# Remediation Action Plan

MProjects

Riverwood North Residential Renewal Project
Riverwood, NSW

January 2011
JBS 41131 - 16137

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# List of Abbreviations

A list of the common abbreviations used throughout this report is provided below.

| | |
|---|---|
| ACM | Asbestos Containing Material |
| AHD | Australian Height Datum |
| As | Arsenic |
| bgl | below ground level |
| BTEX | Benzene, toluene, ethylbenzene and xylenes |
| B(a)P | Benzo(a)pyrene |
| Cd | Cadmium |
| CSM | Conceptual site model |
| Cr | Chromium |
| Cu | Copper |
| DECCW | NSW Department of Environment, Climate Change and Water |
| DNR | Department of Natural Resources |
| DoH | Department of Health |
| DQIs | Data Quality Indicators |
| DQOs | Data Quality Objectives |
| DWE | NSW Department of Water and Energy |
| EMP | Environmental Management Plan |
| EPA | NSW Environment Protection Authority |
| GILs | Groundwater investigation levels |
| GPR | Ground Penetrating Radar |
| GPS | Ground Positioning System |
| Ha | Hectare |
| Hg | Mercury |
| HIL | Health based investigation level |
| HRA | Human Risk Assessment |
| JBS | JBS Environmental |
| LOR | Limit of Reporting |
| Mn | Manganese |
| Ni | Nickel |
| NSW | New South Wales |
| OCP | Organochlorine Pesticides |
| PAHs | Polycyclic aromatic hydrocarbons |
| Pb | Lead |
| PBIL | Phytotoxicity based investigation level |
| PCBs | Polychlorinated Biphenyls |
| PPE | Personal Protective Equipment |
| PQL | Practical Quantitation Limit |
| QA/QC | Quality Assurance/Quality Control |
| RAP | Remedial Action Plan |
| RPD | Relative Percentage Difference |

| | |
|---|---|
| SAQP | Sampling, Analysis and Quality Plan |
| SI | Supplementary Investigation |
| SMP | Site Management Plan |
| SPLP | Synthetic Precipitation Leaching Procedure |
| TCLP | Toxic Characteristic Leaching Potential |
| TPH | Total Petroleum Hydrocarbons |
| UST | Underground Storage Tank |
| VOCs | Volatile Organic Compound |
| WA | Western Australia |
| WQOs | Water Quality Objectives |
| w/w | by weight (weight for weight) |
| Zn | Zinc |

# Executive Summary

### Introduction

JBS Environmental Pty Ltd was engaged by MProjects Pty Ltd (MProjects) to prepare a Remedial Action Plan (RAP) on the area of the Riverwood North Residential Renewal Project, located off Washington Avenue, Riverwood, NSW (the site). The site is identified as Lots 445, 446, 450, 458, 459 and 460 in Deposited Plan (DP) 243672, and has an approximate area of 3.55 hectares (Ha).

The site is registered to the Housing Commission of NSW, currently the Department of Housing NSW, and is occupied by several free standing residential apartment buildings and vegetated open space land. Approval is currently being sought for development of the site into new public housing apartments, private dwellings and recreational areas. It is understood the development of the site is expected to commence in August 2011.

### Objectives

The objectives of the RAP include to:

- Define the extent of remediation required;
- Assess appropriate remediation options and select a preferred option;
- Document the remediation methodology, including the associated safety and environmental management controls;
- Establish pre-determined validation criteria relevant to the likely future landuse and detail the validation program (including reporting); and
- Outline any potential ongoing monitoring or management requirements to ensure the continued protection of human health and the environment.

### Contamination Issues

Previous contamination assessments conducted on the site (Douglas Partners 2008[1], JBS 2010[2]) identified the potential for the presence of widespread filling across the site impacted by asbestos containing materials (ACM) present as fibre cement sheet. The ACM impacted fill was observed to extend through the lateral boundaries of the site to depths of between 0.3 and 1.2 metres below ground level.

### Extent of Remediation and Preferred Remediation Approach

To determine the extent of remediation required JBS has adopted the values provided in the draft revised NEPM as the assessment criteria in the absence of DECCW endorsed guidelines relating to asbestos in soil. Reference to the draft revise NEPM is being made as it is anticipated the revised NEPM will be issued early in the second quarter of 2011 and it is expected at it will be the guidance document endorsed by DECCW for the assessment and remediation of asbestos in soil. It is noted that asbestos criteria proposed in the revised NEPM are based on those developed by and already endorsed by WA DoH

[1] '*Report on Preliminary Geotechnical, Contamination and Hazardous Materials Assessment, Urban Renewal Project, Riverwood North'* Reference 45788, dated 5 November 2008

[2] '*Stage 1 Environmental Site Assessment, Riverwood North Residential Renewal Project'* JBS 41131-15354, dated 30 October 2010

(2009). WA DoH also provides investigation procedures for the quantification of asbestos in soil.

If, on receipt of planning consent for the redevelopment, the criteria for asbestos in soils provided in the draft revised NEPM have not been endorsed in NSW, then JBS will be able to undertake a health risk assessment (HRA) to develop site specific criteria for acceptable levels of ACM in soil. The HRA criteria, if adopted, will require submission to NSW Health for review and endorsement. While NSW Health will need to consider the site-specific criteria for asbestos in relation to the proposed remediation of the site, it is noted that site specific criteria for asbestos in soil previously derived by JBS to guide similar asbestos in soil remediation works have been endorsed by NSW Health and site auditors.

With consideration to DECCW's endorsed guideline hierarchies for soil remediation options and groundwater cleanup objectives (DEC 2006), and to the site specific contaminants and environmental setting, the preferred remediation strategy is outlined as follows:

- Excavation and offsite disposal of material at the 7 locations with free asbestos fibres detected. Validation of the resulting excavations will be required;
- Excavate the material present at the remaining 18 locations with ACM fragment impacted sub-surface soils. Hand pick the ACM fragments from the excavated material, validate the picked material to confirm the mass of ACM is less than the adopted criteria. Reinstatement of material successfully validated to the required finished level; and
- Import validated material to construct a capping at least 0.3 m thick over the residual ACM impacted surface soils that have been validated as meeting the adopted criterion. This shallow capping layer is required to address the criterion for surface ACM as an aesthetic issue. Alternatively, the top 0.1 m of reinstated material may be handpicked to remove ACM and then validated as being absent of visible ACM.

The remediation strategy also requires that:

- Hazardous Materials Building Surveys (HMBS) are completed on all buildings to be demolished;
- asbestos quantification testing is completed in the footprint of the existing buildings; and
- screening of landfill gas concentrations in the cleared footprints of the proposed building.

Review of the concept plan for the site provided indicates that development has been divided into several stages. The preferred remedial strategy can be applied across the site as a whole, or on a staged basis. Regardless of the proposed staging of remedial works, a Construction Environmental Management Plan (CEMP) must be prepared for the site to ensure all site workers, even those involved solely with construction works, are made aware of the presence of asbestos on the site. The requirement for the CEMP is discussed further in **Section 10.2**

Subject to the successful implementation of the measures detailed in this RAP and subject to the limitations in **Section 13**, it is considered that the site can be made suitable for continued residential use with minimal access to soils and recreational land use.

It is further noted that groundwater has been assessed in a limited capacity. This is considered appropriate based on the site conditions and historical data. If potential sources of groundwater contamination are identified during remediation, an additional groundwater quality assessment should be undertaken.

# 1 Introduction

## 1.1 Background

JBS Environmental Pty Ltd was engaged by MProjects Pty Ltd (MProjects) to prepare a Remedial Action Plan (RAP) on the area of the Riverwood North Residential Renewal Project, located off Washington Avenue, Riverwood, NSW (the site). The site is identified as Lots 445, 446, 450, 458, 459 and 460 in Deposited Plan (DP) 243672, and has an approximate area of 3.55 hectares (Ha).

The site is registered to the Housing Commission of NSW, currently the Department of Housing NSW, and is occupied by several free standing residential apartment buildings and vegetated open space land. Approval is currently being sought for development of the site into new public housing apartments, private dwellings and recreational areas. Previous contamination assessments conducted on the site (Douglas Partners 2008[3], JBS 2010[4]) identified the potential for the presence of widespread filling across the site impacted by asbestos containing materials (ACM) present as fibre cement sheet.

This RAP has been developed to incorporate remedial areas based on results of the Stage 2 Environmental Site Assessment (ESA) (JBS 2010). Remedial activities will be focused on areas of ACM impacted soils (both surface and near surface material).

The RAP details the procedures that will be implemented to effect the remediation of any asbestos impacted soils and validation of resultant excavations. It is understood that the site is to be redeveloped for continued use as residential land use with minimal access to soils and recreational open space land.

This RAP has been developed in accordance with guidelines made or approved by the NSW DECCW with consideration of the methods presented in the WA DoH (2009[5]).

## 1.2 Objectives

The objectives of the RAP are to:

- Summarise the site characteristics;
- Define the extent of remediation required;
- Assess appropriate remediation options and select a preferred option;
- Document the remediation methodology, including the associated safety and environmental management controls;
- Establish pre-determined validation criteria relevant to the likely future landuse and detail the validation program (including reporting);
- Identify the regulatory requirements relevant to the proposed remedial works; and

[3] '*Report on Preliminary Geotechnical, Contamination and Hazardous Materials Assessment, Urban Renewal Project, Riverwood North'* Reference 45788, dated 5 November 2008

[4] '*Stage 1 Environmental Site Assessment, Riverwood North Residential Renewal Project'* JBS 41131-15354, dated 30 October 2010

[5] *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*. WA Department of Health, 2009 (WA DoH 2009)

- Outline any potential ongoing monitoring or management requirements to ensure the continued protection of human health and the environment.

# 2 Site Description and Surrounding Environment

The information provided in the following sections is summarised from JBS (2010). Readers are referred to the original report for the full details and source documents.

## 2.1 Site Identification

The location of the site is shown in **Figure 1**, and current site layout is shown in **Figure 2**. The site details are summarised in **Table 2.1** and described in detail in the following sections.

**Table 2.1 Summary Site Details**

| | |
|---|---|
| Lot/DP | Lots 445, 446, 450, 458, 459 and 460 in DP 243672 (6 in total) |
| Address | 9-11 Washington Avenue, Riverwood, 2-4 Vermont Crescent, Riverwood 45-51 Kentucky Avenue and 70-76 Kentucky Avenue, Riverwood |
| Local Government Authority | Canterbury City Council |
| MGA Coordinates (MGA 56) of approximate centre of the site | E: 1430655<br>N: 6198070 |
| Site Zoning | Residential |
| Previous use | Agricultural prior to 1943 then a wartime hospital and emergency housing until the 1950s when the site was acquired for development of public housing. |
| Current Use | Public housing apartments |
| Proposed Use | Mixed public housing apartments and private dwellings |
| Site Area | Approximately 3.55 Ha |

## 2.2 Site Description

The site comprises six irregular parcels of land occupying an area of approximately 3.55 Ha. Vermont Crescent and a section of Kentucky Road intersect the site. With the exception of Lot 450, property lots are currently occupied by free standing multi-storey residential apartment blocks. Lot 450, comprising the roughly semi-circular parcel of land encircled by Vermont Crescent and Kentucky Avenue is a Council reserve and parkland area. On all other property lots, the areas between the residential buildings were covered in grass or vegetation with concrete lined pedestrian walkways, vehicle access roads and parking areas. These areas appeared to be used as communal open space areas by the apartment tenants. The site was unsecured at the time of the site inspection.

There were minor amounts of general debris and rubbish across the site, however, overall the site appeared to be generally well maintained. Fill material was observed on the ground surface in and around areas of vegetation on the site. No significant staining indicative of surface spills and contamination was observed on the surface during the site visit and no unusual odours were noted. No signs indicative of underground storage tanks (UST) were noted at the site such as fill points or breather pipes. It is noted, however, that there are a number of service pits, consistent in design with stormwater pits (particularly along the north-eastern boundary of the site). Based on the condition of the pits they did not appear to be in use.

## 2.3 Surrounding Landuse

The current landuse of adjacent properties or properties across adjacent roads is shown in **Figure 2** and summarised below.

The site is bound to the north and north east by the Salt Pan Reserve which comprises public open space land including an arm of Salt Pan Creek which is understood to currently be used as a wetland area/bird habitat. To the west the site is bound by more residential apartment buildings which are similar in appearance and layout to those currently occupying the site. To the south the site is bound by Washington Avenue, and more residential apartment blocks further south.

Based on review of the surrounding land uses, no major off site sources of potential contamination are present in the vicinity of the site.

## 2.4 Topography

Review of the topography of the general area undertaken as part of (JBS 2010) indicated that the elevation of the site is approximately 17 metres above Australian Height Datum (m AHD). The site slopes down gently to the north to northeast towards Salt Pan Creek.

## 2.5 Hydrology

An arm of Salt Pan Creek is located approximately 10 m northeast of the site.

External to the existing apartment buildings the ground surface on site is predominantly unsealed and precipitation falling on these areas is expected to infiltrate the subsurface. As such, surface runoff would only be expected following extended periods of heavy rainfall, where it would be expected to flow in accordance with local topography to the northeast.

Rainfall would otherwise be collected by the stormwater systems of the buildings and roads and directed to the municipal systems in the streets. The fate of the collected stormwater was not determined but is expected to ultimately discharge to the nearby arm of Salt Pan Creek.

## 2.6 Geology

A review of the regional geological map (BMR 1966[6]) indicated that the site is underlain by Ashfield Shale comprising black to dark grey shale and laminite from the Wiannamatta Group of the Middle Triassic Period.

Review of the regional soil map (DLWC 2002[7]) indicated that the soil in the area is of the Birrong Group, and is alluvial in origin. The landscape typical of the Birrong Group is characterised by level to gently undulating alluvial floodplain landscapes draining Wiannamatta Group shales. Local relief is typically up to 3 m high with slopes of up to 3 %. The typical soils of the group include deep (>250 cm) yellow podzolic soils and yellow solodic soils on older alluvial terraces and deep (>250 cm) solodic and yellow solonetzic soils on current flood plains. The soil landscape is also prone to localised flooding, high erodability, saline subsoils and seasonal waterlogging and very low soil fertility.

[6] *Sydney Geological Series Sheet S1 56-5 (3rd Edition)*. Bureau of Mineral Resources 1966 (BMR 1966)

[7] *Sydney Soil Landscape Series Sheet 9130 (2nd Edition)*. Department of Land and Water Conservation 2002 (DLWC 2002)

Review of the Acid Sulphate Soil Risk Map (DLWC 1997[8]) indicated that there are no known occurrences of acid sulphate soils within the vicinity of the site. It is, however, noted that the area to the north of the site is mapped as disturbed terrain.

## 2.7 Hydrogeology

A review of the registered groundwater bores in the area (NRAtlas website 2010[9]) indicated there are 2 bores within 1 km of the site. Relevant attributes of the bores are summarised below:

- Bore GW103657 is located approximately 0.8 km west of the site, and is noted as being installed for monitoring purposes. The bore is 3.3 m in depth and installed through clay and weathered shale. No details regarding standing water level were recorded on the corresponding summary sheet.
- Bore GW109275 is located approximately 0.95 km west of the site and is noted as being installed for industrial purposes. A standing water level of 6 m below ground level was reported in this bore.

It is noted that both of these bores are located on the western side of Salt Pan Creek.

Based on local topography, the direction of groundwater flow is anticipated to be north east towards the wetlands of the tributary of Salt Pan Creek located in Salt Pan Reserve.

Based on the relative elevation of the site to nearby registered bores, and the depth to groundwater within those bores, groundwater at the site is likely to be greater than 5 m deep within clay soil and weathered shale beneath the site. The regional groundwater is likely to be recharged by infiltration through the soils in the area.

## 2.8 Proposed Development

The site forms an area identified for redevelopment and known as the Riverwood North Residential Renewal Project (RNRRP). Concept Plan approval is being sought for the residential renewal of Riverwood North, which comprises 3.55 hectares of land accommodating residential flat building under the management of Housing NSW. The Concept Plan application seeks an increase in the existing residential density and building height to accommodate 150 social housing units and up to 500 dwellings to be made available for private purchase. The development will be staged and is anticipated to be undertaken within nine years. This RAP accompanies the subject Project Application for the construction of the Phase 1 development for 150 social housing units and public domain improvements. This RAP relates to the entire development site under the Concept Plan including the land subject to the Stage 1 Project Application. Demolition works are to be undertaken by Housing NSW as development without consent in accordance with the provisions of the Affordable Housing SEPP.

Based on the draft concept plan provided to JBS for review, it appears that the residential units/dwellings will be constructed in free standing blocks with landscaped open space

[8] *Prospect/Parramatta River Acid Sulphate Soil Risk Map (2nd Edition)*. Department of Land and Water Conservation 1997 (DLWC 1997)

[9] *NSW Natural Resource Atlas website*, http://www.nratlas.nsw.gov.au/ accessed 27 October 2010

areas shown between the proposed building footprints. A copy of the draft concept plan is provided as **Appendix A**.

# 3 Previous Environmental Investigations

Former sampling locations are shown in **Figures 2** and **3**. Tabulated results from previous assessments are provided in **Appendix B**.

## 3.1 Preliminary Geotechnical, Contamination and Hazardous Materials Assessment (2008)

The Preliminary Assessment report by Douglas Partners Pty Ltd (DP) documents the findings of the program of limited soil and groundwater over a 4 Ha area, which included the subject site. The objectives of the contamination assessment component of the works were to ''*... provide an opinion on the site's suitability for the proposed redevelopment with a view to identifying any constraints to the development, the need for further investigation and the need for remedial works (if required)*'' .

Based on the findings of the site history review it was assessed that the study area had previously been pastoral and a private golf course before being redeveloped for use as a wartime hospital between 1942 and 1946. Subsequent to 1946 the study area was used as public housing, initially within the hospital structures, and later within new buildings constructed following demolition of the hospital facilities. Demolition of all former hospital buildings was reported to have been completed by 1970. It was also noted that the study area was located approximately 300 m from Salt Pan Creek Landfill.

The potential sources of contamination associated with the historical use of the study area were reported to be asbestos and lead based paint associated with the existing site buildings and former wartime hospital facilities, and pesticides associated with potential golf course use. JBS notes that the location of the wartime hospital is within the current subject site. However, the extent of the area used as a golf course was not identified by DP and it is uncertain as to whether this use included land within the current site boundaries. Given the location of the study area relative to the landfill, it was also assessed by DP that there was potential for landfill gas migration to occur.

A limited program of soil and groundwater sampling was undertaken over the study area which comprised soil sampling from fifteen testpit locations and the installation of two groundwater monitoring wells. A limited program of landfill gas sampling was conducted in addition to the soil and groundwater sampling

The soil profile observed during excavation and drilling reported the presence of approximately 1 m of silty clay fill underlain by natural silty clay and shaley clay soils. Testpit logs reported the presence of ACM, glass, trace metal and brick fragments, slag, porcelain pipe and plant material inclusions within the layer of fill. During installation of a monitoring well at the eastern end of the study area, close to Salt Pan Creek, groundwater was encountered within 2 m of the ground surface within the natural clay soils. A second well was installed at the western end of the site. Free groundwater was reported to not be observed during drilling to a depth of 5 m at this location. The report indicates that this well failed to produce groundwater and was dry at the time of sampling.

Analytical results reported for the limited sampling program are summarised below:

- Heavy metals (As, Cd, Cr, Cu, Hg, Ni, Pb and Zn) were reported to be below the adopted assessment criteria for residential use;

- Concentrations of TPH $C_6$-$C_9$ fraction and BTEX compounds were below the laboratory limit of reporting (LOR) in all the samples analysed;
- Concentrations of TPH $C_{10}$-$C_{36}$ fraction were reported to be below the adopted site criterion in all samples analysed;
- Concentrations of PAH were reported below the adopted assessment criteria in all the samples analysed;
- Concentrations of OCPs, PCBs and VOCs were less than the LOR for all reported samples;
- ACM fragments were observed in fill material present in 8 of the 15 testpits excavated. Fragment samples submitted to the laboratory were all positively identified as containing asbestos. Laboratory testing on the corresponding soil samples did not identify the presence of asbestos; and
- The one sample of groundwater, collected from the well placed on the eastern end of the site, was reported to contain concentrations of nickel and zinc above the adopted assessment criteria.

Results of landfill gas monitoring within the new wells, indicated that concentrations of methane were generally low or undetectable during field measurements. An initial methane concentration of 1.8% was reported in BH9, at the western end of the site, however the concentration was reported to have reduced quickly to 0%. DP concluded that "*…the methane detected in the bore may be associated with naturally occurring methane from the breakdown of plant matter, however, migration of landfill gas from the nearby landfill can not entirely be ruled out."*

A copy of the plan showing the previous investigation sample locations is provided as **Figure 2**.

It was concluded that ''*…the site can be made suitable for the proposed site use subject to the appropriate remediation and/or on site management of asbestos contaminated soils''*.

### 3.2 Stage 1 ESA (JBS 2010)

JBS undertook a Stage 1 ESA of the site is identified as Lots 445, 446, 450, 458, 459 and 460, in Deposited Plan (DP) 243672. The ESA was restricted to the boundaries of the site only with an approximate area of 3.55 hectares (Ha).

The objective of the investigation was to document the site history, assess potential on and off-site sources of contamination and draw preliminary conclusions about the potential contamination status of the site.

The scope of the work comprised: review of historical documentation to identify potential areas of environmental concern and chemicals of concern; a detailed inspection of the site and immediate surrounds; and preparation of a preliminary site investigation report.

At the time of inspection it was reported that the site was primarily occupied by several free standing multi-storey residential apartment buildings. The areas between apartment buildings were covered in grass or vegetation and appeared to be used as communal open space areas by the apartment tenants. Each of the eleven property lots comprising

the site had frontage onto Washington Avenue, Vermont Crescent and/or Kentucky Avenue.

The site has been owned by the Housing Commission of NSW since 1946. Prior to 1946 the site was owned by private citizens and used as rural/residential land and also a wartime hospital.

It was concluded that the site was once part of a wartime hospital facility. While hospital activities may not have directly impacted the site, it was considered likely that the hospital buildings, constructed and demolished on the site, contained asbestos. It is therefore concluded that the fill material present on the site may be impacted with asbestos. Additionally, it was reported that there was a minor potential for other, shallow imported fill to be present on the site, and it is also possible that this material may also be impacted by contamination.

Given the proposal for continued residential and recreational use of the site and the potential for contamination to be present, it was recommended that a Stage 2 intrusive investigation should be completed in accordance with DECCW guidelines, to assess the suitability of the site for this purpose and determine the potential presence of contaminated media or residual asbestos in soils.

### 3.3 Stage 2 ESA (JBS 2010)

A total of 87 testpits were excavated across the site. Fill materials were encountered across the site to depths ranging between 0.3 m and 1.2 m bgl. Fill material generally consisted of brown silty clay. Inclusions of bricks, wood, glass, igneous gravels, slag and concrete were noted in addition to ACM fragments.

Selected samples from the site were analysed for asbestos, heavy metals, total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs) and polychlorinated biphenyls (PCBs).

The concentration of all chemical COPCs tested in soils were less than laboratory detection limits and/or less than the corresponding assessment criteria, and were, therefore, considered not to pose a contamination issue in soil at the site.

ACM fragments were observed in the fill material at seventy-nine of the eighty-seven testpits excavated. Approximately fourteen percent of all the test pits assessed (18 of the total 87) contained concentrations of ACM above the adopted criterion.

Results to note from the comparison of the testpitting results against the adopted ACM criterion of 0.02% (w ACM/w soil) are:

- The mass of ACM fragments encountered in the eight testpits ranged between 0.03 and 7.6 kg. The locations of the eight test pits absent of visible ACM were scattered across the site. No pattern or clustering of these locations was evident to suggest that these detections were associated with a particular area or layer on the site.
- Loose fibres were identified in samples from TP1, TP17, TP24, TP42, TP67, TP70 and TP83 below the reporting limit of 0.1g/kg. However, it is noted that discussions with the analytical laboratory indicated that these loose fibres are not fine enough to be considered ‘respireable’. All the test pit locations in which the presence of loose asbestos fibres in soil were reported were generally located in

the central portion of the site. However, no pattern or clustering of these locations was evident to suggest that these detections were associated with a particular area or layer on the site; and

- Respirable fibres were not detected above the reporting limit of 0.1 g/kg in samples from any of the 87 test pit locations.

