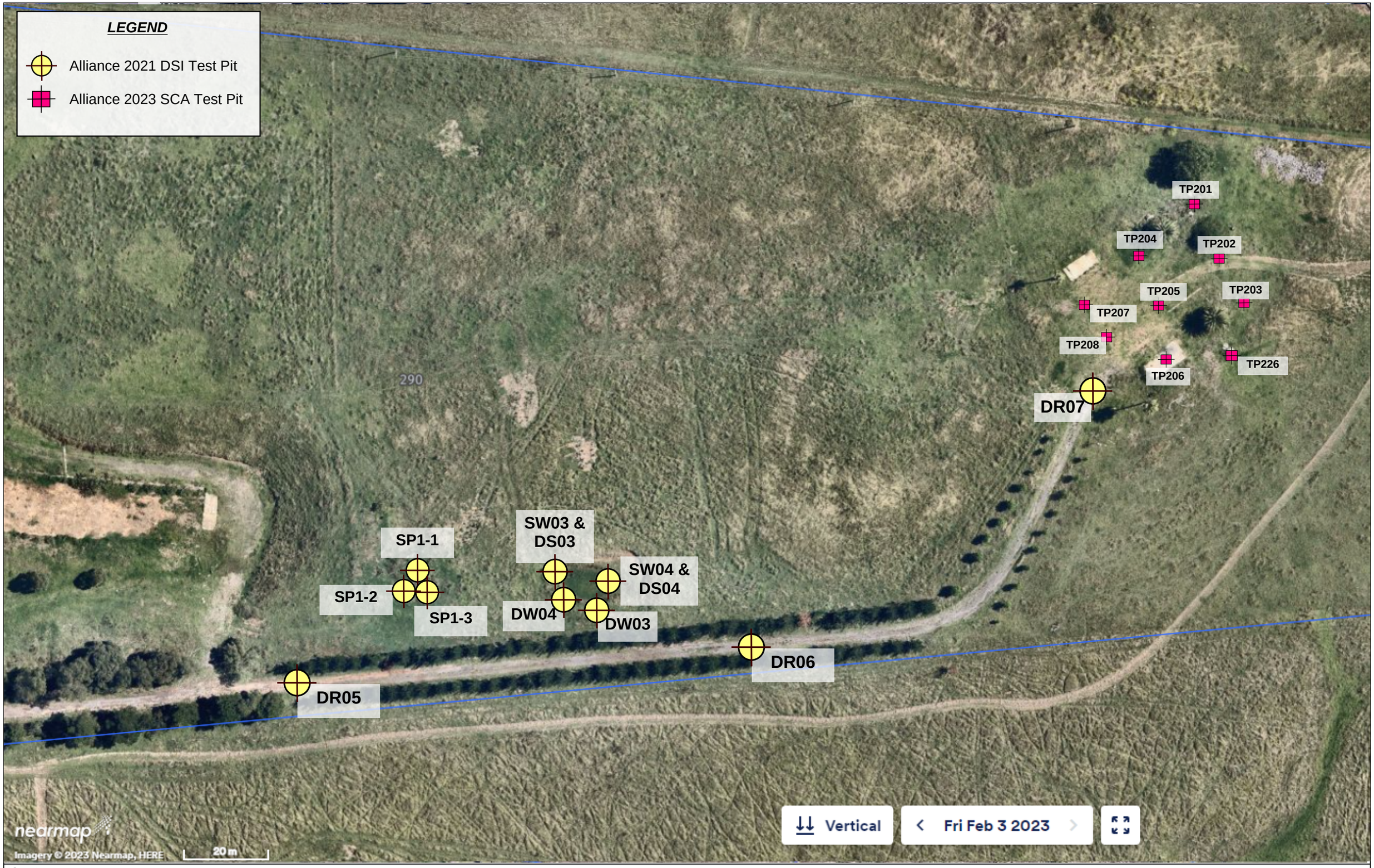

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Previous Sampling Locations Lot 13 (DSI & SCA)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3c
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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Scale: 20 m

