1 Introduction

1.1 Introduction and Objectives

JBS Environmental Pty Ltd was engaged by Incoll Management Pty Ltd (Incoll) to prepare an Air Quality Management Plan (AQMP) for the proposed treatment of contaminated soil at a site on the Chullora Railway Workshops (CRW) facility, located off Worth St, Chullora, NSW (**Figure 1**). The contaminated soils under consideration are those to be generated during remediation of the former Macdonaldtown Gasworks site, owned by the Rail Corporation NSW (RailCorp).

This AQMP has been prepared to accompany an Environmental Assessment (EA) for the proposed remediation of the former Macdonaldtown Gasworks site located at Burren St Erskineville NSW, in the event that RailCorp consents to the transfer of contaminated materials to the CRW facility, for treatment prior to reuse at Macdonaldtown or off site disposal. A separate AQMP has been compiled for works proposed at Macdonaldtown in '*Air Quality Management Plan, Remediation of Former Macdonaldtown Gasworks*' JBS 40913-15972 – Revision C (JBS 2011).

This AQMP has been based only on the potential air emissions that may be generated from the nominated treatment area on the CRW facility. The AQMP is required to monitor and control potential air emissions from the proposed works. The provisions of the AQMP will be incorporated into the Environmental Management Plan (EMP) prepared for the project.

An Air Quality Impact Assessment[1] (AQIA) has been prepared for the use of a nominated area at CRW for treatment of contaminated soils from the Macdonaldtown site. The AQIA assessed a range of potential sources likely to generate air emissions into the surrounding area. It was assessed that unacceptable levels of air pollutants will not occur at the surrounding areas during the treatment works where a range of control and monitoring provisions are implemented on the site. The AQMP has been prepared to document the recommended control and monitoring works as identified by the AQIA.

1.2 Site Identification

The site is located off Worth St Chullora. The site is located within the RailCorp Chullora Workshops, being present within the north-eastern portion of the site. The site is irregularly shaped, having a longer north-south dimension than east-west, and has an area of approximately 2.3 hectares. The site location is shown in **Figure 1**. The site details are summarised in **Table 2.1** and described in more detail in the following sections.

Table 2.1 Summary Site Details

Lot/DP	Part of Lot 1 in DP 883526
Address	Off Worth St, Chullora
Geographical Coordinates	320681 E 6248891 N
Local Government Authority	Strathfield
Current Use	Railway materials storage

[1] *Air Quality Assessment– Remediation of Former Macdonaldtown Gasworks – Chullora material Receipt Facility, NSW* JBS Environmental Pty Ltd August 2011 (JBS 2011) – report in draft

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Site Area	Approximately 2.3 ha

A site plan is provided as **Figure 2** and proposed setup during the treatment works program is provided as **Figure 3**.

1.3 Current Site Condition

The site is currently cleared, open land, with an area of approximately 2.3 hectares. It is generally flat, with a slight slope to the north, and the surface is gravelled. There is minimal vegetation present, with trees present outside the southern and eastern boundaries. There are three semi-permanent site structures present on the western half of the site. The site is reportedly currently used for the temporary storage of railway materials including sleepers and rails.

1.4 Surrounding Landuse

Surrounding land-uses to the Chullora Railway Workshop facility include:

- North – The railway line lies directly north. Beyond the railway line, Strathfield Golf Course is present. Rookwood Cemetery is present to the northwest;
- East – The railway line lies to the east. The rail line is a service line used as part of the Chullora site operations, beyond which is a steep vegetated embankment. Beyond the eastern boundary of the Chullora Railway Workshop site are 2 to 3 storey medium density residential apartments (located on Marlene Crescent). A number of commercial properties also exist in this area;
- South – the site is bordered by trees to the south, before the service line for Chullora Workshops. Beyond this, the Hume Highway is present, and residential properties are present along the southern side of the highway; and
- West – The Chullora RailCorp Workshops are present to the west and includes some Railcorp industrial lease sites.

1.5 Purpose

This AQMP has been designed to ensure, via the implementation of a number of ongoing monitoring and management measures pertaining to the receipt, handling, treatment and storage of contaminated soil, that the risk to the remediation workforce within the treatment area, to workers on the adjoining railway facility, to users of nearby commercial and residential properties, and to the surrounding environment is acceptable. The measures have also been designed to reduce the potential odour emissions resulting from the works program such that the likelihood of offensive odours impacting likely receptors is minimised.

The AQMP is intended to form part of the EMP being prepared for the site.

1.6 Responsibilities

The treatment works on the site shall be undertaken under the guidance of a principal contractor who is yet to be appointed. The principal contractor will be responsible for the implementation of the majority of procedures provided to the AQMP and EMP. It is noted that where the specific procedures are technical or complex in nature then the Environmental Consultant as appointed to the project shall fulfil the requirements of the procedure, or advise the appropriate implementation of the procedure.

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A formal list of procedures is provided to the AQMP based on an assessment of potential environmental emissions from anticipated site works required for the demolition, earthworks and building works. Specific responsibilities are nominated for the implementation of these procedures within the relevant procedure.