It was concluded that the site can be made suitable for the continued residential and recreational use subject to remediation of ACM impacted fill materials. A recommendation was made for a RAP to be developed and implemented to render the site suitable for continued residential and recreational use. It was recommended that the RAP should also address screening for the presence of landfill gas in proposed building footprints and contingencies in the event that potential sources of groundwater contamination encountered, other than those previously identified.

# 4 Remediation Options

## 4.1 Remediation Objectives

The remediation objectives are outlined as follows:

- Remove unacceptable risks to human health and the environment, relevant to the continued residential and recreational use of the site in regards to:
  - Asbestos in the sub-surface soils;
  - Asbestos on the surface of the site;
- Validate the remedial works in accordance with the relevant NSW DECCW guidelines and with reference to the site specific criteria (JBS 2010); and
- Document the validation process.

The RAP is consistent with the following guidelines and legislation:

- *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land*; (DUAP 1998).
- *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*, published by Australian and New Zealand Environment and Conservation Council and the National Health and Medical Research Council (NHMRC), January 1992 (ANZECC/NHMRC 1992).
- *Contaminated Sites: Sampling Design Guidelines*, September 1995 (EPA 1995).
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites*, November 1997 (EPA 1997).
- *Contaminated Sites: Guidelines for NSW Site Auditor Scheme, April 2006* (DEC 2006).
- *National Environment Protection (Assessment of Site Contamination) Measure,* National Environment Protection Council, 1999 (NEPC 1999).
- *Code of Practice for the Safe Removal of Asbestos, 2nd Edition, National Occupational Health and Safety Commission,* April 2005 *(*NOHSC 2005*).*
- *Occupational Health and Safety Regulation 2001*.
- *Management of asbestos in the non-occupational environment,* enHealth Council, 2005 (enHealth 2005).
- *Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia*. W.A. Department of Health, May 2009 (WA DoH 2009).

It is also noted that, in the absence of any currently endorsed criteria for asbestos in NSW, the RAP has been developed with consideration of the criterion for asbestos provided in the revised '*National Environmental Protection Measure release 2011 – Schedule B11*' (NEPM), report in draft, National Environmental Protection Council (NEPC). This criterion is likely to be endorsed once the NEPM document is finalised, which is anticipated to be in early to mid 2011.

## 4.2 Criteria for determining the extent of Asbestos Remediation

In the absence of DECCW endorsed guidelines for the assessment and remediation of asbestos in soils JBS has adopted criteria provided in the draft revised NEPM as discussed below.

The draft NEPM presents a hierarchy of quantified ACM criteria that may be applied to a site. With respect to assessment criterion it states that "*…for ACM in sound condition, the use of the basic criterion of 0.01% w/w asbestos in soil is adopted for Australian sites as a conservation approach*". Notes are included on the Netherlands' guideline level of 0.1% w/w asbestos by weight, i.e. 10 times greater, that has been based on simulated trials of both bonded and friable asbestos and was confirmed as equating to a negligible risk to the public.

Additionally, reference is made to WA DoH (2009), noting that the following criteria as provided in WA DoH (2009) are appropriate screening criteria for the assessment of asbestos:

- 0.01% w/w asbestos in ACM standard residential use;
- 0.04% w/w asbestos in ACM residential, minimal soil access;
- 0.02% w/w asbestos in ACM parks etc.;
- 0.05% w/w asbestos in ACM commercial/industrial; and
- 0.001% w/w asbestos for assessment of friable asbestos and asbestos fines.

The discussion provided in the draft NEPM preceding these criteria also provided the following example of an acceptable remediation approach as follows. "*For example, if a preliminary site assessment clearly indicates the extent of contamination to consist only of scattered ACM fragments on the surface, then remediation is relatively simple. After remediation the exposed surface of the site under assessment should be free of visible ACM fragments and all ACM should be removed from the top 10 cm of soil as far as practicable*".

Based on the review of advice provided in the draft NEPM, the following criteria have been selected to determine the extent of remediation required on the site:

- No visible ACM on the ground surface and surface soils (i.e. within 0.1m of the ground surface);
- 0.01% w/w asbestos in soils present below a depth of 0.1m adopting the most conservative criterion available for asbestos in ACM in soil, which is consistent with both the draft revised NEPM value for ACM in sound condition and the WA DoH (2009) screening criteria ; and
- No identification of unbonded asbestos, in soils at any depth of the site. This criterion will apply to all loose fibrous material (such as insulation material and low density fibreboard) and asbestos fines (comprising free fibres of asbestos, small fibre bundles and fragments of ACM passing through a 7 mm x 7 mm sieve) as identified during laboratory testing.

Further discussion of the appropriateness of these criteria are provided in **Section 6.4**. It is noted that the Stage 2 ESA used a value of 0.02% w asbestos as the assessment criterion for ACM in soils. Following further consideration of the available guidance and

proposed site use it was decided that the most conservative quantified criterion for asbestos (as ACM) in soils should be adopted in determining the extent of remediation required.

### 4.2.1 Surface Soils (≤0.1 m)

Based on the findings of the previous investigations (DP 2008 and JBS 2010b) ACM was observed in fill material at approximately 90% of the test pits excavated.

It is therefore considered that remediation and validation of the surface (*i.e.* 0–0.1 m bgl) of the entire site will be required. Details of the requirements of remediation for surface soils are provided in **Section 5.5.1** below.

### 4.2.2 Sub-surface Soils (>0.1 m)

Based on the findings of the Stage 2 ESA (JBS 2010b) and subject to the limitations of that investigation, the anticipated extent of the proposed remediation is shown in **Figure 4**. Based on the currently available information, the following areas[10] require remediation/validation, however it is noted that additional areas of impact may be identified in other parts of the site:

- BLUE Areas – Sub-surface soils containing free asbestos fibres were identified at 7 testpit locations (approximately 8% of locations) as shown in **Figure 4**. For the purposes of remediation each testpit location is representative of an area approximately 7.5 x 7.5 m, centred on the testpit location. Based on approximately 8% of the site requiring remediation, and assuming an average fill depth at impacted locations (1.0 m), the estimated volume of material impacted with asbestos fibres is in the order of 2840 $m^3$.
- RED Areas – Sub-surface soils containing ACM concentrations above the adopted criterion were identified at 18 testpit locations (approximately 20 % of locations) as shown in **Figure 4**. Each testpit location is representative of an area approximately 7.5 m x 7.5 m centred on the testpit location. Based on approximately 20% of the site requiring remediation, and an average fill depth at impacted locations (1.0 m), the anticipated volume of ACM impacted fill is in the order of 7100 $m^3$.

It is noted that the asbestos in soil percentage at a total of 20 locations exceeded the assessment criterion. As asbestos fibres were also positively identified at two of these test locations, TP17 and TP83, these locations were included as BLUE remediation areas only, and the total number of RED remediation areas was reported as eighteen.

## 4.3 Possible Remedial Options

The *Contaminated Sites: Guidelines for the NSW Auditor Scheme* (DEC 2006) states that the policy of the then Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC) on the remediation of contaminated sites as published in the *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites* (ANZECC &

[10] The areas, depths and volumes discussed in the following paragraphs are estimations based on current site knowledge.

NHMRC 1992) is followed in NSW. This means that soil remediation and management is implemented in the following preferred order:

- On-site treatment of the soil so that the contaminant is either destroyed or the associated hazard is reduced to an acceptable level;
- 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;
- Removal of contaminated soil to an approved site or facility, followed, where necessary, by replacement with clean fill; and
- Consolidation and isolation of the soil on-site by containment within a properly designed barrier.

Consideration of each of these options is presented in **Table 4.1**.

**Table 4.1 Remedial Options Screening Matrix**

| Option | Discussion | Conclusion |
|---|---|---|
| Option 1<br><br>On-site treatment of the soil so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level. | ACM within surface soils (≤0.1 m) A<br><br>Hand picking of ACM within fill material is labour intensive and can be costly and time consuming. The success of the remediation method is highly dependant upon the soil type and the amount of other building rubble present within the fill, and also on the adopted validation criterion. The more clayey the soil, or the more building rubble present, the harder it is to remove all ACM.<br><br>Given the surficial nature of the soils requiring validation to the adopted 'no visible ACM' criterion, and the space and time available to conduct the picking, this Option is feasible. Should the material prove high in building rubble or clay content, or prove difficult to achieve validation, consideration should be given to offsite disposal (Option 3). | Possible option. |
| | ACM within surface soils (≤0.1 m) B<br><br>The placement of a capping layer to a minimum thickness of 300 mm across the site areas identified to contain ACM at levels below the adopted criterion for soils deeper than 0.1m. Imported material would need to be validated prior to entering the site, and the surface layer validated visually and analytically.<br><br>This option would minimise the time required to deal with the surface impacted material, while providing the required reduction in hazards to an acceptable level. | Preferred option. |
| | ACM fragments in sub-surface soils (>0.1 m)<br><br>As noted above, hand picking of ACM within fill material is labour intensive. Given the less stringent criterion of <0.02 % asbestos concentration for sub-surface soils, achievement of the validation criterion via hand picking is less difficult than that of surface soils. This option is considered viable for the locations exceeding the criteria for subsurface ACM by weight of soil, but it is not suitable for the locations where free asbestos fibres were detected (discussed in the following section).<br><br>Should the material prove particularly high in ACM content, or prove difficult to achieve validation, consideration should be given to offsite disposal (Option 3). | Preferred option. |
| | Free asbestos fibres in soils<br><br>As noted above for the 7 locations where asbestos free fibres were detected this is not a viable option due to the inability to see free asbestos fibres with the naked eye. | Not a suitable option. |
| Option 2.<br><br>Off-site treatment of the soil so that the contaminants are either destroyed or the associated hazards are reduced to an acceptable level, after which the soil is returned to the site. | ACM within surface and sub-surface soils<br><br>As above (Option 1), however, there are reductions in noise and dust emissions on site in comparison to on-site treatment (Option 1), but these are offset by increased truck movements. Typically, the costs associated with returning the treated materials to site often result in them being disposed to landfill. Additional disadvantages of this option include finding an appropriately licensed site on which to process the material and obtaining approvals to return the treated material back to site, | Not a suitable option. |

| Option | Discussion | Conclusion |
|---|---|---|
| Option 3.<br><br>Excavation and offsite removal of the impacted material. | ACM within surface and sub-surface soils<br><br>There are currently suitably licensed waste facilities in the Sydney Metropolitan region capable of accepting ACM contaminated soils.<br><br>Offsite disposal of ACM impacted material is likely the fastest method of remediating the site fit for continued residential land use with minimal access to soils and open space use. This option generates the highest quantity of waste, since the materials are disposed to landfill rather than treated and reused (i.e. Options 1 & 2) or retained on site (Option 4). This option generates additional truck movements and associated fuel/emissions over Option 1 and Option 4, but less than Option 2, since materials are not returned to site.<br><br>Given the likely success of remediation via hand picking for the 18 test locations shown to contain unacceptable levels of ACM and without free asbestos fibres, and the application of a quantified validation criterion for sub-surface soils, offsite disposal is not the preferred remedial Option. However, should validation prove difficult to achieve because of the nature of fill or the ACM contamination, this Option may be reconsidered. | Not the preferred option. |
| | Free asbestos fibres in soils<br><br>There are currently suitably licensed waste facilities in the Sydney Metropolitan region capable of accepting ACM contaminated soils.<br><br>For the 7 locations with free asbestos fibres reported in soils, offsite disposal or on-site containment (Option 4) are the only suitable options. Offsite removal of the impacted material will generate additional truck movements and associated fuel emissions over Option 4. However it should be noted that offsite disposal will be more time efficient and unlike option 4, will not require a notation on the title at the completion of works. | Preferred option. |
| Option 4<br><br>Consolidation and isolation of the soil by on-site containment within a properly designed barrier and ongoing management. | ACM on ground surface and sub-surface soils<br><br>Containment of ACM impacted soil at the site is not the preferred Option given the shallow depth to natural soil.<br><br>However, containment of ACM impacted material is an appropriate method of remediation given that the contaminant (ACM) is relatively immobile and not volatile. Containment cells are able to be placed in areas under roadways, where potential exposure to contamination can be managed by the implementation of an ongoing Environmental Management Plan. It is noted that there must be acceptance on the part of the ultimate custodian of the land that future controls will be implemented, and that a notation will be made on the Title of the land. The minimum capping layer for a containment cell under a roadway is 0.2-0.3 m.<br><br>The benefit of this option is that the VENM material excavated to construct the containment cell can be re-used on site as fill material, and the excess VENM sold. | Not the preferred option. |

## 4.4 Preferred Remediation Option

With consideration to DECCW's endorsed guideline hierarchies for soil remediation options and groundwater cleanup objectives (DEC 2006), and to the site specific contaminants and environmental setting, the preferred remediation strategy is outlined as follows:

- Excavation and offsite disposal of material at the 7 locations with free asbestos fibres detected. Validation of the resulting excavations will be required;
- Excavate the material present at the remaining 18 locations with ACM fragment impacted sub-surface soils. Hand pick the ACM fragments from the excavated material, validate the picked material to confirm the mass of ACM is less than the adopted criteria. Reinstatement of material successfully validated to the required finished level; and
- Import validated material to construct a capping at least 0.3m thick over the residual ACM impacted surface soils that have been validated as meeting the adopted criterion. This shallow capping layer is required to address the criterion for surface ACM. Alternately the top 0.1m of reinstated material may be hand picked for ACM for validation as being absent of visible ACM.

As the concept plan for the site has been divided into several stages, the preferred remedial strategy can be applied across the site as a whole, or on a staged basis. Additionally, the concept plan also requires the construction of at least one basement level for the majority of the proposed new buildings. Whether the excavation of basement footprints occurs prior to or following execution of the remediation strategy will be dependent on whether the entire site needs to be remediated as one event , or whether the remediation will occur in stages roughly in line with the site redevelopment program.

- In the event that the entire site is to be remediated in one event prior to building construction, then the ACM impacted fill in the area of the building footprints will need to be included in the area remediation as per the preferred strategy; or
- In the event that the site is to be remediated on a staged basis in line with the building construction program, then all ACM impacted fill in the area of the building footprints can be excavated and disposed directly to landfill as '*Special Waste- Asbestos Waste'*, prior to implementation of the preferred strategy over the remainder of the site.

Regardless of the proposed staging of works, a Construction Environmental Management Plan (CEMP) must be prepared for the site to ensure all site workers, even those involved solely with construction works, are made aware of the presence of asbestos on the site. Further details of the requirement of the CEMP are provided in **Section 10.2**.

# 5 Remedial Plan

## 5.1 Define the Boundary of Contamination

The exact boundaries of the contaminated area shall be determined by the observations made during excavation works and validation results. However based on the observations and testing undertaken as part of DP (2008) and JBS (2010b) the current understanding of the extent of the contaminant is as follows:

- The ACM impact appears to be restricted to the top fill layer, ranging to depths of between 0.3 and 1.2m bgl; and
- Laterally, the ACM impact appears to exist across the entire area of site, extending, as a minimum, to the property lot boundaries. While testing was not completed under the existing public roads that traverse the site, it is also likely some ACM impacted fill is also present under these areas.

## 5.2 Site Establishment

All safety and environmental controls are to be implemented as the first stage of remediation works. These controls will include:

- Locate and isolate all required utilities in the proximity of the works;
- Work area security fencing;
- Site signage and contact numbers;
- Sediment fencing (attached to security fencing); and
- Stormwater runoff and sediment controls (hay bales).

## 5.3 Pre-Demolition Surveys of Existing Buildings

No Hazardous Materials Building Surveys (HMBS) have been conducted on the site which included sampling and analysis of materials. The preliminary works conducted as part of DP (2008) comprised a visual assessment only without confirmatory sampling and analysis. Prior to demolition of the existing buildings a HMBS should be conducted on each building to be demolished.

Additionally, as a precautionary measure a survey of surface landfill gas concentrations should be undertaken within each building, and in any external service pits, to determine whether landfill gas has accumulated within voids to such an extent that a risk of explosion exists.

## 5.4 Demolition of Existing Buildings

Demolition of the existing buildings should be completed in accordance with the recommendations of the HMBS. This should include, as a minimum, use of contractors licensed for the removal of asbestos and other identified hazardous materials and air monitoring as specified. Following demolition, ACM quantification testpitting should be completed over the former building footprint.

## 5.5 Requirements of Soil Asbestos Remedial Works

The remediation and validation works will be supervised by an appropriately qualified and experienced environmental consultant and undertaken by a licensed AS1 asbestos removal contractor.

### 5.5.1 All Surface Soils

The criteria of no visible asbestos will need to be met in all surface soils (≤0.1 m deep) across the site, including areas where the subsurface is remediated, validated and reinstated. This may be achieved by undertaking manual picking over these areas to demonstrate compliance. In the event that manual picking is not preferable, then a surface capping layer of no less than 300 mm of imported validated material will need to be placed over the these areas, in accordance with the requirement of DoH (2009). The capping layer, if applied, will be subject to validation inspections to assess the thickness and confirm the absence of ACM visible at the surface.

### 5.5.2 Sub-surface (>0.1 m deep) BLUE Areas

The following remediation works shall be undertaken in the 7 identified BLUE areas of sub-surface soils:

- Excavation of the impacted material. The specified 7.5 m by 7.5 m grid square will require excavation and should be extended through impacted fill to natural materials, which based on previous investigations is likely to be less than 1.3m deep;
- The excavated material will be loaded directly into trucks for offsite disposal, or relocated to a designated holding area (which will be covered appropriately) for future offsite disposal.
- If asbestos fibres are identified in the wall soil samples, then the excavations will be extended in the direction of the failed wall, and the validation process repeated for that area.
- If the validation samples are free of asbestos fibres, but the mass of ACM fragments in wall soil samples exceeds the site criteria, then the excavation will be extended in the direction of the failed wall, and the material generated will be remediated as per **Section 5.5.3**. It is noted that only sufficient material will be removed that is practicable to achieve validation and that a full 7.5 m grid square may not require removal in this circumstance.
- Off site disposal of the excavated asbestos impacted material to a licensed waste facility as detailed in **Section 5.3.4**.

### 5.5.3 Sub-surface (>0.1 m) RED Areas

The following remediation works shall be undertaken in the 18 identified RED areas of sub-surface soils:

- Excavation of the impacted material. The specified 7.5 m by 7.5 m grid square will require excavation and should be extended through impacted fill to natural materials, which based on previous investigations is likely to be less than 1.3m deep;

- If ACM fragments exceed the site criteria in the wall soil samples, then the excavation will be extended in the direction of the failed wall, and the validation process repeated for that area.
- If asbestos fibres are identified in the wall soil samples, then the excavation will be extended in the direction of the failed wall, and will require validation in accordance with process detailed in Section 5.5.2 for that area.
- Stockpiling of excavated material for additional remediation 'pad' works as detailed below;
- Spreading of the excavated material to form a 'pad' with dimensions of 20 x 20 x 0.1 m in a dedicated screening area. This may need to occur in stages depending on the excavated soil volume;
- Picking of ACM fragments by non mechanical means (*i.e.* raking and hand picking) from the pad of spread material. It should be noted that mechanical action which may result in the breakdown of the ACM matrix is to be avoided (*i.e.* mechanical screening, excessive excavator handling of soils);
- Appropriate storage of collected ACM fragments for off site disposal to a licensed waste facility; and
- Onsite re-use of material once successfully validated in accordance with **Sections 6.4**.

### 5.5.4 Offsite Disposal of Material

Impacted soils and ACM removed from remediated soil to be disposed off-site shall require a waste classification in accordance with DECC (2009) '*Waste Classification Guidelines Part 1: Classifying Waste'*. The potential presence of asbestos in fill materials must be noted in the preparation of the waste classification.

### 5.5.5 Air Monitoring

During the remedial works, perimeter air monitoring will be conducted on each of the site boundaries. Additional downwind monitoring locations will be included in the air monitoring program, as required.

Air monitoring will be conducted in accordance with the requirements of the National Occupational Health and Safety Commission (NOHSC) Asbestos Code of Practice and Guidance Notes, in particular, the Guidance note for the estimation of airborne asbestos dust [NOHSC 3002:2005].

## 5.6 Seepage Water from Excavations

Based on the site investigation activities undertaken to date it is anticipated that groundwater seepage will not be encountered during the remediation works unless rainfall events occur during the works period. However, in the event that seepage is encountered within the excavations, or if significant rainfall events result in impacted water requiring to be removed from the excavation during the remediation works, the water may need to be pumped from the excavation by a licensed contractor and disposed of off-site as 'liquid waste' in accordance with DECC (2009).

## 5.7 Validation

Validation of the remedial works, will be an integral part of the program, to demonstrate that the remediation objectives have been achieved. Details of the validation program are provided in **Section 6**.

## 5.8 Backfilling of excavations

Upon confirmation of soil validation, excavations will be reinstated using validated soils from site remediation activities. In the event that a shortfall of material occurs, then reinstatement may also be completed using validated imported fill material.

The excavations will be reinstated as required for the proposed concept plan, i.e. left unfilled in areas of building basements or, in the proposed open space areas, finished to the design level required for landscaping. Surface surveys of landfill gas concentrations shall be completed over the proposed building footprints following excavation to the required construction level.

## 5.9 Site Dis-establishment

On completion of the remediation works all plant/equipment and safety/environmental controls shall be removed from the site. Details are provided in the Site Management Plan in **Section 8**.

# 6 Validation Plan

From review of the proposed remediation methods, validation activities will be required for:

Asbestos Impacted Soils

- Excavations formed by the removal of ACM impacted soils (BLUE and RED areas);
- Surface ACM impacted material which has been capped (YELLOW area materials); and
- Residual soils underneath stockpiles or sorting pads where ACM impacted material has been stored/remediated.

Validation of Imported Materials

- Review of material characterisation documentation that accompanies any imported material onto site; or
- Sampling, analysis and material characterisation reporting for any material imported onto the site.

## 6.1 Data Quality Objectives

Data quality objectives (DQOs) were developed for the validation assessment, as discussed in the following sections.

### 6.1.1 State the Problem

Asbestos Impacted Soils

Asbestos impacted soils have been identified on the surface and sub-surface across the site. The identified areas require excavation followed by validation of the residual soils to ensure impacted material that may pose an unacceptable level of risk to site users (under a recreational land use scenario) or ecological risk to the surrounding environment has been successfully removed during remediation works.

Excavated materials will fall into two categories, the majority (RED ACM impacted areas) will be remediated through hand picking methods, and validated prior to re-use in backfilling the excavations, and the remainder (BLUE asbestos fibre impacted areas) will be excavated and disposed offsite to a facility licensed to accept the waste.

### 6.1.2 Identify the Decision

The following decisions are required to be made during the validation works:

- Are there any unacceptable risks to future on-site receptors from any residual soil contamination following the remediation of asbestos contaminated soil?
- Was the asbestos impacted soil remediated suitably for reuse onsite, or classified and disposed off site to a facility licensed to accept the classified waste?
- Did the material imported on to site as backfill meet the requirements of the RAP?

### 6.1.3 Identify Inputs to the Decision

The inputs to the decisions are:

- Physical observations, including visual, olfactory and PID screening results during site activities;
    - Soil analytical data from samples collected from the base and walls of the excavations formed during remediation of asbestos impacted surface and sub-surface soils.
- Soil analytical data collected from any asbestos impacted soils and remediated by hand picking methods;
- Material characterisation documentation accompanying imported fill materials on site, or soil analytical data collected from any imported fill materials for material characterisation purposes.

### 6.1.4 Define the Study Boundaries

The remediation work area is located across the whole of the site. The remedial work area is shown on **Figures 2** and **3**.

The vertical extent of the remediation works was predicted from depths of impact reported during the DP (2008) and JBS (2010b). The majority of the impacted material was reported to be present to depth of between 0.3 m to 1.2 m. The character of the impacted material excavated during remedial works is expected to vary in comparison to that reported during the investigation, as bulk excavation allows a comprehensive visual inspection compared to test pits and boreholes.

