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REMEDIAL ACTION PLAN

110-112 MOUNT VERNON ROAD, MOUNT VERNON NSW

PREPARED FOR: Project Works Design

OUR REFERENCE: REP-19-7963-A1

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1. INTRODUCTION

1.1 GENERAL

EnviroTech Pty. Ltd. was engaged by Mr. Graham Mann of PW Design Pty Ltd to prepare this Remediation Action Plan (RAP) for the remediation of contaminated soils at 110-112 Mount Vernon Road, Mount Vernon NSW 2178 (hereafter referred to as the site). The investigation will accompany a development application to evaluate, on the basis of the available information, the likely suitability of the site for the proposal from a contamination perspective.

The remediation strategy described in this RAP has primarily been established based on the findings of a Detailed Site Investigation conducted at the site by Envirotech dated 8th April 2019 (REP-19-7579-A1).

This RAP outlines procedures for the remediation of the site to a condition suitable for the proposed development. The RAP also provides guidance on how the remedial strategy is to be implemented during construction and relevant occupational and environmental controls to be adopted. The principal objective of this plan was to outline the management techniques and safeguards that should be implemented to ensure the remediation and development are completed in an acceptable manner, preventing any adverse exposure on site contractors and the surrounding environment.

1.2 Objectives

The objectives of the investigation were to:

- Set remediation goals that ensure the remediated site will be suitable for the proposed use and will pose no unacceptable risk to the human health or the environment
- Document the procedures and plans to be implemented to reduce the risk of significant harm to acceptable levels
- Establish the environmental safeguards required in completing the remediation in an environmentally acceptable manner and,
- Identify necessary approvals and licenses required by regulatory authorities if required.

1.3 Scope of Work

The Scope of Works included the following:

- A review of previous investigations and summary of the site's contamination status for the entire investigative site
- Delineate areas of potential concern to determine the lateral and vertical extent of possible ACM contamination within nominated areas TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6
- Additional stockpile sampling and/or stockpile footprint areas within the southern portion of the site to further characterise soil material
- Details of the preferred remediation strategy, and an outline of the methodology for the implementation of the selected strategy within the site

- A brief outline of environmental pollution control, community health and safety, and occupational health and safety measures that should be implemented during remedial works; and
- An outline of regulatory approvals and licenses which may be required to adopt the preferred remedial strategy.

1.4 Legislative Requirements

The legislative framework for the report is based on guidelines that have been set out by the NSW Environmental Protection Agency (EPA) formerly the Office of Environment and Heritage (OEH) in the form of the following Acts/Regulations:

- *Protection of the Environment Operations Act* (1997);
- *Protection of the Environment Operations Regulation* (2008);
- *Contaminated Land Management Act* (1998).

In addition, the following guidelines and technical documents have been reviewed and applied where applicable:

- *Contaminated Land Management - Guidelines for the NSW Site Auditor Scheme (3rd Edition, 2017).*
- *State Environmental Planning Policy No.55 (SEPP55) – Remediation of Land (2018)*
- *NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (2011).*
- *NSW EPA Sampling Design Guidelines (1995).*
- *NSW EPA Waste Classification Guidelines Part 1: Classifying Waste (2014).*
- *NSW EPA Guidelines for Assessing Former Orchards and Market Gardens (2005)*
- *Guidelines on the Investigation Levels for Soil and Groundwater, National Environmental Protection Measure 1999, 2013 Amendment (NEPC, 2013).*
- *Australian Standard AS 4482.1 Guide to the sampling and investigation of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds.*
- *Australian Standard AS 4482.2 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances.*
- *CRC CARE Technical Report No. 39: Risk-based remediation and management guidance for benzo(a)pyrene (2017).*
- *Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (NSW DECCW, 2009).*
- *Guidelines for the Assessment and Management of Groundwater Contamination (NSW DEC, 2007).*
- *Guidelines for the Assessment, Remediation & Management of Asbestos - Contaminated Sites (WA DOH, 2009).*
- *"Technical Report on Synthetic Mineral Fibres' in Technical Report on Synthetic Mineral Fibres and Guidance Note on the Membrane Filter Method for the Estimation of Airborne Synthetic Mineral Fibres" (National Occupational Health and Safety Commission, 1990).*

2. SITE IDENTIFICATION

The study site is 110-112 Mount Vernon Road, Mount Vernon NSW 2178 (Lot 4 DP865818) (Figure 1). It can be identified as a trapezoidal allotment north of Mount Vernon Road. Figure 2 shows an aerial photograph of the site and the surrounding land.

Table 1: Site Identification.

Street Address	110-112 Mount Vernon Road, Mount Vernon
Lot and DP Number	Lot 4 DP865818
Approx. Site Area	10,250 m^2
Local Government Area	Penrith City Council
Zoning	E4 – Environmental Living
LGA Legislation	Penrith Local Environmental Plan 2010

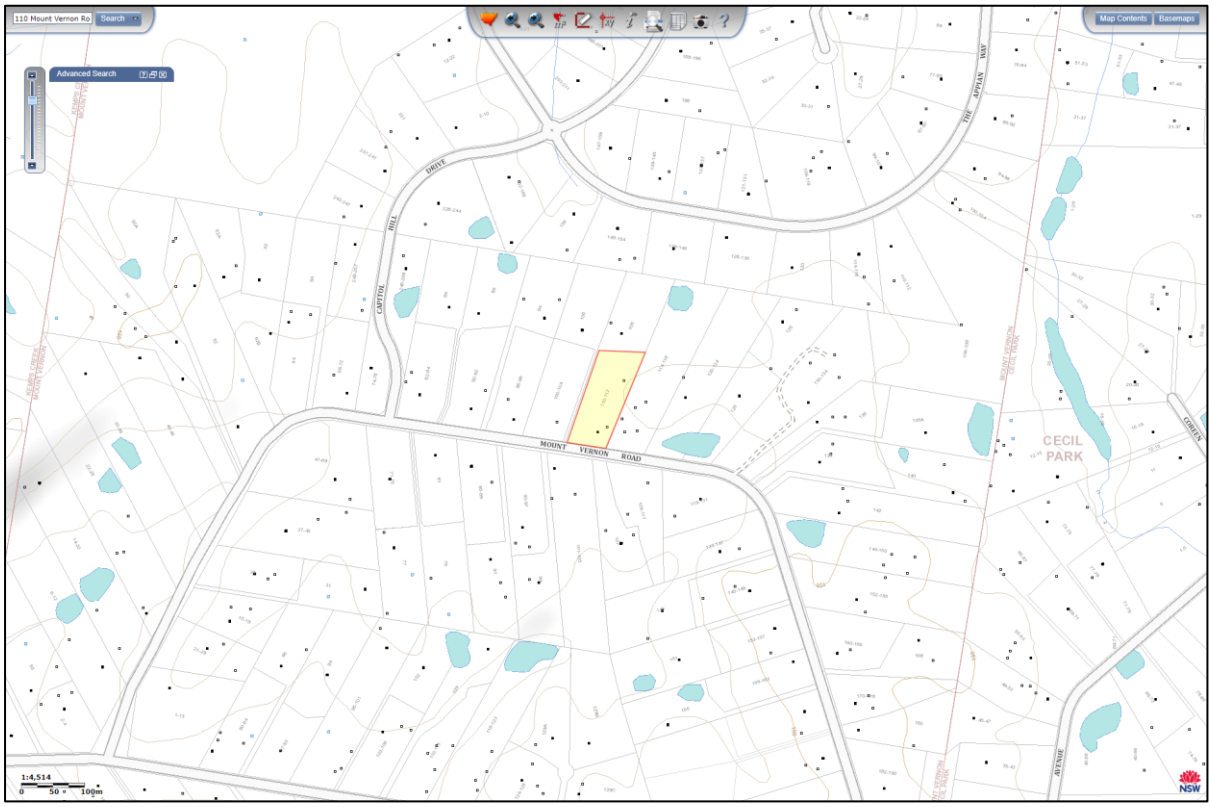


Figure 1: Site location map (NSW Spatial Information Exchange).

The investigation is part of a development application for a proposed childcare centre. The entire site was accessible and was investigated, including the proposed development area within the southern half of the site.

Figure 2: Aerial photograph of the site and surrounding land (NSW Spatial Information Exchange).

3. SITE DESCRIPTION

3.1 Site Inspection

On Tuesday 26th March 2019, a site inspection was conducted by Envirotech consultant Jack Hinchliffe. Field work was carried out in accordance with the methodology described in AS 4482.1 – 2005 and the NEPM (2013). At the time of inspection, the site consisted of a fenced off unoccupied and empty property. The majority of the site was comprised of disused market gardens. At the north-eastern and southern portions of site were the footprint remains of sheds and a residential house that were previously demolished. Stockpiles were present at the southern portion of site.

3.2 Surrounding land use

The site is located within a rural residential setting and bordered by:

- Rural residential allotments surrounding the site in all directions and
- Current Market Gardens surrounding the site to the east, west and south.

3.3 Topography

Gently undulating rises on Wianamatta Shale with local relief 10–30 m and slopes generally >5% but occasionally up to 10%. Crests and ridges are broad (200–600 m) and rounded with convex upper slopes grading into concave lower slopes. Outcrops of shale do not occur naturally on the surface. They may occur, however, where soils have been removed.

3.4 Geology and Soils

The department of environment soil map shows the site is within a Blacktown Soil Landscape characterised by gently undulating rises on Wianamatta Group shales. Local relief to 30 m, slopes usually >5%. Broad rounded crests and ridges with gently inclined slopes. Cleared Eucalypt woodland and tall open-forest (dry schlerophyll forest). Soils generally consist of friable brownish black loam transitioning to moderately to light grey plastic mottled clay.

3.5 Surface Water Hydrology

No groundwater or distinct overland flow paths were noted during the investigation. Stormwater is expected to infiltrate into soils or sheet south into the stormwater drainage system at Mount Vernon Road.

