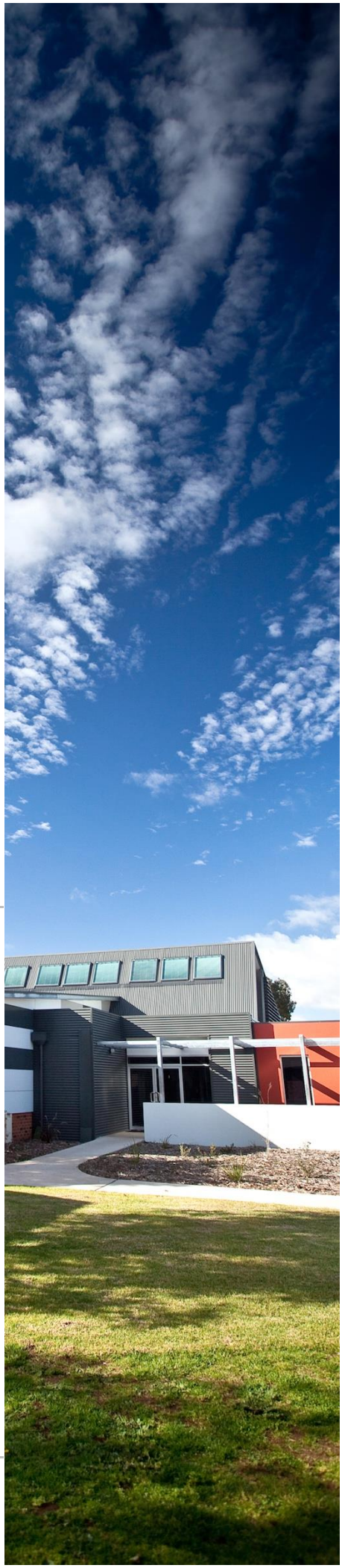

Preliminary Site Contamination Assessment

Maari Ma Health Clinic
Wilcannia
NSW

(Our Reference:32342 ER01)

Disclaimer

This report has been prepared solely for Troppo Architects (the client) in accordance with the scope provided by the client and for the purpose(s) as outlined throughout this report.

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Project Name:	Preliminary Site Contamination Assessment Maari Ma Health Clinic, Wilcannia, NSW 2836
Client:	Troppo Architects
Project No.	32342
Report Reference	32342 ER01
Date:	28/07/2021
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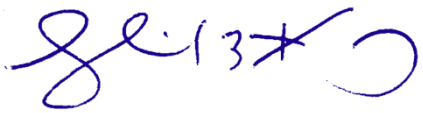
Prepared by:	**Reviewed by:**
	
Nardus Potgieter MSc(Chem) Environmental Scientist	Jim Sarantzouklis MAIBS MEHA RPIA Director

EXECUTIVE SUMMARY

Barnson was engaged by Troppo Architects to undertake a preliminary contaminated site investigation in support of the development of a Maari Ma Health Clinic at Bonney Street, Wilcannia NSW, known as Lot 2, 3 and 4 DP 1201089 and Lot 111 DP 1201028 (referred to as the Subject Site).

The investigation has as its objectives to identify contamination issues that may affect the suitability of the Subject Site for the future commercial use of the site for the Maari Ma Health Clinic and assess the need for possible further investigations, and remediation or management of any contamination issues identified.

The investigation was based on a desktop review of information available for the Subject Site, as well as the findings of a site inspection and confirmatory sampling and analysis of surface soils collected at the site.

A review of the available historical information has deliberated that the Subject Site has not been used for activities/ uses that could be flagged as obvious contamination issues.

The potential for *significant* environmental contamination to be present across the Site has been deduced as being low, however, activities associated with the historical use of the Subject Site have been identified as having a potential to contaminate surface soil. The following potential sources and areas of contamination were identified:

- Historical structures
- Vehicles accessing the Site
- Unclassified fill

A site inspection, supplemented with confirmatory sampling and analysis, was conducted to determine the presence and significance of potential contamination associated with the identified sources.

Based on the findings of the desktop review and site investigation it can be stated with a reasonable level of confidence that the Subject Site is unlikely to be contaminated. This finding is supported with analytical results of soil samples collected at the Subject Site, in which no contaminants were detected above health-risk based screening criteria. The Subject Site is therefore considered suitable for the proposed future commercial use as Health Clinic.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

Barnson was engaged by Troppo Architects (the Client) to undertake a preliminary contaminated site investigation in support of a Maari Ma Health Clinic on Lot 2,3 and 4 DP 1201089 and Lot 111 DP 1201028, known as Bonney Street, Wilcannia, NSW (hereafter referred to as the Subject Site).

The Client has submitted a request for a Preliminary Site Investigation (PSI) in support of the construction of the Maari Ma Health Clinic with associated car parking, ambulance and drop off areas, "Keeping Well" section, nerve centre, 'healthy start' section, entry deck and Elders' deck, community/ gathering areas and landscaping associated with the proposed development.

In accordance with the State Environmental Planning Policy 55 (Remediation of Land) the consent authority must determine if land is contaminated and, if so, whether it is suitable for the intended purpose or require remediation.

1.2 Objectives

The objectives of the investigation are:

- Identify contamination that may affect the site's suitability for residential development, and;
- Assess the need for possible further investigations, remediation or management of any contamination identified.

1.3 Scope of Work

To meet the objectives, Barnson completed the following scope of work:

- Site identification including a review of site history, site condition, surrounding environment, geology and, where available, hydrogeology.
- Desktop review of site history and assessment of potential sources of contamination.
- Development of a Conceptual Site Model (CSM) with information gathered from the data review and site inspection.
- Site inspection to assess site conditions.
- Collection of confirmatory soil samples and analysis to determine nature of possible contamination.
- Provide conclusions as to the suitability of the site for the intended future land use.
- Preparation of a report.

1.4 Purpose of this report

The purpose of this report is to document, with cognisance of the Guidelines of Consultants Reporting on Contaminated sites (NSW EPA, 2020), works undertaken, in accordance with the scope of works as described in Section 1.3, results of the desktop review and site inspection, and recommendations for further actions required to determine fitness of the site for the use.

1.5 Assumptions and Limitations

The following assumptions have been made in preparing this report:

- The future use of the site will be for a health services facility in the form of the Maari Ma Health Clinic, which is pursuant the *Central Darling Local Environmental Plan 2012.* This assumption forms the basis for the conceptual site model (Section 4).

- All information pertaining to the contamination status of the site has been obtained through public record searches, a preliminary site inspection and analysis of confirmatory samples collected at the Subject Site. All documents and information in relation to the Subject Site, which were obtained from public records, are accepted to be correct and has not been independently verified or checked.

