Department of
Environment and Conservation

A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities.

Department of Environment and Conservation
January 2011

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Glossary, acronyms and definitions

Air toxics	Air toxics are gaseous, aerosol or particulate pollutants which are present in the air in low concentrations with characteristics such as toxicity or persistence so as to be a hazard to human, plant or animal life.
Airborne particles (aerosols)	Airborne Particles are suspended in the air and exist as aerosols--dust, fumes, smoke or mists. These different aerosols are classified according to their processes of formation, as indicated below. However, from a health and nuisance impact perspective, particles are classified primarily by size, defined below as PM_{10}, $PM_{2.5}$ and TSP. **Dust** is an aerosol formed by mechanical subdivision of bulk material into airborne fines having the same chemical composition. Dust particles are generally solid and irregular in shape and have diameters greater than one micrometre. **A fume** is an aerosol of solid particles formed by condensation of vapours formed at elevated temperatures. The primary particles are generally very small (less than 0.1 micrometre) and have spherical or characteristic crystalline shapes. Since they may be formed in high number concentrations, they often rapidly coagulate, forming aggregate clusters of low overall density. **Smoke** is formed by condensation of combustion products, generally of organic materials. The particles are generally liquid droplets with diameters of less than 0.5 micrometre. **Mist** is droplet aerosol formed by mechanical shearing of a bulk liquid; for example, by atomisation, nebulisation, bubbling, or spraying. The droplet size can cover a very large range, usually from about two micrometres to greater than 50 micrometres.
Ambient air	The external air environment, it does not include the air environment inside buildings or structures.
BAM	Beta Attenuation Monitor (dust monitoring equipment)
BPM	Best practice measures

DEC	Department of Environment and Conservation
DOH	Department of Health
Dust	The generic term used to describe solid airborne particles generated and dispersed into the air by processes such as handling, crushing and grinding of organic or inorganic materials such as rock, ore, metal, coal, wood or grain and stockpiling of materials and wind blown dust.
Diffuse Source	Source of dust from non-point sources (see definition of point source below) such as land clearing, quarrying etc.
EMP	Environmental management plan
EIA	Environmental impact assessment
EPP	Environmental protection policies
Equivalent aerodynamic diameter (EAD)	The diameter of a spherical particle of density 1000kg/m^3 that exhibits the same aerodynamic behaviour as the particle in question.
$\mu g/m^3$	Microgram per cubic metre referenced to a temperature of 0 degrees Celsius and an absolute pressure of 101.325 kilopascals.
Fugitive dust	Fugitive dust is dust which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.
HRA	Health risk assessment. A process used by developers to demonstrate that their proposals will not adversely affect the health of the surrounding community.
MIL	Monitoring investigation levels
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National environment protection measure
NHMRC	National Health and Medical Research Council
PAHs	Polycyclic aromatic hydrocarbons. PAHs may be emitted during the remediation of contaminated sites which are contaminated with PAHs. PAHs may be released as particulate matter or in gaseous from.
PM_{10}	Refers to dust particles/particulate matter with an equivalent aerodynamic diameter of up to 10 micrometres.
$PM_{2.5}$	Refers to dust particles/particulate matter with an equivalent aerodynamic diameter of up to 2.5

	micrometres.
Point source	Source of dust from a stack/chimney.
POPs	Persistent organic pollutants (air pollutants that may be emitted during activities such as remediation of contaminated sites).
Quality Assurance/ Quality Control (QA/(QC)	All those planned or systematic actions necessary to provide adequate confidence that a service is of the type and quality needed and expected by the customer.
Sensitive receptor	Individuals/communities/components of the environment which could be adversely affected by dust emissions, such as people in dwellings, schools, hospitals, nursing homes, child care facilities, offices, public recreation areas that exist now and in the future and protected wetlands. Some individuals may be more susceptible to adverse air quality, such as, children, the elderly and people with pre-existing medical conditions such as asthma or heart disease.
SEP	State environmental practice
TEOM	Tapered element oscillating microbalance (dust monitoring equipment)
Total suspended particles (TSP)	All particles entrained/suspended in the atmosphere and includes the fine, respirable particles (PM_{10} and $PM_{2.5}$) and larger size particles that may settle out of the air causing nuisance impacts, usually measured as those particles having an equivalent aerodynamic diameter of 50 micrometres or less.
Trigger levels	The 'corrective action' trigger level is the ambient air dust level which if exceeded will result in corrective action being taken to reduce dust emissions until the dust levels fall below the corrective action trigger level. The 'work stoppage' trigger level is the ambient air dust level which will result in work stoppage until the dust levels fall below the work stoppage trigger level.
VOCs	Volatile organic compounds. VOCs are non-dust air pollutants that may be released during the remediation of contaminated sites.

Executive summary

This guideline provides guidance on preparing a plan for the management of dust and associated contaminants arising from various activities such as land clearing for development, remediation of contaminated sites, mining and quarrying, bulk materials handling and storage and demolition works. The preparation of a dust management plan may be a requirement prior to a works approval being granted. The document also contains information that may require consideration during the environmental impact assessment (EIA) process.

The dust generated may be contaminated with heavy metals, polycyclic aromatic hydrocarbons (PAHs) or asbestos. Other non-dust air pollutants such as volatile organic compounds (VOCs) may also be emitted, for example, during contaminated sites remediation works. These emissions could affect the health and amenity of the surrounding communities. It is therefore important that management measures for dust and other air pollutants are put in place to avoid emissions or reduce the levels in the ambient air to acceptable levels. Various dust control measures can be implemented.

Monitoring is important for compliance purposes at sensitive receptors, to ensure that levels of dust and other air pollutants remain below the ambient air quality (off-site) standards. Monitoring should be conducted in accordance with the relevant Australian standards or where no Australian standard exists, in accordance with equivalent USEPA or other standard. On-site dust monitoring is useful to assess the effectiveness of dust management on site and also to facilitate the achievement of the off-site (ambient air) standards.

Some ambient air standards are prescribed in the national environment protection measures (NEPMs) for ambient air and air toxics. Where a standard for an air pollutant is not prescribed in the NEPMs, the standard should be selected in accordance with the DEC interim approach to adopting ambient air quality values.

Prior to commencing works, a dust management plan/program should be prepared and should include details of a site risk assessment. For sites generating uncontaminated dust, a site classification chart has been included, adopted from the 1996 Department of Environment and Conservation (DEC) dust guideline. For sites generating contaminated dust, a health risk assessment (HRA) should be conducted in accordance with the HRA requirements of the Department of Health (DOH). The level of dust management and monitoring will depend of the outcome of the site risk assessment. Sites with high to medium risk will require more stringent dust control and monitoring. The dust management plan should be approved by the relevant decision-making authority – EPA, DEC, DOH and/or local government, prior to implementation.

1.0 Introduction

1.1 Purpose of guideline

This guideline deals primarily with the management of dust generated from diffuse sources such as land clearing activities, earthworks during construction, remediation of contaminated sites, demolition works, bulk materials handling, mining and quarrying activities including the storage, transport and stockpiling of soil or other material on site. The purpose of this document is to assist proponents, consultants and regulators in the development and implementation of dust management programs. The guideline also discusses dust management for the remediation of contaminated sites, where other pollutants may need to be considered. These pollutants include heavy metals, polycyclic aromatic hydrocarbons (PAHs), asbestos and volatile organic compounds (VOCs).

The guideline does not address control or testing of industrial stack emissions (point sources). It is aimed at minimising the impact of fugitive dust (diffuse sources) on the environment and public health. The guideline is not intended to address management or monitoring of particles generated during bushfires or other naturally occurring pollution events such as dust storms.

The guideline identifies and discusses a range of considerations in deciding on appropriate management practices to minimise adverse impacts from dust generating activities. The guideline provides advice on the development of a dust management program including the design of a monitoring program.

1.2 Application of the guideline

The WA Environmental Protection Authority (EPA) *Guidance Statement No. 18 --Prevention of air quality impacts from land development sites* (EPA 2000) and DEC's *Land development sites and impacts on air quality: A guideline for the prevention of dust and smoke pollution from land development sites in Western Australia* (DEC 1996), provide guidance on dust and smoke management from land development sites. DEC's series of documents on contaminated sites management provides guidance on the management of dust and other air pollutants during the remediation of contaminated sites and on community consultation.

This guideline provides an updated and expanded document for the management and monitoring of dust and other air pollutants and applies to all projects in Western Australia with the potential to generate significant levels of dust from diffuse sources. Project proposal assessment and determination of the need for a dust/air quality management plan will continue to be determined through the existing project proposal/works approval processes conducted by the relevant decision-making authorities (DMAs) which include state government departments and local government authorities.

1.3 Document outline

Section 2 of the document provides guidance on the sources and impacts of dust. This section also includes the health impacts of other contaminants contained within the dust particles such as PAHs, heavy metals and asbestos and non-dust air pollutants such as VOCs that may be associated with the remediation of contaminated sites and other activities generating contaminated dust.

Section 3 of the document provides guidance on the legislative and policy framework related to dust management, both at a national and state level.

Section 4 of the document provides guidance on the design of a dust management program and relevant documentation, including the contents of a dust management plan.

2.0 Sources and impacts of dust and other air pollutants

Dust and other air pollutants can arise from a range of natural and man-made sources causing various acute and chronic health effects, as well as nuisance and visibility impacts.

2.1 Sources of dust

There are many man-made sources of dust, which include the following:

- wind-borne dust from exposed surfaces such as cleared land and construction sites
- wind-borne dust resulting from remediation works on contaminated sites
- wind-borne dust from stockpiles of material such as sawdust, coal, fertiliser, sand and mineral ores
- vehicle movements on paved and unpaved roads
- agriculture and forestry activities
- mines and quarries
- road works and road construction
- residential and commercial developments, such as demolition and construction works
- municipal landfills and other waste handling facilities
- explosive blasting of rock
- abrasive blasting
- handling, crushing, grinding/pulverising, screening of mineral ores or other solid matter
- numerous industrial operations, including grain and mineral ore transfer and storage, timber mills, stone masonry, mineral processing, cement handling and batching, and fertiliser storage and processing.