3.6 Hydrogeology

A search of the State Department of Primary Industries Groundwater map showed no groundwater works within 500m of the site.

3.7 Acid Sulfate Soils

The NSW Planning Portal shows the site within the boundary of being within Class 5 Acid Sulfate Soils Risk. Therefore, acid sulfate soils are not typically found in Class 5 areas and areas classified as Class 5 are located within 500 metres on adjacent class 1, 2, 3 or 4 land.

According to Atlas of Australian Acid Sulfate Soils, Appendix E, Lotsearch (page 144), the site is within an Extremely Low (1-5%) area of probability for the occurrence of acid sulfate soils, therefore a preliminary hydrology study in accordance with the ASSMAC Assessment Guidelines 1998 was not undertaken as part of this investigation. Also, as the proposed development will not alter the water table level of the zone during earthworks & construction, further assessment or action was not required.

3.8 Soil Sample Methodology

Soil samples were collected on Tuesday 26th March 2018 via test pitting. Samples were collected from approximately 0 - 500 mm depth using a simple mattock. No Groundwater was encountered in soil profile samples. Asbestos grab samples were taken by carefully removing soil within test pits. The depth of sampling across the site was limited to the top 500mm of soils, to ensure adequate coverage of the average depths of fill material across the entire site.

During the collection of soil samples, any features such as seepage, discoloration, staining, odours, or other physical indicators of contamination were noted. All site work was undertaken by Jack Hinchliffe, Environmental Scientist of Envirotech. Soil Samples were transferred directly from the test pits into laboratory supplied 250 mL sample jars sealed with Teflon lids. Asbestos samples were collected in asbestos sample bags and zip locked. The samples were stored in a chilled esky and transferred to ALS Environmental Division under stringent chain of custody (COC) procedures.

The decontamination of non-dedicated sampling equipment was achieved by washing with phosphate-free detergent and tap water, followed by a final rinse with distilled water. Decontamination was conducted after the collection of samples at each sample location. A clean pair of disposable gloves was used when handling each sample. The hand augers were decontaminated between sampling locations by physically removing soil material between boreholes, washing the augers with Decon 90 and rinsing them with water.

Figure 3: Site sampling plan showing location of the twenty-one (21) test pits (yellow) with the concurrent asbestos sampling (blue). (enhanced image Appendix B).

3.9 Conceptual Site Model

The main areas of potential concern within the vicinity of TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 locations include the following:

- The topsoils and underlying soils within the vicinity of of TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 has the potential to be comprised of unknown fill material containing Asbestos.

Additionally, the stockpiled soils and/or stockpile footprint areas within the southern portion of the site has the potential to be of comprised of contaminated materials

Table 2 identifies the main Potential Areas of Environmental Concern (AECs), and their associated Contaminants of Concern (COCs), using the information gathered through this assessment and qualitative judgement based on consultant experience.

Table 2: Potential Areas of Environmental Concern (PAEC)

PAEC	Potentially Contaminating Activity	Contaminant of Concern	Likelihood of Contamination
Vicinity of TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6	Potentially contaminated ACM fill material.	Asbestos	Possible.
Stockpiles of material (or footprint areas) within southern portion of the site	Potentially containing fill material from an unknown source	Heavy Metals, TRH, BTEX, PAH, Phenols, PCB, OC/OP Pesticides, Asbestos	Possible

3.10 Human Receptors and Sensitive Environments

On-site Human Receptors & Sensitive Environments:

- Construction workers during the excavation / construction process
- Future occupants of the site including Childcare staff and children
- Native vegetation within the site.

Off-site Human Receptors & Sensitive Environments:

- Surrounding rural residential properties
- Ropes Creek 1km northeast of the site
- Adjacent neighbouring dam 80m east of the site

3.11 Potential for Migration and Exposure of Contaminants

Site history information and onsite inspection observations indicated that due to the unsealed and open space condition of the site there may be a potential for contaminants to provide exposure risks to humans and native vegetation within the site.

Exposure routes of contaminants could potentially be through direct dermal contact with exposed underlying soils (Heavy Metals, TPH and PAHs) or airborne dust (Asbestos) and vapour (Phenols and VOCs). These exposure risks will potentially be most likely, and potentially at its highest risk during any earthworks or construction phases within the site.

There is also a potential for these contaminates to be present within stockpiled soils and underlying soils and have the ability to migrate vertically (dispersed up into the atmosphere, or infiltrate down into the groundwater), uptake by vegetation and/or migrate horizontally (through stormwater runoff pathways) from the proposed development, that will likely collect into the Mount Vernon stormwater system.

4. SUMMARY OF PREVIOUS INVESTIGATIONS

The following report was prepared specifically for the proposed works and are the principal documents used in the preparation of this RAP:

- Envirotech Pty Ltd Detailed Site Investigation, 110-112 Mount Vernon Road, Mount Vernon, Reference: REP-19-7579-A1 dated 17th March 2020.

Based on the available information, a targeted sampling plan was considered most appropriate to provide sufficient characterisation data. A total of twenty-one (21) test pits were nominated across the area of investigation (Figure 3).

The samples were measured against the Health Investigation Levels (HIL) for Soil Contaminants – *HIL A; Residential with garden/accessible soil (home grown produce <10% fruit and vegetable intake (no poultry), also includes childcare centres, preschools and primary schools.*

The findings of the Detailed Site Investigation are as follows:

- On Tuesday 26th March 2019, a site inspection was conducted by Envirotech consultant Jack Hinchliffe;
- At the time of inspection, the site consisted of a fenced off unoccupied and empty property. The majority of the site was comprised of disused market gardens;
- At the north-eastern and southern portions of site were the footprint remains of sheds and a residential house that were previously demolished. Stockpiles were present at the southern portion of site;
- The following area of concern were identified:
    - Previous historical site use as a market garden has the potential for OC/OP Pesticides to be impacting soils onsite;
    - Previously existing residential building and sheds originally constructed in an era to have comprised potentially hazardous building materials and incorrectly demolished;
    - Potentially unvalidated stockpiles onsite comprised of unknown building materials;
    - The underlying soils onsite have the potential to be comprised of unknown fill material.
- The site was first developed before 1955;
- The site is not listed by the EPA;
- Based on the available information, a targeted and stratified sampling plan was considered most appropriate to provide sufficient characterisation data. A total of twenty-one (21) test pits were nominated across the area of investigation (Figure 3);
- Samples were analysed for Heavy Metals, Phenols, TRH, BTEX, PAH, Hydrocarbons, OC/OP Pesticides & Asbestos by ALS Environmental Division;
- Soil chemical concentrations were below the thresholds of the adopted human health and ecological assessment criteria for residential land use as specified under the NEPM (2013);

All soil samples collected and tested (26th March 2019) were reported by the laboratory to have concentrations below the adopted site assessment criteria for HIL A, land use as per the NEPM, 2013, except for the following samples:

- **TP6/ASB1 (0-0.5m): Chrysotile Asbestos & Amosite Asbestos presence**
    - BONDED (Three pieces of asbestos cement sheeting approx. 50 x 40 x 5mm)
- **TP7/ASB2 (0-0.5m): Chrysotile Asbestos, Amosite Asbestos & Crocidolite Asbestos presence**
    - BONDED (Three pieces of asbestos cement sheeting approx. 60 x 50 x 5mm)
- **TP8/ASB3 (0-0.5m): Chrysotile Asbestos, Amosite Asbestos & Crocidolite Asbestos presence**
    - BONDED (One piece of asbestos cement sheeting approx. 80 x 30 x 5mm)
- **TP19/ASB6 (0-0.5m): Chrysotile Asbestos, Amosite Asbestos & Crocidolite Asbestos presence**
    - BONDED (Two larger pieces of asbestos cement sheeting approx. 80 x 40 x 5mm and one smaller piece of asbestos cement sheeting approx. 5 x 4 x 3mm)

As soil samples indicate the *presence of BONDED Asbestos*, within four (4) sampling locations, it is recommended that a suitably trained and qualified professional is engaged to prepare the following:

- Additional **Delineation Sampling** at and around the potentially asbestos hotspot areas of TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 to further characterise these potential areas of concern and to determine the lateral and vertical extent of the asbestos contamination according regulatory guidelines and site criteria.
- A **Visual Inspection** is to be undertaken of these areas by a SafeWork NSW Licensed Approved Asbestos Assessor to ensure no visible asbestos containing materials (ACM) are identified on surface soils and provide an Asbestos Clearance Certificate for the potential areas.

Also, to further characterise the site, the additional sampling is required:

- Additional **Stockpile Sampling** to further characterise the stockpiled soils within the southern portion of the site. If the stockpiles have been removed, then the stockpile footprint areas will be sampled to further characterise underlying soils.

Details of the required additional works will be recommended within in the amended Envirotech RAP (REP: 19-7963-A1).

Subject to the above, it is considered that the site can be remediated and made suitable for the intended proposed residential development, pending on the following Delineation Sampling, Visual Inspection and subsequent Remedial and Validation Works, if required.

Figure 4: Site aerial photograph indicating, site sampling plan showing location of the potential contaminated Hotspot locations (yellow outline), within the site, and additional stockpile investigations required within the southern portion of the site (orange outline).

4.1 Data Gaps

The following data gaps were identified which require further assessments:

- Soils sampled within the TP6/ASB1, TP7/ASB2, TP8, ASB3 and TP19/ASB6 sampling areas (26th March 2019) were only tested for Asbestos absence/presence – to further characterise and assess the concentration and distribution of asbestos within these four (4) vicinities, in accordance with WA DOH 2009 and NEPM 2013, further soil assessments are warranted within these areas.
- Delineation sampling within these four locations will determine the lateral and vertical extent of remediation and validations works required, if any, to confirm the suitability of the site for the proposed development and land use.
- Additionally sampling of the stockpile areas and/or the stockpile footprint areas (if the stockpiles have been already removed) to further characterise and assess the suitability of the site for the proposed development and land use.

