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1. INTRODUCTION

1.1 Background

The Midland Redevelopment Authority (MRA) was established in 2000 and charged with the responsibility of remediating and redeveloping the former Midland Railways Workshops site to create a new mixed use development, which adds to Midland as a major regional centre while retaining the important heritage values associated with the workshops.

Several stages of the redevelopment process have been completed and the MRA is now working on the remediation of the Helena-East Precinct. Figure 1 shows the regional location of the site while Figure 2 shows the location of the current development area (Helena East Precinct) in relation to the overall Midland Workshops Development. The Site (Helena East Precinct) is shown on Figure 3, along with historical building names.

The proposed remediation of Helena East represents a significant earthworks event that requires a strong commitment to management and dust control. The MRA has demonstrated through its management team that it can undertake similar large scale earthworks whilst ensuring air quality is maintained at the strict standards set by the DoE and Health Department.

Remediation activities at the former Midland Railway Workshops have been subject to extensive air monitoring since the first major remedial works were carried out in Area E in April 2002.

A review of MRA's management and monitoring of air quality during the remediation of various parts of the site has been undertaken to summarise MRA's commitment to managing this important issue. The review includes dust management and air quality monitoring at Area E, Helena West, Area B, C, and D (WAPS), and Helena Street Extension, and is provided in Appendix A.

Proactive dust management is a key component as experience has shown that air monitoring alone will not ensure maintenance of air quality. A thorough understanding of effective dust management, together with real time air monitoring, ensures the best outcome. MRA is committed to effective dust management measures in addition to undertaking air monitoring to demonstrate and document that acceptable air quality will be maintained during the remediation program at Helena East.

1.2 Purpose

A Dust and Air Quality Management Plan (DAQMP) has been prepared to address the issue of nuisance dust and other adverse air quality impacts during the remediation phase at the Helena East site within the former Midland Workshops area.

The objective of the plan is to ensure that nuisance and contaminated dust, including asbestos fibres, is controlled during the remedial works and is minimised to the greatest practical extent in accordance with ALARA (as low as reasonably achievable) principles. Air quality is to comply with regulatory guidelines set for the protection of human health.

This DAQMP specifically addresses the following:

- measures and practices to minimise the generation of dust;
- location of air quality monitoring sites;
- monitoring for fine particulates;
- monitoring for airborne asbestos fibres;
- monitoring for nuisance dust;
- confirmatory monitoring for heavy metal particulates contained within the dust;
- monitoring for volatile compounds associated with the removal and remediation of hydrocarbon impacted soils;
- identification of regulatory guidelines and compliance criteria; and
- nomination of action levels and contingency measures in the event that air quality approaches or is likely to exceed the relevant compliance criteria.

Section 2 of this document outlines background information, Section 3 details the proposed dust management program, and monitoring is outlined in Section 4. Contingency response to adverse air quality is detailed in Section 5.

The following appendices are also included to provide background information:

- Appendix A — Review of Air Emissions Management at Previous MRA Remediation Sites
- Appendix B — Soil Sampling Results Summaries for Helena East Sampling Programs
- Appendix C — Site Classification Assessment Chart
- Appendix D — Bureau Of Meteorology Monthly Data For Perth Airport

1.3 Nature and Extent of Contamination

Helena East is the most intensively investigated Precinct in the MRA Workshops site, due to the long history of industrial use of that portion of the site, as well as the variety of potentially contaminating activities that took place there. A total of some 250 locations were tested across Helena East; approximately 10 locations across the Southern Embankment, and 43 at the MIA Containment Area.

A review of contamination identified in previous investigations and additional investigations by ATA for inclusion in a Public Environmental Review (PER) indicates that contamination can broadly be assigned to one of three categories as follows:

- Waste Fill deposits from historical dumping at the site (generally comprising bulk soil, metal fragments, ash, slag, asbestos, and other debris). The Waste fill is present in a thin layer (0.5-1metre thickness) over the majority of site as it was used a as a drainage media on top of the natural clay soils. The fill is present to a depth of several metres on the southern embankment of the whole Helen-East Precinct. The waste fill is characterised by low levels of metal and PAH contamination which tend to be tightly bound to the soils matrix and are therefore not highly leachable. The heterogeneous nature of the fill material means that it is geotechnically unsuitable for conventional construction techniques and needs to be removed where feasible.

- In a number locations the Waste Fill and the underlying natural soil has been affected by contamination (typically hydrocarbons). migrating from overlying sources.

- Groundwater impacted via migration of contaminants through overlying fill and/or natural soil.

1.3.1 Soil (including Waste Fill) Contamination Overview

The Waste Fill material is characterised by concentrations of a variety of heavy metals that exceed the EIL guidelines, and some asbestos contamination. Soil underlying contaminated fill generally does not exhibit concentrations of heavy metals that exceed EIL guidelines, indicating negligible impact by the overlying fill.

In some specific areas the waste fill and the underlying natural soil has been impacted by the migration of one of more of the following compounds through the soil profile:

- cyanide;
- total petroleum hydrocarbons (TPHs);
- the solvents benzene, toluene, ethylbenzene, and xylenes (BTEX);
- polycyclic aromatic hydrocarbons (PAHs); and/or
- volatile organic compounds (VOCs), including monocyclic aromatic hydrocarbons, and halogenated aliphatic and aromatic hydrocarbons.

In addition to the above compounds, asbestos has been detected in surface soils around the Panel Shop, Copper Shop, Element, Shop Diesel Shed, Electrical Store, Tarpaulin Shop and Plating Shop as shown on Figure 4. This asbestos cement material is considered to mainly derive from asbestos sheeting that clad the former Plating Shop. Asbestos has also been detected in the Southern Embankment.

Table B1 (Appendix B) summarises concentrations of heavy metals in waste fill and soil samples from Helena East. Overall, contamination associated with Waste Fill deposits comprises the bulk of soil contamination identified at the site, with an estimated *in situ* volume of possibly up to 100,000m^3 in total identified in the Helena East and Southern Embankment areas.

Soil affected by hydrocarbons and/or solvents (i.e. TPHs, BTEX, PAHs and/or minor amounts of VOCs) is also relatively extensive at Helena East and the Southern Embankment, with an estimated *in situ* volume of 30,000m^3 (including 5,000m^3 which overlaps with Waste Fill in the Southern Embankment).

Cyanide contamination is very localised and minor. It is only identified at 3 sample locations adjacent to a former cyanide treatment plant area.

1.3.2 Comparison to Contaminants in Helena West Waste Fill

For the purpose of identifying the most appropriate air sampling methodology and criteria, the concentrations of contaminants in soil and waste fill measured in samples from Helena East were compared with concentrations in waste fill from Helena West. Tables summarising Helena East soil sampling results are provided in Appendix B.

Metals

Table B1 (Appendix B) summarises combined results for concentrations of metals in both waste fill and soil samples from Helena East (ATA, 2005). Table B2 summarises concentrations of metals in waste fill from Helena West (ENV, 2003 and EPA, 2003). The ENV (2003) report provided results on the Helena West Waste Fill separately to the Helena West soil.

The concentrations of metals in material to be remediated from Helena East are, in general, in the same order of magnitude or lower than those that have been previously remediated from Helena West, with two exceptions. Copper and lead, while each having a similar average concentration in the Helena East results (Table B1) to the Helena West results (Table B2), both have a maximum concentration that is approximately an order of magnitude higher in the Helena-East results than in the Helena West results.

Based on the comparison of the data, it is deemed appropriate that the air quality monitoring program and criteria for heavy metals used during the remediation of Helena East is similar to that used during Helena West remedial works.

Cyanide

Tables B1 and B2 (Appendix B) also provide a summary of cyanide results. Cyanide at concentrations above the EIL criterion of 10mg/kg has been detected at 3 locations adjacent to the Tarpaulin Shop, between 0.4mBGL and 1.5mBGL. It is understood that cyanide was used in metal treatment operations and wastewater from these operations was treated in the Waste Water Treatment Plant, which is located in the vicinity of the Tarpaulin Shop.

Concentrations of cyanide measured in soil range from 1.3 to 30mg/kg. The average concentration of 9.4 is lower than the DoE (200x) Health Investigation Level for standard residential housing (HIL-A) and is considered to be of minor importance during the relatively short duration (weeks to months) of remedial works, compared with the lifetime assumption used to calculate HIL-A. Given the relatively low concentrations of cyanide detected in soil, it is considered that cyanide poses a very low risk to the public during remedial works and air monitoring is not required.

Asbestos

Table B3 (Appendix B) provides a summary of asbestos results by sub area within the Helena East Precinct. Asbestos fibres have been identified in soil in the southern half of Helena East as well as in the Southern Embankment. Fibres are primarily found in buried Waste Fill in these two areas as illustrated on Figure 4. Fragments of this sheeting were visually identified in the area of the shop. ENV reports indicate that within Waste Fill, asbestos is present almost exclusively in the form of chrysotile.

Hydrocarbons

In contrast to Helena West, significant concentrations of hydrocarbons have been detected in soils from Helena East.

Tables summarising Helena East soil sampling results are provided in Appendix B. Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH) are summarised on Table B4 (Appendix B). Volatile Organic Compounds (VOC) are summarised on Table B5 (Appendix B).