Due to the nature of potential contaminants identified, seasonality was not assessed as part of this investigation.

### 6.1.5 Develop a Decision Rule

#### 6.1.5.1 *Surface Asbestos Impacted Soils*

Once remediation of ACM impact at depth has occurred and reinstatement of the area has been completed, one of the following works must be completed over the surface of the site:

- the importation and spreading of validated material to form a capping layer at a minimal thickness of 300mm; or
- picking of the top 100mm of soil across the remediated and reinstated site;

Subsequent to completion of either of the above visual inspections will be undertaken to ensure ACM is suitably aesthetically capped. The assessment will be assessed against criterion of no visible asbestos. In the case of the visual inspection failure, additional capping material will be placed, or additional manual picking will take place across the area.

#### 6.1.5.2 *Sub Surface Asbestos Impacted Soils*

Soils on the walls of excavations and soils which have been remediated will be subjected to both an inspection and a quantification assessment to ensure the remediation meets the remediation acceptance criterion of 0.01% ACM by weight of soil. Additionally, soil

samples will be collected, analysed and assessed for compliance with the free asbestos fibre criterion.

Generally, if an excavation validation sample fails the site specific quantitative criteria, further remediation (by excavation of soils) and subsequent validation of the affected area will be required. If the excavation soil sample analysis detects free fibres the area will be re-defined as BLUE and subject to further excavation for disposal purposes.

#### 6.1.5.3 *Off-site disposal soils*

Soils to be disposed of off-site (where required by failure of remediation) will be classified in accordance with the criteria provided in DECC (2009) Guidelines. Where appropriate statistical analysis may be used to interpret the data set.

#### 6.1.5.4 *Imported Fill*

Soils may be imported onto the site to fill excavation and tank voids and to replace excavated material that must be disposed off site. Imported fill will be accompanied by a letter of VENM certification or will be sampled and compared against selected validation criteria, as per **Section 6.4**.

#### 6.1.5.5 *Summarised Decision Rules*

The decision rules adopted to answer the decisions identified in **Section 6.1.2** are summarised in **Table 6.1**.

**Table 6.1 Summary of Decision Rules**

| Decision Required to be Made | Decision Rule |
|---|---|
| 1. Are there any unacceptable risks to future on-site receptors from any residual soil contamination following the remediation of asbestos contaminated soil? | Soil analytical data will be compared against DECCW endorsed criteria. Statistical analyses of the data in accordance with relevant guidance documents will be undertaken, if appropriate, to facilitate the decisions. The following criterion will be adopted with respect to soils:<br>the reported concentrations are all below the site criteria;<br>If the criterion stated above is satisfied, the decision is No.<br>If the criterion stated above is not satisfied, the decision is Yes. |
| 2. Was the asbestos impacted soil remediated suitably for reuse onsite, or classified and disposed off site to a facility licensed to accept the classified waste? | Soil analytical data will be compared against site specified risk-based criteria (JBS 2010b). Quantitative analysis of the ACM will be undertaken for weight in soil criterion (0.02 % w/w). Additionally, soil samples will be collected for analysis of free asbestos fibres (criterion: non detect).<br>If the quantitative criteria stated above are satisfied, AND no detectable fibres are reported above the criterion, the decision is Yes, or if receipts are provided recording the disposal of material to an off-site licensed facility, the decision is Yes.<br>If the material fails the site criteria, and/or no disposal receipts are provided, the answer is No. |
| 4. Did material imported to site as backfill meet the requirements of the RAP? | Soil material characterisation reports will be reviewed or if no material characterisation provided, soil analytical data will be compared against the DECCW endorsed criteria.<br>If material characterisation reports detail the imported material as VENM, or if the soil analytical data meets the above criteria, the answer is Yes.<br>If the material is classified as anything other than VENM in provided documentation, or it fails the specified criteria, the answer is No. |

### 6.1.6 Specify Limits of Decision Error

Specific limits for this project have been adopted in accordance with the appropriate guidance from the NSW DECC, NEPC (1999), ANZECC/ARMCANZ (2000), DEC (2007), appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard JBS Environmental procedures for field sampling and handling.

Australian Standard AS4482.1-2005 (AS4482-2005) nominates two types of errors that require assessment:

a) Deciding that the site is acceptable when it actually is not; and

b) Deciding that the site is unacceptable when actually it is.

It is recommended in AS4482.1 that limits of 5% probability for type a) errors and 20% probability for type b) errors be set during environmental assessments. These recommendations have been adopted for this investigation.

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined Data Quality Indicators (DQIs) for completeness, comparability, representativeness, precision and accuracy. The acceptable limit on decision error is 100% compliance with DQIs.

The pre-determined Data Quality Indicators (DQIs) established for the project are discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parameters), and are shown in **Table 6.2**.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD)[11] of duplicate samples for chemical COPCs. For asbestos precision is assessed by whether the identification results for duplicate samples were in agreement with the original sample.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards. Note only applied to chemical COPC.
- **Representativeness** –expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.

[11] $$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where $C_0$ is the analyte concentration of the original sample
$C_d$ is the analyte concentration of the duplicate sample

- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; and ensuring analysing laboratories use consistent analysis techniques; and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.
- **Sensitivity** – expresses the appropriateness of the chosen laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted site assessment criteria.

**Table 6.2: Summary of Data Quality Indicators for Soil Validation Program**

| Data Quality Indicator | Frequency | Data Quality Criteria |
|---|---|---|
| **Precision** | | |
| Blind duplicates (intra laboratory) – asbestos quantification | 1 / 20 samples | Agreement with primary sample |
| Blind duplicates (inter laboratory) – asbestos quantification | 1 / 20 samples | |
| Blind duplicates (intra laboratory) – chemical COPC | 1 / 20 samples | <50% RPD[1] |
| Blind duplicates (inter laboratory) – chemical COPC | 1 / 20 samples | <50% RPD[1] |
| **Accuracy** | | |
| Laboratory control samples | 1 per lab batch | <LOR |
| Surrogate spikes – hydrocarbon only | All organic samples | 70-130% |
| Matrix spikes – hydrocarbon only | 1 per lab batch | 70-130% |
| **Representativeness** | | |
| Sampling appropriate for media and analytes | All samples | All samples |
| Samples extracted and analysed within holding times. | All samples | No holding time |
| Rinsate – required for analysis of chemical COPC only | 1 per sampling event | <LOR |
| Trip spike – required for analysis of chemical COPC only | 1 per sampling event | 70-130% recovery |
| Trip blank – required for analysis of chemical COPC only | 1 per sampling event | <LOR |
| **Comparability** | | |
| Standard operating procedures for sample collection & handling | All Samples | All samples |
| Standard analytical methods used for all analyses | All Samples | All samples |
| Consistent field conditions, sampling staff and laboratory analysis | All Samples | All samples |
| Limits of reporting appropriate and consistent | All Samples | All samples |
| **Completeness** | | |
| Soil description and COCs completed and appropriate | All Samples | All samples |
| Appropriate documentation | All Samples | All samples |
| Satisfactory frequency and result for QC samples | All QA/QC samples | - |
| Data from critical samples is considered valid | - | Critical samples valid |

(1) If the RPD between duplicates is greater than the pre-determined data quality criteria, a judgment will be made as to whether the excess is critical in relation to the validation of the data set or unacceptable sampling error is occurring in the field.

### 6.1.7 Optimise the Design for Obtaining Data

The purpose of this step is to identify a resource-effective field investigation sampling design that generates data that are expected to satisfy the site manager's decision

performance criteria, as specified in the preceding steps of the DQO Process. The output of this step is the sampling design that will guide development of the field sampling and analysis plan. This step provides a general description of the activities necessary to generate and select data collection designs that satisfy decision performance criteria.

Validation will be undertaken for locations on a regular grid from the walls and floor of excavations and from remediation stockpiles.

## 6.2 Soil Validation Methodology

### 6.2.1 Asbestos Impacted Soils

Soil Sampling

A suitably qualified person trained and experienced in the identification of asbestos, will be required to undertake the sampling. New nitrile gloves will be used to collect each sample. Soil samples will be immediately transferred to sample containers of appropriate composition, which are supplied by the testing laboratory. All sample containers will be clearly labelled with a sample number, sample location, sample depth, sample date and samplers initials. The sample containers will then transferred under chain-of-custody conditions to the testing laboratory. The samples will be analysed at a laboratory NATA accredited for the required analyses.

Specific quantification methodology for sampling and quantification is provided as follows:

Quantification Assessment of Excavation Walls

- Following confirmation that the excavation extends into natural material, asbestos quantification samples will be collected from the walls of the excavation at a rate of 1 sample per 10 m linear of wall. The asbestos quantification sample will comprise a column of fill material with an area of approximately 0.25 $m^2$ which extends from the top of the excavation wall to the base of fill. The sampled material shall be spread on plastic of a contrasting colour and raked. All ACM within the asbestos quantification sample shall be recovered, bagged and weighed. The volume of the fill material within the asbestos quantification sample shall be calculated based on the dimensions of the sampled area within the excavation wall. The mass of fill will be calculated using a soil density of 1.63 $kg/m^3$ (based on a density of 1.63 $g/cm^3$ from US EPA 2003[12]) based on the predominant fill type at the site being silty clay;
- As per the following formula, the mass of recovered ACM and the mass of fill material within the sample will be used to calculate the concentration of asbestos within the sample which is representative of that section of wall.

$$\%\ Soil\ Asbestos = \frac{\%\ Asbestos\ Content \times ACM\ (kg)}{Soil\ Volume\ (L) \times Soil\ Density\ (kg/L)}$$

- A soil sample will be collected for laboratory analysis from within the asbestos quantification sample to confirm that no asbestos fibres are present. The samples

[12] *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings.* US EPA Office of Emergency and Remedial Response, June 19 2003 (US EPA 2003)

will be analysed in accordance with the validation program summarised in **Table 6.3**.

Quantification Assessment of Remediation Pad

- Each uniquely identified 'pad' (20 x 20 x 0.1 m) of spread and picked material will be inspected by the environmental consultant by walking 1 m spaced transects to observe the presence of any remaining ACM fragments. Any observed ACM will be collected;
- As per the following formula, the mass of recovered ACM and the mass of fill material within the sample will be used to calculate the concentration of asbestos within the sample which is representative of that section of pad.

$$\% \text{ Soil Asbestos} = \frac{\% \text{ Asbestos Content} \times \text{ACM (kg)}}{\text{Soil Volume (L)} \times \text{Soil Density (kg/L)}}$$

- If the visual inspection does not identify residual ACM fragments above the adopted criteria (*i.e.* a concentrations of asbestos <0.01 % for sub-surface soils[13]), then a soil sample will be collected and analysed in accordance with **Table 6.3**.

## 6.3 Laboratory Analyses

All laboratories engaged for the project will need to be NATA accredited for the required analyses.

In addition, each laboratory is required to meet internal QA/QC requirements consistent with NEPM. Laboratory analysis of samples will be conducted with reference to COPCs listed in **Table 6.3**.

The proposed soil validation sampling, quantification and analytical program for asbestos impacted soils is outlined in **Table 6.3**.

**Table 6.3 Quantification and Analytical Schedule**

| Validation Area | Sampling Frequency | Analytes[1] |
|---|---|---|
| Excavations formed by the removal of ACM and asbestos fibre impacted sub-surface soils (BLUE Areas) | 1 validation sample per 5 m linear of walls and 1 base validation sample per 25 $m^2$ | Asbestos |
| | 1 quantification sample per 10 m linear of walls | NA |
| Excavations formed by the removal of ACM impacted sub-surface soils (RED Areas) | 1 quantification sample per 10 m linear of walls | NA |
| | 1 validation sample per 10 m linear of walls and base, collected from fill material within the ACM quantification sample | Asbestos |
| Remediated ACM impacted material | 1 quantification sample comprising the entire pad of remediated material | NA – field measurement only |
| | 1 sample per 20 x 20 m pad (or 1 sample per 40 $m^3$) | Asbestos |
| Footprints of former ACM impacted stockpiles or sorting pads | 1 sample per 10 m linear (or 100 $m^2$) and inspection for the presence of ACM | Asbestos |

[13] Based on an approximate pad volume of 40 $m^3$, using a soil density of 1.63 $g/cm^3$, approximately 4.34 kg of ACM would be required to be identified within the pad material for the pad to fail the validation criterion of 0.01%.

| Validation Area | Sampling Frequency | Analytes[1] |
|---|---|---|
| Imported Soils (VENM) | Minimum of 3 samples per source site * | 8 metals/TPH/BTEX<br>PAHs/OCPs/PCBs<br>Asbestos |

**Note:** 1 Laboratory analysis is proposed for validation samples only, and is not required for quantification samples.

### 6.3.1 Sampling Rationale

The sampling and analytical regime presented in **Table 6.3** for asbestos impacted soils is based on the rationale provided in JBS (2010).

Virgin excavation natural material (VENM) importation sampling frequencies exceed the minimum 1 composite sample requirement outlined in EPA 1995.

## 6.4 Soil Validation Criteria

Given the intention to continue to use the site for residential (minimal soil access) and recreational use, soil results will be compared against the validation criteria stipulated in **Table 6.4**. The asbestos criteria are based on the site-specific risk-based criteria derived in JBS (2010). The remaining criteria are based on DECCW endorsed investigation levels which, while being used as clean-up levels instead of site-specific criteria derived through a process of risk assessment, are considered adequately conservative for the purposes of validating the site (see **Section 6.4.2**).

**Table 6.4 Remedial Excavation Soil Validation Criteria (all units in mg/kg)**

| | Limit of Reporting | Laboratory Method | Validation Criteria for Industrial Areas [1] |
|---|---|---|---|
| **Asbestos** | | | |
| Asbestos | Presence | PLM / Dispersion Staining | No fibres reported AND<br>no visible fragments in surface soils AND<br>asbestos less than 0.01% total weight in sub-surface soils[3] |

[1] Criteria as provided in draft NEPM

### 6.4.1 Application of Soil Criteria

For soil to be considered as validated (*i.e.*, not posing an unacceptable risk) all reported concentrations must be below the site remediation criteria. In addition consideration shall be given to the presence of odorous or discoloured soils (caused by contamination), and aesthetic issues.

### 6.4.2 Justification of Asbestos Soil Criteria

The decision to use quantified asbestos criteria for determining the extent of remediation required at the site and that validation of remediation has been reached following lengthy consideration of a range of factors including site conditions and the proposed land use, available criteria for asbestos, ACM and asbestos fibres in soil, the ability of commercial laboratories to achieve required reporting limits and advice regarding the management of asbestos impacted soils in several guidance documents endorsed for use in NSW.

Advice provided in the draft revised NEPM states that ACM in sound condition, even if broken or fragmented, represents a low human health risk and that "*It is an inappropriate response to declare a site a human health risk on the basis of the presence of ACM alone"*. Conditions encountered on the site are consistent with this scenario, in that the

widespread presence of ACM in fill material has been observed across the entire area to depths of 1.3m, with loose fibres reported at only a low number (8%) of test locations. Furthermore no respireable fibres were identified in any samples tested from the site.

Based on this advice, for bonded ACM in subsurface soils across the entire site area, the adoption of the WA DoH (2009) screening levels for residential land use with accessible soils (0.01% w asbestos / w soil) is considered appropriately conservative given that:

- From review of the proposed development of the site provided in the concept plan there is the potential for access to soil in a residential setting as opposed to in an openspace, recreational setting;
- 0.01% is a more stringent value than 0.02 and 0.04% which are provided as the screening values, respectively, provided for recreational land use and residential land use with minimal access to soils; and
- The 0.01% value is provided as a screening criterion which would generally be used in the initial site investigations stages and so are conservatively low. At the remediation stage it is typical to adopt a site specific target level based on a health risk assessment as the criterion for asbestos in soils. However, as risk based levels are generally less stringent (and in this case likely to exceed the 0.01% value adopted) the use of the screening level is considered to be acceptably conservative. Correct implementation of the adopted criterion during validation is unlikely to result in an unacceptable risk to future site users.

Adoption of the criterion for asbestos fibres has considered the advice provided in both the enHealth and draft revised NEPM documents. enHealth (2005) references criteria recommended by Imray and Neville of <0.001 F/mL in air and <0.001 % in soil to classify a site as suitable for all land uses. The draft revised NEPM also states that a nominal 0.001% criterion is applicable for assessment of asbestos fines and unbonded asbestos. The criterion specified for asbestos fibres in **Table 6.5** is however more stringent than the published 0.001% value given that the enHealth document also notes that "*suitable, readily available analytical techniques to quantify low levels of asbestos in soil have not been identified*". JBS' experience is that commercial laboratories continue to struggle with reporting of asbestos fibre detection. While the limit of reporting for the Australia Standard (AS) testing method is set at 0.1 g/kg, the commercial laboratories are often able to identify loose fibres present in soil below this value and include the observation as a note to the 'not detected result' obtained using the AS method. Furthermore, when these observations of fibres below the limit of reporting are noted, no assessment is made of what percentage by mass the observed fibres account for. To remove this potential ambiguity in the validation process associated with laboratory reporting limits JBS has adopted a 'no fibres reported' criterion for all samples analysed.

The requirement for the top 0.1 m of the finished site to be absent of visible ACM (or capped with 0.3 m of imported, validated material) has been included to address the enHealth (2005) assessment that retention of asbestos material *in-situ* is acceptable:

- when there is negligible risk of/from offsite exposure;
- asbestos waste is stable and to liable to be disturbed or eroded.

The thickness of the layer needing to be free of ACM is consistent with the requirements of WA DoH (2009).

These three levels of asbestos validation are considered to be acceptable approach for the site. It is noted that the proposed use of the site includes multi-storey apartment buildings surrounded by large open space areas. In such land use scenarios, unauthorised works in the subsurface are less likely to occur, compared to private lot ownership.

### 6.5 Imported Soil Criteria

The importation of material to reinstate excavations may be necessary during the proposed remediation works. In accordance with current DECCW policy, only material that does not represent an environmental or health risk at the receiving site may be considered for resource recovery. In accordance with this requirement, only Virgin Excavated Natural Material (VENM) as defined in the *Protection of the Environment Operations Act* (1997) Schedule 1; ENM, as defined in DECC (2008b); or any other suitable material granted an applicable DECCW Exemption under the *Protection of the Environment Operations (Waste) Regulation 2005* may be imported to reinstate the excavations.

### 6.6 Validation Reporting

At the completion of the remedial works a Validation Report will be prepared in general accordance with the NSW EPA *Guidelines for Consultants Reporting on Contaminated Sites* (EPA 1997), documenting the works as completed. This report will contain information including:

- Details of the remediation works conducted;
- Information demonstrating that the objectives of the RAP have been achieved, in particular the validation sample results and assessment of the data against both the pre-defined data quality objectives and the remediation acceptance (validation) criteria;
- Information demonstrating compliance with appropriate regulations and guidelines;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents; and
- Other information as appropriate, including requirements (if any) for ongoing monitoring / management.

The report will serve to document the remediation works for future reference.

# 7 Contingency Plan

A review of remediation works has been undertaken to identify potential risks to meeting the specified site validation criteria. A number of potential risks have been identified. These are listed following with contingencies that will be implemented to ensure that validation criteria are met.

## 7.1 Unexpected Finds

The possibility exists for hazards other than those identified and expected based on previous investigations, to be present at the site.

Environmental sampling is based on chemical analytes identified as a potential concern during a documented process of reviewing historical site activities. However, ground conditions between sampling points may vary, and further hazards may arise from unexpected sources and/or in unexpected locations. The nature of any additional hazards which may be present at the site are generally detectable through visual or olfactory means, for example:

- Previously unidentified asbestos fibre impacted soils;
- Drums or underground tanks;
- Chemical bottles; and
- Odourous or unusual coloured soils;

As a precautionary measure to ensure the protection of the workforce and surrounding community, should any of the abovementioned substances be identified (or any other unexpected potentially hazardous substance), the procedure summarised in **Flowchart 7.1** and detailed in the following sections is to be followed.

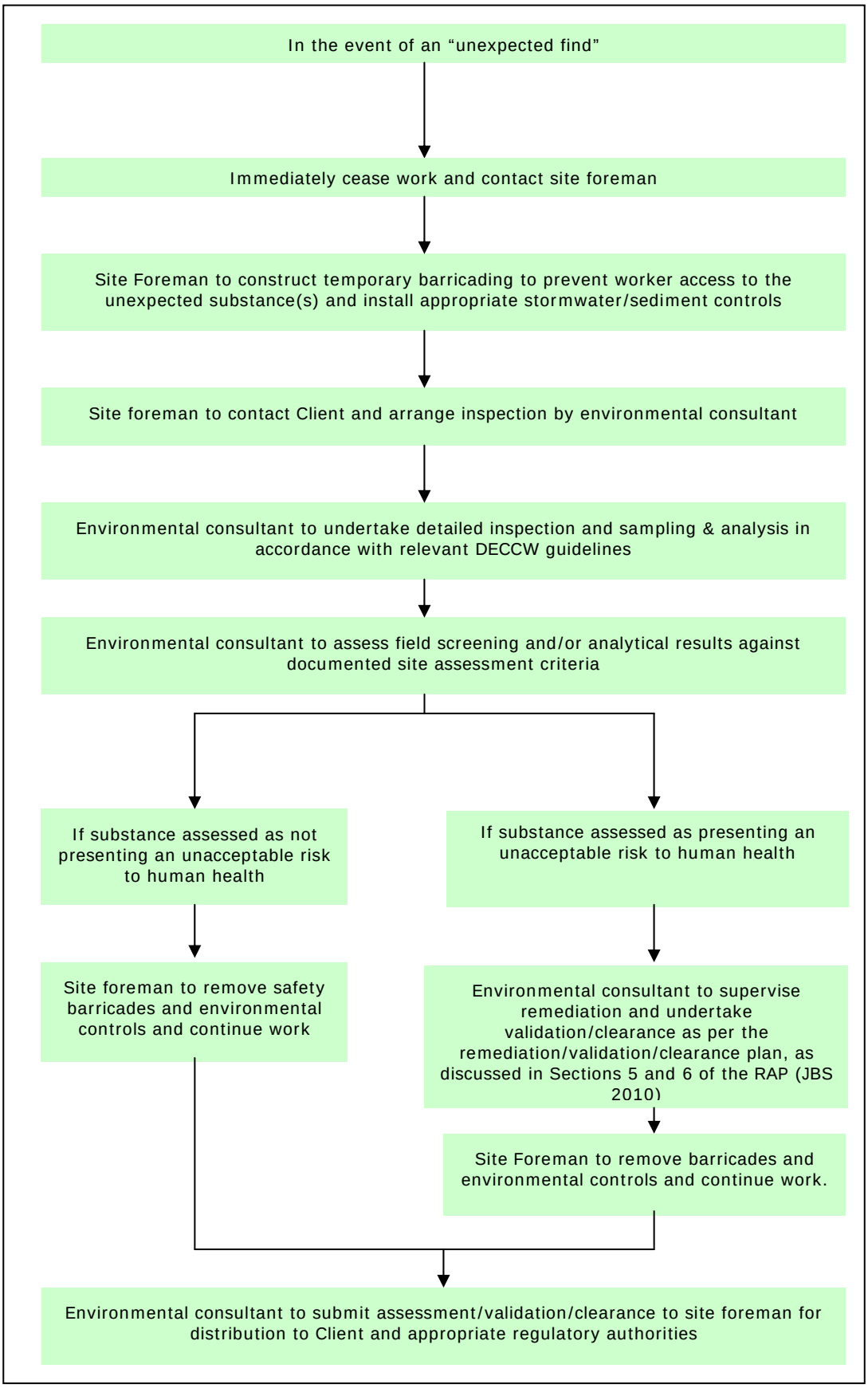
An enlarged version of the unexpected finds protocol, suitable for use on site, should be posted in the Site Office and referred to during the Site Specific Induction by the Principal Contractor.

The sampling strategy for each 'unexpected find' shall be designed by a suitably qualified environmental consultant, in accordance with guidelines made or endorsed by DECCW. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, is it at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance / materials shall meet the requirements the *NSW EPA Sampling Design Guidelines* (1995).