5. DATA QUALITY OBJECTIVES

5.1 Step 1 – State the Problem

The Envirotech (2020) Detailed Site Investigation report indicated that soil samples (TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6) reported the presence of fragments of BONDED ACM identified within the specific areas within the site as a result of historical demolition of building structures which may of contained hazardous construction materials (Asbestos).

5.2 Objectives

The objectives are to:

- Characterisation of soils around the vicinity of TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6
- To determine the lateral and vertical extent of asbestos impacted soils within the TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 locations
- To determine if Asbestos is a contaminate of concern within the TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 vicinities
- Characterisation of stockpiled soils and/or stockpile footprint areas (if stockpiles have been already removed).

5.3 Step 2 – Identify the Decisions

Based on the results of the additional assessments, are there any other areas that require further management when assessed under the adopted site criteria?

5.4 Step 3 – Identify Inputs to the Decisions

The following information is required for input into the decisions identified in Step 2;

- Findings and conclusions from previous assessments carried out on site
- Laboratory analytical results from soil analysis previously carried out
- Field observations made on site during additional assessment or characterisation
- Collection and laboratory analysis of soil samples from locations specified in this RAP
- Laboratory analysis in accordance with USEPA/APHA methods and
- Comparison and interpretation of laboratory results against the adopted soil investigation and screening levels as specified in this RAP.

5.5 Previous Reports

The findings from the following Detailed Site Investigation previously prepared for the site was referenced to assist in the preparation of this RAP:

- Envirotech Pty Ltd, Detailed Site Investigation, 110-112 Mount Vernon Road, Mount Vernon: REP-19-7579-A1, dated 17th March 2020.

5.6 Contaminants of Concern

The contaminants of concern identified in soils during previous investigations are listed in the table below:

Table 3: Summary of Areas and Contaminants of Concern

Areas of Environmental Concern	Contaminating Activities	Contaminants of Concern
Vicinity of TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6	Fragments of ACM within surface soils	Asbestos
Stockpiles of soil within the southern portion of the site	Stockpiles containing unknown fill material	Heavy Metals Hydrocarbons OC/OP Pesticides Asbestos

5.7 Step 4 – Define the Study Boundaries

The spatial and temporal aspects of the additional assessment areas that the data must represent to support the decisions identified in Step 2 are as follows:

- The lateral extent of the additional ACM assessment is limited one (1) metre around the vicinity of each the TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 locations
- The vertical extent of the ACM study boundary is the surface top-soils 0-100mm within the vicinity of the TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 locations
- The lateral extent of the stockpile assessment is limited to the perimeter boundaries of each of the stockpiles and/or the stockpile footprint areas
- The vertical extent of the stockpile study boundary is the height of each of the stockpiles, or 0-100mm of the stockpile footprint area (if stockpiles have been removed).

5.8 Step 5 – Develop a Decision Rule

The acceptable limits for laboratory QA/QC parameters are shown in the table below and are based upon the laboratory reported acceptable limits and those stated within the NEPM 2013 Guidelines.

Table 4: Acceptable Limits for QC Samples

Type of QC Sample	Control Limit
FIELD	
Rinsate Blanks	Analytes <LOR
Intra-Laboratory Duplicates	RPD's <± 30-50%
Inter-Laboratory Duplicates	RPD's <± 30-50%
Trip Blanks	Volatiles <LOR
Trip Spike Recovery	>70%
LABORATORY	
Method Blanks	< Laboratory LOR
Matrix Spike	Recovery targets: • Metals: 70% to 130% • Organics: <30%
Laboratory Duplicate	GRPDs <30%
Laboratory Control Samples	Laboratory specified
Surrogate Spike	Laboratory specified

The following conditions should be adopted:

- If the control limits are exceeded, then an assessment of the significance of the results should be carried out
- If the results of the DQI assessment indicate that the data set is reliable, then the data set will be deemed to be acceptable for the purposes of the investigation and
- If the measured concentrations of additional soil and groundwater samples analysed meet their respective regulatory criteria, then no additional assessment is required.

5.9 Step 6 – Specify Limits on Decision Errors

There are two types of decision errors:

- **Sampling errors**, which occur when the samples collected are not representative of the conditions within the assessment/validation area; and
- **Measurement errors**, which occur during sample collection, handling, preparation, analysis and data reduction.

These errors may lead to following (null hypothesis):

- Deciding that the site is not suitable for the proposed development when it actually is (Type I error);
- Deciding that the site is suitable for the proposed development when it is actually not (Type II error);

- Deciding that the risks to human health from the additional soil and groundwater concentrations are high and require further management or remediation, when the risks are actually low (Type I error); and
- Deciding that the risks to human health from the additional soil and groundwater concentrations are low and requires no further management, when the risks are actually high (Type II error).

A 5% significance level has been selected for Type I errors on the basis that 95% of the data set will satisfy the DQIs. Therefore, the acceptable limit of the decision errors is based on a 5% probability of the hypothesis being incorrect.

An assessment will be made as to the likelihood of a decision error being made based on:

- The acceptable limits for inter/intra laboratory duplicate sample comparisons as specified in Step 5 of the DQOs; and
- The acceptable limits for laboratory QA/QC parameters are based upon the laboratory reported acceptable limits and those stated within the NEPM Guidelines.

If the concentration of a particular contaminant of concern exceeds its assessment criteria, then a further assessment is required to address the significance of the result.

Statistical analysis based on 95% UCL may be used to assess the significance of the data provided the following conditions are met:

- the arithmetic mean of the data set must be less than its respective threshold level; that is, it is acceptable for individual results to exceed its respective threshold level, but the cumulative mean of the data set of soil sample results must not exceed the threshold level
- the standard deviation of the data set is less than 50% of the relevant threshold level and
- no individual sample result should be greater than 250% of the relevant threshold level.

5.10 Optimise the Design for Obtaining Data

The optimum design for obtaining data in order to achieve the Data Quality Objectives is as follows:

- Review of previous reports prepared by Envirotech
- Adhering to the specifications of this RAP, and other requirements that the Council may have
- NATA-accredited environmental testing laboratories will be commissioned to analyse soil samples and will implement a quality control plan conforming to the NEPM (Assessment of Site Contamination) Measure Guidelines; and
- An assessment of the Data Quality Indicators to determine if the field procedures and laboratory analytical results are reliable.

6. VALIDATION CRITERIA

6.1 General

The selection of appropriate human health, ecological and groundwater site validation criteria were based on the following guiding documents:

- "National Environmental Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1)", NEPC (2013);
- "Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000" (ANZECC);
- "Australian Water Quality Guidelines 2000" (AWQG);
- "Australian Drinking Water Guidelines 2011" (ADWG); and
- "Guidelines for Managing Risk to Recreational Waters 2008 (GMRRW).

It is acknowledged that the guideline values adopted are generally intended for application as investigation and screening levels and are based on a conservative approach. However, the guidelines do not necessarily preclude their use in determining the suitability of a site for its proposed land use in the absence of remediation guideline values. Therefore, should the validation samples be at concentrations below their respective adopted criterion, they are considered to render the site suitable for the proposed use.

It should be noted that should validation samples fail their respective validation criteria, a justifiable decision should be made to determine whether a quantitative risk assessment would be warranted, based on the likelihood that it would result in a beneficial outcome in avoiding further unnecessary remediation costs.

Full details of the validation criteria for each contaminant of concern in soils, groundwater and soil vapour are presented in below.

6.2 Soils

6.2.1 Health Investigation Levels (HILs)

The NEPM presents Tier 1 Health Investigation Levels (HILs) for a broad range of chemicals such as metals, inorganics, PAHs, phenols, pesticides and other organics. The HILs are applicable to generic land uses such as residential, commercial/industrial or public open space and all soil types, generally within the first 3 metres of soil below ground level. The HILs have been applied to assess human health risks via all relevant pathways of exposure.

Based on the proposed development, soil investigation results within the building footprint/site will be assessed against the following criteria:

- ***HIL 'A' -*** *Residential use with gardens/accessible soils, including children's day-care centres, preschools and primary schools*
- ***HIL 'B' –*** *Residential with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments*

- ***HIL 'C' –*** *Public open space such as parks, playgrounds, playing fields, secondary schools and footpaths*
- ***HIL 'D' –*** *Commercial/industrial, including premises such as shops, offices, factories and industrial sites.*

6.2.2 Health Screening Levels (HSLs)

The NEPM presents Tier 1 Health Screening Levels (HSLs) for the following petroleum compounds and fractions:

- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX);
- Naphthalene; and
- TPH C_6-C_{10} and TPH >C_{10}-C_{16} fractions

The HSLs are applicable to generic land uses such as residential, commercial/industrial or recreational/public open space and different soil types between the ground surface and soils >4 metres below ground level. The HILs have been applied to assess human health risks via the inhalation and direct contact pathways of exposure.

Point 1 of Table 1A (4), which indicates that HSL D can be used in lieu of HSL B for buildings that comprise car parks or commercial properties on the ground floor.

6.2.3 Ecological Investigation Levels (EILs)

The NEPM presents Ecological Investigation Levels (Interim EILs) for As, Cu, CrIII, Ni, Pb, Zn, DDT and naphthalene.

The EILs are applicable to generic land uses such as areas of ecological significance, urban residential areas and public open space, and commercial/industrial land uses. The EILs have been applied to assess risks to terrestrial ecosystems, generally, within the top 2 metres of soil at the final surface/ground level.

Site specific EILs for Copper, Zinc, Nickel and Chromium III can be derived by adding the Ambient Background Concentration (ABC) to the Added Contaminant Limits (ACL), as per the following formula:

$$EIL = ABC + ACL$$

The ABC of a contaminant is the soil concentration in a specified locality that is the sum of the naturally occurring background level and the contaminant levels that have been introduced from diffuse or non-point sources by generating anthropogenic activity not attributed to industrial, commercial, or agricultural activities.