Hydrocarbon contamination in soil is localised, in contrast to the widespread metals contamination at the site. Specific hydrocarbons were detected at the following areas (Figure 3):

- Foundry Area – PAH, TPH
- Main Blocks (1, 2, 3) – PAH, TPH
- Power House Area – TPH
- Element Shop – PAH, TPH, xylenes, VOCs (including trichloroethene and tetrachloroethene)
- Diesel Shed & Refuelling Area – PAH, TPH
- Tarpaulin Shop Area – PAH, TPH, VOCs (including trichloroethene and tetrachloroethene)

Air Quality monitoring to be undertaken during remediation of hydrocarbon contaminated soil is discussed in Section 4.

1.3.3 Groundwater Contamination Overview

Hydrocarbon and solvent contamination in groundwater is localised within areas of the site where extensive hydrocarbons and/or solvents were identified in soil, particularly south of the Power House/Element Shop and south of the Tarpaulin Shop. Based on soil and groundwater results for hydrocarbons, it is considered that there may be multiple overlapping plumes of different composition in the vicinity of the Power House/Element Shop, and two separate plumes south of the Tarpaulin Shop.

A layer of light non-aqueous phase liquid (LNAPL) comprising hydrocarbon fractions similar to mineral turpentine and degraded diesel was identified in one bore south of the Element Shop. PAHs that exceed the Fresh Waters assessment levels are naphthalene

(3 bores) and total PAHs (2 bores). Solvents that exceed the Drinking Water assessment levels are benzene (2 bores), toluene (1 bore), ethylbenzene (2 bores), and xylenes (1 bore); one other bore is likely to exceed the criteria for BTEX, based on detectable concentrations of $C_{6\text{-}9}$ chain-length hydrocarbon material. A variety of VOCs were identified in six bores adjacent to the Power House/Element Shop, predominantly comprising halogenated aliphatic hydrocarbons (including tetrachlorethene, trichlorethene, dichloroethane, dichloroethene, and vinyl chloride). At three bores, one or more VOCs exceed both Fresh Waters and Drinking Water assessment levels.

Organochlorine pesticides are present at concentrations exceeding the Fresh Waters assessment levels in the same bore where free-phase LNAPL was identified.

The available data suggest that the hydrocarbon and solvent plume south of the Power House/Element Shop has a limited lateral extent within the Shallow Superficial Aquifer.

Two hydrocarbon plumes are located south of the Tarpaulin Shop: one to the southeast, by the Water Tank (which was used for diesel storage), and one adjacent the southwest corner of the Tarpaulin Shop. Both plumes extend from the southern portion of Helena East into the Southern Embankment and have a significant lateral extent. Both also appear to be migrating towards the Helena River. TPH in groundwater, derived from an LNAPL source (light non-aqueous phase liquids, which are less dense than water) appears to have migrated through the Upper Clays to the Lower Sands; consequently, contamination is migrating through this material along the upper surface of the Lower Superficial Aquifer. No free-phase NAPL was identified in the affected bores.

Widespread low level metal contamination is not considered of significance for air quality.

2. AIR QUALITY ISSUES

2.1 Overview

The Proponent recognises the need to control dust emissions during the remediation phase in order to maintain the health and well being of people who are involved in the remedial works and those that work and live in areas adjacent to the site. The location of the site in relation to nearby users is described in Section 2.4.

The major potential sources of dust generation will be from earthmoving activities associated with the excavation of contaminated soil. Due to the presence of low levels of contaminants in the fill, special efforts are required to minimise the generation of dust.

Dust is generated when there is sufficient wind velocity and frequency to lift fine particles from the ground surface. The susceptibility of the particles to lift is a function of the presence of any ground cover, compaction and the moisture content of the ground. Dust has traditionally been measured as Total Suspended Particles or TSP, which refers to particles that can remain suspended in the atmosphere but not necessarily inhaled into the lung.

Recent research has shown that the finer dust fractions (<10 micron) are of greater concern because they tend to remain airborne for longer and are capable of penetrating deeply in to the human respiratory system. As a result TSP measurements tend to be used as an indication of overall dust burden and the nuisance impact of dust emissions while measures such PM_{10} (the concentration of particulate matter less than 10 micron in diameter) are used when assessing health impacts.

The following subsections describe the potential for dust to be generated from the remediation program and the potential human health risks. The proposed monitoring program is outlined in Section 3.

2.2 Potential for Emissions

Remediation activities will involve the handling of up to 100,000m^3 of low-level contaminated soil that contains levels of heavy metals that are generally in compliance with commercial land use health based criteria. Hydrocarbon based Volatile Organic Compounds (VOCs) are also contained in some soils.

Activities will include excavation of the soil, loading into trucks, movement of vehicles on unsealed tracks, temporary stockpiling and placement of clean sand fill. Dust could be generated as a consequence of any of these activities. The severity of dust generation will be a function of the magnitude of earthworks, moisture content of the fill, prevailing weather conditions and the presence of fine particles. High wind speeds may exacerbate the potential for dust generation.

VOC’s are volatile compounds which unlike metals will potentially be emitted when soils containing VOC’s are simply uncovered or disturbed in any way. As a result the management and monitoring techniques for VOC contaminated soils require a different approach.

2.3 Potential Contaminants in Air

The contaminants identified in the soils to be disturbed are discussed in Section 1. These contaminants may be present in airborne particulate matter or as gaseous phase emissions in the case of VOCs. The extent of any impact will depend on the extent of contamination, the extent of earthworks and the management measures employed to limit emissions.

The criteria proposed for assessing the acceptability of air quality are described in Section 4.

2.4 Potential Receptors - Surrounding and Onsite Land Use

2.4.1 Helena East and the Southern Embankment

Helena East and the Southern Embankment area are surrounded by the following land uses (see Figure 4).

- North - Railway Reserve and Midland town centre.
- South - Helena River floodplain and Helena River.
- East - Area E (proposed hospital development) and Areas B, C, D (to be used for Western Australian Police Service site (WAPS) activities and commercial activities). The CADCOM complex is located adjacent to the central eastern boundary of Helena East.
- West – Former rail yards remediated and subject to future residential redevelopment (Helena West). Housing is being built in the far western section of Helena West, adjacent to Amherst Road, as part of the Woodbridge Lakes residential development.

The nearest established residential areas are the new housing being constructed in Helena West, approximately 250m to the west of the Helena East Precinct and existing housing located approximately 200m to the north from the northern boundary of the site across Railway Parade in Midland. Semi-rural residences exist approximately 150m-200m south of the southern site boundary but approximately 180m from the nearest earthworks. The closest primary schools are Midland and Woodbridge Primary Schools located approximately 800m both north and west of Helena East, respectively.

The majority of the soil to be remediated is located centrally in the precinct and as a result the separation distances between the remediation operation and the sensitive land uses is generally somewhat larger than the distances stated above.

Various parties holding lease agreements with the MRA are currently using several buildings within the Helena East site on a daily basis. Several of these leases are due to expire in the next 12 months. A list of buildings being occupied by lessees, their activities and expected period of occupation is presented below.

TABLE 1
ONSITE LAND USE

Location	Tenant	Use	Lease End
Former Chief Mechanical Engineers Building	Midland TAFE	Education Purposes	end December 2005
Former Chief Mechanical Engineers Building	ECU	Education Purposes	(begin Jan 2006) ongoing
Former Works Managers/Tool Office	WA Police Services South Spur Rail Services	Communication Infrastructure Project offices	December 2006 (demolition then construction of Education Bldg)
Block 1	South Spur Rail Services	Storage of Tourist Train & maintenance purposes of locomotives & rolling stocks	June 2006
Block 1	Australian Railway Historical Society	Restoration & storage of heritage locomotives &* rolling stock	Ongoing
Block 1	EDI Rail	Final commissioning of Public Transport Authority Suburban rail cars	to 30 June 2006 minimum
Pattern Shop	Circa Furniture	Fine wood industry incubation program	Ongoing
Copper Shop	Machinery Preservation Club	Restoration & storage of heritage machinery items	Ongoing
Element Shop	Machinery Preservation Club	Restoration & storage of heritage machinery items	Ongoing
Portion of Block III	Machinery Preservation Club	Restoration & storage of heritage machinery items	Ongoing
Former Railway Institute Building	Midland Redevelopment Authority (MRA)	MRA Offices	Until completion of MRA project (ongoing)
Former Timekeepers Office	MRA / Rail Heritage WA	Railway Workshops Interpretive Centre. Starting point for Workshops tours.	Ongoing

2.4.2 MIA Containment Area

As part of the remediation process, it is proposed that a containment cell is established on land to the east of the Helena-East Precinct. The cell will be constructed as low hill (12-15 metres above existing grade) with waste being placed in compacted in layers and then capped with clay to form a stable non-eroding landform. The location of the MIA bund is shown in Figure 4.

The MIA containment area is surrounded by the following land uses:

- North Saleyards to be redeveloped as commercial use subject to MOU with MIA.
- South Brickworks (Austral Bricks).
- East Saleyards to be developed for commercial use subject to MOU with MIA.
- West WAPS site to be used for WAPS activities and commercial activities (Areas B, C, and D), portion of Austral brickworks site.

The containment area is located within a commercial/light industrial area, with the closest residential areas situated approximately 350m to the north across Railway Parade and approximately 650m to the south near Stirling Crescent.