It should be recognised that even the most comprehensive site assessments may fail to detect all contamination on a site. This is because contaminants may be present in areas that were not previously surveyed or sampled or may migrate to areas that showed no signs of contamination when sampled. Investigative works undertaken at the Subject Site by Barnson identified actual conditions only at those locations in which sampling and analysis were performed. Opinions regarding the conditions of the site have been expressed based on historical information and analytical data obtained and interpreted from previous assessments of the site. Barnson does not take responsibility for any consequences as a result of variations in site conditions.

2.0 SITE DESCRIPTION

2.1 Site Identification

Table 2.1 presents a summary of the available information pertaining to the identification of the Subject Site. The Subject Site is zoned as General Residential (R1). The information regarding the Subject Site is in Table 2.1 below.

Figure 2.1 presents a map indicating the location of the Subject Site.

Table 2.1: Summary of Subject Site identification details.

Information	Details
Site address	Bonney Street, Wilcannia, NSW, 2836
Lot/Section and Deposited Plan No.	Lot 2, 3 and 4 DP 1201089 and Lot 111 DP 1201028
Zoning	R1 – General Residential
County	Young
Parish	Wilcannia
Local Government Area	Central Darling Shire Council

Figure 2.1: Location of the Subject Site.

2.2 Layout and Features

Figure 2.1 shows the Subject Site has a direct frontage to Bonney Street which is connected to Ross Street. Bonney Street is to become the entrance to the proposed development. The southern boundary of the site is bounded by the Darling River, the east is adjacent the Wilcannia Hospital and to the west are residential developments. The Subject Site is located approximately 800m from the main business district of the Wilcannia township.

The Subject Site has previously been used for water supply with evidence of a pump shed adjacent the Subject Site and other unknown uses as remnants of an old building were also found on site. An unsealed road (Bonney Street) is the entrance to the Subject Site. The site is abundant in vegetation, as shown in Figure 2.1, and is covered in a variety of flora including trees, shrubs, and grasses.

Figure 2.2 presents a plan of the Subject Site that is supplemented with photographs showing the different elements of the Site (Figure 2.3 to Figure 2.7). Figure 2.2 includes markers indicating the vantage point and direction of the photographs.

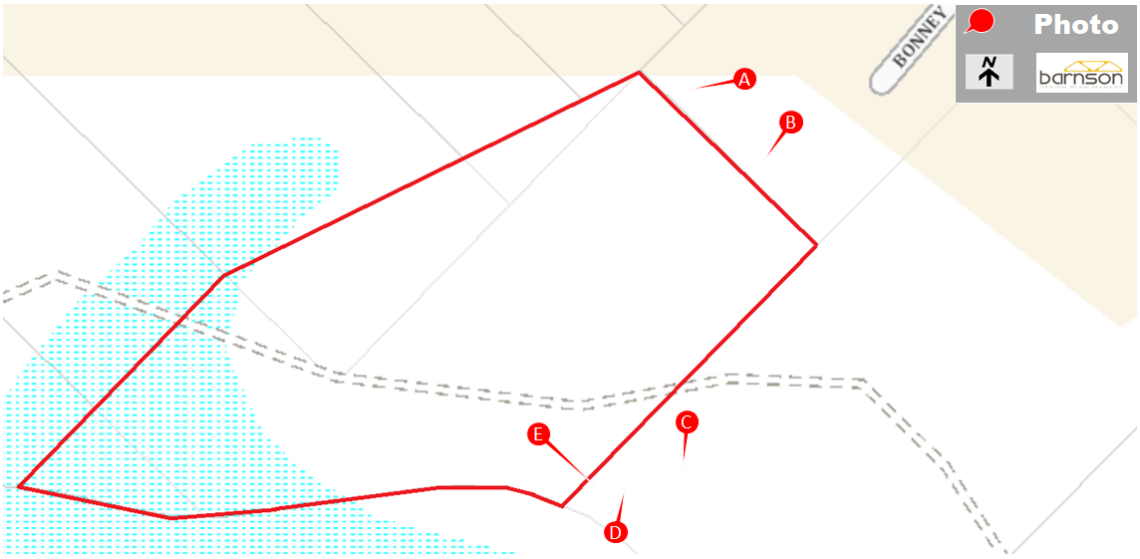


Figure 2.2: Existing Subject Site layout.

Figure 2.3: Photo A –Photo of existing driveway heading west of the Subject Site

Figure 2.4: Photo B – View of the Subject Site.

Figure 2.5: Photo C – View of pump shed on adjacent Lot

Figure 2.6: Photo D – Remnants of old building adjacent pump shed.

Figure 2.7: Photo E – Photo of fill and brick remnants on site

2.3 Proposed Development

Troppo Architects approached Barnson to provide support in the preparation of a Development Application (DA) for the proposed Maari Ma Health Clinic within the township of Wilcannia on Lot 2, 3 and 4 DP 1201089 and Lot 111 DP 1201028. The development will include associated car parking, ambulance and drop off areas, “Keeping Well” section, nerve centre, “Healthy Start” Section, entry deck and elders’ deck, community and gathering areas and related landscaping throughout. The proposed development can be deemed a health services facility.

Figure 2.8 shows a detailed layout of the proposed health clinic and its associated developments. It is accepted that the proposed development will not require to significantly disturb the surface soil of the Subject Site.