2.2 Physical nature of dust

Airborne particles are characterised as fumes, smokes, mists or dusts depending on the nature of the particle and its size. Particles are commonly classified by size expressed as equivalent aerodynamic diameter (EAD) in micrometres (μm) as follows:

- total suspended particles (TSP) – diameter ≤ 50μm
- PM_{10} – diameter ≤ 10μm
- $PM_{2.5}$ – diameter ≤ 2.5μm

2.3 Composition of dust

The composition of dust particles will depend on the nature of the source material. For example, wind-borne dust from cleared areas will reflect the

composition of the underlying soil types. In cases where soil has been contaminated, dust may also be associated with inorganic and organic pollutants such as heavy metals, PAHs, and asbestos.

2.4 Health and nuisance impacts of dust

The impacts of dust are influenced by particle size, chemical composition and concentration.

Particle size

Human health effects of dust tend to be associated with particles with an aerodynamic diameter of 10 µm or less (≤ PM_{10}). These smaller particles tend to remain suspended in the air for longer periods and can penetrate into the lungs.

The $PM_{10\text{-}2.5}$ fraction (coarse fraction) is termed “thoracic particles”. These particles are inhaled into the upper part of the airways and lung.

$PM_{2.5}$ particles are fine particles that are inhaled more deeply and lodge in the gas exchange region (alveolar region) of the human lung and are termed “respirable dust”. Further, if contaminated, these fine particles may pose a further health risk through absorption of the chemicals on the particles in the blood stream.

The World Health Organisation (WHO) and United States Environmental Protection Agency (USEPA) indicate that numerous scientific studies have linked particle pollution exposure to a variety of health effects, including:

- increased respiratory symptoms, such as irritation of the airways, coughing, aggravated asthma, development of chronic bronchitis, and breathing difficulty through decreased lung function
- irregular heartbeat
- non-fatal heart attacks
- premature death in people with heart or lung disease
- toxic effects by absorption of the toxic material into the blood (e.g. lead, cadmium, zinc)
- allergic or hypersensitivity effects (e.g. some woods, flour grains, chemicals)
- bacterial and fungal infections (from live organisms)
- fibrosis (e.g. asbestos, quartz)
- cancer (e.g. asbestos, chromates, benzene)
- irritation of mucous membranes (e.g. acid and alkalis).

Particles with an aerodynamic diameter less than 50µm (usually referred to as TSP) are also associated with adverse aesthetic effects in addition to health effects. TSP comprises particles of all sizes up to 50µm in diameter, so while the larger particle fraction (PM_{10}-PM_{50}) may cause nuisance impacts, the finer

particle fraction (≤ PM_{10}) may pose a health risk as indicated above. The larger particle fraction (PM_{10}-PM_{50}) may also be trapped in the upper respiratory tract (just behind the nose and mouth) when inhaled causing irritation of the mucosal membranes (eyes, nose and throat) and if contaminated may pose an increased health risk through ingestion. These larger particles are called inhalable particles and are often termed "nuisance dust", causing amenity impacts by settling on surfaces and causing soiling and discolouration.

Sensitive groups such as people with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. However, even healthy people may experience temporary symptoms from exposure to elevated levels of particle pollution. Recent epidemiological research suggests that there is no threshold at which health effects do not occur.

Chemical composition

Contaminated dust, such as dust generated during the remediation of a contaminated site or metal ore handling, may contain contaminants attached to the dust particles. These contaminants include heavy metals, PAHs (particle phase) and asbestos. For very fine particles that are inhaled deep into the lungs, these chemicals can be absorbed through the lining of the alveoli into the blood stream. For larger particles, exposure may result through ingestion. Further deposition of contaminated dust may result in contamination of water in rain water tanks. Health impacts of heavy metals, PAHs and asbestos include cancer, asbestosis and impairment of neurological, skeletal, reproductive and foetal development. Details are provided in the WHO publication: *Air Quality Guidelines for Europe, Second Edition (2000).*

2.5 Health Impacts of other air pollutants

Emissions of air pollutants other than dust such as VOCs, PAHs (vapour phase) and acidic aerosols, may also occur during remediation works at contaminated sites, with a range of potential short-term and long-term effects. A Health Risk Assessment (HRA) would be required to determine whether any potential health risks may arise during the remediation of a particular site. [The National Health and Medical Research Council (NHMRC) has developed a document for ambient air quality standard setting using an approach to health-based hazard assessment (NHMRC, 2006).

The purpose of the NHMRC document is to:

- develop air quality standards or guidelines for air pollutants not covered by current National Environment Protection Measures (NEPMs), or
- revise existing standards or guidelines.

The NHMRC document is designed to provide a framework for jurisdictions, industry bodies, authorities or other stakeholders to establish numerical benchmarks to assist in the management of short-term or long-term air quality issues at the local, regional or national level. This is beyond the scope of individual proposals.]

The Department of Health (DOH) recommends the following two documents specifically designed to guide proponents through the HRA process. Proponents can also contact DOH for guidance through the HRA process.

Document (a) provides a brief introduction to the HRA process and document (b) details the HRA methodology.

a) Health Risk Assessment in Western Australia – Department of Health (2006).

b) Environmental Health Risk Assessment *Guidelines for Assessing Human Health Risks from Environmental Hazards.* – enHealth (2002).

3.0 Legislative and policy framework

3.1 National position

The National Environment Protection Council (NEPC) is the national body responsible for making NEPMs. NEPMs are broad framework-setting statutory instruments defined in the NEPC Act. They outline agreed national objectives for protecting or managing particular aspects of the environment, such as air quality. Ambient air NEPMs developed that are relevant to this guideline are *the National Environment Protection (Ambient Air Quality) Measure* (NEPC, 2003) and *the National Environment Protection (Air Toxics) Measure* (NEPC, 2004). Information on the ambient air and air toxics NEPMs can be accessed on the NEPC website at http://www.ephc.gov.au.

The ambient air NEPM includes six 'criteria' pollutants as primary indicators of air quality:

- nitrogen dioxide (NO_2)
- ozone (O_3)
- carbon monoxide (CO)
- sulphur dioxide (SO_2)
- particles (as PM_{10})
- lead (Pb).

Standards and goals for these criteria air pollutants are specified. An advisory standard for particles as $PM_{2.5}$ is also specified.

The air toxics NEPM includes:

- benzene
- formaldehyde
- benzo(a)pyrene as a marker for PAHs
- toluene
- xylenes (as total of ortho, meta and para isomers).

Monitoring investigation levels (MILs) for these air toxics are specified. The MILs are based on the protection of human health.

Western Australia has voluntarily met its obligations to the NEPC by implementing the framework for the Ambient Air Quality NEPM under the *National Environment Protection Council (Western Australia) Act 1996*.

The EPA is developing an Ambient Air Quality State Environmental Policy and Ambient Air Quality Declaration to guide air quality management and to help meet the Ambient Air NEPM compliance goals within the 10-year implementation timeframe.

3.2 State position

The legislation, agencies and processes directly concerned with dust management in Western Australia are outlined in this section.

3.2.1 *Environmental Protection Act 1986* (EP Act)

Development proposals and activities that are likely to generate dust may be subject to the provisions of the EP Act and policies developed pursuant to that Act.

Part II of the EP Act
Part II of the Act enables the development of state environmental policies (SEPs). SEPs are a non-statutory government policy position on a particular aspect of the environment that can include ambient air. SEPs are enabled under Part II Section 17(3) of the EP Act and are developed by the Environmental Protection Authority (EPA). Following a public consultation process, SEPs are approved by the Minister for the Environment and adopted by Cabinet on a whole-of-government basis.

SEPs can include the scope to develop environmental quality objectives and can identify a framework for implementation using existing statutory mechanisms such as environmental protection policies (EPPs), environmental impact assessment (EIA), licensing and regulation.

As indicated above, the EPA is developing an ambient air quality state environmental policy.

Part III of the EP Act
Part III of the EP Act authorises the EPA to prepare and publish environmental protection policies (EPPs) which, following Parliamentary approval and gazetting, have the force of law.

EPPs set environmental values, objectives, standards and/or targets that Natural Resource Management agencies must adopt when carrying out their environmental responsibilities.

The *Environmental* Protection (Kwinana) (Atmospheric Wastes) Policy 1999 (EPA, 1999), known as the Kwinana EPP, refers to standards and limits for sulfur dioxide and total suspended particles. The policy applies to the local government areas of Cockburn, Kwinana and Rockingham.

Part IV of the EP Act
Under Part IV of the EP Act a proposal that appears likely, if implemented, to have a significant effect on the environment must be referred to the EPA for a decision on whether or not it should be subject to the environmental impact assessment (EIA) process.

In assessing a proposal, the EPA may make recommendations to the Minister for the Environment concerning what conditions, if any, should be imposed on the project in the event that it is approved. Ministerial conditions commonly include a requirement to prepare and implement an environmental management plan (EMP) to control and monitor the environmental impacts of the project. For example, where an approved proposal includes activities that may result in significant generation of dust, the Minister may require the proponent to prepare and implement a dust management plan. Conditions imposed under Part IV of the EP Act are legally enforceable, as are proponent commitments that appear in ministerial statements.

EPA guidance statements

In pursuing its objectives to protect the environment and to prevent, control and abate pollution, the EPA also publishes guidance statements for the environmental impact assessment of proposals. These guidance statements set out the minimum requirements for the protection of the environment.

The *EPA guidance statement no. 18: Prevention of air quality impacts from land development sites* (EPA, 2000) should be considered for activities that can generate dust, particularly when the activities form part of a project requiring formal impact assessment. The EPA Guidance Statement provides general direction on the control of dust and smoke from land development sites. This 2008 dust guideline is specifically aimed at providing practical advice for the development and documentation of management strategies, plans and programs aimed at controlling impacts of dust.