3. MANAGEMENT OF AIR EMISSIONS

3.1 Overview

This section describes the measures that will be employed to minimise air emissions generated as a result of earthmoving activities. The objective is to ensure that any on-site or off-site airborne contaminant emissions are kept to a minimum and comply with the relevant health protection criteria.

For the full duration of the works, the Environmental Supervisor will perform a daily check as to the adequacy of control measures and siting of monitors. The Supervisor will be responsible for maintaining the log book and reporting results to the DoE.

3.2 Dust Management

3.2.1 Overview

The remediation works are anticipated to commence in the third or fourth quarter of 2006 and are expected to take less than 6-8 months to complete.

A Site Classification Assessment Chart for Helena East is provided in Appendix C. As per the guideline “Land Development Sites and Impacts on Air Quality” (DEP, 1996), the site is Classification 3, considered a medium risk.

Bureau of Meteorology (2005) data for the Perth Airport station is considered relevant to the weather patterns experienced at the site, and is presented in Appendix D.

Dust management will comprise wind fencing, surface stabilisation and the use of dust suppression in the form of water trucks and sprinklers. These will be made available for the entire remediation phase.

A windscreen will be constructed on the boundaries of earthworks area where they adjoin properties that are under active use. The wind fences act to reduce wind velocities over disturbed areas and thereby reduce dust lift-off. The windscreen will be constructed of shade cloth or Hessian on a 1.8m security high-fence. This will also act as a visual screen to the remedial earthworks.

Clean fill imported onto the site is to be sufficiently damp to prevent dust emissions during transportation to site and tipping. The moisture content of the fill being brought onto site will be inspected periodically by the Environmental Supervisor. If too dry, the cartage firm will be required to wet the fill at the source.

3.2.2 Earthworks

Dust control measures will conform with DEP Guidelines (DEP, 1996). This will involve the following measures:

- Earthworks will be undertaken in stages to avoid the creation of large areas of disturbance which represent a source of dust emissions.

- Wind fencing will be used as described previously.

- Water carts will be available with a total storage capacity of 10,000 litres per 5ha of disturbed site. This equates to at least two trucks with a total of 20,000 litres available.

- Watering will be conducted using water trucks and impulse sprinklers at the following areas:

  - sites undergoing excavations (includes the hydrocarbon dump). In areas being remediated, the application of water will be controlled to prevent ponding or run-off occurring.
  - on all internal access tracks and machinery storage areas.

- Given water restrictions related to the use of sprinklers, the irrigation bore on-site will be utilised where possible to supplement or fully source the water demands related to dust suppression. This groundwater is from a separate aquifer system and is not contaminated. It is therefore suitable for such a use. The Police site currently has a Water & Rivers Commission licence to extract 60,000 kilolitres (60 million litres) per year from the Leederville aquifer.

- Long-term stockpiles or large exposed areas that will remain open for extended periods will be mulched. Mulch will also be used as required to stabilise areas that may be emitting excessive dust in strong winds or during extended periods of hot dry weather.

3.2.3 Internal Access Tracks

Waste material will be carted between the area of excavation and relocation along a dedicated internal road (limestone base track as a minimum) capable of supporting the volume of traffic.

Trucks and roads will be wetted down and fine water sprays will be applied to minimise dust generation in transport areas. Application of a fine water spray will prevent water runoff from occurring in these areas. Water will be applied to the access tracks in the morning prior to each day or activity. Additional water will be applied to the tracks during the day as required.

To prevent the spread of contaminated material back into remediated areas, a vehicle washdown pond will be provided on the exit route from contaminated areas to remove any soil adhering to vehicle tyres and undercarriage. If required, vehicles leaving the contaminated zone will be cleaned by high pressure water spray.

The washdown pond will be constructed of a compacted layer of limestone. Any sediments accumulating in the washdown pad will be considered waste and will be disposed off-site to landfill after sampling and analyses to determine contaminant levels.

3.2.4 Off-site Transport of Waste

Waste fill will also be disposed off-site. Any material that is carted off-site will be transported along the major arterial road network.

To prevent the spread of contaminated material onto the public road system, all loads will be below tare, thoroughly wetted and covered with tarpaulins. A vehicle wash-down pond will be provided on the exit route from contaminated areas to remove any soil adhering to vehicle tyres and undercarriage. If required, vehicles leaving the site will be cleaned by high pressure water spray.

The wash-down pond will be constructed of a compacted layer of limestone. Any sediments accumulating in the wash-down pad will be considered waste and will be disposed off-site to landfill after sampling and analysis to determine contaminant levels. The *Waste Management Plan* (PER Appendix 12, Section 6) describes in detail the management of waste taken off-site.

3.2.5 Importation and Placement of Clean Fill

It is envisioned that up to 100,000m^3 of clean fill will be imported onto the site using the public road system. In order to prevent nuisance dust emissions arising, all fill is to be sufficiently damp to prevent dust emissions on route and during tipping. The moisture content of the fill being brought onto site will be inspected periodically by the Environmental Supervisor. If too dry, the cartage firm will be required to wet the fill at the source.

3.3 Dust Management – Post Remediation Phase

3.3.1 Pre-Development Phase

During the period between completion of remediation and prior to site development, the potential exists for dust emissions due to the bare ground surface.

In order to minimise dust emissions form the uncovered land, soil stabilisation will be undertaken over the entire disturbed part of the site using suitable dust suppressors such as chipped vegetation, hydromulch or a chemical equivalent (e.g. Dustex).

Most dust suppressors effectively stabilise soil for a period of months before they deteriorate, provided there is no traffic on the surface. Traffic over the stabilised surface will therefore be minimised to avoid breaking the crust. In the event that traffic on the surface is unavoidable, all traffic will be restricted to a designated track to limit overall damage to the stabilised surface. This track will be maintained to prevent soil erosion.

For the period between the completion of remedial works and commencement of development, dust monitoring will consist of visual inspections of the dust suppression and visual assessments of dust generation during strong winds. Where visual assessments indicate a problem, additional dust control agents will be applied to stabilise the areas that are generating dust.

3.3.2 Development Phase

Once development proceeds, portions of the site could be the responsibility of either the MRA, City of Swan or an independent developer. In each case the owner at that time will be will be responsible for managing any potential dust generation during development. However, since contaminated soil will be removed and replaced by clean fill, the dust issues will be those typical of development sites.

4. AIR QUALITY MONITORING

4.1 Overview

This section describes the monitoring program and rationale that will apply to ensure that the removal and relocation of the contaminated soil does not result in air quality levels that exceed criteria set for the protection of human health.

Monitoring will consist of three set monitoring stations measuring a mixture of TSP (High Volume Samplers) Asbestos Fibre concentrations and fine particulates (TEOM or DusTrak). These will be supplemented, if considered necessary by ad hoc use of DusTrak samplers in high risk areas and monitoring of VOC emissions in proximity to hydrocarbon remediation earthworks using specially prepared canister samplers if concerns exist that the fixed monitors are not adequate

The following subsections provide details on air quality monitoring:

- 4.5 Asbestos fibres;
- 4.6 Total Suspended Particulates (TSP);
- 4.7 Fine Particulates (PM_{10});
- 4.8 Dust Management Assistance – DustTrak; and
- 4.9 Heavy Metals.

4.2 Air Quality Management Objective

The objective of the air quality management program is to manage earthworks to prevent the exposure of remedial workers, employees in nearby workplaces and members of the public in areas outside the site boundary to possibly harmful levels of airborne contaminants.

The purpose of air monitoring is to confirm that members of the groups mentioned above are not being exposed to potentially hazardous levels of contaminants.

4.3 Air Quality Zones

A remediation zone will be established by the contractor around those areas undergoing active earthworks to prevent unprotected personnel coming into contact with contaminated material. The earthworks contractor will be responsible for assessing the exposure of employees within the remediation zone and ensuring compliance with occupational legislation and policy. The contractor will also be responsible for controlling access by others into the remediation area and ensuring that all necessary personal protective equipment (PPE) is worn.

Air quality outside of the site boundary at publicly accessible areas will be monitored by the MRA to ensure compliance with standards set for the protection of public health. This will be along the northern, eastern and western site boundaries.

4.4 Siting of Monitoring Stations

To the extent that is feasible given the number of large buildings on the site, the air monitoring sites will be situated so that they are representative of the particular location and contaminant being tested for. In accordance with Australian Standard 2922-1987, *Ambient Air-Guide for the Siting of Sampling Units*, the following considerations will need to be taken into account when locating permanent monitoring sites:

- Avoiding sites with restricted air flows such as near buildings and trees. The minimum clear sky angle for the sampling inlet should be 120 degrees.
- Avoiding sites that may cause physical and chemical interference such as motor vehicle emissions.
- Avoiding sites that may adsorb and absorb contaminants such as trees. Monitoring stations should be located at least 20m from trees and leafy vegetation.
- Locating the monitoring inlet near the human breathing zone, ie 1m to 2m above ground level.

To ensure that short-term monitoring is always undertaken downwind of the earthworks, a wind vane and anemometer will be permanently located at the MRA site. Fixed monitoring stations will be located in locations that are downwind in the direction of the major prevailing breezes for the season prevailing during the remediation.