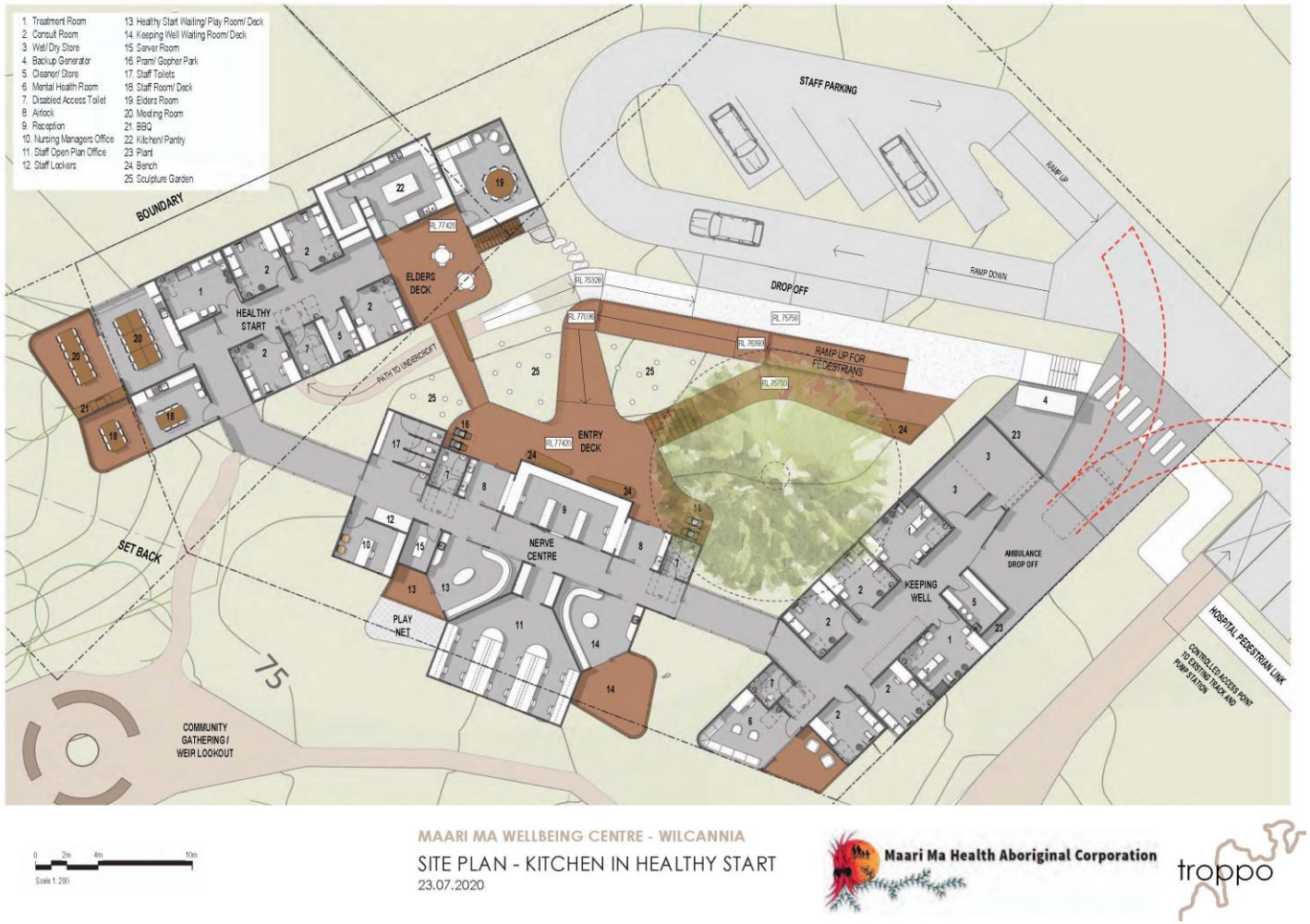


Figure 2.8: Proposed development layout

3.0 SITE SETTING

3.1 Geology

A review of the 1:250000 Geology map of Wilcannia (refer to Figure 3.1) shows that geologically, the Subject Site is underlain by Mesozoic age units of sandstone, siltstone and claystone; with flat to gently undulating plains of red and brown clayey sand, loam and lateritic soils.

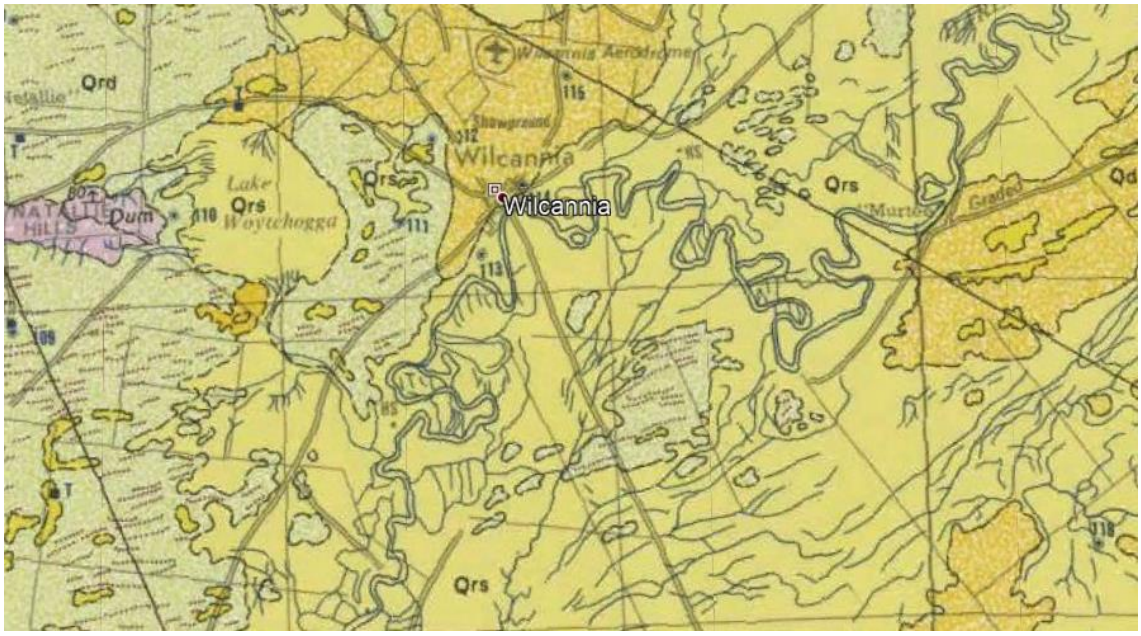


Figure 3.1: Wilcannia 1:250000 geology map showing the location of the Subject Site

An examination of the Geological Survey of NSW maps of Naturally Occurring Asbestos (accessed on 27th of July 2021), shows that the geological units underlaying the Subject Site has no asbestos potential.

3.2 Soils

The dominant soil type at the Subject Site is described as moderately deep sands and red earths with loamy sand to sandy loam topsoils. The is amenable to water sheet erosion under low vegetation cover.

The Atlas of Australian Acid Sulfate Soil has the subject site in an area of 'very low' probability of occurrence (a 0-5% chance of occurrence).

3.3 Topography and Drainage

Figure 3.2 presents topographical information overlain on the map of the Subject Site. The presented data shows that the Subject Site is relatively flat throughout. there is a gradual fall from the north-eastern end of the Subject Site to the south-western.