The ACL is the added concentration (above the ABC) of a contaminant above which further appropriate investigation and evaluation of the impact on ecological values is required. ACLs are based on the soil characteristics of pH, CEC and clay content. Different soils types / profiles will have different contaminant EILs rather than a single generic EIL for each contaminant. ACLs apply chromium

III (CrIII), copper (Cu), nickel (Ni) and zinc (Zn) for site-specific EIL determination. The soil properties to be measured for site-specific derivation of ACLs for CrIII, Cu, Ni and Zn are summarised below:

- pH - Cu
- CEC - Cu, Ni, Zn
- % clay - CrIII

Note – the lowest concentration of copper that is derived from the pH or the CEC calculation is to be used for the ACL.

Insufficient data was available to derive ACLs for As, Pb, DDT and naphthalene. As a result, the derived EILs are generic to all soils and are presented as total soil contaminant concentrations in Tables 1(B)4 and 1(B)5.

6.2.4 Ecological Screening Levels (ESLs)

Table 1B (6) of the NEPM presents Ecological Screening Levels (ESLs) for TPH C_6-C_{40} fractions, BTEX and benzo(a)pyrene.

The ESLs are applicable to generic land uses such as areas of ecological significance, urban residential areas and public open space, and commercial/industrial land uses. The ESLs have been applied to assess risks to terrestrial ecosystems, generally, within the top 2 metres of coarse or fine soil at the final surface/ground level.

6.2.5 Petroleum Hydrocarbon Management Limits

Table 1B (7) of the NEPM presents petroleum hydrocarbon management limits for application to TPH fractions C_6-C_{10}, $>C_{10}$-C_{16}, $>C_{16}$-C_{34} and $>C_{34}$-C_{40}. The management limits are applicable for coarse or fine soils in residential, parkland, public open space or commercial/industrial land uses following consideration of relevant ESLs and HSLs.

6.2.6 Asbestos in Soils

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 5 in Schedule B1.

Table 5: Health screening levels for asbestos contamination in soil

	Health Screening Level (w/w)			
Form of asbestos	Residential A[1]	Residential B[2]	Recreational C[3]	Commercial/ Industrial D[4]
Bonded ACM	0.01%	0.04%	0.02%	0.05%
FA and AF[5] (friable asbestos)	0.001%			
All forms of asbestos	No visible asbestos for surface soil			

- *Residential A with garden/accessible soil also includes children's day care centres, preschools and primary schools.*
- *Residential B with minimal opportunities for soil access; includes dwellings with fully and permanently paved yard space such as high-rise buildings and apartments.*
- *Recreational C includes public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and unpaved footpaths.*
- *Commercial/industrial D includes premises such as shops, offices, factories and industrial sites.*
- *The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures (refer Section 4.10). This screening level is not applicable to free fibres.*

Based on the proposed development, soil assessment/validation results within the site will be assessed against the HS for "Residential A" for bonded asbestos and 0.001%w/w for asbestos as AF/FA.

Asbestos and dust monitoring may be necessary during DSI, remediation and site development, and should meet the Guidelines (0.01fibre/mL) and NEPM ambient air criteria (PM10 of 50 mg/m3 over 24 hours), respectively.

Any admissible exposure to airborne asbestos should be kept as low as achievable and in any case below the specified exposure standards. These standards are determined by the *National Commission for Occupational Exposures*. Below is a summary of the threshold limits for airborne concentrations measured as a time-weighted average (TWA) fibre concentration.

Table 6: Exposure Standards – TWA Fibre Concentration Limits

Asbestos Species	Concentration (fibres/mL)
Chrysotile	0.1
Crocidolite	0.1
Amosite	0.1
Other forms	0.1
Other mixtures of species	0.1

Air monitoring must be conducted by an Occupational Hygienist or SafeWork NSW Approved Asbestos Assessor, in accordance with the following guidelines: *Guidance Note on Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [NOHSC: 3003(2005)].*

Note: Air sampling results should not be used to conclude that there has been no asbestos fibre release from soils or materials, or to justify use of less stringent site management measures, because the sampling methodology is not sufficiently accurate or representative for these purposes.

6.2.7 Groundwater Investigation Levels (GILs)

Groundwater investigation and screening levels were established by identifying the potential beneficial uses of groundwater down-gradient from the site based on the Six Environmental Values presented in the table below.

Table 7: Potential Beneficial Uses of Groundwater

Environmental Value	Applicability
Freshwater aquatic ecosystem	×
Marine aquatic ecosystem	✓
Agricultural use - irrigation	×
Agricultural use – stock watering	×
Recreational use	✓
Raw drinking water	✓

The applicable Environmental Values were selected on the basis of the following down-gradient receptors:

- *Recreational users and aesthetics at Botany Bay, located approximately 4.0 km to the south;*
- *The marine water aquatic ecosystem at Botany Bay;*
- *The nominated site is located within the Botany Groundwater Management Zone 2 area, therefore according to the Botany Sands Groundwater Source Fact Sheet for Residents, dated February 2018, all groundwater usage for domestic purposes is banned within this area.*

For each relevant Environmental Value identified above, the groundwater investigation and screening levels adopted are discussed in the following sub-sections.

If the screening or investigation levels are exceeded, then further consideration will be given to processes such natural attenuation, advection, adsorption and contaminant flux to assess potential risks to down-gradient aquatic ecosystems or drinking water sources.

6.2.8 Protection of Aquatic Ecosystems

Table 1C of the NEPM presents Groundwater Investigation Levels (GILs) for the protection of fresh water and marine water in slightly to moderately disturbed ecosystems. However, where the closest sensitive receptor is high value or highly disturbed, Section 3.1 of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) provides a range of water quality guidelines values based upon three levels of ecosystem conditions as shown in the table below.

Table 8: Aquatic Ecosystem Values

Ecosystem Value	Protection Level	Brief Definition	Applicability
High value ecosystems (HVE)	99%	Effectively unmodified, with ecological integrity regarded as intact.	×
Slightly to moderately disturbed ecosystems (SMDE)	95%	Small impacts to aquatic biological diversity within moderately cleared catchments with reasonably intact riparian vegetation.	✓
Highly disturbed ecosystems (HDE)	90%	Measurably degraded ecosystems typically associated with shipping ports or urban catchments.	×

Based on observations made during the site walkover, the aquatic ecosystem value of the Botany Bay area was considered to be highly disturbed and that the NEPM GILs are applicable.

However, where contaminants are potentially bio-accumulative, trigger values for the protection of 99% of species were used. Low reliability trigger values presented in Table 3.4.1 of the ANZECC 2000 guidelines were also adopted in the absence of high or moderate reliability trigger values.

6.2.9 Recreational Water Use and Aesthetics

The GMRRW guidelines (as referenced in NEPM) recommend adopting a multiplication factor of 10 to 20 to the ADWG for the assessment of recreational water quality. This is based on the rationale that the ADWG guideline values are based on a daily consumption of 2L, which is considered to be very conservative for application to recreational water exposure. On this basis, a multiplication factor of '10' (i.e. recreational consumption of 200mL per day) will be applied to the ADWG health guidelines to establish screening criteria.

6.2.10 Export of Waste

To assess the waste classification of materials to be disposed of off-site, the NSW EPA refers to the NSW DECC (2009) "*Waste Classification Guidelines, Part 1: Classifying Waste".*

6.2.11 Duty to Report

In accordance with Section 2.3.4 of the EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*, notification is required when:

- friable asbestos is present in or on soil on the land, AND
- the level of asbestos (% weight for weight) in an individual soil sample is equal to or above the health screening level of friable asbestos in soil (0.001%) specified in Section 4.8, Schedule B1 of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 2013); AND
- a person has been, or foreseeably will be, exposed to elevated levels of asbestos fibres by breathing them into their lungs.

In accordance with Section 2.3.5 of the EPA (2015) Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997, notification is required when:

- the contaminant has entered or will foreseeably enter groundwater or surface water; and
- the concentration of the contaminant in the groundwater or surface water is, or will foreseeably be, above the groundwater investigation level for that contaminant as specified in Section 6, Schedule B1 of the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC 2013); and
- the concentration of the contaminant in the groundwater or surface water will foreseeably continue to remain above the specified concentration.

Furthermore, the guideline specifies situations not intended to be captured by the duty to report such as:

- sites without off-site contamination where
  - on-site contamination is not likely to migrate to a neighbouring property, and
  - any on-site contamination has been assessed and the site found to be suitable for the proposed use in accordance with the requirements under the Environmental Planning and Assessment Act 1979
- sites with contaminants that are at levels above the triggers but are equal to, or below, the ambient background concentration.
- sites with non-friable asbestos materials (fibro) in or on soils, or naturally occurring asbestos.

7. SAMPLING AND ANALYSIS PLAN

7.1 General Methodology

In order to meet the Data Quality Objectives, the additional soil assessment will comprise fieldwork and sample collection carried out in general accordance with industry accepted standard practice.

The sampling strategy is based on our current level of understanding of the site conditions and to address Auditor comments. However, the fieldwork and the sampling and analysis program may be subject to change based on the observations made during field work, such as soil profiles beneath the site and visual extent of contamination.

The drilling method adopted should ensure that no pathways of contamination are created between various strata encountered. Where a confined layer is encountered, a bentonite seal should be used to prevent potential cross-contamination between the overlying and underlying strata.

7.2 Additional Soil Sampling Assessment

Sampling Density and Sampling Location Rationale

The following table presents the minimum number of samples to be collected at each area to be targeted during the validation and additional soil assessment sampling.