Sampling Plan Lot 12 (DSI)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3D
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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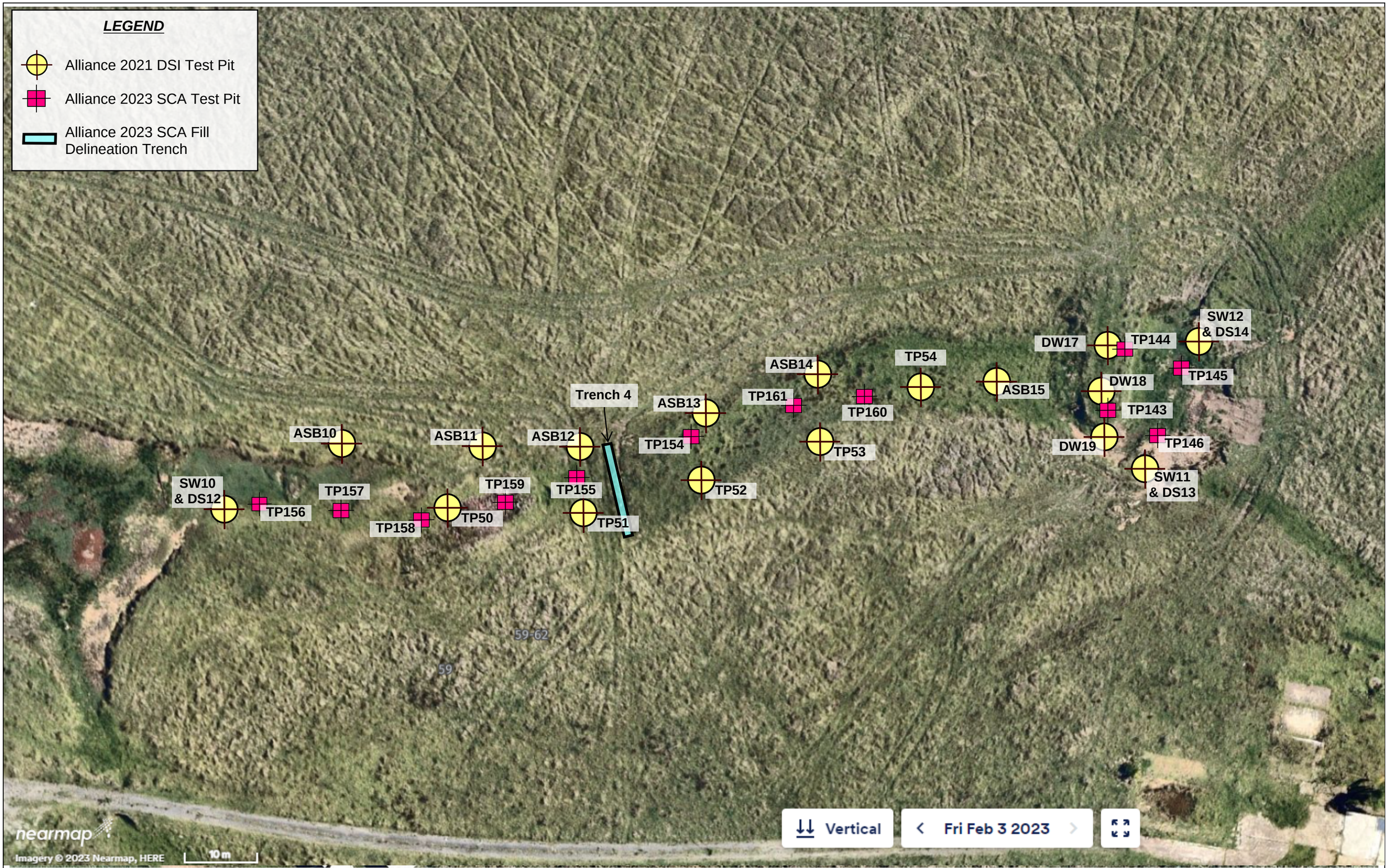