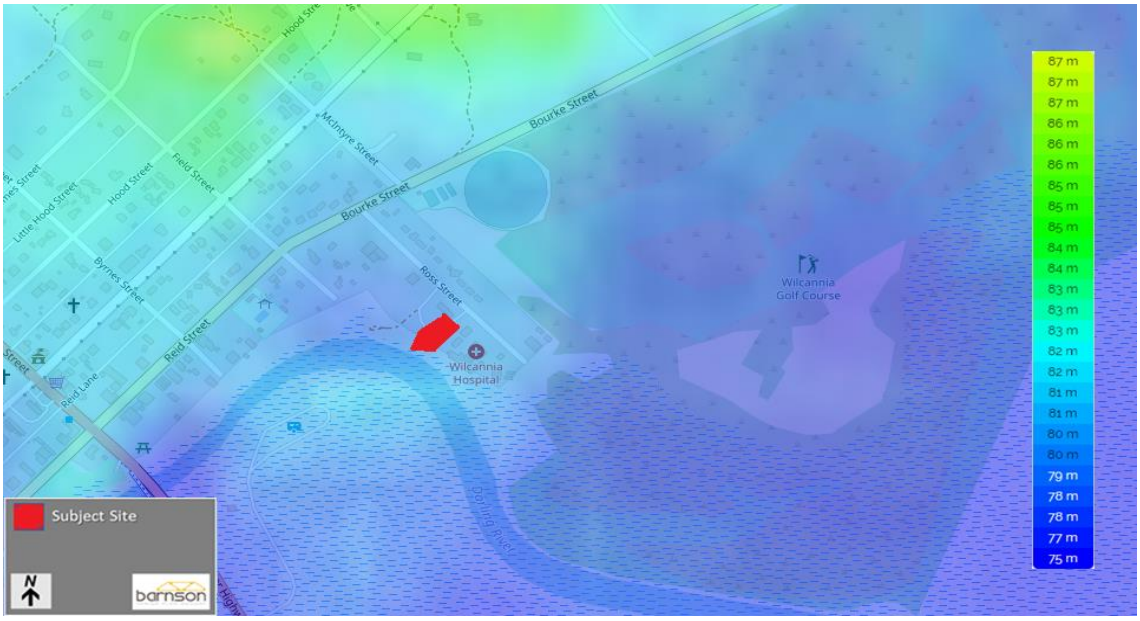


Figure 3.2: Subject Site topography.

The nearest natural water body to the Subject Site is the Darling River, which at is closest is located at a distance of less than 10m to the south-west.

3.4 Groundwater Resources

A review of existing groundwater bore records (WaterNSW, 2021) indicate no registered groundwater bores inside the boundary of the Subject Site, and only one within 500m of the Subject Site. The only groundwater bore within 500m of the Subject Site is identified in Figure 3.3, it is located to the north-west of the site.

Figure 3.3: Groundwater bores near the Subject Site.

The information recorded in the database for the closest off-site bore indicate the depth of the bore is 35.10m with a Standing Water Level (SWL) of 12.20m. The shallowest water bearing zone for GW019002 was recorded at 33.50m. According to the database, the bore is for domestic/ general use purposes.

The *Central Darling Local Environmental Plan 2012* does not offer information regarding the locality's groundwater vulnerability.

4.0 SITE HISTORY

4.1 Historical Land Use

Historical aerial images show the Subject Site has defined vehicular access in the form of an unsealed vehicle path which leads both to the river and a water pump shed. There is evidence of a demolished building near the pump shed, however when the building was demolished is unknown. The rest of the Subject Site is abundant with vegetation, with one tree being identified as a scar tree, having heritage significance.

4.2 Historical Record of Site Contamination

Datasets maintained by the Office of Environment and Heritage (OEH) including notices under CLM Act, POEO Environment Protection License Register and environmental incidents were reviewed.

- List of NSW contaminated sites notified to EPA – The sites appearing on the OEH "List of NSW contaminated sites notified to the EPA" indicate that the notifiers consider that the sites are contaminated and warrant reporting to EPA. However, the contamination may or may not be significant enough to warrant regulation by the EPA. The EPA needs to review information before it can make a determination as to whether the site warrants regulation. A search of the listing returned no record for the Subject Site.
- Contaminated Land Record of Notices – A site will be on the Contaminated Land Record of Notices only if the EPA has issued a regulatory notice in relation to the site under the *Contaminated Land Management Act* 1997. A search of the register in July 2021 returned no record for the Subject Site and indicated no listings for any site within a radius of 1,000m.

There is further no record of the Subject Site or within a radius of 1,000m from these areas, in any of the following databases:

- Former Gasworks database
- EPA PFAS Investigation Program
- Defence PFAS Investigation & Management Program
- Air services Australia National PFAS Management Program
- Defence 3 Year Regional Contamination Investigation Program

4.3 Previous Site Investigations

No information relating to any previous assessment of contamination at the Subject Site was available for review.

5.0 CONCEPTUAL SITE MODEL

5.1 General

The conceptual site model (CSM) is intended to provide an understanding of the potential for contamination and exposure to contaminants within the investigation areas. The CSM draws together the available historical information for the site, with site specific geological, and hydrogeological information to identify potential contaminants, contamination sources, migration and exposure pathways and sensitive receptors.

5.2 Sources

The identification of sources presented here is based on the review of available historical information and photographs, as well as an understanding of current conditions at the Subject Site. The following is a summary of the potentially contaminated areas and sources of contamination identified:

- Historical structures

The Subject Site include remnants (demolition waste) of former structures. The former structures could potentially have included hazardous materials such as asbestos and lead based paint. Deterioration and demolition of the former structures can result in the localised dispersion of hazardous materials over the surface of the Subject Site.

- Vehicles accessing the Site

The well-defined informal vehicle path crossing the Subject Site is evidence of motorised vehicles entering and driving across the surface of the site. These vehicles can potentially contribute to localised hydrocarbon contamination of the surface soils in this area.

- Unclassified fill

There is evidence of fill material being stockpiled at the Subject Site. Unclassified fill material could potentially originate from other contaminated sites or could contain demolition wastes contaminated with hazardous materials such as asbestos or lead based paints.

- Uncontrolled disposal of waste.

Although the Subject Site is not fenced and is clearly accessible by vehicles there is no evidence to suggest that significant quantities of domestic or demolition waste has been disposed of at the Subject Site. Uncontrolled disposal of waste is therefore not considered a potential source of contamination.

5.3 Contaminants of Potential Concern

Considering the potential sources relevant to the Subject Site, a wide variety of contaminants may be present. With the demolition waste and unclassified fill material, as well as the movement of vehicles across the site considered the primary potential sources of contamination, hazardous materials (i.e. asbestos and lead based paint) and hydrocarbons are accepted as the most likely contaminants.

Based on this understanding of the site history and activities, the contaminants of potential concern identified for the investigation include:

- heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn);
- hydrocarbons (mainly fuel and lubricants); and
- asbestos.

5.4 Pathways

The primary pathways by which receptors could be exposed to the contaminants outlined above include:

- Inhalation of dust or vapours.
- Dermal contact with contaminated soils.
- Incidental ingestion of contaminated soils.
- Surface runoff, sediment transport and discharge to surface waters.
- Vertical and horizontal migration of contamination through the soils into the underlying groundwater.