The assessment criteria for any unexpected find are provided **Appendix C.** Should any unexpected finds require remediation and validation, the works will be conducted in general accordance with **Sections 5 and 6** of this RAP, and with appropriate measures based on the nature of the unexpected find.

**Figure 7.1 - Unexpected Finds Protocol**



# 8 Remediation Works - Site Management Plan

## 8.1 Hours of Operation

Remediation works shall only be permitted during the following hours:

Monday to Friday: 7:00 am to 6:00 pm

Saturdays: 8:00 am to 1:00 pm

Sundays and Public Holidays: No work permitted.

Emergency work is permitted to be completed outside of these hours.

## 8.2 Soil and Water Management

All works shall be conducted in strict accordance with the soil and water management measures outlined in this section.

To prevent the migration of impacted soil/sediment off site, silt fences shall be constructed at the down-gradient work area boundaries, as per the specifications contained in *Managing Urban Stormwater – Soil and Construction Volume 1, 4th Edition,* NSW Government, March 2004. Any material which is collected behind the sediment controls shall be treated as potentially contaminated and will be suitably managed.

In a storm event, the sediment controls located on-site will need to be monitored and replaced or altered if necessary. Collected material will need to be suitably managed in accordance with remediation works.

### 8.2.1 Site Access

During remediation works, perimeter fencing will be maintained to restrict access to the works area. Only authorised persons will be able to enter the works area.

Vehicle access to the works area shall be stabilised to prevent the tracking of soil around the site and the adjoining driveway/access point to the road will be swept or cleaned on an as-needed basis. Any collected materials shall be treated as potentially contaminated and will be suitably managed.

### 8.2.2 Stockpiles

The following procedures will be implemented:

- No stockpiles or other materials shall be placed on footpaths or roadways and will be away from all stormwater infrastructure (including drainage lines, stormwater pits, gutters, etc) where possible. Where this is not possible, sediment controls will be placed over stormwater grates to prevent ingress of sediment to stormwater drainage lines;
- Stockpiles shall be formed with sediment control structures placed immediately down slope to protect other lands and waters from sediment pollution;
- All stockpiles likely to generate substantial dusts or potential asbestos fibres shall be covered and, if left for more than 24 hours, be stored in a secure area; and
- All stockpiles will be placed on a level area as a low elongated mound.

### 8.2.3 Excavation Pump-out

Excavation pump out water (if any) shall be pumped from the excavation by a licensed contractor and disposed of off-site as 'liquid waste' in accordance with DECC (2009).

## 8.3 Noise

The remediation works shall comply with the *NSW EPA's Environmental Noise Control Manual* for the control of noise from construction sites.

All machinery and equipment used on site will be in good working order and with the fitted with appropriate silencers when necessary.

## 8.4 Vibration

The use of plant and machinery shall not cause vibrations to be felt or capable to be measured at the neighbouring premises.

## 8.5 Air Quality

### 8.5.1 Dust Control

During the remediation of the impacted areas, dust levels will be monitored and minimised by using mist sprays as necessary.

During the removal of the ACM impacted materials from the site, the excavation area will be wetted down using a water spray to minimise the potential for dust to be generated. Given that this area lies across the site, the site boundary fencing will be covered with plastic sheeting as an added measure to contain any dust which may be generated as part of the soil removal works. In addition to these controls, air sampling will be conducted during the asbestos remediation works to monitor the amount of airborne asbestos fibres released. The monitoring results will be used to adjust the work technique, in particular the amount of water used to wet the excavation.

Dust shall also be controlled by ensuring vehicles leave via the designated (stabilised) site access and all equipment has dust suppressors fitted.

## 8.6 Material Transporting

Trucks will be loaded in a designated area away from the contaminated material excavations. The transporting contractor shall ensure that there is no material tracked out onto the street and that the load is securely covered. In addition, all site vehicles must leave the site in a forward direction.

All appropriate road rules shall be observed and state roads will be selected as far as practicable over local roads when deciding on the transport route to the off-site material disposal location.

Where material is to be imported, controls are to be implemented to maintain separation between contaminated and non-contaminated materials.

## 8.7 Hazardous Materials

All hazardous and/or intractable wastes (if any) shall be removed and disposed of in accordance with the relevant regulatory requirements. In particular, any hazardous wastes will be transported by a DECCW licensed transporter.

### 8.8 Disposal of Contaminated Soil

All soil will be classified, managed and disposed in accordance with the *Waste Classification Guidelines Part 1: Classifying Waste* (DECC 2009a).

### 8.9 Imported Fill

If any materials are required to be imported on site to re-establish existing ground levels, then only material meeting the requirements outlined in **Section 6.5** will be accepted onto the site.

### 8.10 Site Signage and Contact Numbers

A sign shall be displayed throughout the duration of the works with the contact details of the remediation contractor and project manager. Council shall also be notified of these details at least 14 days prior to commencing works.

### 8.11 Complaint Reporting and Resolution

Complaints from adjoining site occupants or workers on site will be directed initially to the civil contractor on site. Following that, discussion with the environmental consultant and the complainant will investigate the issue and remedy it as required or applicable.

# 9 Remediation Works - Health and Safety

The objectives of the health and safety plan are:

- to apply standard procedures that reduce risks resulting from the above works;
- to ensure all employees are provided with appropriate training, equipment and support to consistently perform their duties in a safe manner; and
- to have procedures to protect other site workers and the general public.

These objectives will be achieved by:

- assignment of responsibilities;
- an evaluation of hazards;
- establishment of personal protection standards and mandatory safety practices and procedures; and
- provision for contingencies that may arise while operations are being conducted at the site.

This health and safety section does not provide safety information specific to construction and other demolition or excavation activities carried out by contractors, such as the safe operation, maintenance and inspection of plant, etc. Contractors will be required to prepare their own Safe Work Method Statements for their work activities. All parties working on the site shall comply with all applicable Health and Safety legislation, regulations, codes and guidelines.

## 9.1 Responsibilities

### 9.1.1 Remediation Supervisor

The remediation supervisor is responsible for ensuring that the work is carried out in accordance with the health and safety plan. This will include:

- Ensuring a copy of the health and safety plan is available at the site during the remediation/validation activities;
- Confirming individuals are competent in performing allotted tasks;
- Liaison with the contractor representatives, as appropriate, regarding safety matters; and
- Investigation and reporting of incidents and accidents.

The remediation supervisor will be confirmed by the nominated contractors prior to the commencement of site remediation works.

### 9.1.2 Other Members of the Site Workforce

Every individual worker is responsible for conducting their allocated tasks in a safe manner and in accordance with their training and experience. They must give due consideration to the safety of all others in their proximity and cooperate in matters of health and safety. All workers must leave their work areas in such a condition that the location will not be hazardous to others at any time.

## 9.2 Hazards

The known or potential hazards associated with the work activities are listed below:

- Inhalation hazards associated with the presence of asbestos containing materials.
- Chemical hazards associated with the presence of contaminated soil;
- Physical hazards, including:
    - work in or near excavations;
    - operating machinery;
    - heat stress and UV exposure;
    - underground or overhead services;
    - manual handling; and
    - noise.

In the event of the discovery of any condition that would suggest the existence of a situation more hazardous than anticipated, or of any new hazard that could potentially cause serious harm to personnel or the environment, work will be suspended until the Remediation Supervisor has been notified and appropriate instructions have been provided to field personnel.

### 9.2.1 Inhalation Hazards

The main inhalation hazards from the remediation/validation works are consequent of the presence of asbestos.

Measures require to be put in place to prevent/ minimise the generation of airborne fibres. These have been described in the environmental controls for the works. Where airborne emissions are generated, PPE shall be required to be worn to prevent potential exposure, as described in **Section 9.3**.

### 9.2.2 Physical Hazards

Operating Machinery

Heavy plant and equipment operating in the vicinity of field personnel presents a risk of physical injury. Personnel should be cognisant of their position in relation to operating machinery at all times. Personnel must wear high visibility clothing when onsite.

Never walk behind or to the side of any operating equipment without the operator's knowledge. Do not assume that the operator knows your position. Personnel should stay at least 1 m from the operational area of heavy equipment and should not stand directly below any load or piece of equipment (e.g. backhoes, excavators, vehicles).

Work In or Near Excavations

No site personnel are to stand closer than 0.5 m to the edge of an excavation. No site personnel are to enter excavation greater than 1 m deep. Additionally, at the end of each day excavations are to be barricaded to prevent access.

Cuts and Abrasions

The manual work associated with the remediation works gives rise to the risk of cuts and abrasions to personnel working in the area. As well as the direct consequences of any cut

or abrasion, such injuries can lead to the possibility of exposure to contaminants through the wound as well as diseases such as tetanus. To minimise the risk of direct or indirect injury, personnel will wear the personal protective equipment described.

Heat Stress and UV Exposure

Site personnel may experience heat stress due to a combination of elevated ambient temperatures and the concurrent use of personal protection equipment; this depends in part on the type of work and the time of year.

In addition to heat stress, overexposure to UV radiation in sunlight can result in sunburn to exposed skin. The use of a high protection sunscreen (SPF15 or greater) on all exposed skin is recommended. Hats (including hard hats in specified areas) will also provide additional sun protection during the peak (i.e. 10:00 am to 3:00 pm) sun period. Sunglasses should be worn (where appropriate) to protect eyes from effects of UV exposure.

Underground Services

There is the potential for underground services (electricity, natural gas lines, water, telephone, sewer, and stormwater) to be present beneath the work area. The remediation contractor shall ensure that appropriate procedures will be taken to minimise the risk associated with excavation near services.

Aboveground Electrical Hazards

All electrical plant and equipment must comply with the requirements of Australian Standard AS 3000. Hand held portable tools shall comply with AS/NZS 3160 "hand-held portable electric tools" and shall be double insulated. Cord connected portable hand lamps shall comply with AS/NZS 3118. A Residual Current Device (RCD) shall protect plug-in portable equipment, which is connected to a supply above Extra Low Voltage - 12-24volts (including equipment supplied from a generator or welding set). RCD protection shall be provided during maintenance of portable electrical equipment at all times while the equipment is connected to a power supply above Extra Low Voltage, irrespective of whether power is switched ON or OFF. RCD's shall comply with AS 3190 and shall be type II units, rated to trip at or below 30 milliamps within 40 milliseconds.

In the vicinity of overhead power lines, the WorkCover NSW '*Guidelines for Working Near Overhead Power Lines*' (2006) should be consulted to determine the appropriate 'approach distance' specific to the line voltage present and tasks under completion. No excavator, drill rig or crane may work within the nominated 'approach distance', unless specifically approved by the Remediation Supervisor and/or the asset owner if required.

Manual Handling

When lifting or handling heavy objects, use correct lifting techniques, bending the knees not the back. If the item to be lifted is too heavy or awkward for one person to lift, seek assistance from other company employees or use mechanical help.

Noise

Long-term exposure to high levels of noise is unlikely. However, operating machinery may cause significant noise exposures for short periods. Earplugs or earmuffs should be worn in any situation where noise levels make normal conversation difficult.

## 9.3 Personal Protective Equipment

All workers who may come into direct contact with contaminated soil will wear the following personal protective equipment:

- Overalls or long sleeved collared shirt;
- Heavy duty outer gloves (e.g. leather) where there is a risk of cuts or abrasions, otherwise PVC outer gloves if in direct contact with contaminated soil;
- Steel capped boots;
- Safety glasses;
- High visibility vest or jacket; and
- Hard hat.

In addition to the above, the following personal protective equipment will be worn by the licensed personnel responsible for removing the asbestos impacted soils, or potentially exposed to airborne emissions:

- During any work in the asbestos impacted area prior to final clearance, overalls worn should be made from either 100% synthetic material or a mixed natural/synthetic fabric capable of providing adequate protection against fibre penetration. Gloves, rubber soled work shoes or gum boots should be provided for personnel involved in the wet work. These shoes will remain inside the work area for the duration of the work.
- Approved respirators shall be worn in the asbestos impacted area at all times to provide respiratory protection. The minimum protection is an approved properly fitting disposable respirator or half faced respirator fitted with a particulate cartridge. However it is expected that the contractor will conduct a risk assessment in relation to the works and should consider the requirement for positive pressure, hood or full-face powered air-purifying respirator fitted with an approved Class M filter.
- The contractor shall supply and keep in good order, two complete sets of protective clothing and respirators for authorised inspection personnel. These will remain the property of the contractor at the end of the contract.
- Respirators should be issued for personal use only and shall be kept in a clean condition. Alcohol based antiseptic swabs should be made available for the cleaning of respirators.
- Any respirator defects should be reported for subsequent repair. They should be maintained in a clean and safe working condition.
- Employees must receive instruction in the correct method of using the respirator and on the importance of correct facial fit and maintenance. No person with a beard shall be allowed within the asbestos work area except using an approved positive pressure continuous airflow hood.

It is further noted that additional PPE may be required as part of the WorkCover permitting process. If this occurs, then the above PPE requirements will be upgraded to reflect WorkCover's requirements.

In the event that workers will be exposed to highly odorous soil conditions during remediation works, the following additional PPE should be adopted:

- Impermeable disposable overalls; and
- Half or full face respirator with organic vapour cartridge.

## 9.4 Monitoring procedures

It is prudent practice to conduct monitoring for airborne asbestos fibres during asbestos works. The results of air monitoring can be used:

- To identify failures in containment;
- To identify poor work practices; and
- To provide proof of containment for occupiers and regulatory authorities and to provide evidence of good work practices for both present and future needs.

Monitoring will be conducted in accordance with the National Occupational Health & Safety Commission (NOHSC) membrane filter method as approved by the National Association of Testing Authorities (NATA).

The appropriate TWA (NOHSC) levels are:

- Amosite - 0.1 fibre/mL;
- Chrysotile – 0.1 fibre/mL;
- Crocidolite - 0.1 fibre/mL;
- Other forms of asbestos - 0.1 fibre/mL; and
- Any mixture of these, or where the composition is unknown - 0.1 fibre/mL.

With consideration to these levels the following trigger levels have been developed:

- If airborne fibre levels reach 0.01 fibres/mL the source of fibre release is to be found and rectified. Work in the affected area does not have to stop; and
- If airborne fibre levels reach 0.02 fibres/mL work in the work area should stop and additional controls measures employed. This will involve additional water spraying during excavations.

Air monitoring results will be obtained within 24 hours of sample collection. While this precludes “real time” monitoring, visual indications will be made during all excavation works and, if there is any visible dusts, light water spays will be used to wet the excavation and prevent the release of any airborne asbestos fibres.

## 9.5 Decontamination Procedures

The decontamination procedures specified below will be followed whenever personnel, plant or equipment leave the site.

Personnel

The following steps should be taken to ensure personnel do not leave the site with potentially contaminated clothing:

1. Wash boots in clean water

2. Remove outer gloves and store for reuse
3. Remove overalls and store for reuse (during the day) or place in the skip for the asbestos wastes for disposal.
4. Remove respirator and goggles (if used) and store clean for reuse or decontamination, as appropriate.
5. Thoroughly wash hands and face.

If any part of a worker's body comes into direct contact with any potentially contaminated material, the affected part(s) should be immediately washed with clean water.

Vehicle, Plant and Equipment

All equipment, including personal protective equipment, will be washed or otherwise cleaned to ensure that contaminated soil, water or dust is removed before it leaves the Site. All plant and equipment will have their outer bodies thoroughly cleaned of soil and sediment before moving off the site.

## 9.6 Emergency Response

The remediation contractor will be responsible for preparing an emergency response plan, which will provide details on appropriate action and evacuation procedures in the event of an emergency.

In the event of an emergency arising on the site, appropriate action should be taken. Site evacuation procedures should be followed, as necessary.

In the event of an accident: evaluate the seriousness of the injury, and contact emergency services, if necessary; provide first aid, as appropriate, and if safe to do so evacuate the injured person (adopting the decontamination procedures specified in **Section 9.5** if safely possible) ; make the area as safe as possible without jeopardising safety.

If a serious accident occurs, do not disturb the scene, except to make safe and prevent further injury or damage, and keep all unauthorised people out, and report all accidents to the Remediation Supervisor.

# 10 Post Remediation Site Management Plan

## 10.1 Long Term Management Plan

Subsequent to implementation of the preferred remediation strategy, and demonstration of successful validation of the site in accordance with the requirements of this RAP, no long term Environmental Management Plan (EMP) will be required for the site.

## 10.2 Construction Environmental Management Plan (CEMP)

As discussed in **Section 4.4**, the preferred remediation strategy must include the preparation and implementation of a CEMP for all construction works on the site after the completion of remediation works.

With respect to asbestos in soils the CEMP shall include, but not be limited to:

- The project hierarchy and persons(s)/parties responsible for ensuring correct implementation;
- Procedures for inducting all site works including informing workers of the presence of asbestos, correct use of PPE to prevent uncontrolled exposure to asbestos;
- Environmental controls to be implemented to prevent exposure to asbestos;
- Identification of tasks that may cause disturbance to the remediation and mitigation areas;
- Requirements for daily airborne asbestos fibre monitoring for the duration of all site works, including trigger levels to be adopted and procedures to be implemented if exceeded;
- Contingency plans if incidents occur;
- Reporting requirements for the CEMP;
- A procedure for reporting incidents or near misses;
- A procedure for reviewing the implementation of CEMP including audit of monitoring records; and
- A procedure for improving the CEMP as required in response to changes in site conditions or other.

# 11 Regulatory Approvals / Licensing

## 11.1 State Environment Planning Policy Number 55 (SEPP55) Remediation of Land

The proposed remediation works are considered to be classified as 'Category 2' Remediation Works – *i.e*. not requiring consent. However, the notification requirements of SEPP 55 include notification to Council 30 days before Category 2 remediation works commence. The notification will provide Council with the information needed to verify the work is not Category 1 by reference to the following criteria:

- The work is not designated development under schedule 3 of the EPA&A Regulation or under a planning instrument (an area of less than 3Ha will be disturbed by actual remediation works);
- The work proposed is not on land identified as critical habitat under the *Threatened Species Conservation Act 1995;*
- Consideration of s.5A of the EP&A Act indicates the remediation work is not likely to have a significant effect on threatened species, populations, ecological communities or their habitats. However this may require revision based on the ecological status of the nearby Salt Pan Creek wetlands at the time of commencement of remedial works;
- The work is not proposed in an area or zone identified in a planning instrument as being an area of environmental significance such as scenic areas or wetlands; and/or
- The work does not require consent under SEPP or another regional environmental plan.

In addition, the notification will also include relevant contact details and a proposed remediation schedule.

Notice is also required to be given to Council within 30 days of remediation works completion.

## 11.2 Protection of the Environment Operations Act 1997

In relation to the licensing requirements under the *Protection of the Environment Operation Act 1997*:

- The works do not fall within the licensing requirements for Contaminated Soil Treatment Works; and
- The works do not fall within the licensing requirements for Crushing, Grinding or Separating Works.

All material to be excavated and removed from the site (including associated activities such as classification) will be undertaken in strict accordance with the requirements of the POEO Act 1997. Such requirements include:

- Ensuring waste is classified appropriately and in accordance with relevant guidelines;
- Waste materials are disposed of to appropriately licensed facilities;
- Other materials are removed to facilities lawfully able to accept such materials.

### 11.3 Protection of the Environment Operations (Waste) Regulation 2005

The regulations make requirements relating to non-licensed waste activities and waste transporting. The proposed works on the site will not require to be licensed. Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner and that vehicles used to transport waste must be covered when loaded.

The Regulation exempts certain waste streams from the full waste tracking and record keeping requirements. Waste tracking is required only for special waste (asbestos waste) and restricted solid wastes.

### 11.4 Waste Classification Guidelines, Part 1: Classifying Waste

All wastes generated shall be classified and managed in accordance with the NSW DECC Waste Classification Guidelines Part 1: (2009).

### 11.5 Canterbury City Council requirements

Canterbury City Council does not have a DCP relating to contaminated land. Where required, Canterbury City Council will be notified of the commencement of works.

### 11.6 Asbestos Removal Regulations and Code of Practice

The removal and disposal of asbestos will be managed in accordance with the National Occupational Health & Safety Commission (NOHSC) *Asbestos: Code of Practice and Guidance Notes*, the NSW Occupational Health and Safety Act and Regulations, NSW WorkCover Guidelines and the NSW EPA Environmental Guidelines: Assessment, Classification & Management of Liquid and Non-Liquid Wastes.

Before starting the affected works, a site-specific permit approving the asbestos works must be obtained from NSW WorkCover. A permit will not be granted without a current licence and the permit application must be made at least seven days before the work is due to commence.

# 12 Site Suitability

Subject to the successful implementation of the measures detailed in this RAP and subject to the limitations in **Section 13**, it is considered that the site can be made suitable for continued residential use with minimal access to soils and recreational land use.

It is further noted that groundwater has been assessed in a limited capacity. If during remediation potential sources of groundwater contamination are identified, an additional groundwater quality assessment should be undertaken.

# 13 References


ANZECC (2000*), Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand

Australia and New Zealand Environment and Conservation Council / National Health and Medical Research Council (ANZECC/NHMRC) 1992. *Guidelines for the Assessment and Management of Contaminated Sites.*

Australian Standard 4432.1-2005 *Guide to the investigation and sampling of sites with potentially contaminated soil, Part: Non-volatile and semi-volatile compounds* (AS4482 2005).

Douglas Partners Pty Ltd (2008) *'Report on Preliminary Geotechnical, Contamination and Hazardous Materials Assessment, Urban Renewal Project, Riverwood North'* Reference 45788.

JBS Environmental Pty Ltd (2010) *'Stage 1 Environmental Site Assessment, Riverwood North Residential Renewal Project'* JBS 41131- 15354

JBS Environmental Pty Ltd (2010a) *'Stage 2 Environmental Site Assessment, Riverwood North Residential Renewal Project'* JBS 41131- 16110

NEPC 1999. National *Environmental Protection (Assessment of Site Contamination)* Measure (NEPM) 1999. Schedule B (1) Guideline on the Investigation Levels for Soil and Groundwater. National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) 1999, National Environmental Protection Council.

NSW EPA 1994, *Contaminated Sites: Guidelines for Assessing Service Station Sites*, NSW Environment Protection Authority, Sydney (NSW EPA 1994).

NSW DEC (2006) *Contaminated Sites: Guidelines for the NSW Auditor Scheme* (2nd Edition) (DEC 2006).

NSW DEC (2007) *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination*.

NSW DECC 2009, *Waste Classification Guidelines Part 1: Classifying Waste*, Tables 1 and 2 Guidelines (DECC 2009).

NSW Department of Natural Resources, *NSW Natural Resource Atlas*, www.nratlas.nsw.gov.au

NSW EPA *Protection of the Environment Operations (Waste) Regulation 2005* (EPA 2005)

NSW EPA *Protection of the Environment Operations (underground Petroleum Storage Systems) Regulation 2008* (EPA 2008)

US EPA *Guidance for the Data Quality Objectives Process* (1994), EPA QA/G-4 (EPA 600R96055).

# 14 Limitations

This report has been prepared for use by the client who has commissioned the works in accordance with the project brief only, and has been based in part on information obtained from the client and other parties. The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose. JBS Environmental Pty Ltd accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS Environmental Pty Ltd, and should not be relied upon by other parties, who should make their own enquires.