1.7 Proposed Works on the Site

The proposed works at the Chullora site which are the subject of this air quality assessment potentially include:

- Receipt of contaminated soils / materials from the Macdonaldtown former gasworks remediation;
- Storage of contaminated soils / materials within stockpiles or similar;
- Treatment of contaminated soils / materials by stabilisation; and
- By review of the remediation works at the Macdonaldtown site, the quantities of contaminated soils which may be treated at Chullora (classified above 'general solid waste' in NSW DECC 2009 Waste Classification Guidelines) are summarised in **Table 1.1**.

Table 1.1: Summary of Remediation Volumes

Description	Volume	Indicative Waste Classification
Soils impacted with PAHs, TPH $C_{>10}$, heavy metals, asbestos containing materials and demolition wastes	1,900m^3	Restricted Solid
Soils impacted with coal tar. Potentially malodorous.	14,820m^3	Restricted Solid / Hazardous
Tar	420m^3	Hazardous
Tar Impacted water (known).	640m^3	Hazardous liquid waste

Though tar impacted water is present on the Macdonaldtown site, it is considered highly unlikely that transfer of liquid wastes to the Chullora site will be feasible. These have not been considered in this AQMP.

1.8 Identification of Potential Air Emissions

The proposed scope of the treatment works has been reviewed to identify potential sources of air emissions. The following potential air emissions have been identified as summarised in **Table 1.2**.

Table 1.2: Summary of Air Emissions

Stage	Task	Emissions
Preliminary	Project planning and licensing.	-
Site Establishment	Setup of site offices, sediment and erosion	Particulates, Air Toxins, Odours

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Stage	Task	Emissions
Treatment	controls Installation of temporary enclosure and associated air extraction/treatment system. Installation of cement stabilisation plant within the enclosure 2A- commission air treatment system 2B – receive materials for treatment. Onsite stockpiling until minimum treatment volume achieved 2C – once minimum volume achieved treatment of soils by cement stabilisation within the enclosure 2D – off-site disposal of treated material to an appropriately licenced landfill	
Disestablishment	Decommissioning of air treatment plants, disestablishment of enclosure and site offices. Post treatment works assessment of in-situ soils remaining on treatment area	-

It is assumed that the plant used for soil treatment will be operated, consistent with best practice techniques and in a manner that prevents the occurrence of any fugitive emissions.

The most significant potential emissions have been identified as occurring from:

- Particulate, chemical and odour emissions from receipt and handling of fill materials; and
- Particulate, chemical and odour emissions from the treatment of fill materials.

1.9 Environmental Procedures

A number of environmental control and monitoring provisions have been recommended in the AQIA's prepared for the remediation program. These have been prepared as outline air quality management procedures, are provided in **Appendix A**, and are summarised in **Table 1.3** following.

Table 1.3: Summary of Air Quality Management Procedures

Procedure No.	Name
01	Odour Prevention and Control
02	Odour Masking
03	Dust and Airborne Hazard Control
04	Handling of Environmentally Impacted Material
05	Air Monitoring – Odours
06	Air Monitoring – Volatile Organic Compounds
07	Air Monitoring – Particulates
08	AQMP Review
09	Training

Implementation of these control measures by the Principal Contractor will effectively mitigate risks associated with air emissions during the treatment works.

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2 Limitations

This report has been prepared for use by the client who commissioned the works in accordance with the project brief only and has been based in part on information obtained from other parties. The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

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

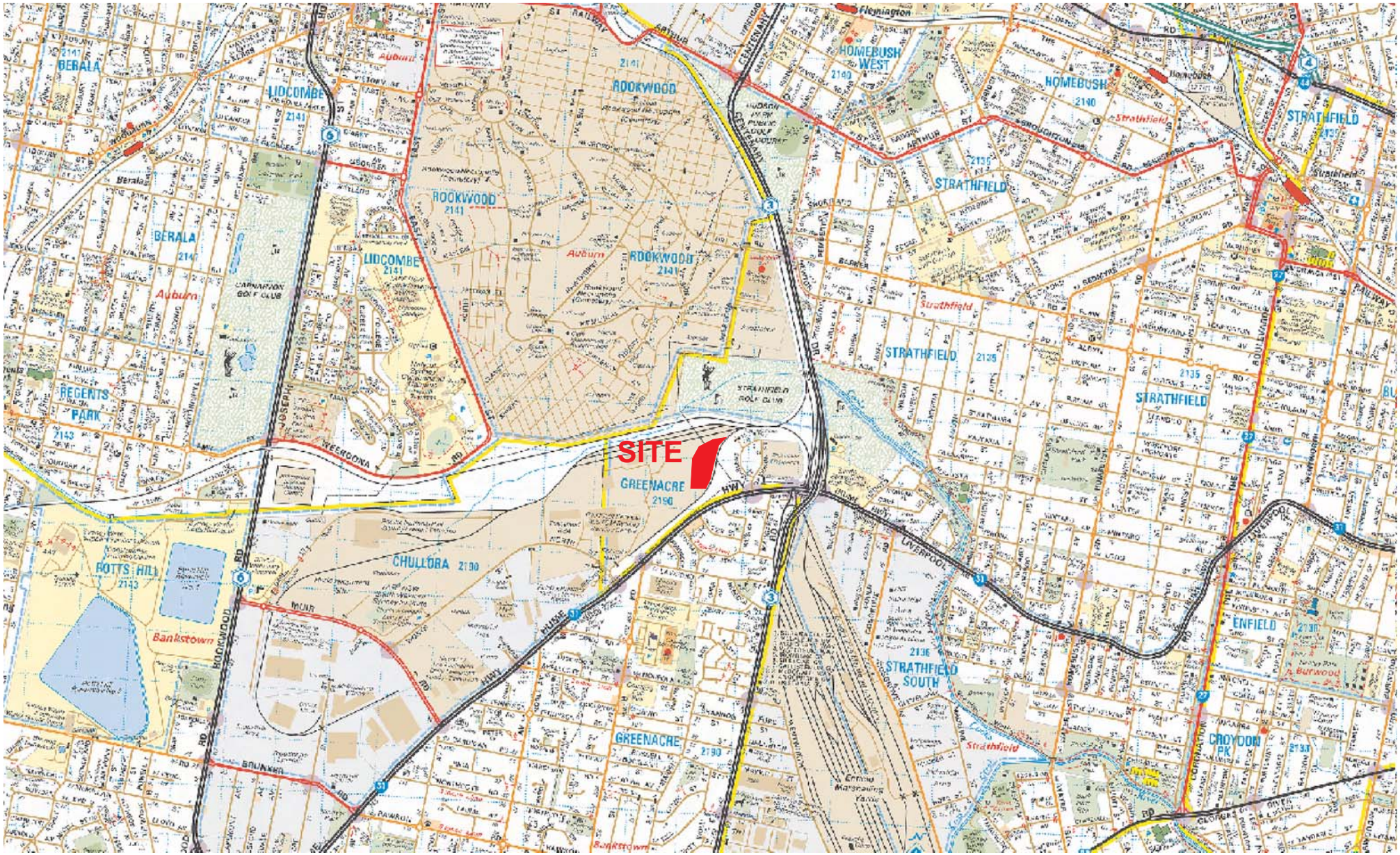
Changes to the subsurface conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are based on the information obtained at the time of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