Of the listed potential pathways, the contamination of water resources through infiltration is considered the most unlikely. The Subject Site is not indicated as a groundwater vulnerable zone and the depth to groundwater in the general area is reported as >30m. This depth to groundwater would limit vertical migration of any contaminants which may be entering the surface soil from above.

5.5 Receptors

Potential receptors may include:

Human receptor populations

- Visitors to the site (e.g. members of the public making use of the facility, workers conducting maintenance, contractors,);
- Workers at the Clinic; and
- Workers involved in the construction of the Clinic facility.

Environmental Receptors

- Local drainage channels and receiving surface water bodies; and
- Groundwater resources beneath the site (negligible likelihood of contamination expected).

5.6 Potential for Contamination

The Subject Site is not listed in any of the contaminated land databases. Based on the results of the desktop assessment, the overall likelihood for *significant* chemical contamination to be present within the site is low.

Although former land use and activities at the site is reasoned to have a potential for contaminating surface soils, the type and quantity of contaminants introduced through this land use is not expected to have led to significant contamination.

6.0 SITE INSPECTION

6.1 General

The objective of the investigation is to determine whether there are any environmental risks associated with the Subject Site that could affect the proposed future development and would require further investigation or action to render the site suitable for its intended use.

The desktop evaluation of the site history and current use of the site did not identify any significant risks in this regard but did identify both historical and current land use activities that could contribute to contamination of the surface soils of the Subject Site.

Barnson conducted an inspection of the Subject Site on 11 March 2021. The purpose of the site inspection was to verify the findings of the desktop assessment, as well as to collect confirmatory samples of soil from areas of the Subject Site where development is proposed or contamination is suspected. Based on the findings of the CSM the inspection and sampling were focussed on the surface soils (50-300mm). The site inspection included all areas of the Subject Site.

During the site inspection the following observations were made:

- The Subject Site is in general good order without visible signs of disturbance to the soils or vegetation at the Site.
- All visible open ground and prominent features at the Subject Site were inspected. No visible discoloration or staining of open ground or soil, and no obvious discoloration or irregularities in the occurrence of vegetation was observed during the inspection.
- Concrete and bricks remaining from the demolition of the historical structures at the site were observed at two locations (see Figure 6.1).

Figure 6.1: Historical demolition waste.

- The areas with demolition waste were carefully inspected for hazardous materials. No evidence of any fibre cement sheeting, paint or staining associated with hydrocarbons were observed.
- No evidence of any waste disposal was noted at the Subject Site and no general waste was observed in any other part of the Subject Site during the site inspection.
- A stockpile of fill material was observed near the informal vehicle pathway.
- There is a drainage channel across the western portion of the Site, draining stormwater runoff across the site to the Darling River.

6.2 Confirmatory Sampling

The purpose of collecting confirmatory samples as part of the site inspection is to determine if any of the potential contaminants identified from the CSM are present. The samples are not intended for statistically valid characterisation or quantification of contamination levels. The collection of surface soil samples at the site was therefore focussed on areas where contamination of the surface soil could most likely have occurred or accumulated.

Samples of soil were collected from the stockpile of fill material as well as the drainage channel. Reasoning is that any surface soil contamination present at the Subject Site could have washed down and accumulated in the sediments of the drainage channel. It has to be noted that the drainage channel in the most part crosses through other lots not included in the Subject Site. Any contamination potentially present at any of these off-site lots may also accumulate in the drainage channel.

Table 6.1 is a summary description of the collected samples.

Table 6.1: Summary of sample details.

Sample Reference Number	Description
BLF-01	Soil sample collected from fill stockpile.
BLF-02	Soil sample collected from fill stockpile.
BLF-03	Soil sample collected from fill stockpile.
BLF-04	Sediment (0-100mm) sample collected from drainage channel.

The pattern followed for the soil sampling can be described as Judgement Sampling, where points are selected on the basis of the investigator's knowledge of the proposed land use and likely distribution of contaminants at a site. It is an efficient sampling method for confirmatory sampling that utilises knowledge of the site history and field observations to direct sample collection (NSW EPA, 1995).

All samples were submitted to the Envirolab Services laboratory in Sydney, for determination of the following parameters:

- metallic element (cadmium, chromium, copper, lead, nickel and zinc) concentrations, including arsenic and mercury in soil;
- extraction with organic solvent and analysis of Total Recoverable Hydrocarbons (TRH) fractions C6 to C40, benzene, toluene, ethylbenzene and total xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs), polychlorinated biphenyls (PCBs); and
- the presence of asbestos fibres.

Although pesticides and herbicides are not considered potential contaminants for the Subject Site, the analytical package included extraction with organic solvent and analysis of Organochlorine (OCP) and Organophosphorus (OPP) pesticide compounds. The laboratory is NATA accredited for all the analysis indicated above.

6.3 Analytical Results

The Envirolab Services laboratory report for the samples is attached as Appendix A. The laboratory report indicates that heavy metals, mixtures of straight chain organic compounds ranging from C10 to C40 and trace quantities of polycyclic organic compounds were detected in the soil. The concentrations of petroleum hydrocarbons, asbestos (total recoverable) as well as persistent pesticide and herbicide compounds are indicated as below the limits of detection in the surface soil samples.

The metals detected include chromium (Cr), copper (Cu), lead (Pb), nickel (Ni, and zinc (Zn). Concentrations of arsenic, cadmium and mercury are reported to be below the limit of detection in all samples.

Table 6.2 presents a summary of the compounds and elements detected above the limit of detection. The laboratory performed a duplicate and triplicate (metals only) analysis of sample BLF-01 for quality control purposes. The results of this duplicate and triplicate analysis are also listed in Table 6.2.

Table 6.2: Summary of metal, hydrocarbon and pesticide concentrations detected in surface soil samples from the Subject Site.

Analyte	BLF-01	BLF -01 Duplicate	BLF -01 Triplicate	BLF -02	BLF -03	BLF -04
	mg.kg-1					
Metals (mg.kg^{-1})						
Arsenic (As)	<4	<4	<4	<4	<4	<4
Cadmium (Cd)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium (Cr)	14	13	14	12	13	21
Copper (Cu)	29	24	24	16	11	16
Lead (Pb)	42	35	36	54	51	11
Mercury (Hg)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel (Ni)	8	8	8	7	7	16
Zinc (Zn)	370	240	210	85	120	38
Hydrocarbons (mg.kg^{-1})						
TRH C10 - C14	<50	<50	-	<50	<50	74
TRH C15 - C28	140	150	-	<100	<100	420
TRH C29 - C36	110	120	-	<100	<100	440
TRH >C10-C16	<50	<50	-	<50	<50	130
TRH >C10 - C16 less Naphthalene (F2)	<50	<50	-	<50	<50	130
TRH >C16-C34 (F3)	220	240	-	<100	<100	680
TRH >C34-C40 (F4)	<100	<100	-	<100	<100	360
Total positive PAHs	<0.05	<0.05	-	<0.05	0.82	<0.05
Pesticide (mg.kg^{-1})						
Dieldrin	0.2	0.2	-	<0.1	<0.1	<0.1

The laboratory results further indicate that no asbestos fibres were present in any of the soil samples analysed.