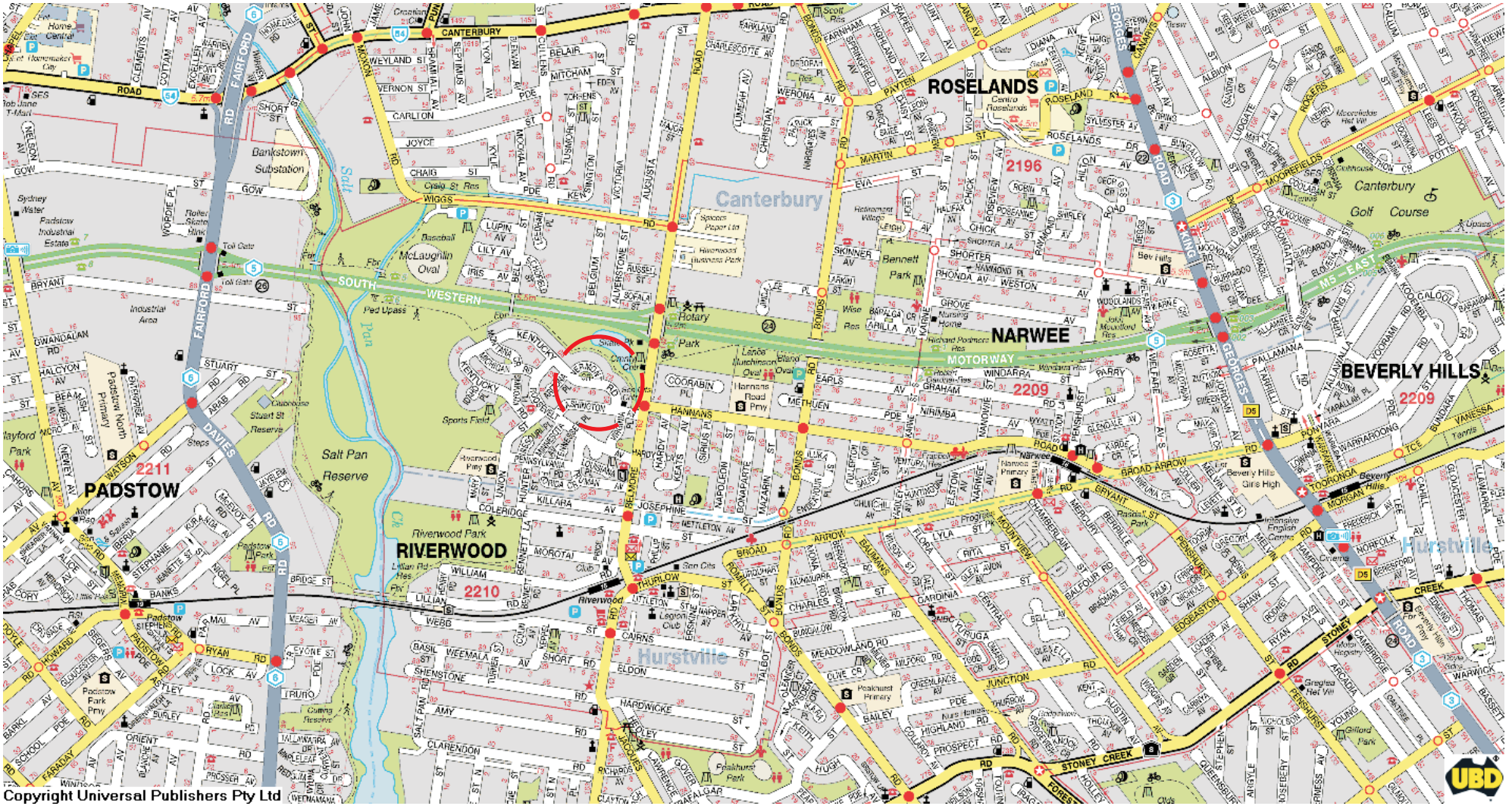
Sampling and chemical analysis of environmental media is based on appropriate guidance documents made and approved by the relevant regulatory authorities. Conclusions arising from the review and assessment of environmental data are based on the sampling and analysis considered appropriate based on the regulatory requirements and site history, not on sampling and analysis of all media at all locations for all potential contaminants.

Limited sampling and laboratory analyses was undertaken as part of the investigations, as described herein. Ground conditions between sampling locations may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site.

Changes to the sub-surface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of the investigations.

This report does not provide a complete assessment of the environmental status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site including previously unknown sources of contamination, JBS Environmental Pty Ltd reserves the right to review the report in the context of the additional information.

**Figures**




**Legend**

Approximate site location

0 2000m

Approximate scale



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Figure 1 Site Location

Client: Mprojects

Job Number: 41131

Site Address: Washington Avenue
Riverwood, NSW

File: 4113101.cdr


Figure 2: Previous Sampling Locations DP (2008)

Client: Mprojects Job Number: 41131

Project: Stage 2 Environmental Site Assessment

Site Address: Riverwood North Residential Renewal Project

File Name: 41311-02 Site PreLocation.cdr (Rev 0)


## Legend

- Sample Locations
- Site Boundary



0 25 50 100 m

JBS ENVIRONMENTAL

**Figure 3: Locations exceeding 0.01% w asbestos in soil criterion or locations recording a positive laboratory detection of fibres**

**Client: MProjects** **Job Number: 41131**

**Site Address: Riverwood North - Residential Renewal Project** **File Name: 41131_Figure 3.mxd**


Areas requiring surface soil remediation (0-0.1m or placement of capping 0.3m of validated fill
Areas requiring excavation, off-site disposal of fill and validation;
Areas requiring excavation, ACM removal, validation and reinstatement

## Legend

- Sample Locations
- Site Boundary



0 25 50 100 m

JBS ENVIRONMENTAL

**Figure 4: Remediation Areas**

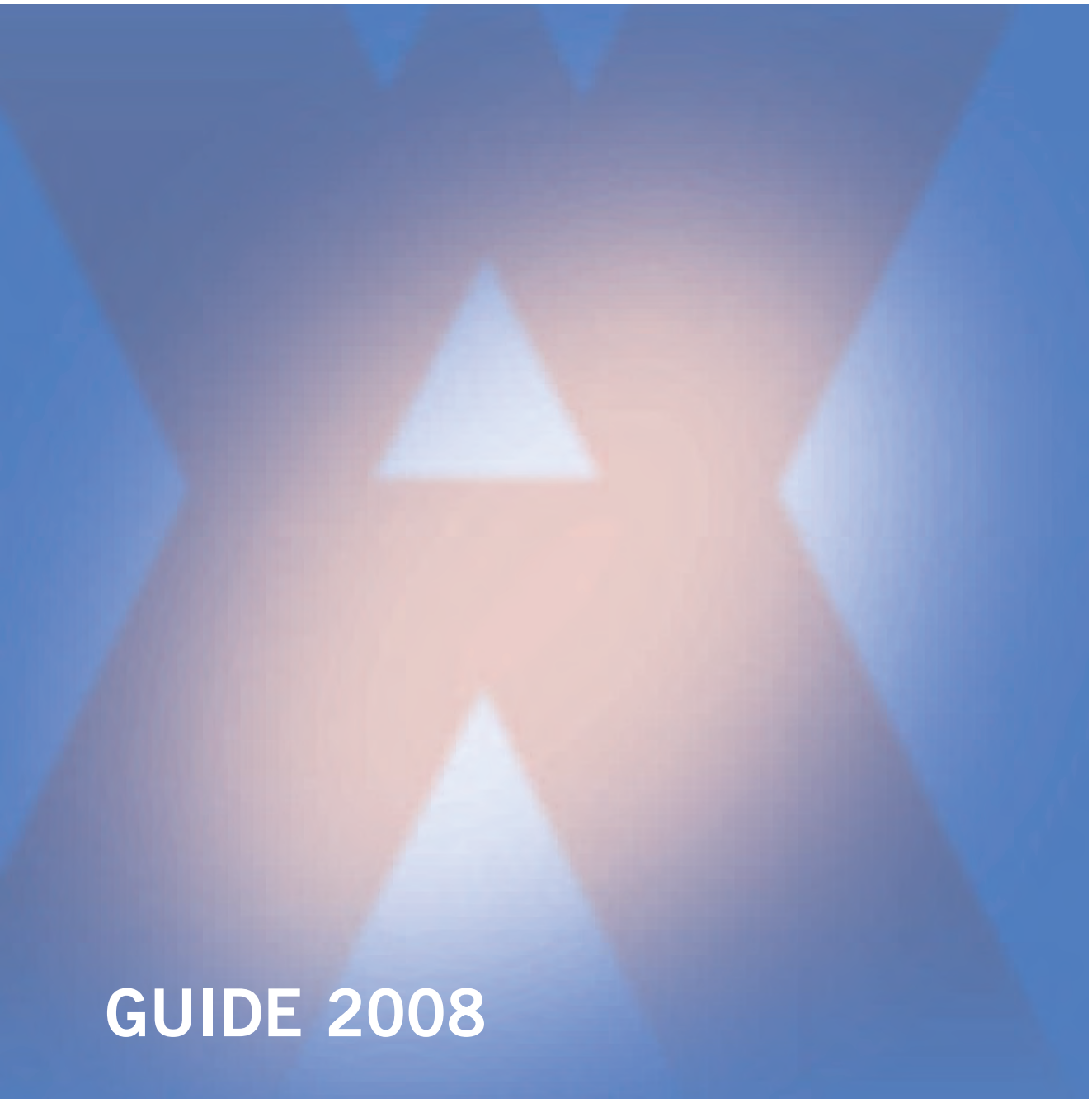
| | |
|---|---|
| **Client: MProjects** | **Job Number: 41131** |
| **Site Address: Riverwood North - Residential Renewal Project** | **File Name: 41131_Figure 3.mxd** |

**Appendix A**

**WorkCover Fact Sheet 3_1**

WorkCover
NEW SOUTH WALES

# WORKING WITH
# ASBESTOS



## GUIDE 2008

WorkCover. **Watching out for you.**

New South Wales Government

# CONTENTS

# INTRODUCTION

Asbestos is the generic term for a number of fibrous silicate minerals. There are two major groups of asbestos:

- the **serpentine** group contains chrysotile, commonly known as white asbestos
- the **amphibole** group contains amosite (brown asbestos) and crocidolite (blue asbestos), as well as some other less common types, such as tremolite, actinolite and anthophyllite.

Since 31 December 2000, using all forms of asbestos has been banned.

## SERPENTINE GROUP

Chrysotile is the only form of asbestos that has been used commercially from the serpentine group.

In the past, chrysotile has been used in the manufacture of:

- asbestos cloth, tapes, ropes and gaskets for packing, and in thermal and chemical insulation
- asbestos cement sheets and pipes for construction, casing for water and electrical/ telecommunication services
- rubber, plastics, thermosetting resins, adhesives, paints, coatings, caulking compounds and sealants for thermal, electrical and insulation applications
- fire-rated doors, equipment and structural beams of buildings
- fillers and filters.

Until recently, chrysotile was used almost exclusively in the manufacture of packing and friction material, such as gaskets, and brake and clutch linings. Take care that imported products do not contain any chrysotile asbestos.

## AMPHIBOLE GROUP

Until the early 1980s, amosite and crocidolite were used in many products but, in the mid-1980s, the use of all types of asbestos in the amphibole group was banned. The products included:

- asbestos cement sheets and pipes for construction, casing for water and electrical/ telecommunication services
- thermal, acoustic and chemical insulation – eg fire-rated doors, limpet spray, lagging and gaskets.

# EFFECTS ON HEALTH

Asbestos is formed in fibre bundles and, as it is further processed or disturbed, the fibre bundles become progressively finer and more hazardous to health. The small fibres are the most dangerous. They are invisible to the naked eye and, when inhaled, penetrate the deepest part of the lungs (respirable fibres).

Significant health risks may arise from the inhalation of airborne asbestos fibres. Compared with straight amphibole fibres, such as amosite and crocidolite,.chrysotile fibres are curly and less likely to penetrate the deepest parts of the lung.

Breathing in fibres brings a risk of asbestosis, lung cancer and mesothelioma. Evidence suggests that asbestos causes gastrointestinal and laryngeal cancers in humans, but to a far lesser extent than lung cancer. Usually, asbestos-related diseases have a delay or latency period of 20 to 40 years between first exposure and the onset of symptoms and detection of the disease. Asbestos-related diseases can appear or progress even after a person is no longer exposed.

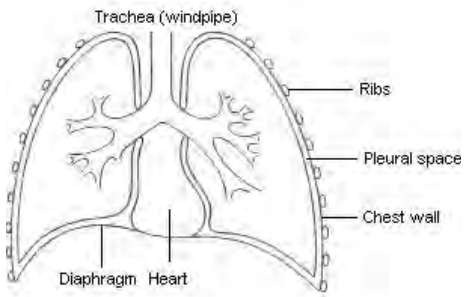
**Asbestosis** is the scarring of lung tissue that can result from the inhalation of substantial amounts of asbestos over a period of years. It results in breathlessness that may lead to disability and, in some case, death. Minor changes in X-ray images may be detected for many years without any symptoms of asbestosis or progression of the disease.

**Lung cancer** is related to the amount of fibre that is breathed in and the risk of lung cancer is greatly increased in those who also smoke tobacco.

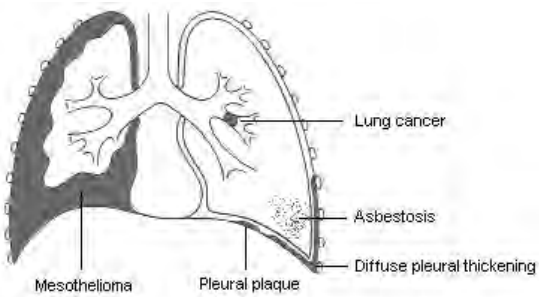
**Mesothelioma** is a cancer of the pleura (outer lung lining) or the peritoneum (the lining of the abdominal cavity). The risk of mesothelioma is less with chrysotile than with other types of asbestos. Both pleural and peritoneal mesothelioma can result from exposure to amosite and crocidolite. Exposure of humans to chrysotile alone has caused few pleural mesotheliomas, and has never produced peritoneal mesothelioma without exposure to either amosite or crocidolite. Mesothelioma rarely occurs in less than 15 years from first exposure, and most cases occur over 30 years after first exposure.

As for many cancer-causing substances, no safe level of exposure for lung cancer or mesothelioma has been identified. However, the amount of asbestos fibre in the air that people inhale is the important factor in determining the level of health risk. The highest risks involve inhaling air that contains a high concentration of asbestos fibre.

**NORMAL LUNG ANATOMY**

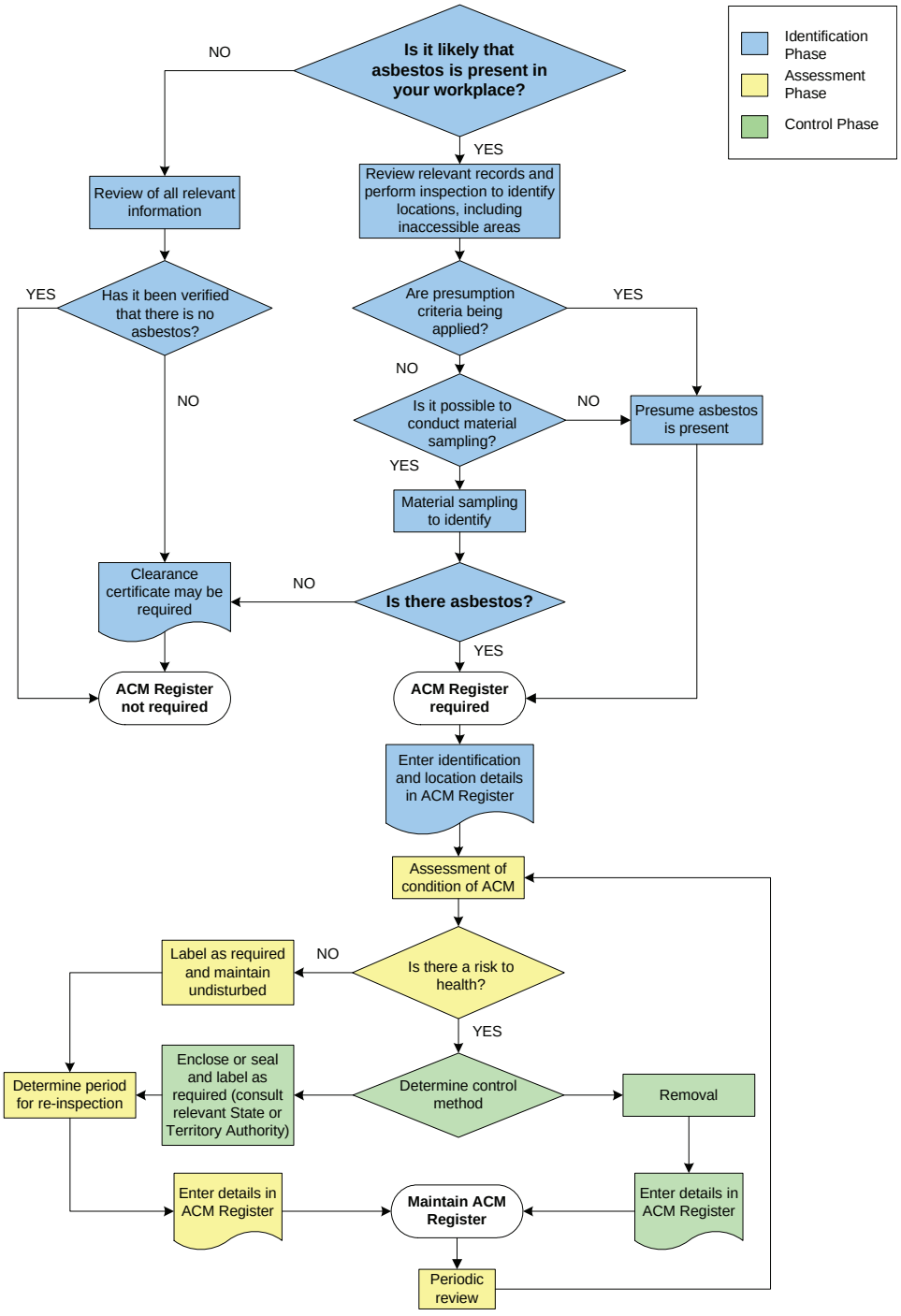



**LUNG DISEASES**



# IDENTIFYING ASBESTOS

It is a legal requirement for the controller of premises to identify all asbestos containing materials (ACM) within a workplace, and these materials must be recorded in an asbestos register. Maintaining an updated asbestos register is part of an overall asbestos management plan.




**Reference** *Code of Practice for the Control and Management of Asbestos in Workplaces (NOHSC 2018 [2005])*

## HOW TO IDENTIFY ASBESTOS CONTAINING MATERIAL

Suspected ACM should be identified using AS 4964 *Method For the Qualitative Identification of Asbestos in Bulk Samples*. Analysis for identification purposes should be carried out by one of the National Association of Testing Authorities (NATA) laboratories accredited for this method.

## ASBESTOS REGISTER

The asbestos register must include details of:

- the location, type and condition of ACM
- the dates of inspection and details of those who carried out the inspection
- details of any materials presumed to contain asbestos material
- any inaccessible areas likely to have ACM
- the results of any analysis that has confirmed (or not confirmed) the presence of asbestos
- the date when the risk assessment was made and details on the competent persons who carried out the assessment
- the findings and conclusions of the risk assessment
- the results of any air monitoring or airborne fibres, and the assessment of these results
- the control measures recommended and decided upon as a result of the risk assessment
- any removal, repair or disturbance of ACM, including the company and persons involved, the date and scope of the work undertaken, and details of the clearance certificates.

The asbestos register must be made accessible to all those within the workplace and should be reviewed and appropriately updated at least every 12 months, or whenever there is a change in circumstances and/or conditions.

# EXPOSURE

## EXPOSURE STANDARDS

Exposure to airborne asbestos should be kept as low as reasonably practicable below the mandated exposure standard of 0.1 fibres per millilitre of air.

The Australian Safety and Compensation Council (ASCC) exposure standards are outlined in *Adopted National Exposure Standards for Atmospheric Contaminants In the Occupational Environment [NOHSC: 1003 (1995)]*. Values for the exposure standards can also be found online in the Hazardous Substances Information System (HSIS) database, and interpretation of these standards can be found in the *Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment [NOHSC:3008 (1995)] 3rd edition*.

The amount of respirable fibre in the air can be measured by an occupational hygienist, using the membrane filter method. The air-monitoring analysis must be conducted by a laboratory with NATA accreditation for airborne fibre analysis.

Occupational hygienists who have training in asbestos identification, and who have knowledge and experience in asbestos removal, should carry out asbestos identification and assessment of the friability of asbestos materials. Contact the Australian Institute of Occupational Hygienists (AIOH) for a list of competent persons.

## MONITORING

There are three different types of monitoring for asbestos work:

- occupational monitoring
- control monitoring
- clearance monitoring.

### Occupational monitoring (personal monitoring)

Occupational monitoring is measuring airborne respirable fibres in the worker's breathing zone and comparing it with the exposure standard. This type of monitoring is generally not carried out during removal work. The exposure standard for all types of asbestos is 0.1 fibres per millilitre of air.

### Control monitoring (area or static monitoring)

Control monitoring indicates the adequacy of controls put into place during asbestos work. Control monitoring is measuring airborne respirable fibre levels and comparing them with the action levels shown below. If these levels are exceeded, action should be taken to re-evaluate controls.

| Action Level (airborne asbestos fibres/mL) | Action |
|---|---|
| Less than 0.01 | Continue with control measures |
| Between 0.01 and 0.02 | Review control measures |
| More than 0.02 | Stop removal work and find the cause |

**Source** *Code of Practice for the Safe Removal of Asbestos [NOHSC:2002 (2005)]*

**Clearance monitoring**

Clearance monitoring should be carried out following asbestos removal work. All friable asbestos removal work must have a clearance certificate at the completion of work. The clearance certificate must be completed by an occupational hygienist and the results assessed by a laboratory accredited by NATA for the test method.

Clearance monitoring generally requires air monitoring, settled dust samples and a visual assessment to determine the effectiveness of asbestos decontamination work.

**Air monitoring should not be used as an alternative to visual assessment in estimating asbestos contamination and exposure.**

## HEALTH SURVEILLANCE

To ensure the health and safety of those in workplaces, health surveillance is an important part of the monitoring of exposure to asbestos.

The main purpose of health surveillance is to ensure that control measures are effective – they should provide an opportunity to reinforce specific preventive measures and safe work practices.

The need for asbestos-related health surveillance should be determined by an assessment of the potential for exposure to asbestos in accordance with the *Occupational Health and Safety Regulation 2001* (OHS Regulation).

Additional guidance on health surveillance may be obtained from the ASCC *Guidelines for Health Surveillance [NOHSC: 7039 (1995)]*, which sets out, in a practical manner, the minimum requirements for health surveillance for those engaged in work that may expose them to asbestos and other hazardous substances.

Medical examinations for asbestos exposure are to be carried out by a WorkCover authorised medical practitioner or the Dust Diseases Board. Medical examinations of those recently exposed cannot reveal the presence or absence of health problems related to that exposure. The recording of exposure or potential exposure under clauses 169 and 170 of the OHS Regulation is a more effective immediate course of action to take when incidental exposure may have occurred.

## ASBESTOS EXPOSURE REGISTER

Under clauses 169 and 170 of the OHS Regulation, employers have an obligation to keep a record of any exposure or likely exposure to asbestos and provide a statement to employees on the termination of their employment. Employers are to include in an asbestos exposure register the name of those exposed, the date and location of exposure, and the type of work being carried out at the time of exposure. All records relating to asbestos exposure are to be kept for 30 years from the date of last exposure.

Upon termination of employment, the employer is to supply a letter to the employee noting that they could have been exposed to asbestos in the course of their employment. The letter (or statement) should contain:

- the name of the carcinogenic substance
- the period of exposure or potential exposure
- how and where records of the exposure or potential exposure can be obtained
- a recommendation to have periodic health assessments
- details of the types of health tests that are relevant in the circumstances.

# PROHIBITIONS AND LICENSING CONTROLS

The use of all forms of asbestos is no longer permitted. The use of all types of asbestos in the amphibole group was banned in the mid-1980s, and the manufacture and use of products containing chrysotile was prohibited nationally from 31 December 2003.

**The OHS Regulation does not allow the use (including the reuse) or sale of any asbestos product.**

## IN SITU ASBESTOS

*In situ* asbestos refers to asbestos material that is fixed or installed in its original position and has not been removed – eg wall sheeting and brake linings.

The prohibition of products containing chrysotile does not extend to the removal of asbestos products *in situ* at the time the prohibition took effect. These *in situ* asbestos-containing materials must be appropriately managed to ensure that the risks of exposure to airborne asbestos fibres are eliminated or controlled.