The draft *EPA guidance statement no. 33: Environmental Guidance for planning and development* (EPA, 2005), provides advice on protecting the environment relevant to land use planning and development, and in particular describes the environmental impact assessment process applied by the EPA to such schemes. The guidance is intended as a significant resource document for local government, state government agencies, consultants, proponents and the public.

Part V of the EP Act

Where pollution or environmental harm arising from dust generation has occurred or is likely to occur, the general pollution prevention provisions of Part V of the EP Act may apply. These provisions refer to compliance with emission standards and taking all practical measures to prevent or minimise emissions.

Environmental protection regulations

Other environmental protection regulations of the EP Act may also be relevant. Under the Environmental Protection (Unauthorised Discharges) Regulations 2004, materials prohibited as listed in Schedule 1 of the Unauthorised Discharges Regulation include dust produced by a mechanical process including cutting, grinding, sawing, sanding or polishing a material.

3.2.2 Department of Environment and Conservation (DEC)

DEP/DEC dust guidelines

In 1996, the then Department of Environmental Protection (DEP) published *Land development sites and impacts on air quality: a guideline for the prevention of dust and smoke pollution from land development sites in Western Australia* (1996 guideline). The 1996 guideline provides procedures to assess the dust-generating potential of a development site and identifies measures and contingency arrangements to manage dust and smoke from land development sites.

This 2008 dust guideline provides an updated and expanded document for the management and monitoring of dust for all projects and land use sizes.

Contaminated sites management

DEC has also produced a series of contaminated sites guidelines which address identification, assessment, remediation and reporting of contaminated sites and community consultation during development and implementation of environmental management plans. The contaminated sites management series of documents are on DEC's website.

DEC selection of ambient air quality guidelines

As of December 2000, DEC has articulated an interim approach to adopting ambient air quality guideline values. This interim approach is to adopt the NEPM standards for ambient air quality. In the absence of a NEPM standard, DEC will adopt the WHO Guidelines for air quality (2000), with consideration for applicability to the WA context; and in the absence of a NEPM standard or a WHO guideline, DEC will adopt criteria from another jurisdiction, once it has been assessed and determined to be applicable to the WA context (DEP, 2000).

Perth air quality management plan

The Perth air quality management plan (AQMP) was developed to ensure that clean air is achieved and maintained in the Perth metropolitan area and meets the ambient air NEPM goals. The Perth AQMP was launched in 2000 and details 126 actions to ensure that clean air is achieved and maintained throughout the Perth metropolitan region over the next 30 years.

3.2.3 Other government agencies

Local governments are involved in subdivisional and development sites work and may require that the proponent prepares a dust management plans before works can start, as part of their approval processes.

The DOH works closely with DEC across many issues. In relation to dust management, DOH provides advice on public health risk assessment and criteria or standards for various air pollutants. DEC also provides several air quality guidelines that outline various reporting requirements. Most of the guidance is targeted towards appropriate monitoring and modelling methods

for the protection of the environment and public health. However the DOH often has specific requirements of how monitoring should be conducted and modelling data presented before DOH can interpret the results or judge the suitability of an air quality management plan or HRA designed to protect public health. Proponents should seek guidance from DOH when public health affected.

The Department of Industry and Resources legislation pertaining to mining and quarrying activities may also be relevant to dust management.

3.2.4 Appropriate authorities for dust and other air pollution issues

DEC generally deals with prescribed premises as listed in the WA Environmental Protection Regulations 1987, while local government deals with non-prescribed premises such as land development/building sites, sand/gravel extraction etc. The EPA deals with dust management issues in the Kalgoorlie-Goldfields region.

4.0 Dust management program design and documentation

The following section presents the main aspects to consider when designing a dust management program and the structural components to include when preparing a dust management plan.

The following is an example of a dust management plan outline.

Dust management plan outline (example only)

1. Introduction (program scope and objectives)

2. Site background (contextual information)

3. Proposed works and potential impacts

3.1 Aspect and impact analysis
3.2 Site risk assessment

4. Designing a monitoring program

4.1 Purpose of the program (objectives)
4.2 Performance criteria and monitoring methods
4.3 Number and location of monitoring sites
4.4 Quality assurance/quality control (QA/QC) requirements
4.5 Stakeholder consultation
4.6 Roles and responsibilities
4.7 Complaints management
4.8 Reporting

5. References

6. Appendices

Details of what to include for each section of a Dust Management Plan as outlined above are provided in the following sections.

4.1. Introduction

The introduction should describe the purpose and scope of the program and specific statutory requirements (if any) regarding control of dust and other air pollutants.

The phases of the project to which the dust management program will apply should be identified; for example, the pre-construction phase (demolition, land clearing etc), construction phase or commissioning and operational stages. The dust management program may apply to all phases of the project.

The geographic areas to which the dust management program applies should also be identified, that is, whether the program applies to the whole of the project site or to specific areas only, for example access roads or stockpiles.

The nature and source(s) of dust generation may vary both in space and time, so it is important to clearly identify and document the range of potential dust generating activities.

Program objectives must be clearly defined in order to ensure that management strategies are tailored to reflect management priorities. The main objective of a dust management program should be to protect human health and the environment, including amenity impacts. Defining the objective of the program is important as it influences the development of performance criteria and the methods used to monitor performance.

4.2. Site background

This should include:

- a description of the physical environment of the site and surrounding land use areas, particularly noting any sensitive receptors and nature conservation areas that could be affected by dust emissions and other emissions from the site
- a description of current and historical land use on the site and the adjacent areas. This will help identify potential for contaminants at the site. DEC's publication '*Potentially Contaminating Activities, Industries and Landuses*' provides preliminary reference for the identification of potential contaminants (DoE, 2004)
- contamination status of the site (if applicable), including distribution of contaminants across the site and levels of contamination
- a description of the geology of the site (including soil particle size distribution). A simple description, for example, gravel, sandy soil, fine soil, clay soil etc., with potential for dust lift off and soil particles to remain suspended in the air for long periods of time
- information on local prevailing meteorological conditions and any physiographic factors (such as site topography or major built features) that may influence how meteorological factors such as wind direction are manifested at a local scale

- other sources of dust in the project locality that can contribute to ambient air particle concentrations. If possible, information should be provided on pre-commencement atmospheric dust levels (background levels) in the project area to estimate dust levels in the absence of the project's dust generating activities.

4.3. Proposed works and potential Impacts

4.3.1 Aspect and impact analysis

The next step is to systematically identify all dust and other air pollutant generating aspects of the project and the environmental, human health and amenity impacts potentially associated with each. An example of this type of assessment is shown in Table 1.

Site maps should also be provided that show:

- property boundaries, topographic contours and nearby natural features
- location of the proposed development, existing surrounding land uses and location of sensitive receptors
- wind roses
- areas to be disturbed
- location of physical barriers such as fencing, windbreaks, trees and buildings
- location of stockpile, storage areas and loading/off-loading areas;
- traffic routes and exit points
- wash-down facilities
- distribution of contaminants at the site.

The maps need to be to scale.

Aerial photos are useful and could also be included.

Additional information that should be provided includes:

- a brief overview of the proposed works to be carried out, including a timeline to show the proposed timing and duration of major works that have the potential to generate dust. It should also include the sequence of site disturbance/remediation and the size of exposed areas
- details on the method used for the removal and replacement of topsoil and remediation.

Table 1. Example of an aspect and impact table for dust generating activities

Activity	Duration (dates)	Aspect	Impact (examples only)
Pre-mining clearing of vegetation	2 weeks (2 to 13 February)	Clearing of vegetation exposes topsoil to wind erosion.	Possible 'blow out' of dunes. Nuisance dust could impact nearby residents by creating amenity issues.
		Mulching of vegetation releases fine organic debris to air.	May impact on health of people.
Stripping and stockpiling of soil	1 month (14 March to 14 April 2007)	Stripping topsoil disturbs and creates a potential for particles to be released to the air.	High dust concentrations could affect visibility on highway adjacent to site or could affect health of endangered vegetation located near works area.
		Stockpiling topsoil releases dust particles to the air.	Dust could be deposited on building roofs, affecting palatability and potability of residents' tank water (and hence tap water/domestic) supply (in areas where scheme water is not provided).
Remediation	2 months (10 October to 10 December 2007)	Remediation works release dust (contaminated and uncontaminated) and emissions of other air pollutants such as VOCs.	The sensitive receptors adjacent to the site could be exposed to dust and other air pollutants causing health effects.
Loading of metal ore/concentrate	Ongoing	The loading of metal ore/ concentrate could result in emissions of contaminated dust.	This dust could be deposited in the surrounding areas providing the risk of exposure to the community and ecosystems, from heavy metals.

4.3.2 Site risk assessment/classification

A site risk assessment/classification is important to determine the level of dust management and monitoring required for the site.

For a site that is generating uncontaminated dust, such as land development sites, the site classification chart in Appendix 1 can be used for assessing the site risk. Appendix 1 also details the provisions and contingency arrangements for dust management which apply to each site classification score.

For sites generating contaminated dust, the DOH HRA methodology can be used, as indicated under section 2.5. The dust management and monitoring requirements will depend on the outcome of the HRA. High and medium-risk projects will require more stringent management and monitoring of dust and other contaminants.

Emissions of dust and other air pollutants from diffuse sources are not readily estimated; however, the factors that influence the levels of dust and other air pollutants in the ambient air can be identified and used to assess a site's risk potential. Factors influencing the levels of other air pollutants include the level of contamination of the site. The importance of these factors may vary from site to site. The factors influencing dust levels are provided in Appendix 2.

Some dust control measures are described in Appendix 3. They are not aimed at specific type of operation (i.e. mining, land development or contaminated site remediation), but are applicable to activities that are common among all operations. New or improved methods will become available and current best practice should always be followed to ensure that control measures are effective in minimising dust. Dust control measures selected will vary from site to site.