6.4 Analytical Data Quality

Samples were collected in new, clean containers using cleaned equipment and were placed in glass jars provided by the laboratory that were refrigerated after filling and transported in an insulated container to the laboratory. Chain of custody was recorded for all samples. A copy of the signed sheet is attached as Appendix A.

The analyses were undertaken at a NATA accredited laboratory. The laboratory quality control procedures in the form of duplicates as well as analyte and surrogate spikes were applied to all contaminant classes analysed. The results reported for the duplicate is within the Relative Percent Difference range of the acceptance criteria for a duplicate sample. The analyte spike recoveries reported for the different sets of organic analytes are indicated as within the acceptance criteria (see Appendix A).

All media appropriate to the objectives of this investigation have been adequately analysed and no area of significant uncertainty exist. It is concluded the data is usable for the purposes of the contaminated site investigation.

7.0 ASSESSMENT

7.1 Assessment Criteria – Human Health and Environmental Risk

Screening for human health and ecological risk, utilises published human health investigation levels (HILs) and ecological screening and investigation levels (ESLs & EILs) from the National Environment Protection (Assessment of Site Contamination) Measure (NEPC, 1999) to identify contaminant concentrations in soil that may pose a risk to future residents, people visiting the site, or to ecological receptors.

HILs are scientifically based, generic assessment criteria designed to be used in the screening of potential risks to human health from chronic exposure to contaminants. HIL's are conservatively derived and are designed to be protective of human health under the majority of circumstances, soil types and human susceptibilities and thus represent a reasonable 'worst-case' scenario for specific land-use settings. The HILs selected for evaluation of the Subject Site, and its intended use as clinic facility, are those derived for commercial/industrial land use (HIL-D) and assumes a commercial land use such as shops, offices or factories with associated levels of access to potentially contaminated soil.

The health risks associated with petroleum hydrocarbon compounds are assessed using Health Screening Levels (HSLs) developed to be protective of human health by determining the reasonable maximum exposure from sources for a range of situations commonly encountered on contaminated sites. HSLs are derived for soil, groundwater and soil vapour and relate to exposure to petroleum hydrocarbons through the vapour inhalation exposure pathway only. Direct exposure pathways such as incidental soil ingestion and dermal exposure pathways are generally not the risk drivers when compared to inhalation exposure (NEPC, 1999). HSLs have been developed for BTEX and naphthalene plus four hydrocarbon fractions namely:

- C6 – C10- Fraction number F1
- >C10 – C16 less Naphthalene - Fraction number F2
- >C16 – C34 - Fraction number F3
- >C34 – C40 - Fraction number F4

Screening values published for polycyclic aromatic hydrocarbons (PAHs) consider the combined total concentration of all PAH compounds detected.

Although the primary concern in most site assessments is protection of human health, the assessment should also include consideration of ecological risks and protection of groundwater resources that may result from site contamination. EILs provide screening criteria to assess the effect of contaminants on a soil ecosystem and afford species level protection for organisms that frequent or inhabit soil and protect essential soil processes.

Ecological investigation levels (EILs) have been derived for common metallic contaminants in soil. The values selected for the evaluation of the heavy metals detected in the soil samples from the Subject Site considers the physicochemical properties of soil and contaminants and the capacity of the soil to accommodate increases in contaminant levels above natural background while maintaining ecosystem protection for identified land uses.

Table 7.1 presents a summary of the health-risk based criteria and ecological investigation levels selected for assessment of the detected metal, PAH and pesticide concentrations. Screening values for commercial land use are presented.

Table 7.1: Human health and ecological risk screening levels for metals.

	Health-based Investigation Levels	Ecological Investigation Levels (EIL)
	HIL D Commercial	Commercial
Element	mg.kg^{-1}	mg.kg^{-1}
Arsenic (As)	3,000	160
Cadmium (Cd)	900	NA
Chromium (Cr) (Total)	NR	680
Copper (Cu)	240,000	320
Lead (Pb)	1,500	1,800
Mercury (Hg)	730	NA
Nickel (Ni)	6,000	460
Zinc (Zn)	400,000	460
Total PAH	4,000	NA
Dieldrin	45	NA

Note: NR=not relevant due to low human toxicity of Cr(III). NA=No applicable screening level. EILs selected for urban residential and commercial land use scenario.

Ecological risks associated with hydrocarbons are evaluated by using ecological screening levels (ESLs), which are based on EC_{25} weight-of-evidence ecotoxicity data, evaluated for a residential land use scenario (NEPC, 1999). The ESLs (Table 7.2) are evaluated for the same four carbon chain fraction ranges (F1 to F4) listed above. Screening values for both commercial and residential exposure scenarios are listed.

Table 7.2: Human health and ecological risk screening levels for hydrocarbon fractions.

Fraction	Management limits for TPH in Soil Residential/ Commercial mg.kg^{-1}	Health Screening Levels (HSLs) for vapour intrusion Commercial (sand) mg.kg^{-1} (soil)	Ecological Screening Levels (ESL) Commercial mg.kg^{-1}
F1	700	260	215
F2	1,000	NA	170
F3	2,500	NA	2,500
F4	10,000	NA	6,600

NA=No applicable screening level.

It was confirmed that limits of detection reported by the laboratory are below the criteria values. All other contaminants analysed for in the soil samples that are reported below the limit of detection by the laboratory can therefore be excluded from further assessment.