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

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Figures

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0 1000m

Approximate scale

Figure 1 **Site Location (Chullora)**

Department of Lands (2010)
Note- All locations shown are approximate only

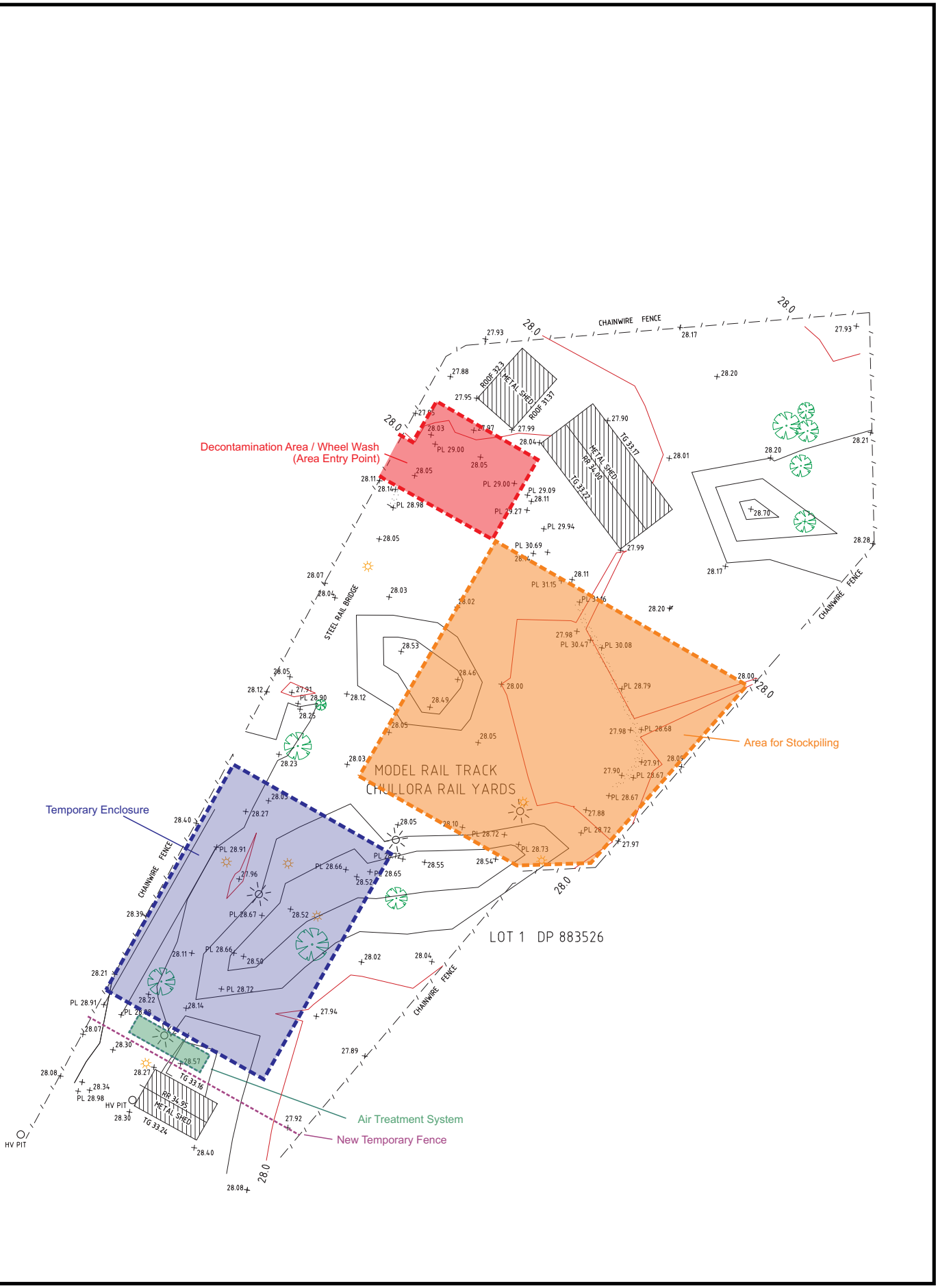


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0 50m
Approximate scale

Figure 2 **Chullora Site Plan**

Department of Lands (2010)
Note- All locations shown are approximate only



Source: Base Image - © 2011 Lynton Surveyors Pty Ltd - 2011C107_DET.dwg

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0 7.5 15 30 m

Scale: Approximate

Datum: MGA94 Zone 56 - AHD		Doc. No: Preliminary	
A4			
A	Original Issue -	RF	19-05-2011
Rev	Description	Drn.	Date

Legend:

- New Temporary Fence
- Air Treatment System
- Temporary Enclosure
- Area for Stockpiling
- Decontamination Area / Wheel Wash

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Figure 3: Proposed Setup of Treatment Area (Chullora)

Client: Incoll Management

Project: RailCorp Macdonaldtown Approvals

Job No: 40913 File Name: 40913_02

Appendix A

Air Quality Management Procedures

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Odour Prevention and Control	AQMP01
Responsibility:	Head Contractor Environmental Consultant
Frequency:	Disturbance of potentially malodorous / impacted soils
Location:	All areas on site
Objective:	To minimise potential odour impacts

Procedure

Malodorous materials will be disturbed during remediation of the site. Coal tar based impact has been identified in soils underlying the majority of the site with the greatest impacts in soil observed in the vicinity of former Northern Gasholder and Retort House. Areas containing free tar (i.e. the former tar wells, pipework etc.) are also likely have the potential to generate offensive odours if exposed and/or disturbed.

Extensive measures require to be undertaken to control potential odour generation and odour emissions from the site as detailed below. The measures require to be sufficient to prevent recognition of offensive odours at residential and commercial properties in proximity of the site.

The construction and operation of the tented enclosure will be the main method of odour control. Odour control measures shall be employed within the tented enclosure comprising:

- Maintenance of the interior of the enclosure at a negative pressure relative to the surrounding environment. Where a negative pressure is able to be effectively maintained there is a reduced importance to the sealing of the enclosure with the surrounding ground level; and
- Venting of all emissions from the tented enclosure through a granular activated carbon (GAC) filter.

Construction of GAC Odour Control Filters

GAC odour control filters are required as described in EMP11 Tented Enclosure and the water treatment plant as described in EMP17 Groundwater Treatment. GAC filters shall be installed and operated as per the following requirements:

- All GAC filters used for odour control shall consist of three distinct units connected in series. The first and second unit shall be identically sized and the third unit must be at least 25% of the capacity of the preceding units;