Unless otherwise stipulated, the actions outlined by each classification level refer to all phases of a project. These measures indicated are the minimum requirements, however, best practice is recommended as per the EPA *Guidance statement No 55 – implementing best practice in proposals submitted to the Environmental Impact Assessment process* (EPA, 2003). The EPA encourages project proponents to adopt not merely minimum management practices to comply with environmental quality standards and limits, but to use 'best practice' approaches in environmental management.

Best practice is founded on the idea that there is no case for unnecessary waste discharges or degradation of the environment, *even where an environmental standard is not exceeded*. Best practice involves preventing or minimising environmental impact to ensure that environmental quality is maintained, through incorporation of best practicable measures (BPM). BPM should be applied when developing and implementing specific dust management actions.

Notwithstanding the allocated 'site classification' given to a site, if, during the actual works the suggested dust control measures are found to be insufficient then dust management should be enhanced. The DEC or relevant local government authority reserves the right to take enforcement action for any unsatisfactory dust control.

4.4. Designing a monitoring program

The dust management program includes control measures for dust and other air pollutants. Monitoring may be required to assess the effectiveness of these measures and for compliance purposes. If monitoring is required, depending on the risk level, a monitoring program should be included in a dust management program and reflect management objectives. Key objectives of a monitoring program are to protect human health and the environment by ensuring that on-site management practices (for dust and other air pollutants) are adequate.

Ambient air monitoring should be conducted in accordance with relevant standards and at locations representative of community exposure. Pollutants to be monitored are to be identified and will vary from site to site. Performance criteria against which the monitoring data will be compared must also be identified.

Background air quality and meteorological monitoring are useful in the design a dust management program and facilitate the interpretation of monitoring results.

A monitoring program that provides continuous particulate and meteorological data is most useful for the assessment of source activity.

Components of a dust monitoring program include the following:

- purpose of the program
- performance criteria and monitoring methods
- number and location of monitoring sites
- quality assurance/quality control (QA/QC) requirements.

These are discussed in detail below.

4.4.1 Purpose of the program

A monitoring program should reflect the objectives of the management program and be designed to monitor the health and environmental impacts of dust and other air pollutants and include management actions such as dust control measures, corrective action and work stoppage to ensure that the off-site performance criteria (ambient air quality standards) are not exceeded.

4.4.2 Performance criteria and monitoring methods

The air pollutants to be monitored will vary from one site to another depending on the contaminants present at the site, level of contamination, toxicity, bioavailability, physical nature of the contaminants, duration of works/remediation works, proximity to sensitive receptors and other factors.

Background monitoring may also be required. This will influence the design of the dust management program as higher background levels will require more stringent dust control measures and on-site criteria. Background monitoring provides information on the levels of air pollutants in the ambient air in the absence of site activity.

Meteorological monitoring for wind direction and speed may also be required to facilitate interpretation of the monitoring data. DOH requires that meteorological data is matched to the activity on the site, wherever possible, particularly if there is considerable potential to adversely affect public health.

Performance criteria

After identifying the air pollutants to be monitored, the next step is to identify the performance criteria. Performance criteria provide a benchmark against which the measured levels of dust and other air pollutants may be compared. Both on-site and off-site performance criteria may be required.

An effective monitoring program should:

1. Monitor dust and other air pollutants levels within the site, close to on-site sources of dust (for comparison against on-site criteria) to assess the effectiveness of management practices in controlling emissions of dust and other air pollutants and therefore guide management decisions. On-site performance criteria are specified for short time periods (15 minutes to one hour) and are designed to prevent exceedences of the off-site criteria.

2. Monitor dust levels at or near the site boundary and/or near sensitive receptors for comparison against off-site criteria to assess health and amenity impacts and for compliance purposes.

On-site performance criteria (trigger levels) are set for corrective action and work stoppage. These criteria assist in achieving the off-site criteria that protect human health. Corrective action trigger levels are the levels of dust concentration on site that if exceeded will result in management action to reduce dust emissions. Work stoppage criteria are the dust concentrations on site which if exceeded will result in work stoppage. These trigger levels are determined on a case-by-case basis as there are a number of variables that can affect the relationship between the dust levels measured within the site and the resulting dust levels occurring off-site. Variables, such as:

- the distance between the dust source and the site boundary/sensitive receptors
- the number of dust sources in the area
- the level of contamination at the site
- background dust levels
- the direction of the prevailing winds in relation to sensitive receptors
- particulate matter size and characteristics.

Trigger levels are arbitrary figures selected by the proponent in consideration of the above factors. If the trigger levels or off-site criteria are exceeded frequently or if complaints are received, then the trigger levels should be reviewed and made more stringent. Dust control measures should also be reviewed.

The samplers should be located downwind of, and relatively close to, the emissions source(s).

Off-site performance criteria are used to provide protection for sensitive receptors against adverse health or amenity impacts that may arise from dust and other air pollutants.

The Victorian EPA sets neighbourhood intervention levels in their State Environment Protection Policy (SEPP – air quality management) that are numerically higher than the NEPM standards. In the absence of a similar WA policy, DEC accepts the use of the NEPM standards as off-site criteria. Exceedences of the standards are not acceptable and indicate that the dust management practices may not be appropriate.

It should be noted that the allowable NEPM exceedences apply to the entire airshed, including emissions from extreme events such as bushfires, and should not be applied to an individual facility or site. For example, only five exceedences per year are allowed for PM_{10}, regardless of whether the exceedences are due to on-site or off-site activities.

The Air Toxics NEPM specifies standards for air toxics, some of which may require monitoring, during the remediation of contaminated sites.

The Kwinana EPP specifies a standard for TSP in the industrial area (Area A), buffer area (Area B) and rural/residential area (Area C) to which the Kwinana EPP applies. The applicable TSP standard for monitoring TSP in the vicinity of sensitive receptors would be the TSP standard applicable to Area C (rural residential) as shown in Table 4.

Table 2. Ambient air quality NEPM standards for lead and particles

Pollutant	Averaging period	Maximum concentration	Goal to be achieved by 2008 - Maximum allowable exceedences
Lead[1]	1 year[2]	0.50 μg/m^3	None
Particles as PM_{10}	1 day	50.0 μg/m^3	5 days a year
Particles as $PM_{2.5}$ (advisory standard)	1 day	25.0μg/m^3	Under development
	1 year	8.0μg/m^3	Under development

Failure to meet agreed performance criteria should result in management review of the control measures for dust and other air pollutants and may serve to trigger contingency actions or work stoppage. If the off-site criteria are regularly exceeded, then the on-site criteria should be reviewed to make them more stringent.

[1] Monitoring for other heavy metals may be required, for example, during the remediation of contaminated sites. Criteria for these could be sought from WHO, DoH or adopted from other jurisdictions and organisations. Any standard chosen would need to be assessed to ensure the criteria it is based on are relevant for WA.

[2] This annual average standard is unsuitable for contaminated sites and a 24 hour average standard will have to be used. The same applies for air toxics.

Table 3. Air toxics NEPM

Pollutant	Averaging period	Monitoring investigation level
Benzene	Annual average	0.003 ppm
Benzo(a)pyrene as a marker for Polycyclic Aromatic Hydrocarbons	Annual average	0.3 ng/m^3
Formaldehyde	24 hours	0.04 ppm
Toluene	24 hours Annual average	1 ppm 0.1 ppm
Xylenes (as total of ortho, meta and para isomers)	24 hours Annual average	0.25 ppm 0.2 ppm

Table 4. Kwinana EPP, total suspended particles (TSP) ambient air quality standards and limits for Area C (rural/residential area)

Pollutant	Averaging period	Standard
TSP	24 hours	90 μg/m^3

Monitoring methods

Where compliance monitoring is required, the monitoring methods selected should be in accordance with Australian Standard methods and where these are not available, USEPA or equivalent methods should be used. Details of established standard methods are provided in Appendix 4. Appendix 4 provides an overview of the various monitoring methods, the suitability of each method as a compliance or management tool, the limitations of each, the principles of operation and the relevant Australian, USEPA or equivalent standard methods. Monitoring methods that rely on the principle of light scattering, such as particle counters are also included, which although not standard methods have been used widely for on-site dust management. Some methods have not been included as they are either not standard methods or have been found to be unsatisfactory in terms of accuracy, particularly when collocated with established monitoring equipment or because the sampling period associated with the method is long therefore not allowing for timely remedial action to be taken in the event of high dust levels.

It is important to consider the sampling time and frequency for monitoring especially for reporting purposes. The sampling time and frequency are usually determined based on the criteria (e.g. 24-hour sampling period for PM_{10}) and the appropriate monitoring method is selected. This facilitates interpretation of data against standards/ guidelines by DOH and DEC.

DOH has specific reporting requirements that facilitate the interpretation of data where potential impact on public health may be of concern. Proponents should be advised to consult with DOH on reporting requirements and on how monitoring data is to be presented.

Sampling can be described as either batch or continuous. Continuous sampling provides uninterrupted monitoring. Batch sampling collects a sample over a designated time period, for example, over 24 hours.

The frequency of sampling could be continuous, daily, etc., depending on the objectives of the monitoring program.

Background monitoring is recommended as it provides a way of comparing levels of dust and other air pollutants that would be expected in the absence of site activity. Where limited background monitoring data are available, DEC will adopt a conservative approach in assessments. For a facility with potentially significant impacts on sensitive receptors DEC's expectation would be for one year's data to be available and reviewed in order for seasonal variations to be observed. Depending on the location of the site, the established buffer and other significant emission sources it may be necessary to undertake background sampling of other parameters in addition to dust.

There are two methods of gathering background monitoring data:

(i) Sampling of the site before works start to provide baseline data: This baseline sampling is most effective when sampling is conducted over a number of years. A longer sampling period will ensure seasonal and annual variability is taken into account, providing a more accurate representation of the dust levels and trends. A dust monitoring program is more effective if background dust levels are measured before work starts, for example, high background dust levels may require more stringent dust control. For short-term projects (of say up to six months) four weeks of background monitoring before works start, would provide an indication of existing air quality.