7.2 Findings

The following findings are presented:

- Direct comparison of the analytical results presented in Table 6.2 with the assessment criteria for commercial land use (refer Table 7.1 and Table 7.2) show that concentrations for all elements and compounds detected in the samples of soil collected at the Subject Site are well below the commercial health-risk based and ecological screening values used for the assessment.
- Concentrations of hydrocarbon fractions were detected in the sample of sediment collected from the drainage channel as well is in one of the three samples collected from the stockpile of fill. The source of the hydrocarbons in the drainage channel sediment is likely off site as no evidence of hydrocarbon contamination was observed in the vicinity of the channel at the Subject Site. The source of the hydrocarbons in the sample of fill is uncertain as no hydrocarbons were detected in any of the other fill samples.
- The hydrocarbon concentrations detected in the sediment and fill are low, even compared to conservative screening levels. However, the presence of these compounds and the variety of compounds measured does indicate the drainage channel conveys contaminated runoff from other areas off-site and can, over time, accumulate in the sediments of the channel contaminants from this runoff.
- The general low concentrations of heavy metals detected in the soil samples at the Subject Site suggest naturally occurring element abundance and are most likely not related to contamination.
- No other contaminants evaluated were detected at concentrations exceeding commercial, screening criteria.
- The confirmatory soil samples thus support the assertion that significant and widespread chemical contamination is unlikely to be present within the Subject Site.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

In accordance with the objectives stated in Section 1.2, and based on the information contained within this assessment, the following conclusions are presented (subject to the limitations noted in Section 1.5):

- Activities associated with the historical and current use of the Subject Site were identified as having a potential to contaminate surface soil at the site.
- The following potential sources of contamination were identified:
    - Historical structures
    - Vehicles accessing the Site
    - Unclassified fill
- A review of the available historical information, including contaminated sites databases and aerial photographs, indicated a low potential for significant environmental contamination to be present across the Subject Site.
- A site investigation and confirmatory soil sampling confirmed that concentrations of all contaminants investigated were below health-risk based screening criteria, for commercial land use, in all surface soil samples collected. Only traces of one persistent pesticide and hydrocarbons were detected in the samples of fill material.
- The highest concentrations of hydrocarbons were detected in the soil sample collected from the drainage channel. The concentrations detected were, however, still below both health and ecological screening levels for commercial land use.
- The screening criteria used in the evaluation of the contaminant concentrations were appropriately conservative and suitable for assessment of the proposed commercial land use.

8.2 Recommendations

- Based on the findings of the desktop review and site investigation it can be stated with a reasonable level of confidence that the Subject Site is suitable for the proposed re-development and land use.
- It is recommended that the stockpiles of fill material as well as demolition waste present at the Subject Site be removed and appropriately disposed, prior to the commencement of any earthworks or construction.
- It is recommended that any material excavated from the drainage channel or its banks be appropriately classified in terms of the Excavated Natural Materials Order ((NSW EPA, 2014)) prior to being used on-site or removed off site.

9.0 REFERENCES

NEPC. (1999). *National Environment Protection (Assessment of Site Contamination) Measure (as amended, 2013).* National Environment Protection Council.

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NSW EPA. (2014). *Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014, The excavated natural material order 2014.* Sydney: NSW Environment Protection Authoroty.

NSW EPA. (2020). *Consultants Reporting on Contaminated Land, Contaminated Land Guidelines.* Sydney: NSW Environmental Protection Authority.

WaterNSW. (2021). *Real Time Data*. Retrieved June 17, 2021, from Water NSW: https://realtimedata.waternsw.com.au/water.stm

Appendix A - Chain of Custody and Laboratory Report

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CERTIFICATE OF ANALYSIS 264406

Client Details

Client	Barnson (Mudgee)
Attention	Nardus Potgieter
Address	Unit 2/108-110 Market St, Mudgee, NSW, 2850

Sample Details

Your Reference	**32342**
Number of Samples	4 soil
Date samples received	16/03/2021
Date completed instructions received	16/03/2021

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	23/03/2021
Date of Issue	22/03/2021

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Asbestos Approved By
Analysed by Asbestos Approved Identifier: Lucy Zhu
Authorised by Asbestos Approved Signatory: Lucy Zhu

Results Approved By
Dragana Tomas, Senior Chemist
Ken Nguyen, Reporting Supervisor
Lucy Zhu, Asbestos Supervisor

Authorised By

Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date extracted	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1
naphthalene	mg/kg	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<3	<3	<3	<3
Surrogate aaa-Trifluorotoluene	%	105	102	106	86

svTRH (C10-C40) in Soil					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date extracted	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	20/03/2021	20/03/2021	20/03/2021
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	74
TRH C_{15} - C_{28}	mg/kg	140	<100	<100	420
TRH C_{29} - C_{36}	mg/kg	110	<100	<100	440
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	130
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	130
TRH >C_{16} -C_{34}	mg/kg	220	<100	<100	680
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	360
Total +ve TRH (>C10-C40)	mg/kg	220	<50	<50	1,200
Surrogate o-Terphenyl	%	107	85	83	112

PAHs in Soil					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date extracted	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	0.2	<0.1
Pyrene	mg/kg	<0.1	<0.1	0.2	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	0.2	<0.1
Chrysene	mg/kg	<0.1	<0.1	0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	0.1	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	0.82	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5
Surrogate p-Terphenyl-d14	%	100	104	104	100

Organochlorine Pesticides in soil					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date extracted	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	0.2	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	108	108	109

Organophosphorus Pesticides in Soil					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date extracted	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	108	108	109

PCBs in Soil					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date extracted	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Aroclor 1016	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1221	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1232	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1242	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1248	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1254	mg/kg	<0.1	<0.1	<0.1	<0.1
Aroclor 1260	mg/kg	<0.1	<0.1	<0.1	<0.1
Total +ve PCBs (1016-1260)	mg/kg	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	106	108	108	109

Acid Extractable metals in soil						
Our Reference		264406-1	264406-2	264406-3	264406-4	264406-5
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04	BLF01 - [TRIPLICATE]
Depth		0-100mm	0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Arsenic	mg/kg	<4	<4	<4	<4	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	14	12	13	21	14
Copper	mg/kg	29	16	11	16	24
Lead	mg/kg	42	54	51	11	36
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	8	7	7	16	8
Zinc	mg/kg	370	85	120	38	210

Moisture					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date prepared	-	18/03/2021	18/03/2021	18/03/2021	18/03/2021
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Moisture	%	11	8.1	7.1	11

Asbestos ID - soils					
Our Reference		264406-1	264406-2	264406-3	264406-4
Your Reference	UNITS	BLF01	BLF02	BLF03	BLF04
Depth		0-100mm	0-100mm	0-100mm	0-100mm
Date Sampled		11/03/2021	11/03/2021	11/03/2021	11/03/2021
Type of sample		soil	soil	soil	soil
Date analysed	-	19/03/2021	19/03/2021	19/03/2021	19/03/2021
Sample mass tested	g	Approx. 40g	Approx. 45g	Approx. 45g	Approx. 45g
Sample Description	-	Red fine-grained soil & rocks	Red fine-grained soil & rocks	Red fine-grained soil & rocks	Brown fine-grained soil & rocks
Asbestos ID in soil	-	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg Organic fibres detected
Trace Analysis	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected

Method ID	Methodology Summary
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-021	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD.
Org-021	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-ECD. Note, the Total +ve PCBs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PCBs" is simply a sum of the positive individual PCBs.
Org-022	Determination of VOCs sampled onto coconut shell charcoal sorbent tubes, that can be desorbed using carbon disulphide, and analysed by GC-MS.
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS/GC-MSMS.
Org-022/025	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC-MS/GC-MSMS. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.