Asbestos products that were *in situ* on 31 December 2003 should be maintained in good order and condition. Once the asbestos material has deteriorated or is no longer fit for use, it must be replaced with a non-asbestos alternative. Asbestos products cannot be reused.

## BONDED AND FRIABLE ASBESTOS LICENCES

Under NSW OHS legislation, material that contains asbestos is referred to as friable or bonded.

### Bonded asbestos material

Bonded asbestos material is any material that contains asbestos in a bonded matrix. It may consist of Portland cement or various resins/binders, and it cannot be crushed by hand when dry. Asbestos cement (AC) products and electrical meter boards in good condition are examples of bonded asbestos material.

A large number of products made from bonded asbestos material are still found in Australian buildings, motor vehicles and plant components. These products include:

- flat (fibro), corrugated or compressed asbestos cement sheeting
- asbestos cement pipes such as electrical, water, drainage and flue pipes
- brake and clutch linings.

**Bonded asbestos licence**

Since 1 January 2008, a bonded asbestos licence has been required to remove more than 10 square metres of bonded asbestos material. A licensed bonded asbestos removalist can remove any amount of bonded asbestos material.

To obtain a bonded asbestos licence you must undertake a WorkCover-recognised training course in bonded asbestos removal and bonded asbestos supervision. Apply to WorkCover on the prescribed form and attach copies of your training records, workers compensation policy, and evidence of your experience in bonded asbestos removal or associated building trades.

The following are key conditions of maintaining a bonded asbestos licence:

- all bonded asbestos removal work must be notified to WorkCover in the prescribed manner at least seven days prior to the work being carried out.
- the work is to be supervised by a person with appropriate qualifications and experience, and who is nominated by the licence holder to be recorded on WorkCover's licensing system.
- all those involved in bonded asbestos removal must have undertaken WorkCover-recognised training in bonded asbestos removal.

**BONDED ASBESTOS (FIBRO)**

**BONDED ASBESTOS TILES**

**Friable asbestos material**

Friable asbestos material is any material that contains asbestos and is in the form of a powder, or can be crumbled, pulverized or reduced to powder by hand pressure when dry. Examples of friable asbestos include:

- sprayed limpet
- asbestos cloth and rope
- millboard
- pipe lagging
- boiler lagging.

Any asbestos cement products that have been subjected to weathering, or damaged by hail, fire or water blasting, are considered to be friable asbestos and an asbestos removal contractor with a WorkCover licence for friable asbestos is required for its removal.

**Friable asbestos licence**

A friable asbestos licence is required to remove, repair or disturb any amount of friable asbestos. A friable asbestos removalist can remove any quantity of bonded and/or friable asbestos.

To obtain a friable asbestos licence you must undertake a WorkCover-recognised training course in friable asbestos removal and friable asbestos supervision. Apply to WorkCover on the prescribed form and attach copies of your training records, workers compensation policy, and evidence of your experience in the supervision of friable asbestos removal, including encapsulation.

The following are key conditions of maintaining a friable asbestos licence:

- an application for a friable asbestos worksite permit must be lodged with WorkCover in the prescribed manner at least seven days prior to the work being carried out.
- all friable asbestos removal work must be supervised by a person with appropriate qualifications and experience, and who is nominated by the licence holder to be recorded on WorkCover's licensing system.
- all those involved in friable asbestos removal must have undertaken WorkCover-recognised training in friable asbestos removal.
- for emergency work, the seven days notice can be waived by contacting WorkCover and providing details of why a waiver is required.
- application forms for licences and information about licence requirements are available at www.workcover.nsw.gov.au

**FRIABLE ASBESTOS – PIPE LAGGING**

**FRIABLE ASBESTOS – SPRAYED LIMPET ON BEAMS**

## NATURALLY OCCURRING ASBESTOS

Asbestos is found as a naturally-occurring mineral in many areas of NSW. Where naturally occurring asbestos (NOA) is encountered – eg in road works, pipe works and telecommunications works – the risk from the NOA disturbance should be assessed by an occupational hygienist.

For NOA, an exemption from holding a friable licence may be obtained. An application should be forwarded to WorkCover with the reason the exemption is being applied for, a comprehensive risk assessment and safe work procedure for the work that is to be carried out, and details of workplace consultation and training that has been provided to employees, contractors and the general public. The application should address all safety issues. WorkCover will consider the application to ensure that there is an equivalent level of safety, the same as that required if a licence were in place.

### ROCKS CONTAINING NATURALLY OCCURRING FIBROUS SILICATE MINERALS

# SAFE WORKING GUIDE

The OHS Regulation calls up the ASCC codes of practice. For specific precautions and procedures of commonly encountered asbestos work, see:

- *Code of Practice for the Safe Removal of Asbestos [NOHSC: 2002 (2005)]*
- *Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC:2018 (2005)]*.

Consider the following generic controls when developing your asbestos management plans:

## WORKING WITH BONDED ASBESTOS MATERIAL

If products containing bonded asbestos are maintained in good order, they do not present a significant health risk. Nevertheless, safety precautions must be taken when working on any product containing asbestos. Work procedures should be developed to minimise the release of dust or fibres.

When working with bonded asbestos products, you should:

- use barriers to restrict entry of unauthorised personnel to the work area and to control contamination
- place asbestos removal caution signs at the barriers, which comply with AS 1319 *Safety Signs for Occupational Environment*
- use personal protective equipment, including coveralls and a respirator (eg a half-face P1/P2 respirator) – coveralls should preferably be disposable and coveralls with Velcro-type fasteners are not suitable
- only use non-powered hand tools as they generate less dust – **do not use power tools, such as abrasive cutters and sanders**
- use wet methods to dampen material, or use a suitable vacuum cleaner that complies with the AS/NZ 60035.2.60 and is fitted with an appropriate attachment to reduce the release of dust – **do not use a household vacuum cleaner**
- work in well-ventilated areas, where possible
- use 200-micron thick plastic drop sheets to collect debris, and label and dispose of appropriately – **take precautions to prevent slips and trips hazards**
- clean-up using wet methods, or a suitable vacuum cleaner – do not use a household vacuum cleaner
- dispose of waste and collected dust in 200-micron thick plastic bags that are sealed and clearly labelled as containing asbestos waste
- avoid any abrading or scrubbing of the material's surface
- recycled plastic is not to be used as it may contain flaws
- plastic used in asbestos removal is not to be reused.

**Water blasting**

It is illegal to water-blast asbestos containing materials because there is a high risk of asbestos fibres being released into the atmosphere and inhaled.

**House relocation**

Although buildings clad in bonded asbestos material are considered to be *in situ*, it is recommended that all bonded asbestos be removed from the building before it is relocated. Moving buildings clad with asbestos cement can cause the material to become loose and fall off, causing a hazard in transit or when the building is re-constructed. This could result in expensive clean-up costs. Any bonded asbestos material that is removed cannot be reused. Weathered asbestos roofing and gutters should be cleaned and removed prior to relocation.

**Cladding**

Over cladding of bonded asbestos material should not be undertaken unless it can be carried out without causing damage to the bonded asbestos. Over-cladding may result in more hazardous and expensive removal at a later date. All buildings with existing cladding over bonded asbestos should be labelled appropriately, somewhere on the building, to highlight to tradespeople and occupiers that the building contains bonded asbestos material.

## REMOVAL OF ASBESTOS CEMENT PRODUCTS

Safe work procedures should be followed when removing asbestos cement products (including sheeting, guttering and down pipes) from buildings and other structures. To minimise breakage, care should be taken when removing asbestos cement products.

You should:

- for external work, close all windows and doors to the building to prevent dust entering the building
- use barriers to restrict entry of unauthorised personnel to the work area and to control contamination
- place asbestos removal caution signs at the barriers to comply with AS 1319 *Safety Signs for Occupational Environment*
- when working on roofs, take appropriate precautions to prevent workers from falling off or falling through the roof – eg use suitable fall restraint devices or elevated working platforms
- where practical, seal the asbestos cement with a PVA sealant or dampen with water (wetting down may not be necessary on previously painted or sealed AC products) – when removing asbestos cement roofs, dampening should be done well before removal to allow the roof to dry sufficiently so workers do not slip
- wear disposable coveralls and respiratory protection (eg a half-face P1/P2 respirators) during the removal and clean-up process
- remove bolts and screws, and remove the asbestos cement sheets with minimal breakage – asbestos cement products should not be thrown into bins or onto the ground, but rather lowered as whole sheets where possible
- wrap the asbestos cement products in 200-micron thick plastic sheeting, label, then transport to the waste facility as soon as possible

- clean gutters by wetting down after removing the asbestos cement roofs – contaminated waste material must be bagged, labelled and disposed of as asbestos waste
- take precautions to prevent slips and trips hazards when working on roof surfaces
- if using a building skip or loading directly into trucks, line the internal surfaces with 200-micron thick plastic sheeting and ensure the load is securely covered and labelled before transporting to an authorised waste disposal facility
- pick-up visible asbestos cement debris in the roof space and around the removal area, then decontaminate using wet methods or a suitable vacuum cleaner
- use PVA to seal any residues of asbestos cement that cannot be removed, such as that on timber beams
- recycled plastic is not to be used as it may contain flaws
- plastic used in asbestos removal is not to be reused.

**Plastic used for drop sheets and debris is not to be reused and is to be disposed of as asbestos waste.**

## ASBESTOS CONTAMINATED SOILS

A competent occupational hygienist should assess the site to determine:

- if the asbestos material is bonded or friable
- the extent of asbestos contamination
- safe work procedures for the remediation of the site.

The assessment and safe work procedures should reflect the level of the hazards and the proposed use of the land. Environmental and planning legislative requirements must be complied with.

You should:

- have a documented safe system of work for the removal of asbestos contaminated soils, which includes clean-up procedures and requirements for personal protective equipment and disposal
- wear coveralls and suitable respiratory protection during the removal and clean-up process – the level of respiratory protection will depend on the type and condition of the asbestos material
- pick-up any obvious asbestos cement debris and place it into labelled asbestos waste bags
- keep asbestos contaminated soil wet at all times, place it in a sealed truck, cover it, then transport it to a Department of Environment and Climate Change (DECC) approved disposal facility
- decontaminate trucks that are used to transport asbestos contaminated soil before leaving the worksite and after disposing of the contaminated soil at the disposal facility
- carry-out work as outlined below under ‘Removal of friable asbestos’, if asbestos material is deemed to be friable.

## REMOVAL OF FRICTION MATERIALS

Prior to 2004, chrysotile was used almost exclusively in the manufacture of motor vehicle friction material, such as brake and clutch linings. However, installed brake components are the major source of asbestos in the motor vehicle industry.

Unless otherwise known, friction materials, such as brake components, should be treated as if they contained asbestos. See *Guidance Note: Working with Asbestos in the Motor Vehicle Repair Industry*. Appropriate written safe work procedures should be in place in all workplaces that handle motor vehicle brake components. Inspection of asbestos friction material should be treated as in *situ* asbestos.

Additional guidance is available in the ASCC *Code of Practice for the Management and Control of Asbestos in Workplaces*.

**Compressed air must never be used to clean dust from surfaces and brake drums.**

## REMOVAL OF FRIABLE ASBESTOS

A friable asbestos removal licence is required to remove friable asbestos.

The procedures as described in the *Code of Practice for the Safe Removal of Asbestos NOHSC[2002(2005)]* must be followed when removing friable asbestos from buildings and other structures. A clearance certificate from an occupational hygienist must be obtained following the completion of all friable asbestos removal work.

## NATURALLY OCCURRING ASBESTOS

All those working in naturally occurring asbestos (NOA) areas must receive training that is appropriate to the work they are carrying out.

A monitoring program for airborne asbestos fibres should be carried out during disturbance work on NOA.

All work associated with disturbing NOA must be done under a friable asbestos removal licence, or an exemption order. Exemption orders are issued by WorkCover and application forms for exemptions are available at www.workcover.nsw.gov.au. An exemption application must include a comprehensive asbestos management plan, training and monitoring requirements.

## DECONTAMINATION OF ASBESTOS SITES AND EQUIPMENT

Consider decontaminating sites and equipment where asbestos containing products have previously been manufactured, used or stored. This should be done in a safe manner. Refer to the ASCC *Code of Practice for the Management and Control of Asbestos in the Workplace*.

## WARNING SIGNS AND LABELS


**Source** *Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC 2018 (2005)]*

# RESPIRATORY PROTECTIVE DEVICES

Respirators should comply with the AS/NZS 1716 *Respiratory Protective Devices* and selected, used and stored in accordance with AS/NZS 1715 *Selection, Use and Maintenance of Respiratory Protective Devices*. Always refer to the manufacturer's or supplier's information regarding the suitability of respirators.

Facial fit is a prime factor in obtaining good protection when utilising half or full-facepiece respirators. Workers must be clean-shaven when wearing respirators that rely on facial fit. Facial fit tests should be conducted to ensure an effective seal.

Employers must provide their employees with appropriate instruction and training on the proper wear and care of the respirators. To ensure that adequate protection is achieved at all times, a full respiratory protection program is essential – it should include training, cleaning and storage requirements, and proper facial fit procedures. *See AS/NZS1715 Selection, Use and Maintenance of Respiratory Protective Devices.*

### BONDED ASBESTOS REMOVAL – LOW RISK

When inspecting areas for the removal of bonded asbestos or where friable asbestos removal work is not in progress, use a half-face piece disposable or cartridge-type particulate respirator (Class P1 or P2 filter).

### FRIABLE ASBESTOS REMOVAL – HIGH RISK

Friable asbestos can generate very high levels of respirable fibre, which may give rise to serious health effects if inhaled. Absolute respiratory protection must be provided - dust masks/respirators (Class P1 or P2 filter) are not suitable. See the ASCC *Code of Practice for the Safe Removal of Asbestos [NOHSC:2002 (2005).*

# RESPIRATORS

The following list of respirators runs from least efficient (figure 1) to most efficient (figure 7).

Figure 1

Figure 2

Figure 3

Figure 4

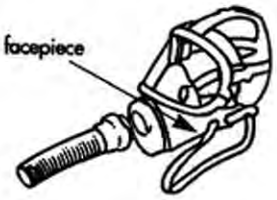



Figure 5a

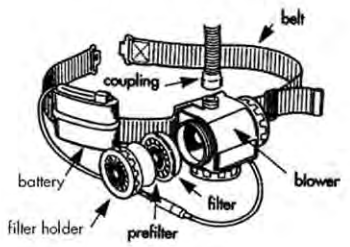



Figure 5b

| FIGURE | RESPIRATOR |
|---|---|
| 1 | Disposable, half-face particulate respirators |
| 2 | Half-face, particulate filter (cartridge) respirator |
| 3 | Powered, air-purifying, ventilated helmet respirator |
| 4 | Full-face, particulate, filter (cartridge) respirator |
| 5a | Full-face, powered air-purifying particulate respirator – face piece |
| 5b | Full-face, powered air-purifying particulate respirator – power pack |
| 6 | Full-face, positive pressure demand air-line respirator |
| 7 | Full suit or hood, continuous flow air-line respirator |

Figure 6

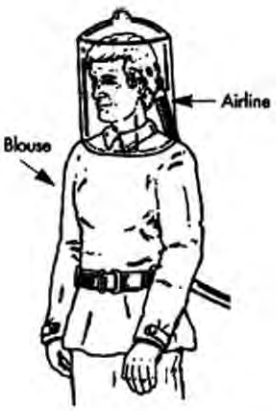



Figure 7

**Source** *Code of Practice for the Safe Removal of Asbestos [NOHSC 2002 (2005)]*

# SAFE DISPOSAL

## COLLECTION AND STORAGE

All bonded asbestos waste must be:

- kept damp (prevent runoff water)
- collected, labelled and sealed using appropriate plastic or leak proof containers
- stored in labelled, plastic-lined bins that are covered, or leak-proof containers that are covered
- placed in bins or trucks that are large enough to contain full sheets without breaking them
- stored in a secure area
- removed from the site as soon as practicable.

All friable asbestos material must be:

- kept damp or sealed with PVA glue
- collected and sealed in 200-micron thick, appropriately labelled, plastic bags
- double wrapped in 200-micron thick plastic bags
- in bags that weigh not more than 25 kilograms, and are less than half full
- stored in a secure area, awaiting removal
- removed from the site as soon as practicable.

The DECC allows transport of asbestos contaminated soil in unlined bulk trucks, provided the soil is kept damp, the load is securely locked and covered with plastic and a fully protective tarp, and the truck is decontaminated before it leaves the waste facility.

## TRANSPORTATION

All asbestos waste must be transported in a covered leak-proof vehicle and:

- not mixed with general building waste
- not taken to a waste facility for recycling.

Only vehicles licensed by the DECC can transport friable asbestos waste in the metropolitan area.

## DISPOSAL

Asbestos waste in any form must be disposed of in a manner approved by DECC and at a waste facility licensed by the DECC to accept asbestos waste.

NSW licensed landfills that accept asbestos waste from the public are listed by region on the DECC website.

Vehicles and their containers must be cleaned before leaving the waste facility.

Contact the DECC and/or the local council for details of waste facilities that can accept asbestos waste.

To demonstrate proof of proper disposal, copies of asbestos waste disposal receipts are to be kept for inspection by WorkCover, the DECC or the local council.

## ASBESTOS WASTE DISPOSAL PROCEDURES

WRAPPING SHEETS

LINING BINS IN 200micron PLASTIC

WRAPPED ASBESTOS WASTE

# OHS LEGISLATION

The *Occupational Health and Safety Act 2000* (OHS Act) states that 'an employer must ensure the health and safety at work of all his employees'.

The *Occupational Health and Safety Regulation 2001* (OHS Regulation) outlines the following requirements for asbestos:

- for the controller of premises, in relation to a risk assessment of asbestos-containing products, the asbestos register and exposure standards – Chapter 4
- for employers, in relation to hazardous substances; all forms of asbestos are a prohibited carcinogenic substance; the use of asbestos in the form of chrysotile, crocidolite, amosite, fibrous anthophyllite, tremolite or actinolite are prohibited except for the purpose of sampling or analysis, maintenance, removal, disposal, encapsulation or enclosure – Chapter 6
- specific conditions for asbestos work on construction sites and prohibition on the reuse of asbestos products or water blasting asbestos products – Chapter 8
- the requirements for licensing bonded and friable asbestos removalists; from the 1 January 2008, a licence is required to remove more than 10 square metres of bonded asbestos material – Chapter 10
- permits for friable asbestos removal work – Chapter 11
- notification of bonded asbestos removal work; exemption requirements for naturally occurring asbestos – chapter 12.

**The OHS Regulation does not allow the use, reuse or sale of any asbestos product.**

# FURTHER INFORMATION

The following **WorkCover publications** are available at www.workcover.nsw.gov.au

- *The Guidelines and Procedures for Asbestos and Electrical Work*
    - Guidelines for working on electrical meter panels that contain asbestos
    - Assessment of commercial and residential metering/electrical panel installations for potential asbestos containing materials – industry model procedure No.1
    - Minor works on asbestos-based electrical mounting boards for domestic and commercial metering/electrical installations – industry model procedure No.2
- *Compliance and Enforcement Strategy for Chrysotile*
    - NSW, in conjunction with other Australian states, banned all uses of chrysotile asbestos (except for bona fide research or analysis, when handled for storage awaiting disposal, for removal or disposal, or when encountered during non-asbestos mining) from 31 December 2003.
- *Guidelines for Licensed Asbestos Removal Contractors*
    - Outlines WorkCover's requirements for the licensing of asbestos removalists. Intended to ensure compliance with legal obligations for asbestos removal work in NSW and are based on the ASCC asbestos publication.
- *Choosing an Asbestos Consultant*
    - A fact sheet outlining selection criteria for choosing an asbestos consultant.
- *Bonded Asbestos*
    - A fact sheet
- *Guidance Note: Working with Asbestos in the Motor Vehicle Repair Industry*
    - Provides guidance for employers and employees in the automotive repair industry to eliminate or minimise the risk of exposure to asbestos during repairs to brakes, clutches and high-temperature gaskets in motor vehicles.

The **Australian Safety and Compensation Council (ASCC)** was previously known as the National Occupational Health and Safety Commission (NOHSC). Visit www.ascc.gov.au

The ASCC publishes the following guidance material:

- *Code of Practice for the Safe Removal of Asbestos [NOHSC: 2002(2005)]*
- *Code of Practice for the Management and Control of Asbestos in the Workplace [NOHSC: 2018 (2005)]*
- *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Dust [NOHSC: 3003 (2005)]*

Additional guidance on the inspection of asbestos friction material is available in the ASCC *Code of Practice for the Management and Control of Asbestos in Workplaces*, in particular *Appendix I (Inspection of Asbestos Friction Materials)* – this guidance may be used when friction materials containing asbestos (eg brake assemblies or clutch housings) need to be inspected or their housings need to be cleaned.

**Australian Standards** are available from Standards Australia (charges apply). Visit www.standards.org.au Phone 131 242; Fax 1300 65 49 49; Email sales@sai-global.com Web shop http://www.saiglobal.com/shop

- *AS/NZS 1715 Selection, Use and Maintenance of Respiratory Protective Devices*
    - Sets out the principles of respiratory protection and provides information on the correct selection, use and maintenance of respirators.
- *AS/NZS 1716 Respiratory Protective Devices*
    - Specifies requirements, performance and testing criteria to be observed in the manufacture of respirators.
- *AS/NZS 60335.2.69: 2003/Amdt 1:2005 Household and Similar Electrical Appliances – Safety Part 2 – 69 Particular Requirements for Wet and Dry Vacuum Cleaners, including Power Brush, for Industrial and Commercial Use*
    - Sets out testing requirement for industrial vacuum cleaners to ensure that those used in industry for collection of particulates hazardous to health do not permit particulates to be recirculated to the immediate atmosphere.
- *AS4964 Method for the Qualitative Identification of Asbestos in Bulk Samples*
    - Sets out the procedure for preparation and analysis of asbestos in bulk samples. This is a qualitative analysis using polarised light microscopy as the primary technique for identification.

**Department of Environment and Climate Change (DECC)**. Visit www.environment.nsw.gov.au
The DECC publishes *Safely Disposing of Asbestos Waste from Your Home* – disposal of asbestos waste.

NSW Government. Visit www.nsw.gov.au See *Fibro and asbestos – A Renovator and Home Owner's Guide* – provides guidance on safe disposal of fibro and some general tips about what to do if fibro is damaged and a safety checklist.