Monitoring for public exposure will be undertaken continuously with permanent stations located along the northern and western boundaries. Figure 5 presents indicative monitoring locations pending permission from MRA, CADCOM and the WAPS.

Monitoring for asbestos will be performed along the northern and western boundaries, and also in the CADCOM Police yard. Figure 5 shows the monitoring locations. The CADCOM location may not fully comply with *AS 2922-1987* (Standards Australia, 1987) because of the number of large buildings, which will induce major wake effects in the air flow but it is the nearest area where a substantial number of persons may be impacted by emissions.

Table 2 details the monitors that will be sited at each location.

TABLE 2
AIR MONITORING EQUIPMENT

Station Number	Station Location	Equipment	Compound(s)	Monitoring Duration
1	CADCOM Building to the East of Helena East	Portable Personal Air Samplers	Asbestos	8hrs/day – active remediation works
		Hi-Vol Sampler w/TSP fitting	TSP Particulates (incl. PM_{10})	Initial 2-4 weeks of remediation
		High Vol/TSP fitt.	Heavy Metals	Initial 2-4 weeks of remediation
		TEOM (for compliance monitoring	PM_{10} Fine Particulates (management works)	During active remediation works
		DusTrak (for management only)	PM_{10} Fine Particulates (management only)	Throughout works
		Canister Methods TO-15 & TO-13A	Hydrocarbons	During hydrocarbon remediation
2	Northern Boundary of Helena East	Portable Personal Air Samplers	Asbestos	<u>All Equipment:</u> During Active remediation works
		Hi-Vol Sampler w/TSP fitting	TSP Particulates (incl. PM_{10})	Initial 2-4 weeks of remediation
		High Vol w/TSP fitting	Heavy Metals	Initial 2-4 weeks of remediation
		Canister Methods TO-15 & TO-13A (downwind of HC remediation)	Hydrocarbons	During hydrocarbon remediation
		DusTrak (for management only)	PM_{10} Fine Particulates	Throughout works
3	Western Boundary of Helena East	Portable Personal Air Samplers	Asbestos	<u>All Equipment:</u> During Active remediation works
		Hi-Vol Sampler w/TSP fitting	TSP Particulates (incl. PM_{10})	Initial 2-4 weeks of remediation
		High Vol w/TSP fitting	Heavy Metals	Initial 2-4 weeks of remediation
		Canister Methods TO-15 & TO-13A (downwind of HC remediation)	Hydrocarbons	During hydrocarbon remediation
		DusTrak (for management only)	PM_{10} Fine Particulates	Throughout works
Ad Hoc	As required	As required	As required	As required

4.5 Asbestos Fibres

4.5.1 Monitoring Program

Airborne asbestos fibres will be monitored using personal air samplers at three locations. A sampler will be located along the northern and western site boundaries. In addition, a personal air sampler will be placed within or adjacent to the CADCOM Police building.

The personal air samplers are to be used in consultation with occupational testing procedures and sampling will be undertaken for no less than 8 hours duration during each day of activity.

Asbestos was mostly detected in the south portion of the site and then only as a few discrete fibres in soil samples, although asbestos containing material has not been detected (or rarely detected) at the balance of the site, asbestos air samplers will operate at all times when active remediation works are being undertaken to be conservative, given the nature and history of the site.

4.5.2 Analytical Method

Asbestos levels will be measured in accordance with the National Occupational Health and Safety Commission's (NOHSC) Membrane Filter method for the determination of airborne fibre. In the field, a known volume of air will pass through the filter with any asbestos fibres being trapped. The filter is treated to become transparent and observed using phase contrast optical microscopic techniques. Particles of conforming dimensions (including non-asbestos fibres) are "counted" as fibres. Hence this method can overestimate the true amount of asbestos present (i.e. err on the side of caution). The volume of air that has passed through the filter is recorded, allowing an average concentration of airborne fibres to be determined.

4.5.3 Air Quality Standards

The applicable standards for monitoring asbestos are provided in *Worksafe Australia Asbestos: Code of Practice and Guidance Notes*, (NOHSC, 1988a); *Worksafe Australia No. 2002 Code of Practice for Asbestos Removal* (NOHSC, 1988b); and the Occupational Safety and Health Regulations 1996.

In terms of protecting public health at the CADCOM Police building (nearest site with a large number of employees), the target background level will be the NATA collection and detection limit of 0.01 fibres/mL (10 times below the occupational limit). In view of the sensitivity of this monitoring location, it is proposed that excavation work will cease while dust management procedures are reviewed if this target criteria is exceeded while the wind is likely to be directing dust from the excavation site to the CADCOM monitor. Table 3 outlines the asbestos fibre air quality criteria.

TABLE 3
ASBESTOS CRITERIA

LOCATION	TARGET CRITERIA (fibres/mL)	WORK STOPPAGE (fibres/mL)
Off-site	<0.01	0.01

4.6 Total Suspended Particulates

4.6.1 Monitoring Program

Total Suspended Particulates (TSP) dust monitoring is a general measurement for assessing the performance of the dust management program. TSP includes fine particulates (PM_{10}) and larger particles that are suspended in air as dust. It is anticipated that, with good dust prevention and management measures in place, there may not be the requirement to undertake both PM_{10} and TSP monitoring.

TSP monitoring will be undertaken for off-site exposure at all three monitoring sites for the first 2-4 weeks of the remediation program.

The short-term TSP program will be undertaken for two reasons:

1. Firstly to provide a site specific relationship between TSP and PM_{10} results to allow the TEOM and DusTrak results to be used to develop conservative estimates of TSP values. It if recognised that this relationship will be affected by factors such as meteorology and the distance between the remediation site and the monitoring sites. But the PM_{10} measurement is the primary result of concern and the TSP estimate simply be used to estimate amenity impacts; and

2. To provide an estimate of contaminant levels contained in TSP. This will be achieved by analysing the daily filter papers for the following parameters:
   - metals (arsenic, cadmium, chromium, copper, mercury, lead, nickel and zinc)
   - PAHs

The results will be assessed at the end of the two weeks monitoring and decision made whether to undertaken further TSP monitoring.

4.6.2 Analytical Method

High Volume (Hi-vol) sampler with TSP fittings as per *AS3580.9.3* (Standards Australia, 2003).

4.6.3 Assessment Criteria

TSP results will initially be compared to the TSP criteria (Table 4) derived from the criteria used in the current Kwinana Air Quality Environmental Protection Policy for residential area air quality (DEP, 1999).

TABLE 4
TSP CRITERIA

LOCATION	**TARGET CRITERIA** (Ng/m^3)	**WORK STOPPAGE** fibres/mL (Ng/m^3)
Off-site	90 (24 hour average) 750 (15 minute average)	150 (24 hour average) 1000 (15 minute average)

The 15 minute criteria will only be used in the event that complaints are being received that excessive dust emissions as the measurement of 15 minute average data for TSP requires the use of specialised portable equipment. The continuous PM_{10} measurements can act as surrogate for 15 minute TSP data in the first instance.

As described in Section 4.6.1, the filter papers from each day of the first two weeks of sampling will be subjected to analysis to determine whether there is a need to adjust the TSP or PM_{10} criteria adopted as a result of contaminant loads in the particulate matter.

4.7 Fine Particulates (PM_{10})

4.7.1 Monitoring Program

Fine particulate (PM_{10}) dust monitoring captures that fraction of airborne particulates which represents the greatest potential health issue as it is capable of being respired into the lung.

PM_{10} monitoring will be undertaken for off-site exposure at the eastern site boundary for the duration of the remedial works. Monitoring will be with a continuous air sampler capable of providing alert messages for initiating corrective action.

In addition, DusTrak monitors will be used at other fixed monitoring locations to provide an estimate of PM_{10} levels.

Results will be assessed against the relevant standards as outlined in Section 4.7.3.

4.7.2 Analytical Method

Particulate monitoring for public exposure will be undertaken using a TEOM (Tapered Element Oscillating Microbalance) analyser in accordance with *AS3590.9.8-2001*.

This monitor will be placed at a fixed location near the CADCOM Police building, and provides constant real time measurements of PM_{10} particulates. The monitor will be run for 24 hours per day seven days per week during the course of the works.

A SMS text alert will be connected to the monitor and set up so that an SMS message will be sent to the Site Supervisor and Environmental Supervisor if the Corrective Action Response Level is ever exceeded. The averaging period for the results will be set at 10 minutes as this was the monitor default settings rather than 15 minutes as nominated by the DoE. This shorter averaging period provides for a greater degree of conservatism as the 10 minute results will be compared to the 15 minute criteria specified.

As indicated in section 4.7.1 DusTrak particulate monitors which use an optical light scattering in technique will be used to estimate PM_{10} levels at other fixed monitoring stations

4.7.3 Assessment Criteria

PM_{10} results will be assessed against the *National Environmental Protection Measure (NEPM) for Ambient Air Quality* (NEPC, 1998). This standard represents a longer term goal for ambient air quality "that allows for the adequate protection of human health and well being".