- An air sampling port shall be installed between the first and second filter vessel; and
- The sizing of the GAC filters will require to be determined at the commencement of the works. The GAC filters shall be sufficiently sized so that at commissioning stage (under actual project conditions) there is no recognisable odour between the first and second filters. The potential for odour emissions to increase during the works shall be considered (where applicable) and correction factors determined where necessary to ensure appropriate sizing of filters.

GAC Filters will become saturated during the source of the works. Monitoring is required to assess when Filter saturation occurs. This shall be undertaken by daily monitoring of the air sampling port between the first and second GAC filter using a PID. Where the PID records a reading above 10ppm, an air sample shall be collected and assessed for a recognisable odour. Where a recognisable odour is detected the filter shall be considered to be saturated and replaced with new GAC media.

Odour Prevention Measures

Tented Enclosure of Soil Treatment Works

Any treatment works relating to cement stabilisation must occur within the enclosure. The tented enclosure shall be designed and operated such that atmospheric emissions comply with those identified in relevant environmental guidelines at all times. These guidelines include:

- NEPC (1998) 'National Environment Protection Measure for Ambient Air Quality';
- Environmental criteria provided to NSW DEC (August 2005) 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'; and
- Ambient air criteria provided to US EPA (2004) 'Region IX Preliminary Remediation Goals' for constituents not available in local literature.

No recognisable odours shall be discharged from the tented enclosure. The tented enclosure shall be constructed of a metal clad structure sufficiently sized to allow the operation of tippers, excavators and associated equipment required for the excavation, stockpiling and handling of soils and any associated equipment. Openings in the structure shall be minimised so as to reduce ventilation requirements.

Tippers and other heavy machinery shall be required to enter and exit the tented enclosure to allow the

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removal of soils. The following must apply to any tipper loads removing malodourous soil or other material from the tented enclosure:

- Tipper speeds when exiting the tented enclosure shall be minimised to the extent possible to prevent wake effects at the rear of the tipper causing uncontrolled release of odours. Where wake effects and associated discharge of recognisable odours are evident at tipper exit from the tented enclosure, then ventilation shall require to be increased;
- Spraying of the exposed malodorous soil surface with an odour sealing solution. A mixture of 'Anotec 0307' (http://anotec.com.au/prod.htm), or similar, and water may be suitable to be used for this purpose. Covering of the load to prevent particulate emissions; and
- Continuous monitoring odours in accordance with **AQMP5.0 Odour Monitoring**.