Table 9: Soil Sampling Density

Area	Remediation Works	Analysis	Samples Number
Hotspot TP6/ASB1	To collect surface soil 0-100mm samples, and deeper samples 300-400mm at the TP4/ASB1 location. To collect surface soil 0-100mm samples, and deeper 300-400mm samples, 1000mm around the centre TP4/ASB1 location at four locations to delineate lateral extent of potential asbestos contamination.	Asbestos %w/w	Two (2) base location samples at the TP4/ASB1 vicinity. Four (4) delineation sampling locations 1000mm around the TP4/ASB1 vicinity at two (2) depths.
Hotspot TP7/ASB2	To collect surface soil 0-100mm samples, and deeper samples 300-400mm at the TP6/ASB2 location. To collect surface soil 0-100mm samples, and deeper 300-400mm samples, 1000mm around the centre TP6/ASB2 location at four locations to delineate lateral extent of potential asbestos contamination.	Asbestos %w/w	Two (2) base location samples at the TP6/ASB2 vicinity. Four (4) delineation sampling locations 1000mm around the TP6/ASB2 vicinity at two (2) depths.
Hotspot TP8/ASB3	To collect surface soil 0-100mm samples, and deeper samples 300-400mm at the TP7/ASB3 location. To collect surface soil 0-100mm samples, and deeper 300-400mm samples, 1000mm around the centre TP7/ASB3 location at four locations to delineate lateral extent of potential asbestos contamination.	Asbestos %w/w	Two (2) base location samples at the TP7/ASB3 vicinity. Four (4) delineation sampling locations 1000mm around the TP7/ASB3 vicinity at two (2) depths.
Hotspot TP19/ASB6	To collect surface soil 0-100mm samples, and deeper samples 300-400mm at the TP19/ASB6 location. To collect surface soil 0-100mm samples, and deeper 300-400mm samples, 1000mm around the centre TP19/ASB6 location at four locations to delineate lateral extent of potential asbestos contamination.	Asbestos %w/w	Two (2) base location samples at the TP19/ASB6 vicinity. Four (4) delineation sampling locations 1000mm around the TP19/ASB6 vicinity at two (2) depths.
Stockpiles	A minimum of three (3) samples per each stockpile within the southern portion of the site At various depths within the stockpile	Heavy Metals, Hydrocarbons, OC/OP Pesticides, Asbestos	Number of stockpile sampling is dependent of the size of the stockpile and sample numbers in accordance to the Table 10 below.

Notes: Refer to Figure 3 below.

Table 10: Minimum number of Samples for stockpiles 200m3 or less (minimum of 3 then 1:25)

Soil Volume, m^3	No. of Samples
25 or <25	3
50	3
75	3
100	4
125	5
150	6
175	7
200	8
>200	1:25

Source: EPA Victoria Soil Sampling

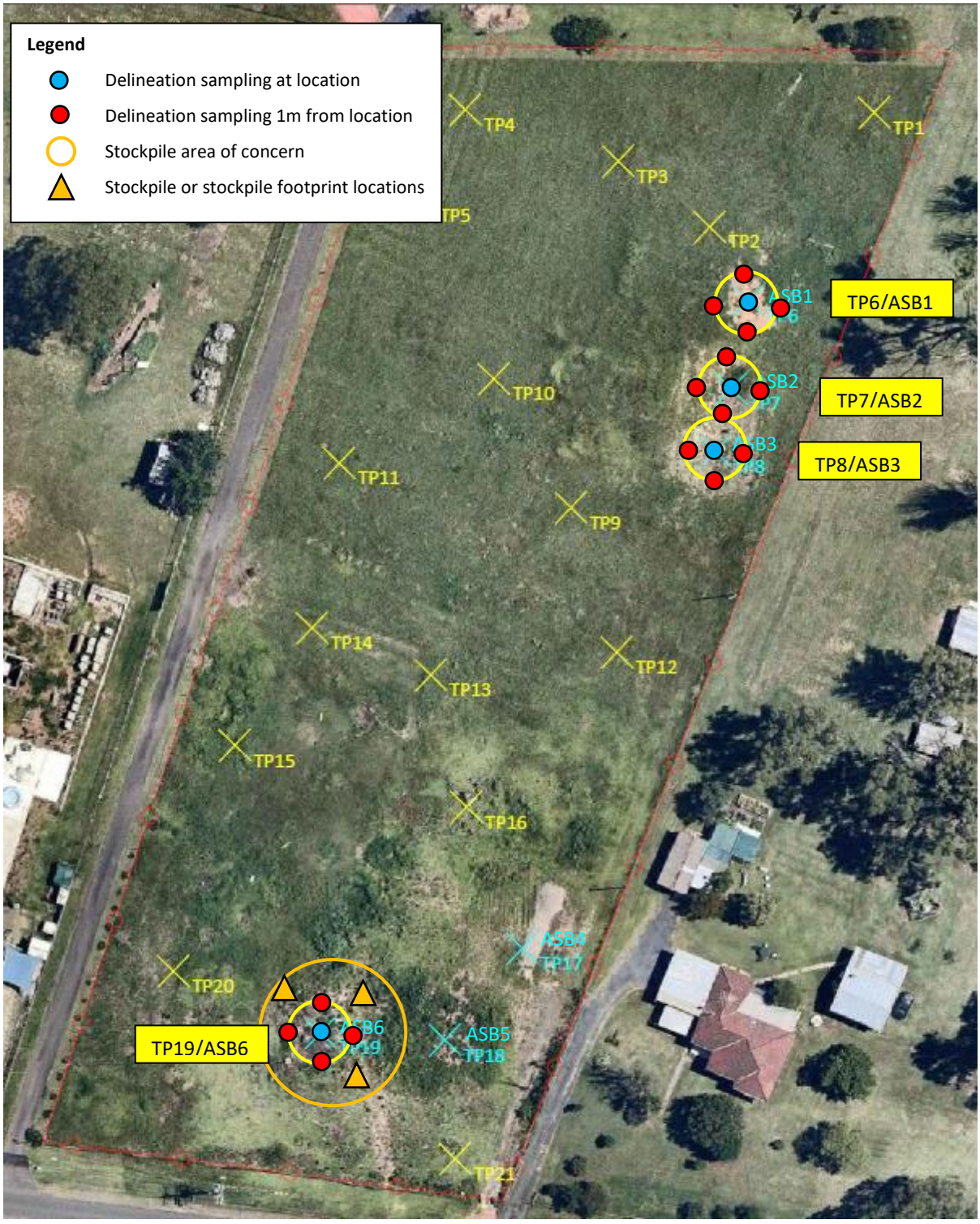


Figure 5: site aerial photograph indicating, proposed delineation site sampling plan showing location of the delineation sampling at and around each of the potential Hotspot locations.

The number of delineation sampling locations to properly characterise the potential hotspots include:

- Potential Hotspots TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 at 0-100mm and 300-400mm depths BGL to determine the vertical extent of potential asbestos contamination (**blue**); and
- 1000mm (north, south east and west) around the centre of the potential hotspots TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6 at 0-100mm and 300-400mm depths BGL to determine the lateral and vertical extent of potential asbestos contamination (**red**).

Sampling for QA/QC purposes as follows:

- Field quality sampling regime sufficient with at least 1 duplicate / triplicate per 20 primary samples per sampling event and per sampling date.
- Rinsate collected / analyses for contaminants of concern (COC) at one per batch per sampling date.

7.3 Sampling Methodology

Delineation soil sampling will be carried out in general accordance with Envirotech Fieldwork Protocols. In summary:

- Soil samples will be collected using a hand auger. Soil samples will be collected from the near surface 100mm fill layer and 300mm depth BGL. Additional samples will be collected where there is visual evidence of contamination; and
- Sampling will occur at the exact location where previous sampling occurred and again at four (4) locations 500mm away from the centre location at two depths. Additional samples will be collected where there is visual evidence of contamination.

Sampling of asbestos will be undertaken as follows:

- A minimum 10L sample from each sample location will be recovered
- Each sample (minimum of 10 L) will be screened through a 7mm sieve and the material retained on the sieve examined for any bonded ACM and / or suspect material and forwarded to the laboratory for analysis if any suspected ACM is encountered
- If visible FA material is present or suspected, the soil should be wetted to minimise the release of fibres
- Identified bonded ACM and FA should be weighed for each sample and
- One wetted 500ml sample from each sampling location will be submitted to a NATA accredited laboratory for analysis for AF. Soil asbestos analysis should comply with Australian Standard Method for the Qualitative Identification of asbestos in bulk samples (AS4964–2004).

Sampling of stockpiles will be undertaken as follows:

- Stockpile sampling will be collected at a rate of 1:25m^3
- Samples will be collected at various depths within the stockpile
- If the stockpiles have been already removed from site then samples will be collected from the stockpile footprint areas, minimum of 3 samples collected

- During the collection of soil samples, any features such as seepage, discoloration, staining, odours, or other physical indicators of contamination were noted.
- Soil Samples were transferred directly from the test pits into laboratory supplied 250 mL sample jars sealed with Teflon lids
- Asbestos samples were collected in asbestos sample bags and zip locked.
- The samples were stored in a chilled esky and transferred to ALS Environmental Division under stringent chain of custody (COC) procedures.

7.4 Soil Laboratory Analysis

Delineation Soil samples will be analysed in a NATA-accredited laboratory under Chain of Custody conditions for a selection of the following:

- Asbestos %w/w

Stockpile / stockpile footprint samples will be analysed in a NATA-accredited laboratory under Chain of Custody conditions for a selection of the following:

- Heavy Metals, TRH, BTEX, PAH, Phenols, PC, OC/OP Pesticides and Asbestos %w/w

Field QA/QC samples will also be collected and analysed for the above analytes in accordance with the QA/QC Plan below.

8. QUALITY CONTROL / ASSURANCE PLAN

8.1 Field QA/QC

The following procedures should be adopted to minimise cross-contamination between sampling locations and to adopt appropriate measures in the transport and storage of samples:

- Any non-dedicated equipment will be decontaminated in between sampling locations, including hand trowel, where used
- QA/QC samples will be collected in accordance with the sampling frequencies specified in Section 5.2
- All glass bottles should be individually bubble wrapped for protection and insulated containers/coolers should be used for sample shipment
- Soil and groundwater sample containers other than asbestos bags will be placed immediately into a chilled cooler box and dispatched to their respective analytical laboratories on the same day. If this is not possible, samples will be temporarily held overnight in the Envirotech office refrigerator at a temperature of no greater than 4ºC and dispatched the following day
- All samples will be dispatched to a NATA-accredited laboratory (or to an EPA approved laboratory for soil vapour samples) under Chain of Custody conditions
- A Chain of Custody form (CoC) will be fully completed for all samples collected and included with the samples for transport and laboratory submission. The CoC will include the laboratory analysis requirements and
- Samples must be delivered to each respective laboratory within relevant holding times.