(ii) Control site sampling: This involves concurrent sampling near the site (usually upwind of the site) and at locations away from the site (outside the zone of the site, but representative of the local environment or the site before works). Control site sampling has the advantage of allowing comparison of control (background) and site samples under similar weather conditions.

Wind direction and speed are the minimum meteorological data required. Information regarding meteorological conditions for many parts of Western Australia can be obtained from the Bureau of Meteorology website at http://www.bom.gov.au. Where meteorological information is not available, or the site characteristics such as topography are different from those at the nearest BoM station, then site specific meteorological monitoring will be required.

DOH requires that meteorological data is matched to the activity on the site, wherever possible, particularly if there is considerable potential to adversely impact public health.

The Australian Standard, *AS2923-1987 ambient air – guide for measurement of horizontal wind for air quality applications*, provides guidance on meteorological monitoring, including equipment selection, installation and operation.

4.4.3 Number and location of monitoring sites

The selection of monitoring sites is of paramount importance, as it can affect the quality of data obtained and the interpretation of results. The prevailing meteorological conditions, topography, predicted area of greatest impact and the location of sensitive receptors are key factors that influence the siting of a monitor. The number and location of monitors should adequately represent community exposure, and should be selected as part of a risk-based approach. The higher the risk, the greater will be the monitoring requirements. It may be useful as part of the community consultation process to engage the community in the selection of sampling locations.

Selection of a monitoring site should be based on the guidance provided in *AS/NZS 3580.1.1:2007 Methods for the sampling and analysis of ambient air – Guide to siting air monitoring equipment*. This standard provides, for example, minimum distances from obstacles that could affect the monitoring/sampling, such as trees and buildings. However, there may be cases where a monitoring site does not meet the requirements of *AS/NZS 3580.1.1:2007* or a deviation from the standard is required. Where this is the case, this should be detailed in the monitoring program and reports.

The practicality of an area should also be considered when determining the location of a monitoring site, such as:

- security (potential for vandalism)
- electrical services, as most monitoring equipment requires power
- access.

4.4.4 Quality assurance/quality control (QA/QC) requirements

Good quality control (QC) and quality assurance (QA) procedures ensure that the monitoring data are of good quality (accurate and reliable) to allow comparison with the performance criteria.

The monitoring method selected must be able to report results according to the requirements of the performance criteria. Its capability as a compliance or management tool must also be considered. Details on monitoring methods are provided in Appendix 4.

Sampling and analysis should be done in accordance with the relevant standards (Australian standard methods where these exist, otherwise USEPA or other equivalent methods), by National Association of Testing Authorities (NATA) accredited laboratories where available and by appropriately trained and competent staff.

A laboratory quality assurance system is a requirement of NATA accreditation and provides credibility as to the technical competence of the laboratory in supplying accurate and reliable results. NATA accredited facilities are

regularly examined to ensure they maintain their standards of technical expertise, calibration and maintenance of sampling instruments.

Variations from the above standards and limitations should be clearly stated and justified by calibration and validation studies to show accuracy and precision comparable with the relevant Australian Standard Method (NEPC, 2004). The alternative monitoring method should provide equivalent information for reporting against criteria and objectives and reference to an ambient standard should also define the measurement method.

4.4.5 Stakeholder consultation

Stakeholder consultation is required as part of the development of a dust management program. Effective consultation allows for industry and other interested parties to involve its stakeholders and community in their proposal prior to seeking approvals from the EPA and DEC. DEC's *Contaminated sites management series – community consultation guideline* (DEC, 2006) provides guidance on the consultation process and is available on the DEC website at www.dec.wa.gov.au. Details on who has been consulted in the development of the management strategy should be included in the dust management plan.

4.4.6 Roles and responsibilities

Personnel responsible for dust management and monitoring at the site should be specified. This could be the site manager, site supervisor, environmental manager etc. Their roles and responsibilities should also be specified.

4.4.7 Complaints management

A complaints management system should be in place to include a feedback loop to the community and provide for corrective action when adverse impacts have occurred. All complaints should be logged and investigated with timely feedback provided to the complainant. Complaint forms should be kept and made available to relevant authorities and community members upon request. A sample complaint form is provided in Appendix 5.

In cases where there are existing dust issues, it would be useful to conduct a survey to assess background issues and perceptions of air quality.

Complaints would be made to the proponent, the local government authority or DEC as outlined in section 3.2.4.

4.4.8 Reporting

A dust management program should detail the format for reporting monitoring results and any necessary corrective action taken to the relevant authority (DEC, DOH, local government etc).

DEC requires that monitoring results and calibration data be provided in a summary report which includes all working spreadsheets showing the raw data

and review of the results. Monitoring data should be recorded and made available to DEC and DOH on a regular basis or upon request. For some contaminated sites the proponent would report the monitoring data via the auditor.

Some proponents publish their monitoring data and reports on their websites as part of their engagement with stakeholders, particularly the community.

The relevant authorities should be notified of any exceedences and corrective action taken, as soon as is practicable after the exceedence has occurred/24 hours. Contact details for DEC and DOH are provided in Appendix 6.

A general site description should be included for each monitoring station to help interpret monitoring results. Table 6 lists the information to be recorded for each monitoring station. The table is based on the New Zealand Ministry for Environment *Good practice guide for air quality monitoring and data management* available at www.mfe.gov.au. A map showing the location of the monitoring sites and wind roses should also be included.

4.5 References

All documents referred to in the development of the management plan, including the dust guideline and the references used on the adoption of standards.

4.6 Appendices

These would include maps showing surrounding landuse and location of sensitive receptors and monitoring sites etc., tables and other attachments.

Table 4. Recommended information to be recorded for each monitoring station

For each monitoring station	
Parameter	**Explanation**
Indicators/contaminants monitored	List all the pollutants that have been or are being monitored at the monitoring station
Coordinates	GPS coordinates if possible
Equipment owners name/s	Name of party/parties who own the equipment
Equipment operators name/names	Name of party/ies who maintain and calibrate the equipment (may be the same as equipment owner)
Data owner's name and address	Party who actually 'owns' and is responsible for the data produced from the equipment (may be the same as above – equipment owner or operator)
Equipment housing	Shed, lab, air conditioning etc.
Housing environment	Air conditioning, humidity etc
Topography	Description of the topography surrounding the station, for example, open valley with little trees or vegetation. This should also include a description of surrounding receptors e.g. residential to the north.
Location of monitoring station.	Reasons for selecting the location e.g. prevailing winds, sensitive receptors etc. Description of potential sources of dust that can contribute to results recorded by the station. Deviations from the siting requirements of AS/NZS 3580.1.1:2007 Methods for the sampling and analysis of ambient air – guide to siting air monitoring equipment.
Supplementary information	Description and dates of any unusual events that may have affected air quality e.g. bushfires, weather extremes etc.
Meteorological variables measured	Wind speed, wind direction, temperature and height at which they are measured.
Meteorological data operator	Operator of the meteorological station.
Location of meteorological station	For example, on site mast 6m high or at the neighbouring airport.
Regional and local meteorological characteristics	A brief description of meteorological conditions likely to affect air quality at the station.
Sampling Objective	On-site, off-site or background.
Instrument/s	Name and any other detail of the instrument/s (make/model and serial number)
Period of operation	Dates (and times, if applicable) when equipment was operated. A minimum data capture of 90% per month is required.
Standard method followed and deviations	Details of the Australian Standard method followed to operate the equipment. If any of the requirements of the standard method is not met or if an alternative standard is used, provide justification.
Data storage	Describe how the data is stored
Data logging	E.g. remote via modem or not used.
Sampling period and frequency	E.g. Sample collected daily or every one in six days, over 24 hrs or over six days.
QA/QC	Field and laboratory QA/QC: • use of standard operating procedures (SOPs) for sample collection and analysis • use of chain-of-custody and sample identification procedures • sample preservation, handling and decontamination

	• use of QC samples such as field and trip blanks duplicates and equipment rinses • instrument standardisation, calibration and verification • use of trained technicians and analysts • use of NATA accredited laboratories.

References

Department of Environment (2004) *Contaminated sites management series – potentially contaminating activities, industries and land uses*. Government of Western Australia: Perth, WA.

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Department of Health (2006) *Health risk assessment in Western Australia*. Government of Western Australia: Perth, WA.

EnHealth (2002) *Environmental health risk assessment--guidelines for assessing human health risks from environmental hazards*. Government of Western Australia: Perth, WA.

Environmental Protection Authority (2005) *Environmental Guidance for Planning and Development--Guidance Statement No. 33*. Government of Australia: Canberra, ACT.

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Environmental Protection Authority (2000) *Prevention of air quality impacts from land development sites – final guidance statement no. 18*. Government of Western Australia: Perth, WA.

National Environment Protection Council (2003) *National environment protection (ambient air quality) measure – as amended*. Government of Australia: Canberra, ACT.

National Environmental Protection Council (2004) *National environment protection (air toxics) measure*. Government of Australia: Canberra, ACT.

National Health and Medical Research Council (2006) *Ambient air quality standards setting – an approach to health-based hazard assessment*. Government of Australia: Canberra, ACT.

Ministry for the Environment (2000) *Good practice guide for air quality monitoring and data management.* New Zealand Government: Wellington, NZ.

World Health Organisation (2000) *Air quality guidelines for Europe, second edition*. Copenhagen, Denmark.