Stockpiling of Soil – Areas external to the Tented Enclosure

Where stockpiles are to be left in place external to the tented enclosure they shall be covered in non-malodourous materials, secured plastic sheeting or low permeability geofabric to prevent odourous emissions. The surface area of uncovered and untreated soil on site will be limited to 150 m^2 at any one time, and will remain subject to the management requirements of AQMP02 Odour Masking and AQMP03 Dust and Airborne Hazard Control.

Malodorous Materials Movement Scheduling – Areas external to the Tented Enclosure

Malodorous materials from Macdonaldtown will be received at the Chullora site for treatment. Odour control measures may not be able to maintained when the material is in transit and during unloading.

The Environmental Consultant appointed to the Project shall advise the most appropriate period of each day to undertake these works based on an assessment of meteorological conditions. Results of environmental monitoring as undertaken during these works, including odour and VOC assessment as per AQMP05 Air Monitoring – Odours and AQMP06 Air Monitoring – Volatile Organic Compounds, shall be used to confirm that the advised meteorological conditions are appropriate.

Conditions which maximise separation distances to downwind receptors and increase dispersion of emissions shall be favoured. Receipt/unloading of malodorous materials from site shall be optimised during these periods to the extent possible. It is anticipated that this will typically comprise afternoon periods. The environmental consultant shall be aware that conditions that favour odour dispersion may not favour reduction in dust emissions.

Similarly where the environmental consultant advises that non favourable meteorological conditions are present, movement and handling of potentially malodorous materials outside the area of the tented enclosure will be prevented (where possible).

Handling / exposure of malodorous materials shall not occur during any periods where unacceptable levels of odour or VOC emissions are identified by AQMP05 Air Monitoring – Odours and / or AQMP06 Air Monitoring – Volatile Organic Compounds.

<u>Odour Masking</u>

All measures possible must be undertaken to prevent odour emissions prior to adopting odour masking measures as described in AQMP02 Odour Masking.

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Odour Masking	AQMP02
Responsibility:	Head Contractor Environmental Consultant
Frequency:	Disturbance of potentially malodorous / impacted soils
Location:	All areas on site
Objective:	To minimise potential odour impacts

Procedure

Extensive measures are proposed to control odour emissions. The nature of the available odour controls means that they are not able to be immediately applied to sources of odour emissions. During some periods of the works momentary 'puffs' of odour may occur during the periods where odour controls are being implemented.

The degree of recognition of these odours will be able to be reduced by the operation of an odour masking system, however it is noted that the odour masking system shall not be used as a substitute for proper odour control technologies.

Odour Masking System

An odour masking system will require to be established along all site boundaries prior to the disturbance of potentially malodorous materials.

Once established, the odour masking system shall only be implemented where environmental monitoring identifies that all other odour control procedures have failed and odour emissions are unable to be prevented.

This system shall comprise the following:

- Provision of odour control solution consisting of a mixture of 'Anotec 0307' (http://anotec.com.au/prod.htm) or similar and water. This shall be prepared by the mixing of one 20L drum of Anotec 307 in 1,000L of water (or as per manufacturer's instructions for other products);
- Provision of an odour control solution spray system consisting of raised irrigation line (at least 1.5m above ground level) provided with sprinkler heads at a frequency of:
    - One head per 5m on the northern, eastern and southern boundaries; and
    - One head per 1.5m for the western site boundary;
- Sprinkler heads should be capable of delivering a fine mist of odour control solution with no discernible droplets; and
- Continuous supply of odour control solution to the raised irrigation line at a sufficient frequency to supply at least 100ml/minute to each sprinkler head included in the irrigation line.

Given the proximity of neighbouring residents along the western boundary, installation and operation of the odour masking system must be designed so that the odour masking solution does not affect the adjacent properties. This may require trials prior to the commencement of excavations and/or programming of works such that excavation of malodours soils does not occur during unfavourable conditions.

System Operation

The odour masking system shall not be used as a substitute for proper odour control technologies. The odour masking system shall only be used during periods where short duration puffs of odour may occur and only where all odour control technologies, as described in AQMP01 Odour Prevention and Control are being implemented.

The odour masking system shall operate for a maximum of four hours on any day. The operation of the Odour Masking System shall be recorded on Form AQMP02.1.

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Odour Masking System Operation	Form AQMP02.1

Date	Commenced Operation	Ceased Operation	Wind Speed and Direction	Comments

Dust and Airborne Hazard Control	AQMP03
Responsibility:	Head Contractor
Frequency:	All site works
Location:	Site Areas External to the Tented Enclosure
Objective:	To minimise dust emissions from demolition and earthworks.

Procedure

Dust and Asbestos Risk

Excavation and handling of soils has the potential to generate dust emissions.