8.2 Data Quality Indicators

The five Data Quality Indicators (DQIs) comprising completeness; comparability; representativeness; precision and accuracy provide an assessment of the reliability of field procedures and laboratory analytical results in accordance with the NEPM 2013 Schedule B2 Site Characterisation Appendix C. These are addressed in the following sub-sections.

8.3 Completeness

Data Completeness is a measure of the amount of useable data (expressed as %) from a data collection activity. The completeness is equal to the percentage of valid quality assurance and quality control results.

The assessment should address the following:

Table 11: Data Completeness

Field	Laboratory
• All critical locations are sampled • All samples collected from critical grids and depths • Consistency in the use of standard operating procedures, equipment, sampler • Completion and correctness of field documentation.	• All critical samples and analytes are analysed in accordance with the RAP; • Appropriateness of laboratory methods and PQLs.

The minimum target frequency for each type of QA/QC sample should be carried out in accordance with the following tables:

Table 12: QA/QC Sample Frequency

Field QA/QC Sample	Frequency (Soil)	Frequency (Groundwater)
Intra-Laboratory Duplicate	1 in 20 samples	1 in 10 samples
Inter-Laboratory Duplicate	1 in 20 samples	1 in 10 samples
Field Blanks	1 per day	1 per day
Trip Blank	1 per day	1 per day

Where any of the above objectives are not achieved for particular samples, steps will be taken to rectify the non-conformance, if possible. Alternatively, data qualifiers detailing the nature of the quality problem will be documented in the report and attached to relevant data in the result summary tables.

The target for overall completeness for each data set is a minimum of 95%. A data completeness of less than 95% may be accepted where it can be justified that the non-conformance does not have a significant effect on the outcome of the results.

8.4 Comparability

Data Comparability is the confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.

The qualitative assessment should address the following:

Table 13: Data Comparability

Field	Laboratory
• Consistency in the use of standard operating procedures, equipment, sampler • Consistency in the method of sample collection for each media • Quantification of influence by climatic conditions.	• Consistency of analytical methods and limits of reporting (LOR) for each analyte • Whether laboratory limits of reporting are set at < 20% of the adopted site criteria value for each analyte • Consistent use of one primary and one secondary laboratory

8.5 Representativeness

Data Representativeness is the confidence (expressed qualitatively) that data are representative of each media present on the site.

The qualitative assessment should address the following:

Table 14: Data Representativeness

Field	Laboratory
• Samples are collected in accordance with the SAQP • Receipt of samples within holding times • Receipt of intact samples • Receipt of adequately preserved samples.	• All samples are extracted and analysed within their respective holding times.

8.6 Precision

Data Precision is a quantitative measure of the variability (or reproducibility) of data.

Intra-laboratory or Inter-laboratory Duplicate Samples (B) results are compared with Primary Sample (A) results using Relative Percentage Differences (RPDs) according to the following formula:

$$\%RPD = \left|\frac{A - B}{A + B}\right| \times 200$$

Duplicate sampling rates for this assessment (**for each separate sample batch**) are to be tested for all the same analytes as the primary sample:

Table 15: Data Precision

Type of QC Sample	Control Limit
Field Intra-Laboratory Duplicate (Blind)	RPD < +/- 30-50%
Field Inter-Laboratory Duplicate (Split)	RPD < +/- 30-50%

Where the laboratory has reported results for a particular analyte below the limit of reporting for either the primary sample or a duplicate sample, the RPD is reported as 'Not Calculable' or NC. A discussion should be made as to which sample should be adopted and compared against the relevant assessment criteria. However, no discussion is required where both the primary sample and the duplicate sample for a particular analyte are below the limit of reporting.

8.7 Accuracy

Data Accuracy is a quantitative measure of the closeness of reported data to the true value. Laboratory measured recovery of analytes in lab control samples with known concentrations. Laboratory QA/QC testing is to include:

Table 16: Data Accuracy

Laboratory QA/QC Sample	Frequency
Method Blank	1 per 20 samples
Matrix Spike	1 per 20 samples
Laboratory Duplicate	Laboratory defined
Laboratory Control	Laboratory defined
Surrogate Spike	All organic samples

9. REMEDIATION OPTIONS

9.1 Overview

With regard to site remediation, the Environment Protection Authority (EPA) endorses the Policy of the 1992 Australian and New Zealand Environment and Conservation Council (ANZECC) and National Health and Medical Research Council (NHMRC) Guidelines for the Assessment and Management of Contaminated Sites. Furthermore, the threshold concentrations presented in the NSW DECC Third Edition 2017 Guidelines for the NSW Site Auditor Scheme and the National Environment Protection (Assessment of Site Contamination) Measure 2013 (NEPM) are considered as appropriate soil and groundwater clean-up criteria.

For groundwater, the ANZECC 2000 Guidelines for Fresh and Marine Water Quality have been generally accepted by the NSW EPA as appropriate investigation levels along with criteria outlined in the National Environment Protection (Assessment of Site Contamination) Measure 2013. The NSW EPA Service Station Guidelines also provide reference guidelines. In addition, the NSW EPA 2009 Waste Classification Guidelines have been used as the basis of technical review for the waste disposal options most applicable to the site.

A risk management approach has provided the basic principle of the remediation technologies/methods selected for the Site. This approach is consistent with the strategy outlined in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites (ANZECC, 1992) and the National Environment Protection (Assessment of Site Contamination) Measure 2013, which are endorsed by NSW EPA.

A contaminated site, as defined by the NEPM 2013 and the ANZECC 1992, is a site at which hazardous substances occur at concentrations above background levels, and where assessment indicates it poses, or is likely to pose, an immediate or long-term hazard to human health or the environment.

Wherever human health is at risk, either on or off-site, or the off-site environment is at risk, a contaminated site should be remediated to the extent necessary in order to minimise such risks in both the short and long terms.

Environmental and Human Health Risk is based on exposure to potential hazards and is defined as:

Risk = Hazard x Exposure

The elimination of the risk can be achieved by the removal of the hazard and/or the exposure pathway. Remediation is defined as any measure that removes the risk to an acceptable level by negating the hazard or exposure pathway. Therefore, remediation can involve removal of the hazard (i.e. no risk remains) or alternatively, management of the risk by removal of the exposure pathway even if the hazard remains. Exposure pathways to contaminated material can be managed by undertaking a physical action (e.g. erection of a fence, installation of cap, etc.) and/or a management plan, which prevents exposure to contaminants (e.g. use of planning controls, management of site activities etc.).

9.2 Typical Remedial Options Available

Several remedial options were reviewed. The suitability of the remedial options was examined with respect to the requirements of the proposed development, whilst taking into account the provisions of a number of relevant guideline documents, including:

- ANZECC/NHMRC document Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Lands 1992 (ANZECC 1992).
- Department of Environment and Conservation (now DECCW), Contaminated Site: Guidelines for the NSW Site Auditor Scheme (3rd Edition) 2017.
- ANZECC, Guidelines for the Assessment of On-site Containment of Contaminated Soil' (ANZECC 1999).
- NSW EPA Best Practice Note: Landfarming (NSW EPA, 2014).

Typical remedial options that may achieve the remedial objectives are identified as:

- Removal of contaminated material to landfill
- Encapsulation of the contaminated soils by a physical barrier system or
- On-site treatment and re-use of contaminated material.

10. SELECTION OF PREFERRED REMEDIATION STRATEGY

10.1 Evaluation of Remediation Options

A summary of the hierarchical policy for site remediation options (Guidelines for the NSW Site Auditors Scheme NSW DEC 2017) is as follows:

1. On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level
2. Off-site treatment of excavated soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level, after which the soil is returned to the site
3. Removal of contaminated soil to an approved site or facility, followed where necessary by replacement with clean fill
4. Bioremediation which uses naturally occurring micro-organisms, such as bacteria and fungi, to eliminate, attenuate or transform polluting or contaminating substances in soils and
5. Consolidation and isolation of the soil on site by containment within a properly designed barrier.

An evaluation of remedial options was considered as follows:

- **Do nothing** – Whereby no remediation is undertaken, and impacted soil remains on site. Given the sensitive nature of the proposed development, including residential and commercial uses, this option is not considered suitable.

- **On-site containment** – Given that this option will result in the site recorded on the Register of Contaminated Sites under section 21(A) of the Environmental Protection Act 1997, it is the least preferred option in the hierarchy of remediation options as outlined above.

- **On-site treatment and re-use of contaminated land** – This strategy is feasible for some contaminants such as bacterial contamination. Bacterially contaminated soil is excavated and then spread thin over plastic exposed to the sun for seven days. This can be carried out by the caretaker/owner of the site. This is an advantageous strategy as the soil, once exposed to the sun, is reusable onsite.

- **Excavation to offsite** – This remedial strategy involves the complete removal of impacted soil from the site for disposal at an appropriately licensed waste management facility. The advantage of this strategy is that it removes the contaminants and their associated problems from the site. The disadvantage is that it is typically more costly than on-site containment and off-site transport of contaminated soil increases the risk of exposure within the surrounding community.

- **Bioremediation** – This remedial strategy involves 'landfarming' wherein engineered bioremediation systems which generally use tilling or ploughing of impacted soils to reduce contaminant levels biologically. Another well-practiced system of bioremediation uses forced air that actively aerates the contaminated mass to encourage bioremediation.

10.2 Preferred Remediation Option

Based on an assessment of the options and considering the proposed land-uses and development, the remediation option which should be adopted for the site is **excavation of contaminated soil offsite**.