Appendices

Appendix 1: Site risk assessment/classification for activities generating uncontaminated dust

Sheet 1: Site classification assessment chart

Part A. Nature of site

Item	Score options				Allocated score
1. Nuisance potential of soil, when disturbed	Very low……..…..**1**	Low…….....**2**	Medium……..……..**4**	High……**6**	
2. Topography and protection provided by undisturbed vegetation	Sheltered and screened.....**1**	Medium screening....**6**	Little screening..…..**12**	Exposed and wind prone……..……**18**	
3. Area of site disturbed by the works	Less than 1ha…..…..**1**	Between 1 and 5ha..**3**	Between 5 and 10ha.....**6**	More than 10ha…….**9**	
4. Type of work being done	roads or shallow trenches……..…**1**	roads, drains and medium depth sewers….....**3**	Roads, drains, sewers and partial earthworks……**6**	Bulk earthworks and deep trenches……...**9**	
				TOTAL score for Part A	

Part B. Proximity of site to other land uses

Item	Score options				Allocated score
1. Distance of other land uses from site	More than 1km…….…..**1**	Between 1km and 500m…….....**6**	Between 100m and 500m……..**12**	Less than 100m..…..**18**	
2. Effect of prevailing wind direction (at time of construction) on other land uses	Not affected……..…..**1**	Isolated land uses affected by one wind direction……..…..**6**	Dense land uses affected by one wind direction……..…**12**	Dense/sensitive land uses highly affected by prevailing winds……**18**	
				TOTAL score for Part B	

SITE CLASSIFICATION SCORE (A X B) =

Sheet 2: Site assessment details

Engineer for the developer _____

Site detail _____

Local government _____

Location of works (use AMG grid reference from Metropolitan Street Directory and nearest main street) _____

Project name/stage _____

Description of works _____

Contract dates (starting/completion dates and duration in weeks) _____

Score from assessment chart _____

Special considerations _____
(refer to Appendix 1, Note 4)

Comments at completion of construction:
(to include details of dust-related problems and provisions and contingency arrangements which were actually carried out)

_____

_____

_____

_____

(Copy of this completed sheet to be returned to the Department of Environment and Conservation)

Sheet 3: Notes relating to 'site assessment classification chart'

1. The site assessment chart is used to differentiate between Classifications 1, 2, 3 and 4, as defined within these guidelines. Classifications 2 and 3 are subject to Note 4, below.

2. Sites may be divided into two or more classifications depending mainly on the proximity of existing land uses.

3. In assessing the relevant score level, the 'effect of prevailing winds' must be carefully considered. While houses, commercial areas, market gardens, schools and factories have high sensitivity ratings, roads, parks and recreational areas have lower sensitivity ratings.

4. Construction during dry period (1 October – 31 March).

(a) Where other land uses are within 100 metres of the site:

(i) sites assessed as Class 3 will automatically become Class 4, and

(ii) sites assessed as Class 2 will automatically become Class 3.

(b) Where other land uses are situated between 100 metres and 500 metres from the site, an on-site re-evaluation of Class 3 sites shall be conducted by the engineer for the developer, the local government or the DEC to determine the extent of additional Class 4 requirements considered necessary (if any).

Sheet 4: Dust management and monitoring requirements for each site classification score

Based on the total score obtained from the 'SITE CLASSIFICATION ASSESSMENT CHART' and notwithstanding any allowance for special site conditions during the dry period, (refer to Note 4, Appendix 1) the following site classification will apply:

Site classification 1 — under 199;

Site classification 2 — 200 to 399;

Site classification 3 — 400 to 799, and

Site classification 4 — over 800.

Note: • Unique sites may need special assessment.
• It is essential that any contracts for construction work on site include the relevant contingency arrangements appropriate for the site classification.

- **Classification 1 (score under 199, considered negligible risk)**

Provisions:
• None required.
Contingency arrangements:
• None required.

- **Classification 2 (score between 200 and 399, considered low risk)**

Provisions:
• The developer shall supply a contingency plan to the local government, which shall detail the activities to be undertaken should dust impacts occur.

Contingency arrangements:
• Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust suppression.
• All areas of disturbed land should be stabilised to ensure that the disturbed area exposed at any time is kept to a practical minimum.

Monitoring requirements:
• Complaints management system in place (complaints recorded and acted on promptly).
• Notice to be erected at the site, providing contact details of the person to be contacted and works.

- **Classification 3 (score between 400 and 799, considered medium risk)**

Provisions:

• Appropriate wind fencing of a length specified in the air quality management programme needs to be stored on site or available within one hour of being required by the engineer for the developer/local government/DEC.
• All areas of disturbed land should be stabilised to ensure that the disturbed area exposed at any time is kept to a practical minimum to prevent exceedence of dust standards (see Section 4.4.2).
• The engineer for the developer shall maintain close control of works with dust creating potential (for example, allowable length of open trenching).
• After all siteworks are completed, and before the contractor has vacated the site, the developer should ensure that the entire site is stable. The developer then retains responsibility for site stability until change of ownership/control takes place. After the change of ownership/control has taken place, the new owner or controlling party will inherit responsibility for site stabilisation.

Contingency arrangements:

• Suitable water-carts in good working condition and of not less than 10,000 litres capacity per 7.5 hectares of disturbed site, or other suitable alternatives, shall be available to commence watering on the site within 18 hours of being required to do so by the engineer for the developer/local government/DEC.
• Surface stabilisation equipment shall be available to commence operation on site within 48 hours of being required to do so by the engineer for the developer/local government/DEC and with sufficient capacity to cover the disturbed site area within a further 48 hours.
• Wind fencing shall be erected within 18 hours of the contractor being required to do so by the engineer for the developer/local government/DEC. Dust generating works on the site shall cease in the interim.
• If dust-related complaints are generated due to activities on the site, the developer may be required by the local government or an authorised DEC officer to distribute advisory notices to adjoining land occupiers within 48 hours. A notice form is provided in Sheet 5 of Appendix 1.
• If dust-related complaints are generated due to material which has been excavated for trenching, the developer shall ensure this material is stabilised within 48 hours of being requested to do so by the engineer for the developer, local government or an authorised DEC officer.
• Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust and wind-borne material suppression.
• Include an allowance for surface stabilisation for the purposes of dust and wind-borne material suppression to be maintained after the construction period and until change of ownership/control takes place.

Monitoring requirements

• Site dust management system in place.
• On-site dust monitoring against short term criteria.
• Off-site (compliance) dust monitoring at site boundary (if close to sensitive receptors) or at sensitive receptors. See Section 4 and Appendix 4.
• Complaints management system in place (complaints recorded and acted on promptly).
• Exceedences to be reported to the relevant authority – DEC, Local Government or DOH.
• Notice to be erected at the site, providing contact details of the person to be contacted regarding the works.

Classification 4 (score over 800, considered high risk)

Provisions:

- Advisory notices shall be issued to adjoining land occupiers, the local government and the DEC at least 48 hours before site works commence. The notices shall include the name of the developer, engineer for the developer, contractor/s, contract period, contact telephone numbers of the site engineer and local government environmental health officer as detailed in Sheet 5 of Appendix 1.
- Fencing to the extent and in locations agreed to by the developer and local government shall be erected before any part of the site surface is disturbed.

Note: This provision does not necessarily mean that the total site boundary is to be fenced. The fence is to be installed to an extent which will protect adjacent land uses and in most cases should be erected on the edge of the area which will be disturbed rather than on the site boundary.

- An amount of wind fencing of a length specified in the air quality management programme needs to be stored on site or available within one hour of being required by the engineer for the developer/local government/DEC.
- The nominated wind fencing is to remain in position until the disturbed surface is stable.
- Surface stabilisation is to be applied to the disturbed area of each section of the site upon completion of the works in that section.
- The engineer for the developer shall maintain strict control of works with dust-creating potential. Material which has been excavated for trenching shall be stabilised if the trench is to be left exposed for longer than 72 hours.
- After all siteworks are completed, and before the contractor has vacated the site, the developer should ensure that the entire site is stable. The developer then retains responsibility for site stability until change of ownership/control takes place. After the change of ownership/control has taken place, the new owner or controlling party will inherit responsibility for site stabilisation.

Contingency arrangements:

- Suitable water-carts in good working condition and of not less than 10,000 litres capacity per 5 hectares of disturbed site, or an appropriate alternative, shall be available to commence immediate watering on the site.
- Surface stabilisation equipment shall be available to commence operation on site within 48 hours of being required to do so by the engineer for the developer/local government/DEC and with sufficient capacity to cover the disturbed site area within a further 48 hours.
- Additional wind fencing shall be erected within 18 hours of the contractor being required to do so by the engineer for the developer/local government/DEC. Dust generating works on the site shall cease in the interim.
- Include an allowance for water-cart operation, wind fencing and surface stabilisation during the construction period for the purposes of dust and wind-borne material suppression.
- Include an allowance for surface stabilisation for the purposes of dust and wind-borne material suppression to be maintained after the construction period and until change of ownership/control takes place.

Monitoring requirements

As for Classification 3.

Sheet 5: Notice to residents

Land development is being carried out in your area by:

_____ (Name of developer)

The development commencement date is: _____

Completion date is expected to be: _____

A site risk assessment has been conducted in consultation with your local

government:_____

It has been agreed by all parties concerned that the:

_____
(Project type - land development project, site remediation works etc.)

must adopt adequate measures to prevent the generation of unacceptable levels of dust. You are advised that the developer of the site has agreed to implement the provisions as outlined in the Department of Environment and Conservation's '*A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities*' (A copy of this guideline may be obtained from your local government). Should you feel that excessive dust or other air pollutants are being generated due to the site works, you are advised to contact the site engineer for the developer:

_____(Name of engineer) by

telephoning _____ to discuss the issue.