Additionally asbestos containing materials have been found to be potentially present in fill materials located across the Macdonaldtown site in the vicinity of the former Northern Gasholder. Previous environmental assessments have identified that asbestos occurs within the bonded matrix of fibre cement fragments. At the time of assessment of this material no testing was undertaken to identify the presence of free asbestos.

Addison et. al. ('The Release of Dispersed Asbestos from Soil', Institute of Occupational Medicine Report No. TM/88/14, September 1988) have found that very high levels of respirable dust must be generated before significant airborne concentrations of asbestos fibres were produced from soils contaminated with respirable asbestos fibres. It is considered that fibre cement sheet fragments must be subjected to intensive mechanical processes to cause the release of asbestos fibres.

Asbestos containing fibre cement fragments potentially present in the materials to be received at the treatment site are not considered to pose a risk, as such the measures recommended for control of dust emissions will be sufficient to control potential asbestos emissions.

Standards

All operations on site are to be conducted so that concentrations of dust and other hazardous substances satisfy those stipulated in NSW DECCW published and endorsed guidelines. These guidelines include:

- NEPC (1998) 'National Environment Protection Measure for Ambient Air Quality' and
- Environmental criteria provided to NSW DEC (August 2005) 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'.

Control

Measures shall be undertaken to reduce airborne emissions from site activities including:

- Water sprays used for dust suppression across unsealed areas of the site, stockpiles and other dust generating areas. All potential dust generating areas (i.e. areas of exposed soils) require to be watered on an hourly basis during periods of site operation or significant dust generation;
- Stockpile heights shall be minimised where possible;
- Where stockpiles are to be left in place for significant periods of time, they shall be seeded to promote vegetation growth to prevent dust emissions; and
- Where unfavourable meteorological conditions exist (i.e. strong winds directed at residential properties) site works shall be restricted to those with low potential for atmospheric emissions. This shall also include consideration of reduced production rates during these periods to minimise dust emissions.

Regular maintenance shall be undertaken of sprinkler heads, as used for dust control throughout the site, to prevent clogging.

It is noted that additional specific requirements have been developed for soils which are identified as potentially malodorous as detailed in AQMP01 Odour Prevention and Control and AQMP04 Handling of Environmentally Impacted Soil which shall also reduce dust and potential asbestos emissions. The requirements of this procedure should be reviewed in accordance with the additional requirements of these other procedures.

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Handling of Environmentally Impacted Soil	AQMP04
Responsibility:	Head Contractor Environmental Consultant
Frequency:	Handling of environmentally impacted soils, including stockpiled soils and receipt of impacted materials
Location:	Areas of site containing environmentally impacted soils
Objective:	To control potential environmental emissions from contaminated soils

Procedure

Potential hazardous emissions (dust, odour and vapours) may be released during the handling of environmentally impacted materials on the site. Measures shall be put in place to minimise such emissions. These measures shall include:

- Measures detailed in AQMP01 Odour Prevention and Control;
- Measures detailed in AQMP02 Odour Masking;
- Measures detailed in AQMP03 Dust and Airborne Hazard Control;
- Transport of all impacted soils as per designated and marked 'impacted' and 'treated' haul routes throughout the site. These routes shall be clearly identified on a site plan as posted within the Site. A heavy vehicle decontamination area shall be clearly marked on this plan. All persons engaged on the site shall be aware of the preferred haulage routes. The identification of preferred routes will assist in the appropriate placement and ready deployment of odour control methods, and prevent transport of impacted materials along site boundaries (where possible).

Where air quality management provisions are insufficient to allow monitoring criteria as detailed in AQMP05 Air Monitoring – Odours and/or AQMP06 Air Monitoring – Volatile Organic Compounds and/or AQMP07 Air Monitoring – Particulates and/or AQMP08 Air Monitoring – Asbestos, then the relevant works shall be ceased until more favourable meteorological conditions or more appropriate work methods are available. The Environmental Consultant shall advise more appropriate meteorological conditions.

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Air Monitoring – Odours	AQMP05
Responsibility:	Head Contractor Site Auditor Environmental Consultant
Frequency:	Handling / excavation of malodorous materials
Location:	Site boundaries
Objective:	To assess compliance with environmental standards for works

Procedure

A program of atmospheric monitoring shall be undertaken throughout the earth works. The extent of required monitoring is described following:

Odour

Odour monitoring shall be undertaken by an appropriately qualified consultant at the downwind boundaries of the site. Odour monitoring shall be commenced prior to the receipt of malodorous materials on the site. Odour monitoring shall be undertaken at three locations, as a minimum, spaced no greater than 20m along the downwind boundary at a frequency of twice daily (as a minimum).

Odour monitoring shall be undertaken using a 'Nasal Ranger' field olfactometer. A single odour measurement shall be undertaken at each monitoring location. Where an odour strength of 2-4 odour units or greater is recorded, an additional four odour measurements shall undertaken on a 1 minute basis. Odour measurements shall be recorded on Form AQMP05.1 for the relevant monitoring period.

Where three (or more) of the total five readings record an odour strength of or in excess of 2-4 odour units (based on coal tar recognition):

- the odour masking system as described in AQMP02 Odour Masking shall be activated (where appropriate);
- monitoring shall be increased to an hourly frequency until the odour strengths recorded at all locations on the downwind boundary do not exceed 2 – 4 odour units over two consecutive hours. Once achieved the monitoring frequency may be returned to the minimum twice daily requirement; and
- the measures prescribed in AQMP01 Odour Prevention and Control shall be reviewed for adequacy in relation to site activities. Improvements or recommendations arising out of the review shall be incorporated into a revised AQMP for the site as per AQMP08 AQMP Review.