Excavation Offsite

The excavation to offsite is considered to be the most appropriate remedial strategy for the majority of the development area. The sensitive nature of the potential inhabitants for the proposed are key to this remediation recommendation. Off-site disposal of contaminated soil is considered a suitable option for managing human health and environmental impacts from the contaminated materials. Off-site disposal harnesses the excavation of soil, classification of spoil, and disposal to a facility which can legally receive it.

The EPA permits disposal of contaminated material subject to an approved landfill. The DECC Waste Classification Guidelines (2009) document sets out the methodology for assessing and classifying wastes to be disposed to landfill. Essentially, wastes are classified into General Solid (Non-putrescible), General Solid (Putrescible), General Solid – Special Waste Asbestos, General Solid – Restricted Waste and Hazardous Waste.

The selection of an appropriate landfill will normally depend largely upon the results of classification of the wastes. It is sometimes necessary for heavily contaminated soils to be pretreated prior to disposal, to reduce the concentrations or minimise the mobility of the contaminants. Special criteria are sometimes applicable to certain categories of waste. Contaminants covered by Chemical Control Orders have restrictions placed on their handling and disposal.

11. IMPLEMENTATION OF SELECTED REMEDIAL STRATEGY

11.1 Roles and Responsibilities

Principal and Principals Representative

- The Principal's representative, Impact Group Pty Ltd, is responsible for the environmental performance of the proposed remediation works, including implementation of acceptable environmental controls.

Principal Contractor and Site Manager

- The Principal Contractor (referred to herein as the Contractor) is anticipated to be the party responsible for the day-to-day implementation of this RAP and shall fulfil the responsibilities of the Principal Contractor as defined by SafeWork NSW.
- If hazardous materials (Asbestos) are identified, SafeWork NSW licensed contractors are to be commissioned to safely remove them from site and dispose of them at a suitably licensed waste disposal facility (tickets retained for proof).
- Furthermore, Principle Representative, Principal Contractor and Site Manager will be responsible for implementing the Remedial Environmental Monitoring Plan (REMP) including:
    - Notification of adjoining residents and local planning authority (involved in remedial works) prior to commencement of remedial works
    - Define hours of operation (complying with council requirements)
    - Define roles and responsibilities for relevant parties to provide contact details
    - Traffic control measures
    - Handling of contaminated material
    - Odour control measures
    - Stockpiling of excavated soils on site and
    - Complaints and how they will be handled.

7.2 Remediation Process – Excavation Offsite

ACM Hotspots

If asbestos contamination is identified above the adopted site criteria within the potential hotspot areas TP6/ASB1, TP7/ASB2, TP8/ASB3 and TP19/ASB6, then the following remediation processes apply:

- Licensed contractors are to be commissioned to safely remove contaminated soils and dispose of them at a suitably licensed waste disposal facility (tickets retained for proof)
- According to the NSW EPA Sampling Guidelines for a site with a size of 10,250m^2, the diameter of the Hotspot that can be detected with 95% confidence is approximately 25.7m diameter.

For each identified contaminated Hotspot(s)

- excavate the area 25.7m diameter around the hotspot x 1.0m depth *(0.5m below the sampling location)*. Estimated volume (using πr^2) = **471m^3 per hotspot area**
- excavated soil surfaces should be visibly clean residual soil material
- unless tested and proven otherwise, the contaminated material from the Hotspot locations will be disposed of offsite at a licensed facility as **Special Waste (Asbestos)**.
- if the material is transported interstate it must be tracked and monitored using an NSW EPA approved tracking waste system.

Note: additional excavations/chasing out of contaminants may be required should further visible contaminants are identified within each of the hotspot areas.

Stockpile Hotspots

If contamination is identified above the adopted site criteria within stockpile areas within the southern portion of the site, then the following remediation processes apply:

- Licensed contractors are to be commissioned to safely remove contaminated soils and dispose of them at a suitably licensed waste disposal facility (tickets retained for proof)
- According to the NSW EPA Sampling Guidelines for a site with a size of 10,250m^2, the diameter of the Hotspot that can be detected with 95% confidence is approximately 25.7m diameter.

For each identified contaminated Hotspot(s)

- excavate the area 25.7m diameter around the stockpile area x 0.1m depth. Estimated volume (using πr^2) = **471m^3 per hotspot area**
- excavated soil surfaces should be visibly clean residual soil material
- Any soil to be removed from the site shall be classified in accordance with the NSW EPA (2014) "*Waste Classification Guidelines, Part 1: Classifying Waste"* before it can be disposed of off-site.
- if the material is transported interstate it must be tracked and monitored using an NSW EPA approved tracking waste system.

Note: additional excavations/chasing out of contaminants may be required should further visible contaminants are identified within each of the hotspot areas.

7.3 Occupational Health and Safety (OHS)

- All transport of waste and disposal of materials must be conducted in accordance with the requirements of the POEO Act
- Removal of waste materials from the site shall only be carried out by suitably licensed contractors holding consent and/ or approvals to dispose of the waste materials per the assigned waste classification; and
- Asbestos containing soils are to be safely disposed at a facility licensed to receive such waste with receipts retained for proof of safe and appropriate disposal.

7.4 Waste Classification

- TP6/ASB1, TP7/ASB2, TP8/ASB3 & TP19/ASB6 – Special (Asbestos) Waste.
- Stockpile material should be characterised before disposal to appropriately licensed landfill facility. Excavated soils that require temporary stockpiling should be placed on a heavy-duty plastic sheet or a sealed surface such as concrete and covered with an impermeable plastic sheet to prevent rain infiltration and dust-dispersion.
- Any soil to be removed from the site shall be classified in accordance with the NSW EPA (2014) "*Waste Classification Guidelines, Part 1: Classifying Waste"* before it can be disposed of off-site.

7.5 Validation Goals/Implementation

If contamination is identified after the delineation sampling around each of the potential ACM hotspot areas and Stockpile areas, then following applies:

- The validation goals are to have no contaminated soils remaining in the area of concern
- A validation certificate must be provided by a suitably qualified occupational hygienist, environmental scientist or equivalent person for each Stage of the proposed residential development
- Validation will involve a validation soil sampling and laboratory analysis regime as per follows:
    - Validation sampling for the contaminates of concern around each wall one validation sample per each wall face (or one sample every 5m of excavated wall) of the excavated hotspot pit(s), additional discretionary samples if necessary
    - Validation sampling for the contaminants of concern a minimum of three (3) validation samples from the base/floor of the excavated hotspot pit(s), additional discretionary samples if necessary
    - Each validation sample retrieved will be analysed for the contaminate of concern

12. ENVIRONMENTAL MANAGEMENT PLAN

12.1 Introduction

A major component of the remedial works shall involve the installation and maintenance of an Environmental Management Plan (EMP). The EMP will provide details of the environmental protection and pollution control measures to be implemented during the operational phase of the remedial works. The pollution control measures have the objective of removing/minimizing any adverse impact on the surrounding environment.

In the following sections, outlines have been presented of the various pollution control measures that would be implemented during most elements of the remedial works. These form the basis of the Environmental Management Plan that should be read in conjunction with this document.

12.2 Site Fencing

Reasonable measures need to be taken to ensure the site boundary remains secure during all remedial site works. Secure temporary fencing is required to be in place for the duration of site works with gates secured and locked outside of site operating hours to prevent unauthorized access.

12.3 Erosion Sediment Control Plan

An erosion and sediment control plan will be prepared for the site. Erosion and run-off control measures will be implemented during all elements of remedial works. Typically, these measures will be designed to prevent the transport of pollutants (including sediments) out of the remediation area (including the designated stockpile areas) via surface run-off. Such measures typically include:

- Minimizing disturbed areas
- Sediment control fencing
- Stabilized site access points
- Strict excavation times tables and
- Prompt rehabilitation of disturbed areas.

12.4 Noise Control Plan

The Principal Contractor and Site Manager will be responsible for keeping noise levels to a minimum and not exceed limits outlined in AS 2436-1981. Noise levels must comply with Council and NSW EPA requirements. It is expected that equipment and machinery used onsite will not generate noise levels above this requirement.

12.5 Dust Control Plan

Dust generation should be kept to an absolute minimum. Dust control measures will be implemented to ensure that dust generated from the site is controlled within acceptable levels. These control measures will be developed considering the site conditions in each remediation area, and are likely to include (but not necessarily be limited) to the following:

- All vehicles leaving the site will be hosed down to remove any potentially contaminated dust
- A water cart or equivalent will be utilized on-site to keep vehicle paths and areas of site work damp to minimise dust generation
- Access to water sprays shall be available to water down excavation / loading areas and
- Plastic sheeting shall be available to cover excavation faces and stockpiles.

12.6 Stormwater Control and Groundwater Management Plan

A stormwater control plan will be prepared for the site. Stormwater and run-off control measures will be implemented during all elements of remedial works. Minimisation of stormwater runoff will prevent contaminated media moving through the water column, into uncontaminated portions of the site, neighbouring properties or into council stormwater systems and are likely to include (but not necessarily be limited) to the following:

- Covering stormwater drains on Mount Vernon Road with filter drain socks or silt traps or hay bales (or similar); and
- Diverting run-off around stockpiles so that surface water collects in a low point on site and does not drain into neighbouring properties or Brocks Ln.

Any groundwater encountered during excavation works will be transferred to and stored onsite in trenches and sumps. No discharge of groundwater will occur without approval of appropriate regulatory bodies.

12.7 Odour Control Plan

All potential odours generated during remedial action is taking place must be monitored and comply with local Council and NSW EPA requirements. Due to the type of contamination present onsite, odours is not expected to be an issue onsite but may still be encountered.

12.8 Health and Safety

A Work Health and Safety (WHS) plan is an essential part of all remediation projects, to ensure the health and safety of all personnel working on or visiting the site. All remediation work would be undertaken in accordance with the provisions set out by the Work Health and Safety Act (2011) and associated Regulations 2011, and any other regulations or directions set out by regulatory authorities.