# USEFUL CONTACTS

**Licensed Asbestos Removalists**

| | |
|---|---|
| WorkCover NSW – Asbestos/Demolition Hotline | (02) 8260 5885 |
| | www.workcover.nsw.gov.au |

**OHS Legislative Requirements**

| | |
|---|---|
| Local WorkCover Office | www.workcover.nsw.gov.au |
| WorkCover Information Centre | 13 10 50 |

**Asbestos Removal Training Courses**

| | |
|---|---|
| TAFE NSW | 1300 131 499 |
| Comet Training Pty Ltd | (02) 9649 5000 |
| Master Builders Association (A.R.C.A.) | (02) 8586 3521 |
| Housing Industry Association (H.I.A.) | (02) 9978 3333 |

**Approved Asbestos Disposal Tips**

| | |
|---|---|
| Department of Environment and Climate Change | (02) 9995 5000 |
| | www.environment.nsw.gov.au |
| Environment line | 13 15 55 |
| NSW Environment Solutions | 1300 6551 116 |
| Relevant Local Council | www.dlg.nsw.gov.au |

**Industry Associations and Unions**

| | |
|---|---|
| Asbestos Removal Contractors Association (ARCA) | Phone: (02) 9642 0011 |
| | Fax (02) 9642 0111 |
| Civil Contractors Federation (CCF) | Phone: (02) 9009 4000 |
| | Fax: (02) 9009 4050 |
| | www.civilcontractors.com |
| Construction, Forestry, Mining, Energy Union (CFMEU) | Phone: (02) 8524 5850 |
| | Fax: (02) 8524 5851 |
| | www.cfmeu.net.au |
| Demolition Contractors Association (NSW) (DCA) | Phone: (02) 9009 4007 |
| | Fax: (02) 9677 2595 |
| Master Builders Association (MBA) | Phone: (02) 8583 555 |
| | Fax: (02) 9660 3700 |
| | www.mbansw.asn.au |

Catalogue No. **WC05484** WorkCover Publications Hotline **1300 799 003**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Locked Bag 2906 Lisarow NSW 2252 WorkCover Assistance Service **13 10 50**
Website **www.workcover.nsw.gov.au**

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**Appendix B**

**Tabulated Results of Previous Assessments**

Douglas Partners
Geotechnics - Environment - Groundwater

**Table 13 - Results of Soil Analysis (All results in mg/kg unless otherwise stated)**

| | | Heavy Metals | | | | | | | | PAH | | TPH[5] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Fill/Natural | As | Cd | Cr[1] | Cu | Pb | Hg | Ni | Zn | B(a)P | total[2] | C6-C9 | C10-C14 | C15-C28 | C29-C36 | Benzene[5] | Toluene[5] | Ethylbenzene[5] | Total Xylene[5] | PCB[2] | OCP[2] | Phenols | Asbestos |
| TP1/0.1-0.4 | F | 6 | <0.5 | 20 | 6 | 31 | <0.1 | 3 | 17 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | None found |
| A7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile asbestos detected** |
| TP1/0.5-0.8 | F | 8 | 0.6 | 23 | 5 | 30 | <0.1 | 3 | 33 | 0.1 | 2.8 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | - |
| TP2/0-0.2 | F | 9 | 0.7 | 26 | 15 | 72 | <0.1 | 5 | 38 | <0.05 | 0 | <25 | <50 | 100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | None found |
| A6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile asbestos detected** |
| TP3/0-0.2 | F | 10 | 0.8 | 31 | 26 | 220 | <0.1 | 5 | 110 | 0.5 | 5.2 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| TP3/2.5-2.7 | N | 5 | <0.5 | 19 | 15 | 21 | <0.1 | 5 | 23 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | - |
| TP4/0-0.2 | F | 7 | 0.5 | 19 | 21 | 61 | <0.1 | 7 | 72 | 0.6 | 6.6 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | - |
| TP4/0.5-0.7 | F | 4 | <0.5 | 19 | 8 | 23 | <0.1 | 6 | 16 | 0.3 | 2.9 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | None found |
| TP5/0.1-0.3 | F | 5 | <0.5 | 13 | 7 | 24 | <0.1 | 6 | 13 | 0.2 | 3 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| BD1 160908 | F | 10 | 0.6 | 34 | 15 | 44 | <0.1 | 3 | 39 | 0.2 | 2.7 | - | - | - | - | - | - | - | - | | - | - | - |
| TP5/1-1.2 | N | 9 | 0.5 | 32 | 4 | 17 | <0.1 | 4 | 3 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| A1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile asbestos detected** |
| BH6/0.5 | F | 9 | 0.6 | 23 | 11 | 49 | <0.1 | 4 | 41 | 0.2 | 2 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| TP7/0.1-0.4 | F | 6 | 0.6 | 17 | 60 | 62 | <0.1 | 9 | 59 | 1.7 | 20.6 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | 0.2 | <5 | None found |
| BD2 170908 | F | 7 | 0.6 | 20 | 32 | 59 | 0.2 | 12 | 74 | 0.9 | 11.2 | - | - | - | - | - | - | - | - | | - | - | - |
| A4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile and Crocidolite asbestos detected** |
| TP7/1.2-1.5 | N | 13 | 1 | 51 | 3 | 28 | <0.1 | 4 | 7 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | - |
| TP8/0.05-0.15 | F | 8 | 0.5 | 22 | 7 | 31 | 0.1 | 2 | 22 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| A5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile asbestos detected** |
| BH9/0.5 | F | 8 | 0.6 | 30 | 7 | 32 | <0.1 | 8 | 25 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| TP10/0.1-0.4 | F | 7 | <0.5 | 30 | 3 | 28 | <0.1 | 2 | 9 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | None found |
| TP11/0.1-0.4 | F | 9 | 0.7 | 27 | 7 | 39 | <0.1 | 4 | 27 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | None found |
| TP11/0.4-0.6 | N | 10 | <0.5 | 35 | 2 | 17 | <0.1 | 3 | 3 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | - |
| TP12/0.1-0.4 | F | 8 | 0.6 | 23 | 9 | 48 | <0.1 | 3 | 48 | 0.06 | 0.26 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | - |
| A2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile asbestos detected** |
| TP13/0.1-0.4 | F | 9 | 0.7 | 26 | 59 | 100 | <0.1 | 5 | 150 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| A8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile and Crocidolite asbestos detected** |
| TP14/0.5-0.8 | F | 10 | 0.6 | 25 | 1 | 22 | <0.1 | 2 | 1 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | None found |
| TP15/0.1-0.4 | F | 13 | 0.8 | 30 | 30 | 78 | <0.1 | 7 | 79 | 0.2 | 2.4 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | None found |
| TP16/0.1-0.4 | F | 9 | 0.7 | 34 | 4 | 25 | <0.1 | 3 | 10 | 0.4 | 5.9 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | - | None found |
| A3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | **chrysotile asbestos detected** |
| TP17/0.1-0.3 | F | 8 | <0.5 | 21 | 4 | 40 | <0.1 | 3 | 17 | <0.05 | 0 | <25 | <50 | <100 | <100 | <0.5 | <0.5 | <1 | <3 | <0.1 | <0.1 | <5 | - |
| **Site Assessment Criteria (SAC)** | | | | | | | | | | | | | | | | | | | | | | | |
| HIL[3] | | 400 | 80 | 48% | 4000 | 1200 | 60 | 2400 | 28000 | 4 | 80 | 65 | 1000 | | | 1 | 1.4 | 3.1 | 14 | 50 | 40/200/800/40[4] | 34000 | nil[6] |
| HIL[8] | | 200 | 40 | 24% | 2000 | 600 | 30 | 600 | 1400 | 2 | 40 | 65 | 1000 | | | 1 | 1.4 | 3.1 | 14 | 50 | 20/100/400/20[4] | 17000 | |
| PPIL[7] | | 20 | 3 | 400 | 100 | 600 | 1 | 60 | 200 | - | - | - | - | - | - | - | - | - | - | - | - | 70 | - |
| PQL | | 4/1 | 1/0.1 | 1/1 | 1/2 | 1/2 | 0.1/0.05 | 1/1 | 1/5 | 0.05/0.5 | 0.5/0.5 | 25/10 | 250/250 | | | 0.5/0.2 | 0.5/0.5 | 1/0.5 | 3/1.5 | 0.1/0.5 | 0.1/0.05 | 0.1/10 | - |

*Notes:*

1 All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment
2 where analytical results below laboratory practical quantitation limit (PQL) for all compounds, results quoted as <PQL of most compounds
3 Health based investigation levels for residential sites with minimal acces
4 OCP thresholds given in order Aldrin+Dieldrin/Chlordane/ DDD+DDE+DDT/Heptachlor
5 Service Station Guidelines
6 No asbestos present in soils at the surface (Correspondence from NSW EPA Director of Contaminated Sites to accredited site auditors
7 Provisional Phytocicity based Investigation Levels
8 Health based investigation levels for Parks and open space
- not analysed/ not applicable
***Bold*** exceed
Shading exceeds PPIL
BD1 160908 Field duplicate of sample TP5/0.1-0.3
BD1 170908 Field duplicate of sample TP7/0.1-0.4
A# samples collected from Test Pit above

Douglas Partners
Geotechnics - Environment - Groundwater

## Table 14 - Results of Water Analysis (All results in µg/L unless otherwise stated)

| Sample ID | Heavy Metals | | | | | | | | PAH[2] | TPH | | BTEX | | | | OCP[2] | PCB[2] | VOC[2] | pH | Hardness (mg CaCO3/L) | EC (µS/cm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | As | Cd | Cr[1] | Cu | Pb | Hg | Ni | Zn | | C6-C9 | C10-C36 | Benzene | Toulene | Ethyl-benzene | Xylene | | | | | | |
| BH6-GW | <1 | 1 | 1.3 | 3.8 | 3 | <0.5 | **110** | **180** | <1 | <10 | <250 | <1 | <1 | <1 | <3 | <0.2 | <2 | <10/<1 | 5.5 | 1900 | 16000 |
| BD1 180908 | <1 | 1 | 7.2 | 3.2 | 3.1 | <0.5 | **110** | **190** | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| GIL[6] | | | | | | | | | | | | | | | | | | | | | |
| GIL | 13.0 | 0.2 | 1.0 | 1.4 | 3.4 | 0.06 | 11.0 | 8.0 | 16[5] | - | - | 950 | 180 | 80 | 550 | 0.08/ 0.01/ 0.2/ 0.02/ 0.09[7] | - | - | - | - | - |
| HMTV[4] | - | 2.0 | 8.4 | 12.6 | 90.8 | - | 99.0 | 72.0 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Reference Values[8] | | | | | | | | | | | | | | | | | | | | | |
| | - | - | - | - | - | - | - | - | - | 150 | 600 | - | - | - | - | - | - | - | - | - | - |

*Notes:*

1 All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment

2 where analytical results below laboratory practical quantitation limit (PQL) for all compounds, results quoted as <PQL of most compounds

3 Replicate of sample directly above it

4 metal thresholds adjusted for hardness values of 400

5 PAH threshold given for napthalene

6 GIL: Groundwater Investigation Level. Trigger Values for the Protection of 95% of fresh water species, ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

7 OCP thresholds given in order: chlordane/ DDT/ endosulfan/ endrin/ heptachlor

8 Airport (Environment Protection) Regulations (1997), Schedule 2 Water Pollution Accepted Limits: Table 1.03 – Accepted limits of contamination.

\- not defined/ not analysed/ not applicable

**Bold** exceeds GIL

Table 15 - Results for Acid Sulphate Soils Assessment

| Sample ID | $pH_{kcl}$ | $pH_{Ox}$ | TAA pH 6.5 | TPA pH 6.5 | TSA pH 6.5 | $S_{KCl}$ | $S_P$ | $S_{POS}$ | Chromium reducible sulphur |
|---|---|---|---|---|---|---|---|---|---|
| | pH units | pH units | moles $H^+$/ tonne | moles $H^+$/ tonne | moles $H^+$/ tonne | %w/w | %w/w | %w/w | %w/w |
| BH6/0.5 | 4.4 | 3.9 | 62 | **125** | 62 | 0.006 | 0.042 | 0.036 | 0.011 |
| BH6/1.5 | 3.8 | 3.8 | 87 | **110** | 22 | 0.045 | 0.061 | 0.016 | <0.005 |
| BH9/1.0 | 4.3 | 3.9 | **80** | **115** | 35 | 0.032 | 0.045 | 0.012 | <0.005 |
| Threshold Criteria for fine textured soils | | | | | | | | | |
| 1-1000 Tonnes | | | 62 | 62 | 62 | 0.1 | 0.1 | 0.1 | 0.1 |
| >1000 Tonnes | - | - | 18 | 18 | 18 | 0.03 | 0.03 | 0.03 | 0.03 |

shading Exceeds >1000 Action Criteria

**bold** exceeds 1-1000 Tonne Action Criteria

**41131 - Riverwood North Renewal**
**Riverwood Residential Renewal Project**
**Table A: Testpitting Works Spreadsheet**

Density: Loamy Sand (1.62), Sandy Clay (1.63)

Mass of Spoil = (Volume * Density)*1000

% asbestos = [(Mass ACM x % absestos in ACM)] / Mass of Spoil] *100

| Test pit | Test pit | | | | | | | | Assumes % asbestos in ACM 15% | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | date excavated | TP Depth (m) | Fill Depth (m) | Width (m) | Length (m) | Volume ($m^3$) | Density (tonnes/$m^3$) | Mass of Spoil (kg) | Sampler | Soil # ID | Frags | Weight (g) | Total ACM weight (kg) | % asbestos | Fibres exceeding detection limit of 0.1 g/kg | Laboratory Reference | Anthropogenic Material |
| 1 | 23/11/2010 | 1.35 | 0.85 | 0.45 | 1.00 | 0.38 | 1.63 | 623.48 | T. Davis | TP1-0.3-0.4 | Yes | 125 | 0.125 | 0.003 | No [1] | | Yes |
| 2 | 23/11/2010 | 1.20 | 0.90 | 0.45 | 1.10 | 0.45 | 1.63 | 726.17 | T. Davis | TP2-0.3-0.4 | Yes | 181 | 0.181 | 0.004 | No | | Yes |
| 3 | 23/11/2010 | 1.45 | 1.05 | 0.45 | 1.15 | 0.54 | 1.63 | 885.70 | T. Davis | TP3-0.2-0.3 | Yes | 64 | 0.064 | 0.001 | No | | Yes |
| 4 | 23/11/2010 | 1.50 | 1.20 | 0.45 | 1.30 | 0.70 | 1.63 | 1144.26 | T. Davis | TP4-0.3-0.4 | Yes | 3500 | 3.5 | **0.046** | No | | Yes |
| 5 | 23/11/2010 | 0.90 | 0.55 | 0.45 | 1.50 | 0.37 | 1.63 | 605.14 | T. Davis | TP5-0.2-0.3 | Yes | 99 | 0.099 | 0.002 | No | | Yes |
| 6 | 23/11/2010 | 0.90 | 0.50 | 0.45 | 1.20 | 0.27 | 1.63 | 440.10 | T. Davis | TP6-0.2-0.3 | Yes | 594 | 0.594 | **0.020** | No | | Yes |
| 7 | 23/11/2010 | 0.80 | 0.50 | 0.45 | 1.30 | 0.29 | 1.63 | 476.78 | T. Davis | TP7-0.1-0.2 | Yes | 16 | 0.016 | 0.001 | No | | Yes |
| 8 | 23/11/2010 | 0.80 | 0.40 | 0.45 | 1.20 | 0.22 | 1.63 | 352.08 | T. Davis | TP8-0.3-0.4 | Yes | 41 | 0.041 | 0.002 | No | | Yes |
| 9 | 23/11/2010 | 0.70 | 0.40 | 0.45 | 1.15 | 0.21 | 1.63 | 337.41 | T. Davis | TP9-0.1-0.2 | - | 0 | 0 | 0.000 | No | | - |
| 10 | 23/11/2010 | 0.80 | 0.45 | 0.45 | 1.60 | 0.32 | 1.63 | 528.12 | T. Davis | TP10-0.3-0.4 | Yes | 5 | 0.005 | 0.000 | No | | Yes |
| 11 | 23/11/2010 | 0.90 | 0.50 | 0.45 | 1.30 | 0.29 | 1.63 | 476.78 | T. Davis | TP11-0.1-0.2 | Yes | 4 | 0.004 | 0.000 | No | | Yes |
| 12 | 23/11/2010 | 0.70 | 0.40 | 0.45 | 1.30 | 0.23 | 1.63 | 381.42 | T. Davis | TP12-0.1-0.2 | - | 0 | 0 | 0.000 | No | | - |
| 13 | 23/11/2010 | 1.50 | 1.20 | 0.45 | 1.30 | 0.70 | 1.63 | 1144.26 | T. Davis | TP13-0.2-0.3 | Yes | 701 | 0.701 | 0.009 | No | | Yes |
| 14 | 23/11/2010 | 1.20 | 0.90 | 0.45 | 1.20 | 0.49 | 1.63 | 792.18 | T. Davis | TP14-0.1-0.2 | Yes | 381 | 0.381 | 0.007 | No | | Yes |
| 15 | 23/11/2010 | 1.30 | 0.90 | 0.45 | 1.20 | 0.49 | 1.63 | 792.18 | T. Davis | TP15-0.3-0.4 | Yes | 459 | 0.459 | 0.009 | No | | Yes |
| 16 | 23/11/2010 | 1.00 | 0.70 | 0.45 | 1.20 | 0.38 | 1.63 | 616.14 | T. Davis | TP16-0.1-0.2 | Yes | 21 | 0.021 | 0.001 | No | | Yes |
| 17 | 23/11/2010 | 1.50 | 1.00 | 0.45 | 1.30 | 0.59 | 1.63 | 953.55 | T. Davis | TP17-0.1-0.2 | Yes | 991.09 | 0.99 | **0.016** | No [1] | | Yes |
| 18 | 23/11/2010 | 1.10 | 0.70 | 0.45 | 1.10 | 0.35 | 1.63 | 564.80 | T. Davis | TP18-0.1-0.2 | Yes | 12 | 0.012 | 0.000 | No | 48761 | Yes |
| 19 | 24/11/2010 | 1.00 | 0.60 | 0.45 | 1.20 | 0.32 | 1.63 | 528.12 | T. Davis | TP19-0.1-0.2 | Yes | 87 | 0.087 | 0.002 | No | | Yes |
| 20 | 24/11/2010 | 1.20 | 0.80 | 0.45 | 1.30 | 0.47 | 1.63 | 762.84 | T. Davis | TP20-0.1-0.2 | Yes | 48 | 0.048 | 0.001 | No | | Yes |
| 21 | 24/11/2010 | 1.10 | 0.70 | 0.45 | 1.30 | 0.41 | 1.63 | 667.49 | T. Davis | TP21-01-0.2 | Yes | 58 | 0.058 | 0.001 | No | | Yes |
| 22 | 24/11/2010 | 1.60 | 1.25 | 0.45 | 1.30 | 0.73 | 1.63 | 1191.94 | T. Davis | TP22-0.1-0.2 | Yes | 27 | 0.027 | 0.000 | No | | Yes |
| 23 | 24/11/2010 | 1.00 | 0.60 | 0.45 | 1.50 | 0.41 | 1.63 | 660.15 | T. Davis | TP23-0.1-0.2 | Yes | 6 | 0.006 | 0.000 | No | | Yes |
| 24 | 24/11/2010 | 0.90 | 0.50 | 0.45 | 1.20 | 0.27 | 1.63 | 440.10 | T. Davis | TP24-0.1-0.2 | Yes | 52 | 0.052 | 0.002 | No [1] | | Yes |
| 25 | 24/11/2010 | 0.90 | 0.50 | 0.45 | 1.20 | 0.27 | 1.63 | 440.10 | T. Davis | TP25-0.1-0.2 | Yes | 99 | 0.099 | 0.003 | No | | Yes |
| 26 | 24/11/2010 | 1.10 | 0.70 | 0.45 | 1.20 | 0.38 | 1.63 | 616.14 | T. Davis | TP26-0.1-0.2 | Yes | 116 | 0.116 | 0.003 | No | | Yes |
| 27 | 24/11/2010 | 1.10 | 0.70 | 0.45 | 1.20 | 0.38 | 1.63 | 616.14 | T. Davis | TP27-0.1-0.2 | Yes | 1164 | 1.164 | **0.028** | No | | Yes |
| 28 | 24/11/2010 | 0.80 | 0.40 | 0.45 | 1.20 | 0.22 | 1.63 | 352.08 | T. Davis | TP28-0.1-0.2 | Yes | 74 | 0.074 | 0.003 | No | | Yes |
| 29 | 24/11/2010 | 1.20 | 0.80 | 0.45 | 1.20 | 0.43 | 1.63 | 704.16 | T. Davis | TP29-0.1-0.2 | Yes | 1055 | 1.055 | **0.022** | No | | Yes |
| 30 | 24/11/2010 | 1.00 | 0.60 | 0.45 | 1.20 | 0.32 | 1.63 | 528.12 | T. Davis | TP30-0.1-0.2 | Yes | 288 | 0.288 | 0.008 | No | | Yes |
| 31 | 24/11/2010 | 1.00 | 0.60 | 0.45 | 1.20 | 0.32 | 1.63 | 528.12 | T. Davis | TP31-0.1-0.2 | Yes | 13 | 0.013 | 0.000 | No | | Yes |
| 32 | 24/11/2010 | 0.90 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP32-0.1-0.2 | Yes | 23 | 0.023 | 0.001 | No | | Yes |
| 33 | 24/11/2010 | 0.90 | 0.60 | 0.45 | 1.20 | 0.32 | 1.63 | 528.12 | T. Davis | TP33-0.1-0.2 | - | 0 | 0 | 0.000 | No | | - |
| 34 | 24/11/2010 | 1.40 | 1.10 | 0.45 | 1.10 | 0.54 | 1.63 | 887.54 | T. Davis | TP34-0.1-0.2 | Yes | 727 | 0.727 | **0.012** | No | | Yes |
| 35 | 24/11/2010 | 1.40 | 1.10 | 0.45 | 1.20 | 0.59 | 1.63 | 968.22 | T. Davis | TP35-0.2-0.3 | Yes | 1012 | 1.012 | **0.016** | No | | Yes |
| 36 | 24/11/2010 | 1.50 | 1.10 | 0.45 | 1.20 | 0.59 | 1.63 | 968.22 | T. Davis | TP36-0.1-0.2 | Yes | 249 | 0.249 | 0.004 | No | | Yes |
| 37 | 25/11/2010 | 1.10 | 0.80 | 0.45 | 1.10 | 0.40 | 1.63 | 645.48 | T. Davis | TP37-0.1-0.2 | Yes | 24 | 0.024 | 0.001 | No | | Yes |
| 38 | 25/11/2010 | 1.50 | 1.00 | 0.45 | 1.30 | 0.59 | 1.63 | 953.55 | T. Davis | TP38-0.1-0.2 | Yes | 279 | 0.279 | 0.004 | No | | Yes |
| 39 | 25/11/2010 | 1.00 | 0.55 | 0.45 | 1.70 | 0.42 | 1.63 | 685.82 | T. Davis | TP39-0.1-0.2 | Yes | 2328 | 2.328 | **0.051** | No | | Yes |
| 40 | 25/11/2010 | 1.10 | 0.70 | 0.45 | 1.40 | 0.44 | 1.63 | 718.83 | T. Davis | TP40-0.1-0.2 | Yes | 2796 | 2.796 | **0.058** | No | | Yes |
| 41 | 25/11/2010 | 1.20 | 0.80 | 0.45 | 1.30 | 0.47 | 1.63 | 762.84 | T. Davis | TP41-0.1-0.2 | Yes | 7568 | 7.568 | **0.149** | No | | Yes |
| 42 | 25/11/2010 | 1.20 | 0.85 | 0.45 | 1.20 | 0.46 | 1.63 | 748.17 | T. Davis | TP42-0.1-0.2 | Yes | 195 | 0.195 | 0.004 | No [2] | | Yes |
| 43 | 25/11/2010 | 1.20 | 0.80 | 0.45 | 1.20 | 0.43 | 1.63 | 704.16 | T. Davis | TP43-0.1-0.2 | Yes | 125 | 0.125 | 0.003 | No | | Yes |
| 44 | 25/11/2010 | 0.90 | 0.50 | 0.45 | 1.30 | 0.29 | 1.63 | 476.78 | T. Davis | TP44-0.1-0.2 | Yes | 410 | 0.41 | **0.013** | No | | Yes |
| 45 | 25/11/2010 | 1.20 | 0.65 | 0.45 | 1.20 | 0.35 | 1.63 | 572.13 | T. Davis | TP45-0.1-0.2 | Yes | 29 | 0.029 | 0.001 | No | | Yes |
| 46 | 25/11/2010 | 0.90 | 0.55 | 0.45 | 1.20 | 0.30 | 1.63 | 484.11 | T. Davis | TP46-0.1-0.2 | Yes | 152 | 0.152 | 0.005 | No | | Yes |
| 47 | 25/11/2010 | 1.10 | 0.70 | 0.45 | 1.20 | 0.38 | 1.63 | 616.14 | T. Davis | TP47-0.1-0.2 | Yes | 99 | 0.099 | 0.002 | No | | Yes |
| 48 | 25/11/2010 | 1.10 | 0.75 | 0.45 | 1.20 | 0.41 | 1.63 | 660.15 | T. Davis | TP48-0.1-0.2 | Yes | 27 | 0.027 | 0.001 | No | | Yes |
| 49 | 25/11/2010 | 1.10 | 0.75 | 0.45 | 1.20 | 0.41 | 1.63 | 660.15 | T. Davis | TP49-0.1-0.2 | Yes | 66 | 0.066 | 0.001 | No | | Yes |
| 50 | 25/11/2010 | 1.00 | 0.70 | 0.45 | 1.10 | 0.35 | 1.63 | 564.80 | T. Davis | TP50-0.1-0.2 | - | 0 | 0 | 0.000 | No | | - |
| 51 | 25/11/2010 | 1.10 | 0.75 | 0.45 | 1.10 | 0.37 | 1.63 | 605.14 | T. Davis | TP51-0.1-0.2 | Yes | 11 | 0.011 | 0.000 | No | | Yes |
| 52 | 25/11/2010 | 1.10 | 0.70 | 0.45 | 1.20 | 0.38 | 1.63 | 616.14 | T. Davis | TP52-0.1-0.2 | - | 0 | 0 | 0.000 | No | | Yes |
| 53 | 25/11/2010 | 1.00 | 0.55 | 0.45 | 1.10 | 0.27 | 1.63 | 443.77 | T. Davis | TP53-0.1-0.2 | Yes | 0 | 0 | 0.000 | No | | Yes |
| 54 | 25/11/2010 | 1.00 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP54-0.1-0.2 | Yes | 60 | 0.06 | 0.002 | No | | Yes |
| 55 | 25/11/2010 | 1.10 | 0.70 | 0.45 | 1.00 | 0.32 | 1.63 | 513.45 | T. Davis | TP55-0.1-0.2 | Yes | 44 | 0.044 | 0.001 | No | | Yes |
| 56 | 25/11/2010 | 1.10 | 0.70 | 0.45 | 1.10 | 0.35 | 1.63 | 564.80 | T. Davis | TP56-0.1-0.2 | Yes | 12 | 0.012 | 0.000 | No | | Yes |
| 57 | 26/11/2010 | 0.80 | 0.40 | 0.45 | 1.10 | 0.20 | 1.63 | 322.74 | T. Davis | TP57-0.1-0.2 | Yes | 9 | 0.009 | 0.000 | No | | Yes |
| 58 | 25/11/2010 | 1.20 | 0.90 | 0.45 | 1.10 | 0.45 | 1.63 | 726.17 | T. Davis | TP58-0.1-0.2 | Yes | 976 | 0.976 | **0.020** | No | | Yes |
| 59 | 26/11/2010 | 1.00 | 0.60 | 0.45 | 1.20 | 0.32 | 1.63 | 528.12 | T. Davis | TP59-0.1-0.2 | Yes | 281 | 0.281 | 0.008 | No | | Yes |
| 60 | 26/11/2010 | 0.90 | 0.60 | 0.45 | 1.10 | 0.30 | 1.63 | 484.11 | T. Davis | TP60-0.1-0.2 | Yes | 0 | 0 | 0.000 | No | | - |
| 61 | 26/11/2010 | 0.90 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP61-0.1-0.2 | Yes | 115 | 0.115 | 0.004 | No | | Yes |
| 62 | 26/11/2010 | 0.90 | 0.55 | 0.45 | 1.20 | 0.30 | 1.63 | 484.11 | T. Davis | TP62-0.1-0.2 | Yes | 60 | 0.06 | 0.002 | No | 48995 | Yes |
| 63 | 26/11/2010 | 1.00 | 0.60 | 0.45 | 1.20 | 0.32 | 1.63 | 528.12 | T. Davis | TP63-0.1-0.2 | Yes | 63 | 0.063 | 0.002 | No | | Yes |
| 64 | 26/11/2010 | 1.00 | 0.40 | 0.45 | 1.10 | 0.20 | 1.63 | 322.74 | T. Davis | TP64-0.1-0.2 | Yes | 0 | 0 | 0.000 | No | | - |
| 65 | 26/11/2010 | 1.10 | 0.65 | 0.45 | 1.10 | 0.32 | 1.63 | 524.45 | T. Davis | TP65-0.1-0.2 | Yes | 147 | 0.147 | 0.004 | No | | Yes |