Personnel who undertake odour monitoring shall be non-smokers and shall be free of any nasal / sinus conditions that may affect the ability to detect / recognise odours.

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Receptor No.	Description	Distance from Site	Easting	Northing
1	29-31 Marlene Cres Greenacre	125m, east	321026	6248922
2	5-9 Marlene Cres Greenacre	160m, east	321084	6249063
3	Strathfield Golf Course, south west corner	160m, north	320795	6249157
4	47 Hume Hwy Chullora	150m, south	320949	6248674
5	Beaufort Pl Chullora	750m, south-west	320208	6248352
6	Chullora Railway Workshop Personnel external to the treatment area	20m east	332101	6248654

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0 100m

Approximate scale

Figure 5.1 **Location of Receptors in Proximity of Site for Daily Odour Monitoring**

Department of Lands (2010)
Note- All locations shown are approximate only

Air Monitoring – Odours	Form AQMP05.1

Date:_____

Downwind Locations (complete as per monitoring periods)

7-8am ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

8-9am ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

9-10am ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

10-11am ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

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11-12am ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

12am-1pm ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

1-2pm ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

2-3pm ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

3-4pm ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

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4-5pm ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

5-6pm ◇ No Malodorous Materials Handled

Boundary Assessed:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

Additional Measurements:_____

_____

Static Locations

Time:_____

Wind Direction and Velocity:_____ _____m/s

Measurements: 1._____OU 2._____OU 3._____OU

4._____OU 5._____OU 6._____OU

Additional Measurements:_____

_____

Completed by: _____

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Air Monitoring – Volatile Organic Compounds	AQMP06
Responsibility:	Head Contractor Site Auditor Environmental Consultant
Frequency:	Handling / receipt / storage of malodorous materials
Location:	All site works external to the tented enclosure
Objective:	To assess compliance with environmental standards for works

Procedure

A program of atmospheric monitoring shall be undertaken at the site throughout the remediation works outside the Soil Enclosure Area. The extent of required monitoring is described following:

Volatile Organic Compounds (VOCs) – Photo-Ionisation Detector

Assessment for VOCs shall be undertaken using a photo-ionisation detector (PID) provided with a 10.6eV bulb. Prior to use and at least on a daily basis the calibration of the PID shall be checked by comparison to a fresh air and isobutylene standard. The calibration check shall be recorded as per the appropriate PID calibration forms.

VOC monitoring shall be undertaken at all times in the proximity of handling of malodorous materials. Contaminants identified on the project site which have potentially significant health impacts are considered to occur within malodorous materials. The identification of malodorous materials is an appropriate measure for the potential presence of significant levels of VOCs.

The PID shall be maintained by an attended operator within a distance of approximately 2m during all periods of handling malodorous materials. Where the operator is unable to safely remain within 2m of the works area (consequent of heavy equipment or otherwise) the PID may be affixed to an excavator or similar in proximity of the works. PID measurements shall be undertaken as one hour averages.

The action level to assess PID readings requires to be determined on the basis of the separation distance to the nearest potentially exposed receptor. Locations of nearest receptors and separation distances are shown on Figure AQMP6.1 attached. The separation distance to the nearest receptor requires to be calculated by estimating the distance from the area of the malodorous materials to the nearest receptor. This is the sum of the distance from the site boundary to the receptor, and the downwind distance from the malodorous materials to the site boundary. The PID screening criteria are summarised following:

Separation Distance (m)	PID Screening Criteria (ppm)
50	0.1
100	0.2
150	0.3
200	0.3
250	0.4
300	0.4
350	0.5
400	0.5
450	0.6
500	0.6
600	0.7
700	0.7
800	0.8
900	0.9
1000	0.9

Where the screening criteria are exceeded then measures as required by EMP02 Odour Control shall be implemented to reduce VOC emissions. It is noted measures identified as appropriate for odour emissions are also appropriate for control of VOC emissions.

Subsequent to implementation of odour control measures, an additional air sample shall be required to be collected using a Draeger Tube.

All PID monitoring results require to be recorded on Form AQMP6.1. The recording of repeated elevated reading will require a substantial review of work methods in accordance with AQMP08 review.

Volatile Organic Compounds (VOCs) – Draeger Tube

Draeger tube samples require to be collected where the PID screening level is exceeded and the maximum PID reading for the day has been recorded. Draeger tube samples require to be specific to benzene.

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Draeger tube ID 81081841 shall be used for sampling. This tube is specific to benzene and has a benzene detection limit of 0.5ppm. Draeger tube samples shall be collected at a height of 1.5m immediately overlying the malodorous materials. Some works may require to be temporarily ceased to allow collection of the sample.