The NEPM specifies an ambient air quality target of 50µg/m^3 for $PM_{10.}$ The NEPM criterion is a 24-hour average. Instantaneous levels can be considerably higher than the NEPM criterion. For works completed previously on the MRA site, the Air Quality Branch of the DoE has also nominated a short-term air quality criteria to be used as a management target and with the aim of ensuring that the 24 hour average complies with the NEPM criterion. The short-term limits are:

- a 15 minute average corrective action limit of 250µg/m^3; and
- a work stoppage value of 400µg/m^3.

Table 5 summarises the fine particulate air quality criteria that are proposed by the MRA.

TABLE 5
FINE PARTICULATES AIR QUALITY CRITERIA

Location	**Target Criteria** (µg/m^3)	**Corrective Action Response Level** (µg/m^3)	**Work Stoppage** (µg/m^3)
Off-site PM_{10}	<50 (24 hour) or background, whichever is the higher	250 (15 minute)	400 (15 minute)

4.8 Dust Management Assistance - DustTrak

4.8.1 Monitoring Program

To provide an additional tool for dust management, an aerosol monitor capable of recording data on a continuous basis will be located along the northern, eastern and western boundaries.

These results will not be used for compliance purposes against the NEPM but rather as a management tool to assess the effectiveness of dust suppression to ensure the Corrective Action Response Level and Work Stoppage values are complied with to protect public health at the boundaries.

The results shall be assessed against the relevant standards as outlined in Section 4.8.3.

4.8.2 Analytical Method

Aerosol monitoring will be determined using a “DustTrak” or equivalent optical scattering monitor. These results will not be used for compliance purposes but rather as a management tool for dust suppression to ensure compliance criteria are met at the boundaries.

Instruments of this type generally rely on an assessment of light scattering or attenuation by particulates over a fixed path and are calibrated with ‘standard dust’. The manufactures suggest that the results can be used as an estimate of PM_{10}.

4.8.3 Assessment Criteria

The criteria to be used for assessment of these results are the same as those for Fine Particulates shown in Table 5. However, the results would be used for dust management purposes only, and not for regulatory purposes.

4.9 Metals

4.9.1 Monitoring Program

The potential for elevated concentrations of metals to be present in airborne particulates is assessed as being low due to the nature of the waste fill material being excavated. The waste fill material is generally coarse material and the metals are generally contained in a slag material which binds the metals and minimises dust generation.

It is proposed that metal concentrations will be assessed in High Volume Sampler filter papers in the initial 2-4 weeks of the remedial works to assess the levels of metals present in the particulate matter. Monitoring will target the significant metals present in the soils from a human health perspective (i.e. copper and lead). The filter papers will be provided to the laboratory on the same day, if possible, to obtain the fastest possible turnaround in results and prompt response to dust management if required.

Results shall be assessed against the relevant standards as outlined in Section 4.9.3.

4.9.2 Analytical Method

Metal particulate monitoring for public exposure will be undertaken using Hi Volume Sampling in accordance with AS 3580.9.3. Laboratory analysis of the filters will be undertaken for the first two weeks of earthworks. This approach provides quantitative results for concentrations of metals in the air, but there is a delay (of 3-5 days) before results are available from the laboratory so that Hi-Vol monitoring is not suitable for immediate management purposes. However, DustTrak samplers will also be employed to assess the effectiveness of dust prevention and management measures as described in Section 3.2.

The results of Hi-Vol monitoring will be assessed against the air quality standards. If the metals results are below the target criteria specified in Table 5, no further monitoring will be required. If concerns exist regarding metal concentrations in airborne dust, monitoring will continue or be re-initiated.

4.9.3 Assessment Criteria

Metal concentrations will be assessed against the criteria specified in Table 6. These criteria are identical to those used during the remediation of the adjacent Helena West site, and are considered to be appropriate to apply to Helena East remedial works due to the similarity of metals concentrations in the material to be remediated. The Target Criteria were set following discussion with staff from the Departments of Environment and Health.

Table 6 lists air quality criteria for metals in airborne particulates. The Corrective Action values have been set at 50% of the Work Stoppage Level. This allows management action to be triggered well before Work Stoppage Levels are reached.

TABLE 6
HEAVY METAL PARTICULATES AIR QUALITY CRITERIA
(24 HOUR AVERAGES)

LOCATION	TARGET CRITERIA (µg/m^3)	CORRECTIVE ACTION (µg/m^3)	WORK STOPPAGE LEVEL (µg/m^3)
Arsenic dust	0.57	0.25	<0.50
Copper dust	45	20	<40
Lead dust *	1.3	0.5	<1
Zinc dust	79	35	<70

* As significant background levels of lead may be present as a result of lead emissions from use of motor vehicles on adjacent roads, lead criteria adopted will be interpreted in conjunction with meteorology data.

4.10 Baseline Monitoring

Baseline continuous monitoring will be conducted before the commencement of remedial works for a period of one week at the monitoring sites to provide a background measure of air quality for the local area. The observed range of background levels will be used as the benchmark for assessing any degradation of air quality as a result of the remedial works; this is described in more detail in the following subsection. Weather conditions will also be noted during this observation period.

The following baseline monitoring will be undertaken:

- Asbestos
- TSP (Total Suspended Particulates) using High Volume Samplers
- PM_{10} (Fine Particulates) using DustTrak samplers
- PM_{10} (Fine Particulates) using TEOM
- etc
- Metals (antimony, arsenic, copper, lead) using High Volume Samplers

4.11 Visible Nuisance Dust

Nuisance dust will be assessed by visual inspection on a regular basis. Visual inspection results will be maintained on a daily logging sheet for reference.

4.12 VOC Monitoring

4.12.1 Monitoring Program

During the excavation of hydrocarbon contaminated soils, monitoring of VOC levels will be undertaken using a evacuated canisters as per method TO-15. Concentrations of PAHs will be monitored using method TO-13A. The excavation works are expected to continue for at least 10 weeks to allow excavation of soil in the vicinity of the Powerhouse and the Southern Embankment.

Canisters will be sited at a location that is down wind of the excavation area and also adjacent to the Police/CADCOM building which is the location of the closest human receptors.

If regular exceedances are detected using this methodology, more comprehensive monitoring regime will be implemented, e.g. using a Photo Ionisation Detector (PID) to provide results at shorter averaging times.

4.12.2 Analytical Method

USEPA Compendium Methods TO-13A and TO-15 *Compendium of Methods for the Determination of Toxic Organic compounds in Ambient Air* (USEPA 1999a, USEPA 1999b).

4.12.3 Air Quality Standards

There are a few published ambient air quality criteria for many of the VOC compounds that may be present on the site. As a result, it is proposed that the World Health Organisation Guidelines are used to assess the results. The 24 hour average guidelines cited in the *Volatile Organic Compounds Monitoring in Perth, Baseline Air Toxics Project* (DEP, 2000) report are used in the absence of other appropriate guidelines. As the WHO Criteria are generally set for long term protection of health in a prolonged exposure environment, they will be used as target values. Corrective action will be initiated at 150% of these WHO Criteria and work will cease where results exceed 200% of the WHO Criteria. The proposed Criteria are set out in Table 7.

TABLE 7
INTERNATIONAL GUIDELINES FOR AMBIENT AIR TOXICS

AIR TOXINS	**CONCENTRATIONS (**ppb)		
	WHO 24-h Average Guidelines[a]	Other Annual Average Guidelines	
		Sweden[b]	UK[c]
Dichloromethane	792	100-250	-
Chloroform	0.2	-	-
1,2-Dichloroethane	159	100-150	-
Benzene	-	0.4	5
Trichloroethylene	-	100-150	-
Toluene	63.2*	10-100	-
Tetrachloroethylene	33.8	100-200	-
Ethylbenzene	4644*	-	-
Xylenes	1013	-	-
Styrene	55.9*	10	-

[a] WHO guidelines quoted are for 24h averages except for compounds with asterisks (*) which are 1 week averages (WHO, 1987, 1994, 1996 & 1997)
[b] OECD, 1995
[c] EPAQS, 1994

5. CONTINGENCY RESPONSE

Should air quality monitoring show that dust and airborne contaminant emissions exceed the ***Corrective Action Response Levels,*** dust management practices will be immediately reviewed and corrective action taken to improve air quality. If the ***Work Stoppage Level*** is exceeded, all remedial work creating the dust source will cease until monitored levels fall below the ***Corrective Action Response Level.***

5.1 Corrective Action during Remedial Works

The corrective action taken will typically comprise the following sequence of actions:

- check all trucks are appropriately covered and that earthmoving machinery is operating in wetted down areas;
- increase the water application rates over all disturbed areas;
- reduce the level of earthmoving activity if evaporation rates are drying the fill quicker than water can be applied;
- reduce the area of disturbance to minimise VOC emissions;
- apply a suitable physical dust suppressant to any inactive areas; and
- cease all work if extreme weather conditions are the prime reason for excessive dust levels and dust suppression techniques have been ineffective in controlling the dust.

5.2 Notification of Exceedence

The DoE will be notified in writing within 24 hours if there has been an exceedence of the corrective action or target values. Should there be a work stoppage this will be notified immediately on the day by phone and in writing.

6. REPORTING

Reporting of the Dust and Air Quality Management for Remediation of Helena East Soils at Midland Railway Workshops will be undertaken in two formats as follows:

- periodic reporting during remediation works
- a summary report will be prepared after the conclusion of the remedial works.