The Environmental Health Officer at _____
(name of local government authority)

may be contacted on: _____

Appendix 2: Factors influencing levels of dust and other air pollutants

Factor	Description
Soil type	• The soil properties of a site will have a considerable impact on the amount of dust generated. • In general soils with a dominant particle size corresponding to gravel size or larger have less potential of becoming airborne than finer particles such as fine sand, silt and clay. However, soil may comprise a mixture of different soil particles, for example, fine contaminated dust, such as heavy metals, mixed with coarse particles. • Soil moisture content is also important. Dry or non-wetting soils are more likely to become air borne. • An assessment of soil particle size distribution can help to determine the potential for particles to become airborne. As a general guide, particle sizes of 50μm or more tend not to become airborne. A soil profile will also provide information on the different soil layers and their potential for particle lift off.
Exposed area on site	• Sites with a larger exposed area are identified as having a greater dust generating potential.
Duration of works	• The longer the project, the greater the dust risk as the potential for exposure increases.
Proximity to sensitive receptors	• The proximity of a site to sensitive receptors has a significant influence on the dust risk potential of a site. • A site that is located close to sensitive receptors, such as, residential housing, children's daycare, schools, hospitals, sports fields etc., will generally require more preventative measures compared to a site in an isolated remote location.
Contamination level	• The concentration and distribution of contaminants at the site will determine the risk potential for dust and other air pollutants of the site. The higher the concentration of contaminants and the greater the distribution of contaminants at the site, the greater will be the risk potential.
Prevailing wind direction and speed	• The direction of the prevailing winds can also influence the risk potential of a site for dust and other air pollutants. If the prevailing winds (predominant wind direction) are blowing towards sensitive receptors, the risk potential increases because the sensitive receptors are more likely to be impacted than if the winds are blowing away from the sensitive receptors. • The higher the wind speed, the greater the potential for dust lift. • Daily and seasonal variation of wind speed and direction should be considered.
Nature of works	• The nature of works to be conducted will affect the dust levels, for example, land clearing and stockpiling may generate more dust than site levelling.
Topography	• The topography of the site may influence wind behaviour at the site which could influence the dispersion of dust and other air pollutants from the site.

Appendix 3: Dust control measures

Dust control measure	Description
Limit cleared areas	Before the commencement of any site works and during the operation, as much vegetation as possible should be retained, including patches and strips to minimise dust. Dust emissions can be controlled using the following procedures: • Before any site works commence, plan and locate the vegetation cover that needs to be retained. • Protect this vegetation by fencing or blocking off from the rest of site operations. • In other areas, maintain the original vegetation cover for as long as possible. • Avoid clearing the entire site at once, instead clear areas as required in stages of the operation. Retaining the original trees, shrubs and grasses is one of the most efficient and effective ways of minimising dust emissions. Even low or sparse scrub can be very effective at dissipating wind velocity at the ground surface, where dust lift off occurs.
Vegetative stabilisation	Vegetation is a very effective form of reducing dust emissions. The following procedures should be considered in minimising dust emissions: • Retain as much existing vegetation as possible. • If an area needs to be cleared, transplant established plants that must be disturbed to areas that need vegetation. • If existing vegetation must be removed and can not be immediately transplanted elsewhere, remove and maintain them for replanting at project completion. • If trees and plants must be removed and it is not possible for them to be replanted, consider chipping and using the material as mulch – the advantage is that reseeding of original vegetation can occur. Where possible, restore vegetation that is native to the area to maximise plant success and improve environmental conditions.
Timing of development	It is the developer's responsibility to schedule work on land development sites such that it is carried out at the time of the year, and in a way, which reduces the potential impacts of dust and smoke to a minimum. The time of year when these activities are conducted is critical. Historical records of complaints received by DEC show that very few dust problems occur during winter. Activities with high dust-causing potential, such as topsoil stripping, should not be carried out in sensitive areas during adverse wind conditions. When necessary, topsoil should be stripped in discrete sections, allowing buffer strips (windbreaks) between clearings.

Dust control measure	Description
Development staging	Dust generated by bulk earthworks being done during the summer months, particularly with housing in close proximity, can adversely impact upon people who live near development sites. These effects may be reduced if developments can be staged in a sequence whereby bulk earthworks are carried out in the winter months and the completed earthworks "front" is kept to about 100 metres in advance of newly-created lots. In planning the staging of developments, it should be recognised that completed subdivisional stages are often quickly built upon and, hence, the completed stage should be considered to be an improved area when developing the next stage. This means that subsequent stages of any development can require more stringent dust control measures, as the completed subdivisional areas represent an increase in the potential for adverse impacts.
Wind barriers	Having appropriate wind barriers can be an effective measure for the control of dust over short distances. Wind barriers provide protection against the movement and impact of dust on nearby land uses. Wind barriers should be placed on site before commencement of works and when it is apparent that one is required during the phase of the operation. Consider the following options when placing barriers to prevent dust emissions: • Wind barriers are most effective when placed perpendicular to the direction of the prevailing wind, but will have little or no effect when the wind direction is parallel to the fence. • When choosing wind barriers it has been observed that solid barriers provide Significant reductions in wind velocity for relatively short leeward distances, whereas porous barriers provide smaller reductions in velocity for more extended distances. • Wind barriers should be at least 2 metres high. • The screening material should have a porosity of 50% or less. •
Earth moving management	Earth-moving works have the potential to generate large amounts of dust. Planning earth-moving works particularly at the start of an operation can reduce dust emissions by limiting the time the site is exposed. Options for dust control can include the following: • Plan earth-moving works so that they are completed just prior to the time they are needed. • Observe weather conditions and do not commence or continue earth moving works if conditions are unsuitable e.g., under conditions of strong winds. • Reduce off-site hauling via balanced cut and fill operations. • Pre-water areas to be disturbed.
Management of Material	Material stockpiles are capable of generating large amounts of dust. In particular, fine materials stored in stockpiles can

Dust control measure	Description
stockpiles	be subject to dust pick-up. Materials being loaded onto conveyor belts or into trucks, rail cars or marine vessels are also potential sources of dust emissions. Dust emissions from material stockpiles can be minimised through the use of the following procedures: • Locate stockpiles in sheltered areas or in warehouses where possible with building panels and doors effectively sealed. Otherwise, stockpiles should be covered. • Where stockpiles are located in open areas, limit the height and slope of the stockpiles to reduce wind pick up, orient stockpiles lengthwise into the wind so they offer the minimum cross-sectional area to prevailing winds, install wind barriers on three sides of the stockpile. • Limit activity to the downwind side of the stockpile. • Limit drop heights from loading facilities and use closed conveyors where possible. Transfer points should also be minimised. Sprinkler systems could also be used on conveyor systems. Alternatively, dust collection systems, such as, cartridge or baghouse systems could be used instead of sprinklers, where moisture is of concern , for example, with mineral concentrates.
Watering	Watering is applicable to almost every aspect of site operations, from reducing dust lift off from roads and other traffic areas and during earthworks, to controlling dust during movement of materials such as loading/offloading and transportation of materials. Watering is a very effective short-term measure, however its efficiency decreases as wind velocity and evaporation rate increase. Dust emissions can be minimised using the following watering procedures: • The surface should be dampened to prevent dust from becoming airborne but should not be wet to the extent of producing run-off. Alternatively, wetting agents could be used, particularly for non-wetting soils. • Watering is more effective when undertaken prior to strong breezes. • Use watering sprays on materials to be loaded and during loading. • The use of scheme water should be discouraged and alternative supplies used whenever possible. However care must be taken to ensure that the quality of water will not have adverse environmental health impacts. • Real time automated response systems to turn on water cannon systems in response to dust levels or high wind speeds could be used. These can help save water by only turning on water cannons during adverse conditions and also help reduce the possibility of operator error. • In cases where severe water restrictions are imposed, other measures like the use of wetting agents such as chemical stabilisation or hydromulch, could be considered. See below.
Hydromulch	Hydromulch is a very effective measure for preventing dust lift-off from areas where bulk earthworks have been

Dust control measure	Description
	completed and little or no further vehicular or pedestrian traffic is likely. It is a versatile tool, as the constituents of spray mulch can be varied to suit the requirements of the user and the site. The following procedures for hydromulch can be utilised to reduce dust emissions: • Vehicular and pedestrian access to treated areas should be restricted to prevent disturbance to the hydromulch layer. • Wind barriers placed in isolated locations or where long-term effectiveness is required to control access and achieve maximum benefit. • For short-term stabilisation, hydromulch without grass seed should be sufficient stabilisation. • For longer-term stabilisation, hydromulch with grass seed and fertiliser should be included in the spray. Organic stabiliser can also be added to the mix to provide a more stable base for the germination of seeds. Recommended application rates for hydromulch should be sought from suppliers to ensure that application rates and the constituents of the mulch are appropriate to the task.
Chemical Stabilisation	Chemical stabilisers provide immediate coverage and protection; they are effective in areas that receive little traffic or disturbance. They provide a longer-term solution compared to watering, although it may be necessary for the chemical ingredients to be evaluated with regard to their environmental effects. Chemical stabilisers work by binding the soil particles together to create an artificial crust on the soil surface that is less prone to disturbance by wind. The following options should be considered when using chemical stabilisers to reduce dust emissions: • Physical barriers or other methods of preventing traffic access should be used to protect stabilised areas. • The manufacturer's instructions should be followed to optimise performance.
Maintenance	The following routine maintenance procedures should also be implemented as a dust control measure: • There should be a nominated person with the responsibility for dust management. • All staff should be aware of the potential for dust generation and inducted on dust minimising practices. Staff operating dust control equipment should be trained and regularly have a refresher course. • Dust control equipment should be inspected regularly and defects repaired promptly. Spares should be kept on site for critical items of control equipment, such as water pumps for dust suppression sprays. • Trucks carrying contaminated soil from the site for disposal off-site should be washed down prior to leaving the site to prevent spreading contamination off-site.

Appendix 4: Relevant standards, monitoring methods and principles of operation[1]

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
Monitoring for dust and other particulate matter					
1	**High volume sampler** (A constant flow rate of ambient air is drawn through a filter paper. The mass of the collected particles is determined by weighing the sample filter before and after sampling in a temperature and humidity controlled environment. Particle concentration is calculated using the mass of sample collected and total volume of air drawn. it is operated to sample over a 24 hour	• Particulate mass (PM_{10} & TSP) • Heavy Metals • PAHs – particulate phase	Compliance (QA/QC requires several working days between the completion of the sampling and calculating results due to filter paper conditioning)	**AS/NZS 3580.9.6:2003 –** Methods for sampling and analysis of ambient air - Determination of suspended particulate matter – PM_{10} high volume sampler with size-selective inlet - Gravimetric method **AS/NZS 3580.9.3:2003 -** Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method **AS 2800 – 1985** – Ambient Air – Determination of particulate lead – High volume sampler gravimetric	A high level of operator skill is required for the siting, operation and processing of results. A power source is required. Generators may be used where a power source is unavailable. Diesel generators produce particles that may influence monitored levels. Security for the equipment is required. Different filters are required for sampling each of the different compounds (TSP, heavy metals,

[1] Equipment costs vary with fluctuations in the value of the Australian dollar, particularly where equipment is imported. Equipment purchase costs my be low, while the associated running costs could be high and vice-versa. Some equipment may be cheap to purchase but have high replacement rates. The proponent is advised to obtain information on equipment purchase costs, running costs, durability/replacement costs, requirement for power source etc., prior to making a decision of what equipment/monitoring method to use.