- Prior to commencing any remediation works, a specific WHS Plan would be prepared by the Remediation Contractor covering the following minimum aspects:

- Method statements
- Identification of the remediation area and exclusion zones
- Induction of personnel
- Personal protective equipment (PPE)
- Hazard identification / locations
- Identification of contaminants of concern and their physical and toxicological properties
- Description of exposure pathways and personal protection requirements
- Location of all underground/aboveground services
- Details of specific work practice procedures to be followed within the designated contaminated areas
- Monitoring protocols to identify a potentially hazardous practice
- Emergency information and
- Incident reporting.

12.9 Onsite Stockpiles

Stockpiles should be managed to minimise the risk of dust generation, erosion and leaching. The measures required to achieve this will depend on the materials in the stockpile and the length of time the stockpile is to remain on site, but should include:

- Restrict the height of stockpiles to reduce dust generation
- Construct erosion, sediment and runoff control measures
- Cover stockpiles of contaminated soils to be left on site no more than 24 hour and
- Keep temporary stockpiles moist, by using water spray where required.

13. UNEXPECTED FINDS PROTOCOL

13.1 Management

Where earthworks are required there is potential to expose unexpected forms of contamination within the surface and subsurface. In such instances, action is required to mitigate potential contaminated soil/material encountered during excavation or construction activities. If potentially contaminated material is encountered the Unexpected Finds Protocol is to be followed. Works in the vicinity will be stopped or modified and will not recommence until the material has been analysed and management measures developed.

13.2 Training

Personnel involved in earthworks on site are to be inducted on the identification of potential unexpected finds and asbestos awareness. The induction can be undertaken at the time of general site induction and refreshed periodically at toolbox meetings. Induction to provide awareness of all types of possible unexpected finds is not practicable. In general, a precautionary approach can be employed and the unexpected finds procedure outlined in the following sections should be implemented.

13.3 Procedure

Personnel involved in earthworks on site are to be inducted on the identification of potential unexpected finds and asbestos awareness. The induction can be undertaken at the time of general site induction and refreshed periodically at toolbox meetings. Induction to provide awareness of all types of possible unexpected finds is not practicable. In general, a precautionary approach can be employed and the unexpected finds procedure outlined in the following sections should be implemented.

Should an unexpected actual or suspected contamination be encountered during the development works, the following procedure applies:

1. Stop work in the potentially hazardous area as soon as it is safe to do so and move to the upwind side of the area, or away from the area.

2. Assess the potential immediate risk to human health posed by the unexpected find and assess if evacuation or emergency services need to be contacted.

3. Delineate an exclusion zone around the affected area using fencing and/or appropriate barriers and signage. Additional control measures may be required for odours and/or volatile compounds: odours suppression and no smoking signage.

4. Contact the appointed environmental consultant for advice and request a site visit to undertake an assessment of the unexpected find. The Site Supervisor should be informed of the find once a preliminary assessment is made.

5. The environmental consultant will assess the unexpected find and provide advice regarding:

a) Preliminary assessment of the contamination and need for immediate management controls;

b) What further assessment and/or remediation works are required and how such works are to be undertaken in accordance with contaminated site regulations and guidelines;

c) Preparation of an addendum to the remediation action plan (if necessary) or provide clean up advice;

d) Remediation works required (where applicable);

e) Validation works required following remediation works (if applicable).

6. Works are not to recommence in the affected area until appropriate advice has been obtained from the environmental consultant and the environmental consultant has provided relevant information to the Site Supervisor, particularly for considering change to the Site Safety Plan.

7. If it is deemed safe to do so by the Site Supervisor, works may resume in the affected area.

14. CONCLUSION

The Site can be made suitable for the intended land-use through remedial action as part of the redevelopment works in accordance with State Environmental Planning Policy No.55 Managing Land Contamination: Planning Guidelines SEPP 55.

In conclusion, the RAP:

- Has been developed in a manner consistent with current industry practice;
- Has selected a preferred remediation strategy based on the site-specific issues and currently available technologies that will allow the site to be made suitable for the intended land use;
- Has presented an outline of the Environmental Management Plan (EMP) and associated contingency plans to ensure the environment is appropriately protected during the proposed works;
- Has presented an information and consultation program to ensure the stakeholders are informed of the works as they proceed; and,
- Has outlined the means of validation of the completed works and ongoing management.

15. REFERENCES

- Protection of the Environment Operations Act (1997);
- Protection of the Environment Operations Regulation (2008);
- Contaminated Land Management Act (1998).
- Contaminated Land Management - Guidelines for the NSW Site Auditor Scheme (3rd Edition, 2017).
- State Environmental Planning Policy No.55 (SEPP55) – Remediation of Land (2018)
- NSW EPA Guidelines for Consultants Reporting on Contaminated Sites (2011).
- NSW EPA Sampling Design Guidelines (1995).
- NSW EPA Waste Classification Guidelines Part 1: Classifying Waste (2014).
- NSW EPA Guidelines for Assessing Former Orchards and Market Gardens (2005)
- Guidelines on the Investigation Levels for Soil and Groundwater, National Environmental Protection Measure 1999, 2013 Amendment (NEPC, 2013).
- Australian Standard AS 4482.1 Guide to the sampling and investigation of potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds.
- Australian Standard AS 4482.2 Guide to the sampling and investigation of potentially contaminated soil. Part 2: Volatile substances.
- CRC CARE Technical Report No. 39: Risk-based remediation and management guidance for benzo(a)pyrene (2017).
- Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (NSW DECCW, 2009).
- Guidelines for the Assessment and Management of Groundwater Contamination (NSW DEC, 2007).
- Guidelines for the Assessment, Remediation & Management of Asbestos - Contaminated Sites (WA DOH, 2009).
- "Technical Report on Synthetic Mineral Fibres' in Technical Report on Synthetic Mineral Fibres and Guidance Note on the Membrane Filter Method for the Estimation of Airborne Synthetic Mineral Fibres" (National Occupational Health and Safety Commission, 1990);

16. LIMITATIONS

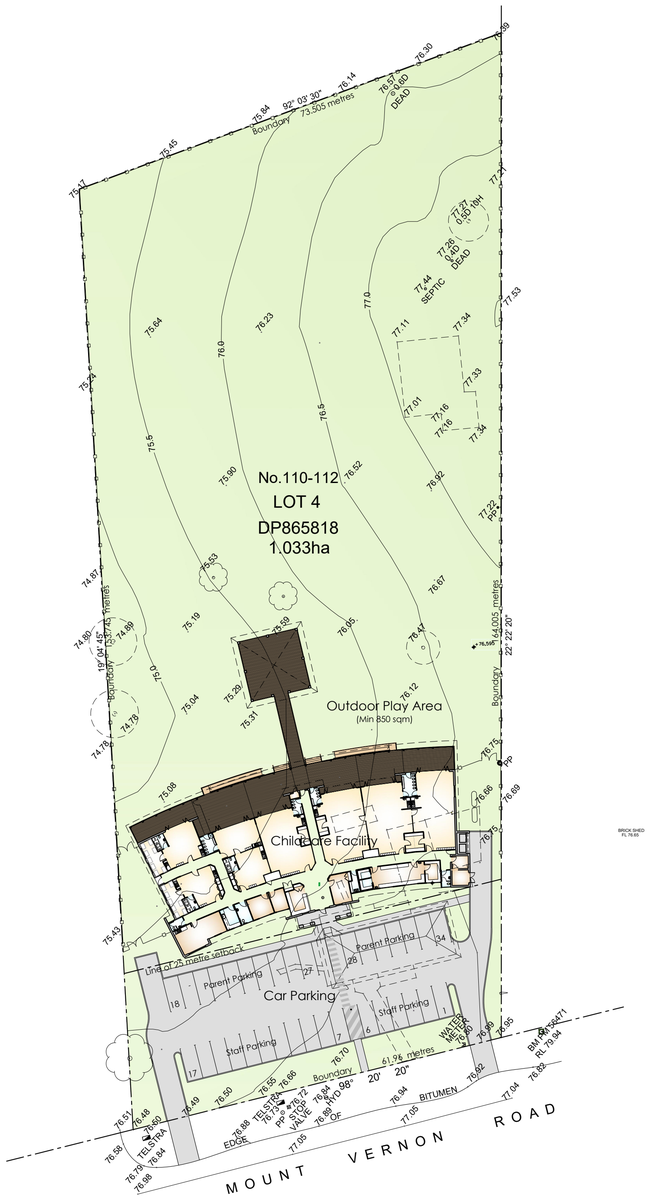
The information contained within this report have been prepared exclusively for the client. Envirotech has carried out the investigation with a degree of care and skill ordinarily exercised in similar investigations by reputable members of the environmental industry in Australia. No other warranty, expressed or implied, is made or intended. This report is to be read in its entirety including attachments and appendixes and should not read in individual sections.

A third party should not rely upon the information prior to making an assessment that the scope of work conducted meets their specific needs. Envirotech cannot be held liable for third party reliance on this document.

The sub-surface environment can vary greatly across an individual site. The conclusions presented in this report are based on limited investigation of conditions at specific sampling locations chosen to be as representative as possible under the given circumstances. However, it is possible that this investigation may not have encountered all areas of contamination at the site due to the limited sampling and testing program undertaken.

Envirotech's professional opinions are based upon its professional judgment, experience, training and results from analytical data. In some cases further testing and analysis may be required, thus producing different results and/or opinions. Envirotech has limited its investigation to the scope agreed upon with its client.

APPENDIX A: DEVELOPMENT PLANS



SITE PLAN
SCALE 1:500

PART SITE PLAN
SCALE 1:200

0 1 2 3 4 5 10
SCALE - 1:200 @ A1 METRES

Concept Design Plans

PROJECT WORKS DESIGN

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Rev Date Description
Amendments

Vladimir Vanovac and Mark Toma

Proposed Childcare Centre

110 - 112 Mount Vernon Road Mount Vernon NSW

North Point

Title: Proposed Site Plan
Drawn: GM
Date: 01.11.18
Checked: GM
Scale: 1 : 500 / 1:200 @A1
Job No. 18307
Dwg No. SK01
Issue: B