Method ID	Methodology Summary
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date extracted	-			18/03/2021	1	18/03/2021	18/03/2021		18/03/2021	18/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
TRH C_6 - C_9	mg/kg	25	Org-023	<25	1	<25	<25	0	103	97
TRH C_6 - C_{10}	mg/kg	25	Org-023	<25	1	<25	<25	0	103	97
Benzene	mg/kg	0.2	Org-023	<0.2	1	<0.2	<0.2	0	106	100
Toluene	mg/kg	0.5	Org-023	<0.5	1	<0.5	<0.5	0	107	101
Ethylbenzene	mg/kg	1	Org-023	<1	1	<1	<1	0	104	97
m+p-xylene	mg/kg	2	Org-023	<2	1	<2	<2	0	100	94
o-Xylene	mg/kg	1	Org-023	<1	1	<1	<1	0	108	101
naphthalene	mg/kg	1	Org-023	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-023	105	1	105	102	3	106	102

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date extracted	-			18/03/2021	1	18/03/2021	18/03/2021		18/03/2021	18/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	20/03/2021		19/03/2021	20/03/2021
TRH C_{10} - C_{14}	mg/kg	50	Org-020	<50	1	<50	<50	0	111	106
TRH C_{15} - C_{28}	mg/kg	100	Org-020	<100	1	140	150	7	77	81
TRH C_{29} - C_{36}	mg/kg	100	Org-020	<100	1	110	120	9	92	81
TRH >C_{10} -C_{16}	mg/kg	50	Org-020	<50	1	<50	<50	0	111	106
TRH >C_{16} -C_{34}	mg/kg	100	Org-020	<100	1	220	240	9	77	81
TRH >C_{34} -C_{40}	mg/kg	100	Org-020	<100	1	<100	<100	0	92	81
Surrogate o-Terphenyl	%		Org-020	83	1	107	101	6	100	85

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date extracted	-			18/03/2021	1	18/03/2021	18/03/2021		18/03/2021	18/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
Naphthalene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	97	99
Acenaphthylene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	99
Fluorene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	95
Phenanthrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	95	100
Anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	100	106
Pyrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	100	104
Benzo(a)anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	108	117
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-022/025	<0.05	1	<0.05	<0.05	0	103	113
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	106	1	100	106	6	101	103

QUALITY CONTROL: Organochlorine Pesticides in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date extracted	-			18/03/2021	1	18/03/2021	18/03/2021		18/03/2021	18/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
alpha-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	94	101
HCB	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
beta-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	102
gamma-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Heptachlor	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	87	89
delta-BHC	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aldrin	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	99	102
Heptachlor Epoxide	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	97	103
gamma-Chlordane	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
alpha-chlordane	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan I	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDE	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	101	106
Dieldrin	mg/kg	0.1	Org-022/025	<0.1	1	0.2	0.2	0	99	105
Endrin	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	96
Endosulfan II	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDD	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	97	101
Endrin Aldehyde	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
pp-DDT	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Endosulfan Sulphate	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	97	84
Methoxychlor	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-022/025	113	1	106	108	2	101	104

QUALITY CONTROL: Organophosphorus Pesticides in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date extracted	-			18/03/2021	1	18/03/2021	18/03/2021		18/03/2021	18/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
Dichlorvos	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	76	73
Dimethoate	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Diazinon	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chlorpyriphos-methyl	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ronnel	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	108	110
Fenitrothion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	93	93
Malathion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	124	112
Chlorpyriphos	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	99	102
Parathion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	96	94
Bromophos-ethyl	mg/kg	0.1	Org-022	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Ethion	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	109	111
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-022/025	113	1	106	108	2	101	104

QUALITY CONTROL: PCBs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date extracted	-			18/03/2021	1	18/03/2021	18/03/2021		18/03/2021	18/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
Aroclor 1016	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1221	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1232	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1242	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1248	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Aroclor 1254	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	80	80
Aroclor 1260	mg/kg	0.1	Org-021	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate TCMX	%		Org-021	113	1	106	108	2	101	104

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-5	264406-2
Date prepared	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
Date analysed	-			19/03/2021	1	19/03/2021	19/03/2021		19/03/2021	19/03/2021
Arsenic	mg/kg	4	Metals-020	<4	1	<4	<4	0	108	104
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	107	96
Chromium	mg/kg	1	Metals-020	<1	1	14	13	7	104	100
Copper	mg/kg	1	Metals-020	<1	1	29	24	19	105	114
Lead	mg/kg	1	Metals-020	<1	1	42	35	18	102	91
Mercury	mg/kg	0.1	Metals-021	<0.1	1	<0.1	<0.1	0	106	112
Nickel	mg/kg	1	Metals-020	<1	1	8	8	0	105	96
Zinc	mg/kg	1	Metals-020	<1	1	370	240	43	106	85

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Asbestos: A portion of the supplied sample was sub-sampled for asbestos analysis according to Envirolab procedures.
We cannot guarantee that this sub-sample is indicative of the entire sample. Envirolab recommends supplying 40-50g of sample in its own container.
Note: Samples were sub-sampled from jars provided by the client.

Acid Extractable Metals in Soil: The laboratory RPD acceptance criteria has been exceeded for 264406-1 for Zn. Therefore a triplicate result has been issued as laboratory sample number 264406-5.

barnson
DESIGN . PLAN . MANAGE

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CHAIN OF CUSTODY AND ANALYTICAL REQUEST

Job Number	32342	Date	15/03/2021
Laboratory	Envirolab - Sydney	Report to	Nardus Potgieter npotgieter@barnson.com.au
Sample Temperature on Receipt			
22 °C	Signature:		

Sample ID	Description	Sample Date	Analysis request					
			1	2	3	4	5	6
BLF 01 (1)	0-100mm dumped fill	10/03/2021		X				
BLF 02 (2)	0-100mm dumped fill	10/03/2021		X				
BLF 03 (3)	0-100mm dumped fill	10/03/2021		X				
BLF 04 (4)	0-100mm drainage line	10/03/2021		X				

Analysis Request	
1	Combo ~~6 (BTEX~~, TRH, PAH, OCP, OPP, PCB, 8metals)
2	Combo 6 (BTEX, TRH, PAH, OCP, OPP, PCB, 8metals) + asbestos ID
3	
4	
5	

Relinquished by / Affiliation	Accepted by / Affiliation	Date
Jim sarantzouklis / Barnson	A-BUI / Envirolab	15/03/2020

ENVIROLAB GROUP
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 264406
Date Received: 16/3/21
Time Received: 1630
Received By: AB
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None