The periodic reporting will provide information on general trends of dust management via dust monitoring results to the DoE. In addition, the DoE will be provided with notification of any compliance breaches (if they should occur) within 24 hours of occurrence.

A Dust and Air Quality Management Report providing the following information will be provided after the conclusion of the remedial works:

- Air Monitoring Parameters
- Air Quality Standards
- Air Monitoring Methods
- Air Monitoring Locations
- Air Monitoring Results
- Conclusion

Upon submission of the Report ATA Environmental on behalf of the MRA, will request that any condition(s) regarding dust and air quality management are formally cleared by the DoE.

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FIGURES

APPENDICES

APPENDIX A

REVIEW OF AIR EMISSIONS MANAGEMENT AT PREVIOUS MRA REMEDIATION SITES

REVIEW OF AIR EMISSIONS MANAGEMENT
AT PREVIOUS MRA REMEDIATION SITES

1. INTRODUCTION

1.1 Background

Remediation activities at the former Midland Railway Workshops have been subject to extensive air monitoring since the first major remedial works were carried out in Area E in April 2002.

In recent times community interest has developed regarding adverse air quality associated with remedial works. As such the Department of Environment (DoE) in subsequent assessments of the former Workshops site has required that maintenance of air quality be considered a key environmental objective of the project. The means to ensure this environmental objective has been achieved is through monitoring of air quality during the remediation phase.

Impacts on air quality during a remediation are a function of many factors including, but not limited to, the following:

- Time of year, which determines the moisture content of the ground and thus dust emission potential;
- Magnitude or the size of the earthworks;
- Rate at which the earthworks are undertaken;
- Proximity of residents or sensitive receptors to the remedial works; and
- How effective the management controls are for controlling air quality.

1.2 Proposed Remediation of Helena East

The proposed remediation of Helena East represents a significant earthworks event that requires a strong commitment to management and dust control. The MRA has demonstrated through its management team that it can undertake these large scale earthworks whilst ensuring air quality is maintained at the strict standards set by the DoE and the Department of Health.

The following is a review of how MRA has managed and monitored air quality during the remediation of various parts of the site including Area E, Helena West Area B, C, AND D (WAPS) and the Helena Street Extension. Experience has shown that air monitoring alone will not ensure maintenance of air quality and that an effective understanding of dust management along with real time air monitoring ensures the best outcome.

2. AIR EMISSIONS MANAGEMENT AT PREVIOUS SITES

2.1 Area E Air Monitoring Review

The remediation of Area E included the excavation and relocation of localised areas of contaminated shallow soil with concentrations above those suitable for an industrial landuse. The soils were contaminated with heavy metals and/or asbestos fibres. Particulate or dust emissions were the primary mode of transport for these contaminants. In addition to the contaminants in the dust is the fact that fine particulates defined as less than 10 microns (PM_{10}) are themselves a potential health issue. The total volume of soil removed was relatively minor at Area E.

Monitoring was extended to include the roadworks associated with construction of Clayton Street due to the large amount of low level contaminated soil that was removed for geotechnical reasons. This additional monitoring was not required by the DoE, but was undertaken by MRA demonstrating a strong commitment to management and dust control.

2.1.1 On-site Air Monitoring for Dust

An on-site portable aerosol monitor was used to measure PM_{10}, which was moved in response to where earthworks were occurring and located immediately downwind. These monitors are a light scattering device and provide real time measurement of fine particulates but are limited in that they are not covered by an Australian Standard and are thus subject to a degree of inaccuracy. The air quality standard applied for the remediation and roadworks was the NEPM (National Environmental Protection Measure) of $0.05 mg/m^3$. This standard is a target value for ambient air quality and is protective of the most sensitive persons such as those with respiratory complaints or asthma.

On-site personnel were requested to wear personal air samplers for collecting respirable dust over the two days of specific remediation earthworks for assessing occupational exposure which is set at $5mg/m^3$. WorkSafe Western Australia provided occupational exposure standards.

A high volume air sampler (HVAS), which measured total suspended particulates (TSP), was located near the earthworks. The HVAS uses a fan to draw large amounts of air through a filter paper where dust is deposited. The dust from the monitor was also tested for heavy metals known to occur in the waste fill. This type of monitoring was not real-time as the filter papers needed to be weighed and analysed at a laboratory. The HVAS method is to a recognised Australian Standard and as such could be directly compared to standards for compliance purposes. Occupational exposure standards were used for assessment purposes.

Asbestos fibres were tested for using an elutriator method where a medium flow pump and baffle is used to draw fine particulate air onto a filter paper where it can then be inspected in the laboratory for fibres. It should be noted that the asbestos fibre monitoring collects any fibre that conforms to a particular size and that the fibre collected may not actually be asbestos. The elutriator method could provide a theoretical asbestos fibre detection level of 0.0002 fibres/mL. It should be noted that subsequent advice from the Department of Health was that this method was not to a recognised Australian Standard for collection and as such the level of detection could not be validated with any surety.

Results of this monitoring indicated that no monitored site person was exposed to unsafe levels of contaminants.

2.1.2 Off-site Air Monitoring for Dust

No off-site monitoring for dust was undertaken due to the small magnitude of remedial works and the fact that the site was relatively isolated from potentially sensitive receptors at the time.

2.1.3 Summary – Area E

Air monitoring for Area E indicated that earthworks at the site did not create adverse air quality and that with good dust management practices and favourable weather conditions, the air quality could be maintained below the NEPM standard (for dust of $50ug/m^3$ 24 hour).

Advice back on the asbestos monitoring method was that only the National Occupational Health and Safety Commission (NOHSC) Membrane Filter method should be used for the determination of airborne fibre. This method provides a detection limit of 0.01fibres/mL, which is 50 times higher than the elutriator method. If a fibre requires confirmation as asbestos then the unused portion of the filter paper will need to be tested using Scanning Electron Microscopy (SEM) techniques with an Energy Dispersive X-ray probe (EDAX).

2.2 Helena West Air Monitoring Review

The remediation of Helena West included the excavation and relocation of significant amounts of waste fill ($63,000m^3$) and recovery of oily sludges from the base of the Coal Dam by means of a dredge, which was then allowed to settle and dry in purpose built ponds. As such, the air monitoring focused on two distinct contaminant sources; particulates from the excavation and handling of the waste fill, and volatile emissions from the dam sludges. The waste fill was contaminated principally with heavy metals and asbestos fibres at particular areas.

The sludges were removed as dredge spoil and thus were in a liquid form. These sludges were contaminated mostly with aliphatic hydrocarbons but also potentially with more volatile forms of hydrocarbons such as benzene, xylenes and naphthalene. When the oils had settled, the sludge was mixed with cinder ash and then placed on top of limestone drying beds for a period of a few months. As the sludges dried they liberated sulphur compounds in the form of sulphur dioxide and hydrogen sulphide.

Remedial works commenced in January 2004 with the dredging of the base of the Coal Dam, and in February 2004 with the earthworks.

Air monitoring was separated into two receptor groups; on-site personnel or occupational exposure and off-site or the public. As such, there were two distinct air quality standards; those for occupational exposure and the other being public exposure. The DoE with advice from the Department of Health provided public exposure standards to be used during the remediation phase.

The primary method for managing dust suppression was through use of dedicated water carts that continuously wet down the earthworks area and access tracks.

2.2.1 On-site Air Monitoring for Dust

On-site portable aerosol monitors were used to measure fine particulates that were moved in response to where earthworks were occurring and located immediately downwind. These monitors are not covered by an Australian Standard and thus subject to a degree of inaccuracy. However they were used as a screening tool to estimate on-site air quality.

On-site personnel were requested to wear personal air samplers from time to time, which collected respirable (fine particulates) dust and the other asbestos fibres on a filter paper. This method of monitoring was to ensure compliance with occupational exposure standards, which are less stringent in comparison to public standards.

A HVAS was located near the earthworks, which measured TSP and heavy metals known to occur in the waste fill. As the HVAS required filter papers to be changed daily and then processed in the laboratory, results took a number of days to be calculated. As such this air monitoring provided historical data (for documentation) rather than real time concentrations. The HVAS method is to a recognised Australian Standard and as such could be directly compared to standards for compliance purposes.

Results of this monitoring indicated that no monitored site personnel were exposed to unsafe levels of either contaminant. Where works were undertaken in known asbestos impacted areas, machinery cabins were kept closed and air conditioning set to recirculation mode.

2.2.2 On-site Air Monitoring for Other Compounds

This monitoring applied specifically with regard to the sludges recovered from the Coal Dam. Monitoring was undertaken on-site, generally in the downwind direction of the drying ponds within 50m.

Of primary health concern was the Volatile Organic Compound (VOC) benzene which is a known carcinogen. Initially air was monitored using specific plastic sampling bags that drew in air. These bags detected low levels of VOCs, which were subsequently considered to be associated with residual contaminants within the bag rather than actual air quality. This sampling method was subsequently modified to absorbent tubes, which provided more accurate and reliable data that was consistently lower than the bags. Both methods required laboratory analysis and as such did not provide real time measurements.

Polycyclic aromatic hydrocarbons were measured using an absorbent tube and filter (USEPA Method TO13). This method measured both the vapour and particulate form. Concentrations were significantly below the public standard, which was measured on-site close to the source. This method required laboratory analysis and as such did not provide real time measurements.