[2] These standards are subject to review and the Australian Standards website should be used to check for updated standards. Where an Australian Standard does not exist, a USEPA or equivalent method could be used. Some methods have not been included as they are either not standard methods or have been found to be unsatisfactory in terms of accuracy, particularly when collocated with the established equipment or because the sampling period associated with the method is long therefore not allowing for timely remedial action to be taken in the event of high dust levels.

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
	period). PAHs occur in the ambient air particle bound or in vapour form. USEPA Method TO-13A uses a combination of a quartz filter (for the particle PAH phase) and a sorbant cartridge (for the vapour phase). Both are then solvent extracted and analysed by gas chromatography with mass spectrometry (GC/MS) detection.			collection – Flame atomic absorption spectrometric method. This method could be used for other heavy metals. Alternatively, **USEPA Compendium Method IO-3.4**. Determination of metals in ambient particulate matter using inductively coupled plasma (ICP) spectroscopy, could be used. High volume sampler gravimetric collection for PAHs, but with analysis by method TO-13A. **(PAH) USEPA Method TO-13A**. Determination of Polycyclic Aromatic Hydrocarbons (PAHs) using Gas Chromatography/Mass Spectrometry (GC/MS) – Jan 1999.	PAHs). For PAHs, both the particle and vapour phase are collected. Does not provide continuous data output.
2	**Tapered Element Oscillating Microbalance (TEOM)** (The TEOM provides near continuous monitoring of particle mass. The TEOM consists of an oscillating tapered tube with a filter on its free end. As particles land on the filter, the filter mass change is detected as a frequency change in the	• Particulate mass (PM_{10}, $PM_{2.5}$ & TSP)	Compliance & management	**AS 3580.9.8-2001** - Method for sampling and analysis of ambient air - Determination of suspended particulate matter – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser	A high level of operator skill is required for the siting, operation and processing of results. A TEOM can be configured with an alarm system that is set off when Trigger Levels are exceeded, which is useful for management purposes. A power source is required. Generators may be used where a power source is unavailable.

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
	oscillation of the tube. The mass change and the flow rate through the system provide a measure of the particle concentration. is typically operated at 10-minute intervals),				Diesel generators produce particles that may influence monitored levels. Security for the equipment is required. A climate –controlled enclosure is required. Operation at 10-minute intervals, allows detailed comparison with meteorological conditions.
3	**Beta attenuation monitor (BAM)** (The BAM is a continuous monitoring method and operates by drawing air through a continuous glass or filter tape. Beta radiation emits low energy electrons that pass through the particles deposited on the tape, and the attenuation of electrons is measured in a sensor located above the tape. The attenuation is converted to an estimate of mass based on the absorption coefficient. The	• Particulate mass (PM_{10}, $PM_{2.5}$ & TSP)	Compliance & Management	Under development.	A high level of operator skill is required for the siting, operation and processing of results. A BAM can be configured with an alarm system that is set off when Trigger Levels are exceeded, which is useful for management purposes. A power source is required. Security for the equipment is required. A climate –controlled enclosure is required.

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
	response of the beta gauge will depend on the absorption coefficient of the particles, and will vary with different particle concentrations. It is operated with a time resolution of 1 hour).				
4	**Particle counter** (Particle counters use the principle of light scattering and measure the particle size distribution and number of particles to provide an estimate of particle mass. A narrow air stream is directed through a small sensing zone, where an intensive light beam illuminates it. Light is scattered by individual particles and sensed by a detector as an electrical pulse. Particle size is determined from the pulse amplitude and the particle number is determined from the number of pulses).	• Particulate Mass (PM_{10}, $PM_{2.5}$ & TSP)	Management	NIL	Particle counters are useful for on-site management monitoring of dust and are used to assess dust levels for comparison against trigger levels for corrective action and work stoppage. An alarm is sent when trigger levels are exceeded. Particle counters are handheld devises so easily deployed around the site and useful for changing wind directions.
5	**Membrane filtration method** (A measured quantity of air is drawn through a membrane	• Asbestos		Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition [**NOHSC:3003(2005**)]	This method was primarily designed for assessment of asbestos exposure in the work place. However, in the absence

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
	filter. The filter is then transformed from opaque to a transparent, optically homogeneous specimen. The respirable fibres are then sized and counted, using a microscope and calibrated eyepiece graticule. The result is expressed as fibres per millilitre of air, calculated from the number of fibres observed on a known area of filter and the volume of air sampled).				of any suitable method for the monitoring of asbestos in ambient air, this method will apply.
Monitoring for non-dust air pollutants					
6	**Stainless steel sample canisters** (6L summa/silico canisters (silica –lined canisters) are used. These canisters are specially prepared by treating the internal surfaces to render them inert. The canisters are then evacuated. In the field, a sample of ambient air is collected by opening the valve of the canister. The canister is then taken to the laboratory for analysis).	• VOCs: including benzene toluene, xylene & formaldehyde[3]		**United States Environmental Protection Agency Compendium Method TO-14A**. Determination of Volatile Organic Compounds (VOCs) In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography – Jan 1999. OR **United States Environmental Protection Agency Compendium Method TO-15**. Determination of Volatile Organic Compounds (VOCs)	Method TO-14A measures non-polar VOCs such as benzene, toluene and xylene. Method TO-15 measures both non-polar VOCs and Polar VOCs (aldehydes and ketones), such as formaldehyde. However, currently there are no laboratories in Australia capable of analysing canisters using method TO-15. Canister samples should be analysed within 30 days of

[3]See Air Toxics NEPM

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
				In Ambient Air Using Specially Prepared Canisters With Subsequent Analysis By Gas Chromatography/Mass Spectrometry (GC/MS) – Jan 1999.	collection.
7	**Adsorbant cartridges** (Adsorbant cartridges are coated with a substance that adsorbs the VOC or PAH of interest. A pump could be used to draw a known volume of air through the adsorbent tube (active sampling) or the tubes could be left in the field for a certain period of time (passive sampling). For passive sampling, the tubes are fitted with different orifices that control the flow of air. Therefore the tubes can be left out for varying periods of time ranging from say 1 hour to I week. The tubes are then taken to the lab for analysis. At the lab the VOCs/PAHs are extracted using an organic solvent or thermally desorbed for analysis).	• Formaldehyde (and other polar VOCs - aldehydes and ketones) • Non-polar VOCs	Compliance	**United States Environmental Protection Agency Compendium Method TO-11A**. Determination of Formaldehyde in Ambient Air Using Adsorbant Cartridge Followed by High Performance Liquid Chromatography (HPLC) [Active Sampling Methodology] – Jan 1999. **United States Environmental Protection Agency Method TO-1.** Method for the determination of Volatile Organic Compounds in ambient air using Tenax® adsorption and Gas Chromatography/Mass Spectrometry (GC/MS). **United States Environmental Protection Agency Compendium Method TO-17.** Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes.	Method requires the use of a sampling pump. The pump sampling rate and time is has to be calculated prior to sampling as these are dependent upon the expected concentrations of the compounds in the air to be sampled. The tubes have to be stored below 4^{o}C after sampling. A power source is required for active sampling. However, most pumps can be operated using battery power. Passive sampling may be conducted. However, the sampling is generally conducted over longer periods (24 hours to 1 week) and there are no standard methods for passive sampling.
Meteorological monitoring and equipment siting requirements					

	Equipment/monitoring method	Pollutants monitored	Suitability for compliance / management monitoring	Applicable standards[2]	Limitations/comment
8	**Meteorological monitoring**	• Wind speed & direction, rainfall, relative humidity and temperature.	Management	**AS 2923-1987** Ambient Air – Guide for measurement of horizontal wind for air quality applications.	
9	**Siting of equipment**		Compliance	**AS/NZS 3580.1.1:2007** Methods for the sampling and analysis of ambient air – Guide to siting air monitoring equipment	The surrounding topography and obstacles such as trees and building, could limit meeting the requirements of AS 3580.1.1:2007.

Appendix 5: Dust complaint form (example only)

Date: Date on which the complaint was received	Time: Time the complaint was received	Received by: Name of the person receiving the complaint
Name: Name of the person making the complaint Address: Address of the person making the complaint Phone: Telephone number of the person making the complaint		
Municipality: Name of the local government where the site is located		
Complaint details (effect/frequency)		
Referred to: Name of local government Environmental Health Officer, DOH or DEC officer if this complaint has been referred. Date: Date of referral to local government officer, DOH or DEC officer		
Possible causes and actions taken: Actions taken to eliminate pollution		
Recorded by: Name of the person completing the form Date: Date on which the form was completed		

Appendix 6: Contact details for DEC and DOH

DEC

For contaminated sites:

Tel : 1300 762 982
E-mail : Contaminated.Sites@dec.wa.gov.au

For all other projects, contact the relevant DEC metropolitan or regional office. Details are available of the DEC website at: www.dec.wa.gov.au.

Postal address for all projects (contaminated and uncontaminated):

Locked Bag 104,
Bentley Delivery Centre WA 6983

DOH

Toxicology Section

Subsections: Air Quality : Tel: 9388 4919
Contaminated Sites : Tel: 9388 4984

Fax for both subsections : 9388 4902

E-mail for both sections : ehinfo@health.wa.gov.au
(indicate Toxicology + relevant subsection – Air Quality or Contaminated Sites, in the subject line)