**41131 - Riverwood North Renewal**
**Riverwood Residential Renewal Project**
**Table A: Testpitting Works Spreadsheet**

Density Loamy Sand (1.62)
Sandy Clay (1.63)

Mass of Spoil = (Volume * Density)*1000

% asbestos = [(Mass ACM x % absestos in ACM)] / Mass of Spoil] *100

| | Test pit | | | | | | | | Assumes % asbestos in ACM 15% | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test pit** | | **TP Depth** | **Fill Depth** | | **Length** | **Volume** | **Density** | | | | | | **Total ACM** | | **Fibres exceeding detection limit of** | **Laboratory** | **Anthropogenic** |
| 66 | 26/11/2010 | 1.00 | 0.60 | 0.45 | 1.00 | 0.27 | 1.63 | 440.10 | T. Davis | TP66-0.1-0.3 | Yes | 14 | 0.014 | 0.000 | No | | Yes |
| 67 | 26/11/2010 | 0.80 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP67-0.1-0.2 | Yes | 323 | 0.323 | **0.012** | No [3] | | Yes |
| 68 | 26/11/2010 | 0.80 | 0.50 | 0.45 | 1.20 | 0.27 | 1.63 | 440.10 | T. Davis | TP68-0.2-0.3 | Yes | 939 | 0.939 | **0.032** | No | | Yes |
| 69 | 26/11/2010 | 1.00 | 0.30 | 0.45 | 0.90 | 0.12 | 1.63 | 198.05 | T. Davis | TP69-0.1-0.2 | Yes | 60 | 0.06 | 0.005 | No | | Yes |
| 70 | 26/11/2010 | 0.60 | 0.30 | 0.45 | 1.00 | 0.14 | 1.63 | 220.05 | T. Davis | TP70-0.1-0.2 | Yes | 29 | 0.029 | 0.002 | No [4] | | Yes |
| 71 | 26/11/2010 | 0.70 | 0.35 | 0.45 | 1.10 | 0.17 | 1.63 | 282.40 | T. Davis | TP71-0.1-0.2 | Yes | 613 | 0.613 | **0.033** | No | | Yes |
| 72 | 26/11/2010 | 1.00 | 0.60 | 0.45 | 1.00 | 0.27 | 1.63 | 440.10 | T. Davis | TP72-0.1-0.2 | Yes | 67 | 0.067 | 0.002 | No | | Yes |
| 73 | 26/11/2010 | 1.00 | 0.60 | 0.45 | 1.10 | 0.30 | 1.63 | 484.11 | T. Davis | TP73-0.1-0.2 | Yes | 609 | 0.609 | **0.019** | No | | Yes |
| 74 | 26/11/2010 | 1.00 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP74-0.1-0.2 | Yes | 54 | 0.054 | 0.002 | No | | Yes |
| 75 | 26/11/2010 | 1.00 | 0.55 | 0.45 | 1.10 | 0.27 | 1.63 | 443.77 | T. Davis | TP75-0.1-0.2 | Yes | 71 | 0.071 | 0.002 | No | | Yes |
| 76 | 26/11/2010 | 0.90 | 0.35 | 0.45 | 1.20 | 0.19 | 1.63 | 308.07 | T. Davis | TP76-0.1-0.2 | Yes | 795 | 0.795 | **0.039** | No | | Yes |
| 77 | 30/11/2010 | 0.80 | 0.45 | 0.45 | 1.10 | 0.22 | 1.63 | 363.08 | T. Davis | TP77-0.1-0.2 | Yes | 64 | 0.064 | 0.003 | No | | Yes |
| 78 | 30/11/2010 | 0.90 | 0.50 | 0.45 | 1.20 | 0.27 | 1.63 | 440.10 | T. Davis | TP78-0.1-0.2 | Yes | 286 | 0.286 | **0.010** | No | | Yes |
| 79 | 30/11/2010 | 1.00 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP79-0.1-0.2 | Yes | 686 | 0.686 | **0.026** | No | | Yes |
| 80 | 30/11/2010 | 0.90 | 0.45 | 0.45 | 1.10 | 0.22 | 1.63 | 363.08 | T. Davis | TP80-0.1-0.2 | Yes | 3 | 0.003 | 0.000 | No | | Yes |
| 81 | 30/11/2010 | 0.90 | 0.45 | 0.45 | 1.10 | 0.22 | 1.63 | 363.08 | T. Davis | TP81-0.1-0.2 | Yes | 21 | 0.021 | 0.001 | No | | Yes |
| 82 | 30/11/2010 | 0.90 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP82-0.1-0.2 | Yes | 9 | 0.009 | 0.000 | No | | Yes |
| 83 | 30/11/2010 | 0.90 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP83-0.1-0.2 | Yes | 435 | 0.435 | **0.016** | No [4] | | Yes |
| 84 | 30/11/2010 | 0.90 | 0.45 | 0.45 | 1.10 | 0.22 | 1.63 | 363.08 | T. Davis | TP84-0.1-0.2 | Yes | 59 | 0.059 | 0.002 | No | | Yes |
| 85 | 30/11/2010 | 0.90 | 0.40 | 0.45 | 1.10 | 0.20 | 1.63 | 322.74 | T. Davis | TP85-0.1-0.2 | Yes | 107 | 0.107 | 0.005 | No | | Yes |
| 86 | 30/11/2010 | 1.00 | 0.50 | 0.45 | 1.10 | 0.25 | 1.63 | 403.43 | T. Davis | TP86-0.1-0.2 | Yes | 72 | 0.072 | 0.003 | No | | Yes |
| 87 | 30/11/2010 | 0.90 | 0.40 | 0.45 | 1.10 | 0.20 | 1.63 | 322.74 | T. Davis | TP87-0.1-0.2 | Yes | 26 | 0.026 | 0.001 | No | | Yes |
| Notes | **BOLD** | denotes exceedance of assessment criteria of 0.01 % (w/w) | | | | | | 65.20 | | | | | | | | | |

1 Reported as *'loose chrysotile fibres found in soils, however this is below the reporting limit of 0.1g/kg'*

2 Reported as *'loose crocidolite fibres found in soils, however this is below the reporting limit of 0.1g/kg'*

3 Reported as *'loose amosite fibres found in soils, however this is below the reporting limit of 0.1g/kg'*

4 Reported as *'loose chrysotile & amosite fibres found in soils, however this is below the reporting limit of 0.1g/kg', in TP84 sample fibres identifed in triplicate sample QC5A only by the secondary laboratory*

**41131 - Riverwood North Renewal**
**Riverwood Residential Renewal Project**
**Table B: Soil Analytical Results**

**BOLD** denotes exceedance of HIL criteria
*italics* denotes exceedance of PIL criteria

| | | | BTEX | | | | Metals | | | | | | | | PAHs | | | | | | | | | | | | | | | | TPH | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Benzene | Ethylbenzene | Toluene | Xylene Total | Arsenic | Cadmium | Chromium (III+VI) | Copper | Lead | Mercury | Nickel | Zinc | Acenaphthene | Acenaphthylene | Anthracene | Benz(a)anthracene | Benzo(a) pyrene | Benzo(b)&(k)fluoranthene | Benzo(g,h,i)perylene | Chrysene | Dibenz(a,h)anthracene | Fluoranthene | Fluorene | Indeno(1,2,3-c,d)pyrene | Naphthalene | Phenanthrene | Pyrene | Sum of PAH | TPH C6 - C9 | TPH C10 - C14 | TPH C15 - C28 | TPH C29-C36 | TPH+C10 - C36 (Sum of total) |
| | | | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| EQL | | | 0.5 | 1 | 0.5 | | 4 | 0.5 | 1 | 1 | 1 | 0.1 | 1 | 1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.05 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 1.55 | 25 | 50 | 100 | 100 | |
| **EPA 1994 Health and Ecological** | | | **1** | **50** | **130** | **25** | | | | | **300** | | | | | | | | | | | | | | | | | | | | **65** | | | | **1000** |
| **NEPM PIL** | | | | | | | **20** | **3** | **1** | **100** | **600** | **1** | **60** | **200** | | | | | | | | | | | | | | | | | | | | | | |
| *NEPM 1999 HIL E* | | | | | | | **200** | **40** | **200** | **2000** | **600** | **30** | **600** | **14,000** | | | | | **2** | | | | | | | | | | **40** | | | | | | |
| *NEPM 1999 HIL D* | | | | | | | **400** | **80** | **400** | **4000** | **1200** | **60** | **1200** | **28,000** | | | | | *4* | | | | | | | | | | *80* | | | | | | |
| **ID** | **Depth** | **Date** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| QC1 | 0.7-0.8 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 9 | <0.5 | 20 | 11 | 47 | <0.1 | 4 | 150 | <0.1 | <0.1 | <0.1 | 0.2 | 0.5 | 0.6 | 0.2 | 0.3 | <0.1 | 0.9 | <0.1 | 0.2 | <0.1 | 0.5 | 0.9 | 7.80 | <25 | <50 | <100 | <100 | <250 |
| QC2 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 11 | <0.5 | 33 | 5 | 35 | <0.1 | 3 | 16 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 15.20 | <25 | <50 | <100 | <100 | <250 |
| QC3 | 0.1-0.2 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 9 | <0.5 | 24 | 16 | 60 | 0.1 | 5 | 58 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | <0.2 | 0.1 | 0.1 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | 0.1 | 0.2 | 1.56 | <25 | <50 | <100 | <100 | <250 |
| QC5 | 0.1-0.2 | 30/11/2010 | <0.5 | <1 | <0.5 | <3 | 8 | <0.5 | 180 | 26 | 62 | <0.1 | 6 | 58 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP11 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 8 | <0.5 | 32 | 7 | 35 | <0.1 | 12 | 24 | <0.1 | <0.1 | 0.2 | 0.3 | 0.3 | 0.5 | 0.1 | 0.4 | <0.1 | 1.1 | <0.1 | 0.1 | <0.1 | 0.9 | 1 | 4.50 | <25 | <50 | <100 | <100 | <250 |
| TP14 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 8 | <0.5 | 20 | 20 | 61 | <0.1 | 8 | 68 | <0.1 | <0.1 | 0.1 | 0.4 | 0.8 | 1 | 0.4 | 0.6 | <0.1 | 1.6 | <0.1 | 0.3 | <0.1 | 0.8 | 1.6 | 12.80 | <25 | <50 | <100 | <100 | <250 |
| TP17 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 9 | <0.5 | 25 | 19 | 65 | <0.1 | 5 | 57 | <0.1 | 0.1 | 0.2 | 0.9 | 1.6 | 2.2 | 0.7 | 1.2 | <0.1 | 3.7 | <0.1 | 0.7 | <0.1 | 2 | 3.5 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP2 | 0.3-0.4 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 10 | <0.5 | 29 | 24 | 43 | <0.1 | 8 | 45 | <0.1 | <0.1 | <0.1 | 0.1 | 0.2 | 0.2 | <0.1 | 0.2 | <0.1 | 0.4 | <0.1 | <0.1 | <0.1 | 0.3 | 0.4 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP8 | 0.3-0.4 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 15 | <0.5 | 35 | 11 | 39 | <0.1 | 3 | 30 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP18 | 0.7-0.8 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 12 | <0.5 | 42 | 4 | 20 | <0.1 | 4 | 5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP21 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 10 | <0.5 | 27 | 25 | 180 | <0.1 | 9 | 120 | <0.1 | <0.1 | <0.1 | 0.2 | 0.3 | 0.5 | 0.2 | 0.3 | <0.1 | 0.9 | <0.1 | 0.1 | <0.1 | 0.5 | 0.9 | 9.60 | <25 | <50 | <100 | <100 | <250 |
| TP28 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 10 | <0.5 | 30 | 8 | 42 | <0.1 | 3 | 23 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP28 | 0.4-0.5 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 13 | <0.5 | 38 | 4 | 25 | <0.1 | 3 | 5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP33 | 0.1-0.2 | 23/11/2010 | <0.5 | <1 | <0.5 | <3 | 5 | <0.5 | 14 | 16 | 27 | <0.1 | 10 | 41 | <0.1 | <0.1 | <0.1 | 0.3 | 0.5 | 0.7 | 0.3 | 0.4 | <0.1 | 1.1 | <0.1 | 0.2 | <0.1 | 0.6 | 1.1 | 6.80 | <25 | <50 | <100 | <100 | <250 |
| TP37 | 0.8-0.9 | 25/11/2010 | <0.5 | <1 | <0.5 | <3 | 5 | <0.5 | 14 | 12 | 18 | <0.1 | 5 | 10 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP41 | 0.1-0.2 | 25/11/2010 | <0.5 | <1 | <0.5 | <3 | 11 | <0.5 | 30 | 34 | 62 | <0.1 | 6 | 65 | <0.1 | <0.1 | <0.1 | 0.3 | 0.4 | 0.6 | 0.3 | 0.3 | <0.1 | 0.8 | <0.1 | 0.3 | <0.1 | 0.3 | 0.8 | <1.55 | <25 | <50 | <100 | 140 | 215 |
| TP47 | 0.1-0.2 | 25/11/2010 | <0.5 | <1 | <0.5 | <3 | 7 | <0.5 | 21 | 19 | 67 | <0.1 | 5 | 120 | <0.1 | 0.1 | 0.1 | 0.5 | 1 | 1.2 | 0.7 | 0.6 | <0.1 | 1.7 | <0.1 | 0.6 | <0.1 | 0.9 | 1.7 | 12.10 | <25 | <50 | <100 | <100 | <250 |
| TP51 | 0.1-0.2 | 25/11/2010 | <0.5 | <1 | <0.5 | <3 | 8 | <0.5 | 27 | 31 | 50 | <0.1 | 9 | 71 | <0.1 | 0.2 | 0.3 | 1.1 | 1.8 | 2.4 | 1.4 | 1.2 | <0.1 | 3.5 | 0.1 | 1.3 | <0.1 | 2 | 3.4 | 15.40 | <25 | <50 | <100 | 120 | 195 |
| TP52 | 0.1-0.2 | 25/11/2010 | <0.5 | <1 | <0.5 | <3 | 6 | <0.5 | 7 | 23 | 50 | <0.1 | 11 | 91 | <0.1 | <0.1 | <0.1 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | <0.1 | 0.5 | <0.1 | 0.1 | <0.1 | 0.2 | 0.5 | <1.55 | <25 | <50 | <100 | 120 | 195 |
| TP58 | 0.1-0.2 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 10 | <0.5 | 23 | 14 | 66 | <0.1 | 5 | 55 | <0.1 | <0.1 | <0.1 | 0.2 | 0.3 | 0.4 | 0.2 | 0.2 | <0.1 | 0.7 | <0.1 | 0.2 | <0.1 | 0.4 | 0.7 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP59 | 0.6-0.7 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 9 | <0.5 | 36 | 4 | 22 | <0.1 | 3 | 4 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP61 | 0.1-0.2 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 9 | <0.5 | 29 | 53 | 49 | <0.1 | 5 | 43 | <0.1 | <0.1 | <0.1 | <0.1 | 0.05 | <0.2 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP66 | 0.1-0.3 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 6 | <0.5 | 23 | 50 | 61 | 0.1 | 11 | *440* | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 | <0.2 | <0.1 | 0.2 | <0.1 | 0.2 | <0.1 | <0.1 | <0.1 | 0.1 | 0.2 | 3.60 | <25 | <50 | <100 | <100 | <250 |
| TP69 | 0.1-0.2 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 7 | <0.5 | 11 | 14 | 48 | <0.1 | 6 | 190 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP72 | 0.1-0.2 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 11 | <0.5 | 19 | 50 | **390** | <0.1 | 6 | *230* | <0.1 | <0.1 | <0.1 | <0.1 | 0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP74 | 0.1-0.2 | 26/11/2010 | <0.5 | <1 | <0.5 | <3 | 10 | <0.5 | 30 | 12 | 50 | 0.2 | 4 | 34 | <0.1 | <0.1 | <0.1 | <0.1 | 0.05 | <0.2 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | 0.10 | <25 | <50 | <100 | <100 | <250 |
| TP77 | 0.1-0.2 | 30/11/2010 | <0.5 | <1 | <0.5 | <3 | 10 | <0.5 | 28 | 79 | 68 | 0.1 | 4 | 56 | <0.1 | <0.1 | <0.1 | <0.1 | 0.06 | <0.2 | <0.1 | <0.1 | <0.1 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | 0.10 | <25 | <50 | <100 | <100 | <250 |
| TP79 | 0.5-0.6 | 30/11/2010 | <0.5 | <1 | <0.5 | <3 | 12 | <0.5 | 34 | 3 | 21 | <0.1 | 2 | 3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |
| TP84 | 0.1-0.2 | 30/11/2010 | <0.5 | <1 | <0.5 | <3 | 9 | <0.5 | 24 | 13 | 71 | <0.1 | 4 | 64 | <0.1 | <0.1 | <0.1 | <0.1 | <0.05 | <0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1.55 | <25 | <50 | <100 | <100 | <250 |

**Appendix C**

**Assessment Criteria for Chemical COPC (Contingency)**

**Table 5.1 Soil Criteria (all units in mg/kg)**

| | Limit of Reporting (mg/kg) | Laboratory Method | Health-Based Investigation Level | | Phytotoxicity-based Investigation level (PIL) [5] |
|---|---|---|---|---|---|
| | | | Residential minimal soil access (HIL-D)[2] | Parks/Open Space (HIL-E)[3] | |
| METALS | | | | | |
| Arsenic | 4.0 | ICP-AES (USEPA 200.7) | 400 | 200 | 20 |
| Cadmium | 1.0 | | 80 | 40 | 3 |
| Chromium (VI) | 1.0 | | 400 | 200 | 1 |
| Copper | 1.0 | | 4000 | 2000 | 100 |
| Nickel | 1.0 | | 2400 | 600 | 60 |
| Lead | 1.0 | | 1200 | 600 | 600 |
| Zinc | 1.0 | | 28 000 | 14 000 | 200 |
| Mercury (inorganic) | 0.1 | | 60 | 30 | 1 |
| PETROLEUM HYDROCARBONS | | | | | |
| C6 – C9 Fraction | 25 | Purge Trap-GCMS (USEPA8260) | 65 | | - |
| C10 – C36 Fraction | 250 | Purge Trap-GCFID (USEPA8000) | 1000 | | - |
| BTEX | | | | | |
| Benzene | 1.0 | Purge Trap-GCMS (USEPA8260) | 1[6] | | - |
| Toluene | 1.0 | | 130[6] | | 1.4[6] |
| Ethylbenzene | 1.0 | | 50[6] | | 3.1[6] |
| Total Xylenes | 3.0 | | 25[6] | | 14[6] |
| POLYCYCLIC AROMATIC HYDROCARBONS | | | | | |
| Benzo(a) pyrene | 0.05 | GCMS (USEPA8270) | 4 | 2 | - |
| Total PAHs | 1.55 | | 80 | 40 | - |
| ORGANOCHLORINE PESTICIDES | | | | | |
| Aldrin + Dieldrin | 0.2 | GCECD (USEPA8140,8080) | 40 | 20 | |
| Chlordane | 0.1 | | 200 | 100 | |
| DDT + DDE + DDD | 0.3 | | 800 | 400 | - |
| Heptachlor | 0.1 | | 4 | 20 | - |
| PCBs | | | | | |
| PCBs | 0.9 | GCECD (USEPA8140,8080) | 40 | 20 | |
| OTHER | | | | | |



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| | | | |
|---|---|---|---|
| Asbestos fibres | Presence | PLM / Dispersion Staining | No asbestos fibres capable of being detected via the analytical program, which comprises both visual identification and sample analysis by a NATA accredited laboratory |
| ACM | NA | Asbestos quantification in accordance with WA (2009) | no visible ACM on the ground surface[8] |

[1] Column 1 (NEHF-A), Health-based Investigation Levels (DEC 2006)

[2] Column 2 (NEHF-D), Health-based Investigation Levels (DEC 2006)

[3] Column 3 (NEHF-E), Health-based Investigation Levels (DEC 2006)

[4] Column 4 (NEHF-F), Health-based Investigation Levels (DEC 2006)

[5] Column 5 (PIL), Soil Investigation Levels for Urban Redevelopment Sites (DEC 2006)

[6] Table 3 (EPA 1994)

[8] To adequately address aesthetic considerations required in DEC (2006) for residential and parks/ recreation open space uses, a criterion of no visible ACM on the ground surface has been adopted, JBS, if commissioned, may undertake a site specific risk assessment to determine alternate criteria


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