A portable PID (Photoionisation Detector) was used to provide real time measurements of VOC emissions. This device is a screening tool and does not differentiate between compounds. It was calibrated to record all gases as benzene as this was the most significant from a human health perspective. A limitation with regard to the PID meter was the limit of detection which was 0.2ppm, more than 10 times higher than the public standard.

Sulphur dioxide and hydrogen sulphide were measured using a portable gas monitor normally used for gas detection in occupational environments, which provided real time measurements. This monitor was placed near the source both during settlement and at the drying pad. At no time did the sulphur gases exceed standards for either occupational or public exposure.

2.2.3 Off-site Air Monitoring for Dust

Off-site monitoring was conducted at three specific fixed stations located to the east, north and west of the site. It should be noted that the western monitor was initially sited within the work site much closer to the earthworks compared to the site boundary. The preferred location was to be within the school grounds; however limited access and a suitable site prevented this from occurring.

Two HVAS were located at each of the monitoring sites, one measured fine particulates and the other TSP. Dust from the TSP monitor was also tested for heavy metals known to occur in the waste fill. As stated, the HVAS required filter papers to be changed daily with results taking a number of days to be provided.

At the western site an additional HVAS was temporarily installed to sample ultra fine particulates referred to as $PM_{2.5}$ or particles less than 2.5 microns. Particles of this size are normally related to industrial air emissions rather than soil particles and as such the sampler was monitoring air quality from diesel powered vehicles and machinery. As such this data was not audited by the DoE as there was no applicable Australian Standard for sampling at the time.

At each sampling station, asbestos fibres were monitored for using a personal air sampler fixed to the fence. These samplers were changed daily.

At no time did the air quality with regard to heavy metals and asbestos fibres exceed the air quality standards at any monitoring station. There was however a number of occasions where the dust measured as both TSP and PM_{10} exceeded the standards nominated by the DoE. This was mainly in response to access tracks constructed of crushed limestone and the fine particle size associated with the clay subsoils and cinder ash in the waste fill.

2.2.4 Summary – Helena West

Air monitoring for Helena West was the most extensive performed for a remediation project in WA at the time. A significant limitation with regard to compliance purposes was for particulates and the time taken to obtain results, thus the absence of real-time monitoring that could be compared directly with a standard. The portable aerosol monitors were subject to variable results and the initial units used did not all have in-built alarms when a predetermined level was exceeded.

The other monitoring equipment was generally fit for purpose with again the limitation regarding real time monitoring with the exception of sulphur compounds. The PID meter provided real time measurement of VOCs, however the instrument was not sensitive enough for monitoring against public standards or capable of identifying individual compounds.

There were a few issues with the siting of the particulate HVAS monitors, which often became exposed to sources of dust not always related to the site works. The northern monitor site was adjacent to the freight rail line and potential soot emissions from passing trains. The eastern monitor was near a gravel car parking area, limestone access track and a spur line into the Workshops. The western monitor was not on mains power and was subject to some influence from soot emissions from the diesel generator. This confirms the importance of locating such monitors away from secondary sources of air emissions.

2.3 WAPS (Area B, C, and D) Air Monitoring Review

The remediation of WAPS included the excavation and relocation of a significant quantity of waste fill (99,000m^3) and recovery of hydrocarbon impacted waste fill from the site of the former solvent dump. This remediation was scheduled to occur prior to Helena West and as such the Management Plan prepared for the works was cleared by the DoE prior to the results and performance of Helena West.

The waste fill was contaminated principally with heavy metals and asbestos fibres at particular areas. The solvent dump contained the VOC's benzene and chlorobenzene.

Remedial works commenced in July 2004 with a start to the solvent dump in August.

As for Helena West, air monitoring was separated into two receptor groups; on-site personnel and the public. Close to the remedial works was the CADCOM facility staffed by the WA Police service; this building was considered the closest public receptor. Air quality standards were set for the remediation based on recognised standards and advice from government departments.

Given the start to remedial works was in mid winter, ground conditions were very damp and not conducive to dust generation. Nonetheless, a water cart was made available to control any dust that was generated mainly in response to access tracks used by dump trucks.

2.3.1 On-site Air Monitoring for Dust

On-site monitoring was kept to occupational exposure through the use of personal air samplers for asbestos fibres, respirable dust and inspirable lead dust as well. Experience with the Helena West remediation showed aerosol monitors were not defendable with regard to compliance against standards. Therefore real time monitoring for fine particulates was undertaken as described below at the site boundary.

Results of this monitoring indicated that no monitored site person was exposed to unsafe levels of either contaminant. Where works were undertaken in known asbestos impacted areas, machinery cabins were kept closed and air conditioning set to recirculation mode.

2.3.2 On-site Air Monitoring for Other Compounds

This monitoring was applied specifically with regard to the removal of the hydrocarbon contamination associated with the solvent dump. The contaminants of concern were VOC's including BTEX (benzene, toluene, ethylbenzene and xylenes) and chlorobenzene. An absorbent tube as per USEPA method TO17 was employed to monitor air quality at the excavation face and where the material was being placed for future bioremediation, which due to site constraints did not eventuate but rather the soil was disposed off-site to landfill. This method provided a 1 hour 'snapshot' of air quality downwind of the contaminant source. The tubes were sent off for laboratory analyses which took a few days for results.

Real time monitoring was undertaken using a PID meter which provided VOC results down to 0.2ppm. This was used as a screening tool and as an alert to stop earthworks if concentrations exceeded a predetermined level set at 5ppm. The PID ran continuously when there was earthwork and data logged regular measurements.

2.3.3 Off-site Air Monitoring for Dust

Off-site monitoring for fine particulates and asbestos fibres was conducted at three specific fixed stations located to the east and west of the site, with one outside the northern boundary within the CADCOM grounds. The CADCOM location was placed in front of the building near the air conditioning inlet so it was sheltered from any off-site wind direction but would collect any dust emanating from the site.

The monitors used were TEOMs (Tapered Element Oscillating Microbalance) which complied with Australian Standards for the measurement of fine particulates (PM_{10}). A wind vane was installed at the eastern monitoring site to provide site specific wind measurements of speed and direction. The TEOMs were connected to a phone system that would send out an SMS text alarm when air quality criteria had been exceeded. This allowed for an immediate response to site activities to manage dust. A daily summary would be provided by email the following morning advising of predominant wind direction and measured levels at each of the monitoring sites including maximum 10 minute values.

Asbestos fibres were monitored for at each station using a personal air sampler fixed to the fence. These samplers were changed daily.

A HVAS was run for the initial three weeks of remedial works to confirm TSP concentrations and heavy metal contaminant levels at the CADCOM facility.

At no time did the air quality with regard to heavy metals and asbestos fibres exceed the air quality standards at any monitoring station. There was however a number of occasions where the dust measured as PM_{10} exceeded the standards nominated by the DoE. This was mainly in response to drying weather conditions as the remediation moved into summer 2004/2005 and the exposed clean clay subsoil being subject to wind erosion. Water carts were always directed as a matter of priority towards the areas of waste due to the contaminant potential. There were a large number of occasions where dust was generated from off-site sources east of the remediation works.

2.3.4 Off-site Air Monitoring for Other Compounds

VOC monitoring was applied at the CADCOM facility during the removal of hydrocarbon impacted fill from the site of the solvent dump. This comprised the absorbent tube as per USEPA method T017.

A passivated canister as per USEPA method T015 was also used to collect air samples over a longer period (8 hours) for three days at the CADCOM facility during removal of the solvent dump. The canister method is an evacuated cylinder that draws air in at a specified rate, which includes analyses for a more extensive suite of VOCs compared to the T017 method. This testing confirmed the absence of other types of volatiles.

Monitoring indicated that the CADCOM facility did not experience any VOC levels above the laboratory detection limit and that gases were only detected immediately adjacent to the contamination source and at concentrations below the standard.

2.3.5 Summary – WAPS (Area B, C, & D)

Air monitoring for WAPS included real time monitoring for fine particulates in accordance with Australian Standards, which enabled an immediate response to air quality issues. The TEOMs provided vector analyses that enabled determination of the contribution of the site to air quality and so the assessor could differentiate off-site sources. This was an important feature as there were consistent dust emissions from off-site sources onto the work area. Use of TEOMs obviated the need for utilising portable aerosol dust monitors which are unable to be directly compared with standards due to data reliability issues.

The VOC monitoring was constrained with regard to real-time monitoring of such emissions and therefore the PID meter was useful as an immediate measuring tool for checking air quality.

Commencement of remedial works in winter significantly assisted in the management of dust at the site compared to starting in drier conditions. Siting of the air monitors away from potential dust sources aided in reducing the number of false alerts due to localised non-contaminated dust emissions.

2.4 Helena Street Extension Monitoring Review

The remediation of Helena Street Extension included the excavation and disposal to landfill of waste fill (4,200m^3) comprising cinders and ash. This remediation occurred following remediation of Helena West and WAPS (Area B, C, AND D). The Helena Street Extension area was excised from Helena East and after referral to the DoE was informally assessed. However, the DoE reviewed and commented on the Dust and Air Quality Management Plan.

The waste fill was contaminated principally with heavy metals. Asbestos containing material had previously been removed from one portion of Helena East, but had not been detected in surrounding soils. Remedial works were undertaken in April and May 2005.