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Sampling Plan Lot 12 (DSI & SCA)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3E
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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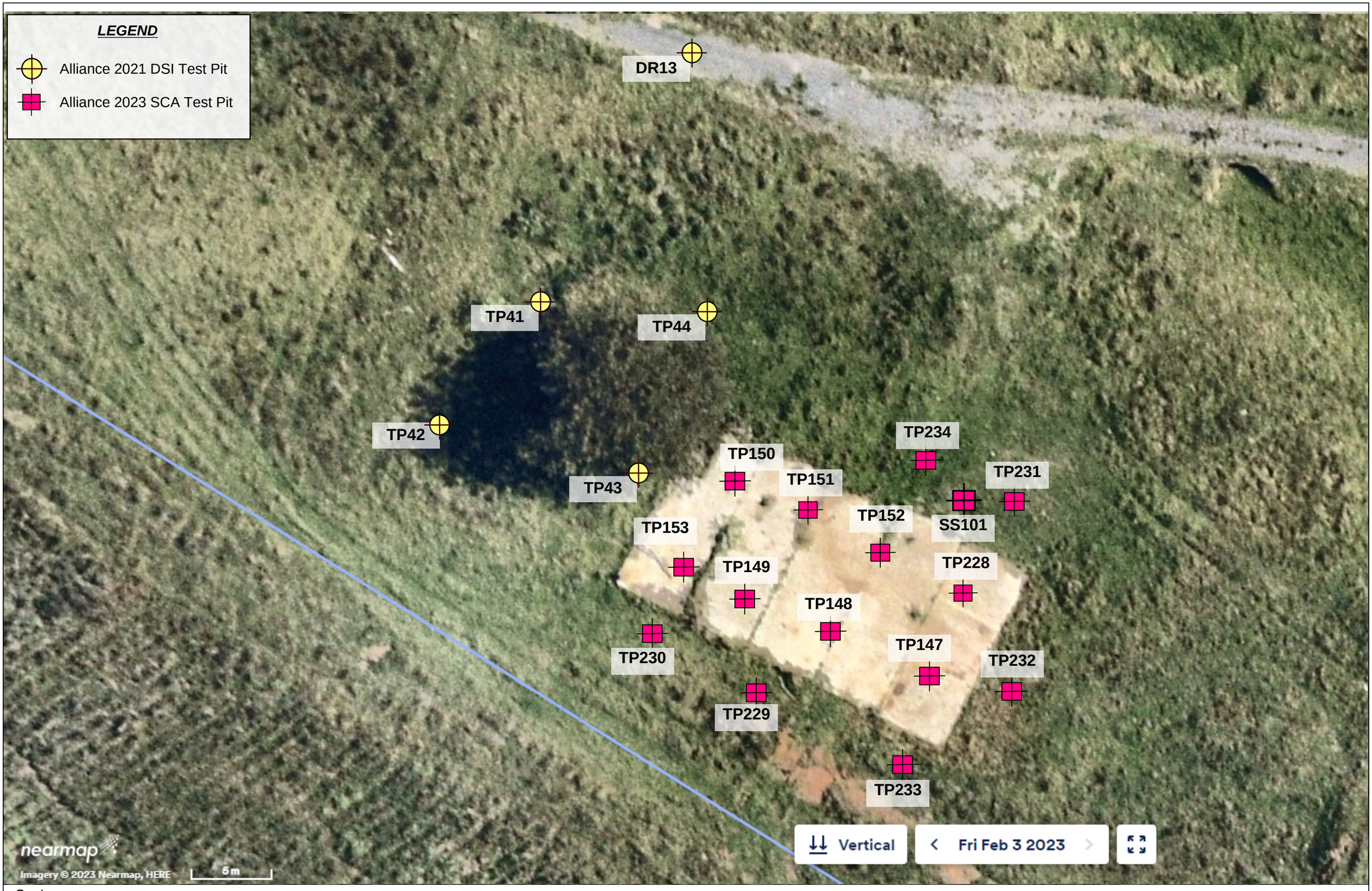

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Sampling Plan Lot 12 (DSI & SCA)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3F
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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Scale: 5 m

Sampling Plan Lot 12 (DSI)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3J
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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Scale: 10 m

Sampling Plan Lot 12 (DSI & SCA)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3G
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

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Scale: 5 m

Sampling Plan Lot 11 (DSI & SCA)

alliance

Client Name:	ESR Investment Management 2 (Australia) Pty Ltd ATF KC Trust No. 1	Figure Number:	3H
Project Name:	Remedial Action Plan	Figure Date:	2/05/23
Project Location:	290-308 Aldington Road and 59-63 Abbotts Road, Kemps Creek NSW	Report Number:	13546-ER-2-2

N