A draft of the Dust and Air Quality Monitoring Plan (DAQMP) was developed by ENV Australia Pty Ltd for the remedial works, which was provided at the initial referral stage of the Helena Street extension. The report was subsequently reviewed by the Air Quality Section of the DoE and its advice was included in a revised Plan issued to the DoE by ENV on 26/4/05.

ATA Environmental co-ordinated the air sampling program that was contracted to Compliance Monitoring of Lesmurdie. SGS Laboratories of Welshpool was subcontracted to perform the asbestos monitoring and testing.

The DAQMP identified specific air quality parameters to be measured. This included asbestos fibres and fine particulates in the form of PM_{10} (air particulates with a size of 10 microns or less).

Asbestos fibres were tested for as a precautionary measure on the premise that there had been asbestos demolition activity prior to remediation and that there may have been some residual fibres.

2.4.1 Off-site Air Monitoring for Dust

Air monitoring to the Australian Standard was performed at a permanent monitoring station located to the immediate south of the TAFE building as this represented the most significant potential receptor in terms of number of persons.

The TEOM monitor operated constantly for the entire duration of the works, including nights and weekends. At no time was the Corrective Action Response Level or Work Stoppage values exceeded. The 24 hour NEPM criteria of 50µg/m^3 was not exceeded.

A portable aerosol monitor was used to check fine dust air quality in locations other than the TAFE building. The Dust Trak monitor was used during the work day to monitor air quality for dust management purposes.

At no time was the Corrective Action Response Level or Work Stoppage values exceeded. The 24 hour NEPM criteria of 50µg/m^3 was not exceeded for the day average.

2.4.2 Off-site Air Monitoring for Other Compounds

Asbestos was monitored at two locations twice daily within the excavation area, at the downwind site boundary with the works. Asbestos levels were below the limit of reporting of 0.01 fibres/mL in all samples analysed.

Fibres were detected on the filter papers at up to 6 fibres/100 field. Two samples with the higher fibre counts were subject to SEM (Scanning Electron Microscopy) analysis to determine whether they were in fact asbestos. Neither sample contained fibres that were confirmed as asbestos by SEM.

2.4.3 Summary – Helena Street Extension

Results of the Helena Street Extension Remedial Works air monitoring program indicate that the air quality associated with the remedial works complied with the nominated DoE and NEPM criteria.

APPENDIX B

SOIL SAMPLING RESULT SUMMARIES FOR HELENA EAST SAMPLING PROGRAMS

TABLE B1
Heavy Metal Concentrations – Average and Range in Waste Fill and Soil
Helena East

Heavy Metals	Average (mg/kg)	Range (mg/kg)	No. Samples
Antimony	44.4	3 - 1,300	123
Arsenic	14.5	4 - 87	254
Barium	26.0	1 - 160	133
Cadmium	1.0	0.1 - 21	254
Chromium (Total)	39.1	3 - 450	253
Chromium (VI)	5.5	11 - 14	37
Cobalt	14.6	2 - 360	45
Copper	427.1	1 - 16,000	254
Lead	360.5	4 - 13,000	254
Manganese	87.0	0 - 566	78
Mercury	0.3	0.03 - 4.7	254
Nickel	20.6	1 - 660	254
Tin	61.5	7 - 800	133
Zinc	229.7	1 - 6,200	254
Cyanide (Total)	9.4	1.3 - 30	34

Note: The results are biased toward the 'worst case' scenario, since sampling was undertaken at various depths to identify maximum contamination.
Source: ATA Environmental (2005). *Helena East Precinct Remediation and Redevelopment Public Environmental Review*. Prepared for Midland Redevelopment Authority. March 2006.

TABLE B2:
Metal Concentrations – Average and Maximum in Waste Fill
Helena West [1]

	Area H1A (36 Samples)		Area H2 (10 Samples)		Area H3 (60 Samples)	
Metals	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**
Antimony[2]	2	<1 - 12	4	<1 - 13	5	<1 - 60
Arsenic	51	<1- 1040	6	<1 - 15	49	<1-1710
Barium[2]	239	1 - 1070	305	50 - 880	207	2 - 688
Cadmium	1	<1 - 2	4	<1 - 14	1	<1 - 4
Chromium	15	<1 - 35	15	8 - 21	22	<1-444
Copper	385	<1- 7870	213	10 - 866	424	1-3930
Lead	428	<1- 4580	484	21- 2500	315	2-3140
Manganese	180	2 - 439	304	38- 1090	212	4 - 786
Mercury	1.9	<0. -17.8	1.4	<0.1-11.9	0.6	<0.1-9.9
Nickel	21	<1 - 67	30	6 - 42	26	<1-114
Tin	48	<1- 1150	60	2 - 551	48	<1-606
Zinc	206	1 - 1410	2043	32- 8520	229	3-1600

Note: These results include Waste Fill only, since Surface Soil results were presented in a separate table.
All results expressed as (mg/kg)
Sources:
1. Unless otherwise noted, data source is: EPA (2003). *Remediation of Midland Railway Workshop site, Helena West, Midland. Proponent: Midland Redevelopment Authority. Report and recommendations of the Environmental Protection Authority.* Perth, Western Australia. Bulletin 1111. September 2003. Page 8, Summary of Site Contamination – Waste Fill.
2. ENV (2003). *Detailed Site Investigation Helena West, Midland Railway Workshop Site.* Prepared for Midland Redevelopment Authority. Prepared by ENV Australia. March 2003.

TABLE B3
Number of Sample Locations Where Asbestos was Identified

Area	Total Locations with Asbestos Detected	Total Locations Analysed	Percentage Detected
North of copper shop/power house	2[1]	15	13%
West of Pattern Store and Panel Shop	2	26	8%
Block 1 to 3, and south of stores	1	32	3%
East of Panel Shop, West of Block 3, to southern embankment	35	80	44%
Southern Embankment	4	10	40%

Notes:
[1] Asbestos was detected beneath floor of Heritage listed Foundry building. Heritage building will be remediated separately as part of the Heritage Restoration Works (ATA, 2006).

TABLE B4:
Petroleum Hydrocarbons and PAH Concentrations – Average and Range in Waste Fill Soil

Petroleum Hydrocarbons	Average (mg/kg)	Range (mg/kg)	No. Samples
Benzene	0.0	0 - 0	98
Toluene	0.0	0 - 0	98
Ethyl-benzene	4.8	0 - 4.8	98
Xylenes	28.0	0 - 28.0	98
C_{6-9}	33.0	0 - 33.0	142
C_{10-14}	466.9	100 - 466.9	142
C_{15-28}	1,553.2	510 - 1,553.2	142
C_{29-36}	130.5	120 - 1,000	142
$C_{>36}$	60.4	20 - 240	142
C_{6-15}	480.8	100 - 1,700	63
C_{16-35} aromatics	628.4	411 - 2,330	63
C_{16-35} aliphatics	1,130.9	116 - 5,960	63
Polycyclic Aromatic Hydrocarbons			
Naphthalene	8.5	0 - 34	47
2-Methylanphthalene	13.0	0 - 68	47
Acenaphthylene	0.0	0 - 0	47
Acenaphthene	0.0	0 - 0	47
Fluorene	1.0	0 - 2.2	47
Phenanthrene	1.0	0 - 3.9	47
Anthracene	0.1	0 - 0.1	47
Fluoranthene	0.1	0 - 0.4	47
Pyrene	0.2	0 - 0.4	47
Benzo[a]anthracene	0.2	0 - 0.2	47
Chrysene	0.2	0 - 0.2	47
Benzo[b]fluoranthene	0.2	0 - 0.2	47
Benzo[c]fluoranthene	0.2	0 - 0.2	47
Benzo[a]pyrene	0.2	0 - 0.2	47
Indeno[1,2,3,-c,d]pyrene	0.2	0 - 0.2	47
Dibenza[a,h]anthracene	0.0	0 - 0	47
Benzo[g,h,l]perylene	0.0	0 - 0	47
Total PAH	53.0	0 - 107	47

Note: Sampling was undertaken at various depths to identify maximum contamination so that results are biased toward 'worst case' scenario.

TABLE B5:
Volatile Organic Compounds – Average and Range in Waste Fill Soil

Volatile Organic Compounds	Average (mg/kg)	Range (mg/kg)	No. Samples
Isopropylbenzene	1.05	1 - 1.1	91
n-Propylbenzene	2.2	1.1 - 3.4	91
1,3,5-Trimethylbenzene	16	1.7 - 34	91
1,2,4-Trimethylbenzene	23	5.8 - 48	91
sec-Butylbenzene	2.3	1.7 - 3	91
4-Isopropylbenzene	3.13	2.3 - 4.7	91
n-Butylbenzene	1.6	1.3 - 1.9	91
cis-1,2-Dichloroethene	3.9	3.9 - 3.9	91
Tricholoethene	1.8	1.2 - 2.4	91
Tetrachloroethene	40.7	16 - 56	91

Note: No other common Volatile Organic Compounds (VOCs) were detected

APPENDIX C

SITE CLASSIFICATION ASSESSMENT CHART FOR HELENA EAST

APPENDIX D

BUREAU OF METEOROLOGY
MONTHLY DATA FOR
PERTH AIRPORT