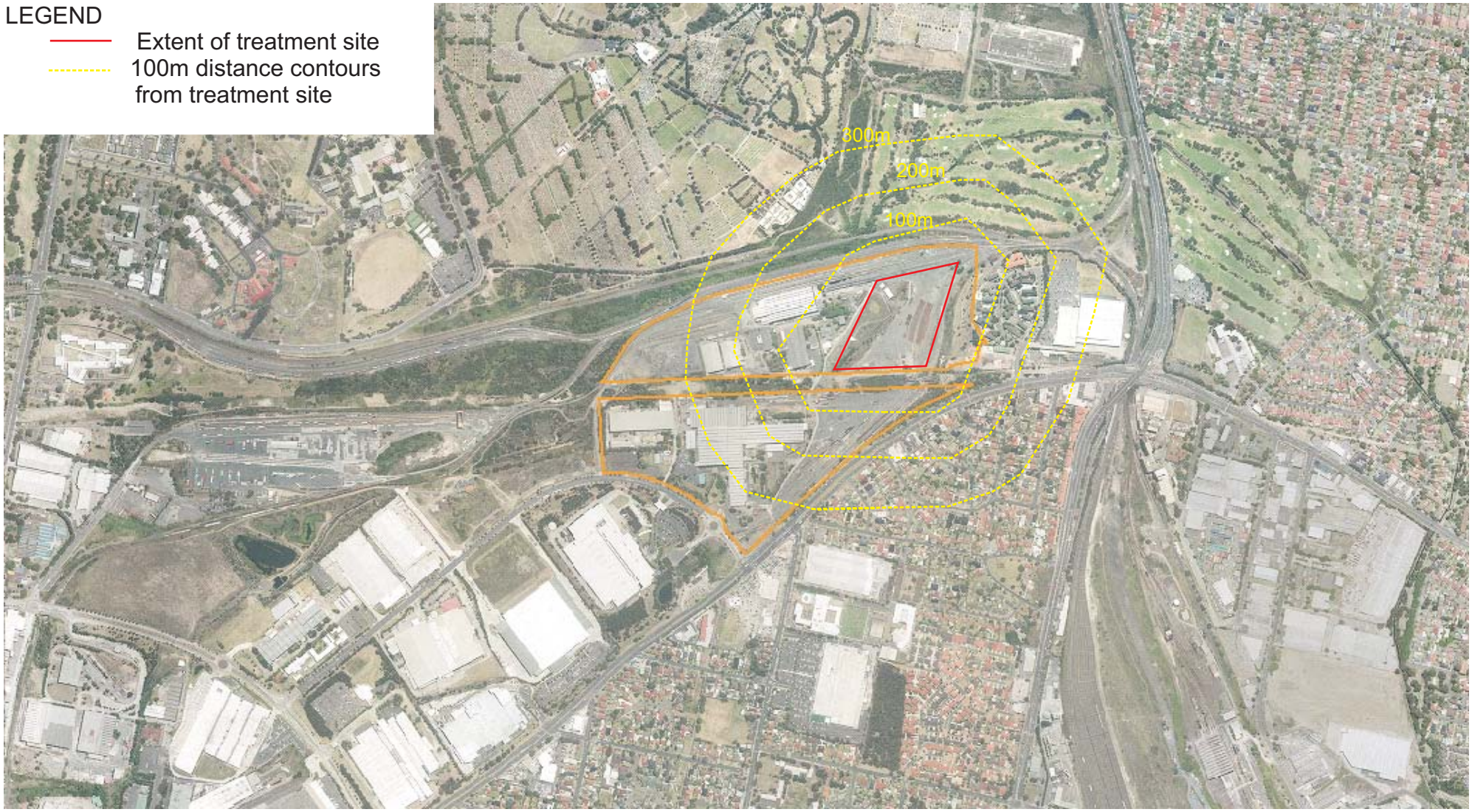
Draeger tubes shall be sampled in strict accordance with the manufacturer specifications. Sampling shall be undertaken using a Draeger Accuro Pump. It shall be ensured that the recommended number of strokes are undertaken with the collection of each sample.

All Draeger tube monitoring results require to be recorded on Form AQMP6.1. The recording of repeated elevated reading will require a substantial review of work methods in accordance with AQMP08 review.

The Draeger tube action level shall be set at a detection of benzene overlying the source (0.5ppm). Where a detection is recorded and odour controls have been implemented, works shall require to be modified. This shall include consideration of:

- Cessation of works until more favourable meteorological conditions are available; and/or
- Reduction in scale of works with VOC impacted / malodorous materials.

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0 250m

Approximate scale

Figure 6.1

Approximate Radial Distances from Treatment Site

Department of Lands (2010)
Note- All locations shown are approximate only

Air Monitoring – VOCs	Form AQMP06.1

Date:_____

Sampling Locations at 2m Distance Downwind of Work Zone (complete as per monitoring periods)

7-8am ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

8-9am ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

9-10am ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

10-11am ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

11-12am ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

12am-1pm ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

1-2pm ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

2-3pm ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

3-4pm ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

4-5pm ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

5-6pm ◇ No Malodorous Materials Handled

Wind Direction and Velocity:_____ _____m/s

Measurements (hourly average): _____ ppm

Drager Tube sample: ◇ No Sample ◇ No Benzene Detection ◇ _____ ppm

Comments:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Completed by: _____

Air Monitoring – Particulates / Dust	AQMP07
Responsibility:	Head Contractor Site Auditor Environmental Consultant
Frequency:	Duration of treatment works
Location:	Site boundaries
Objective:	To assess compliance with environmental standards for works

Procedure

A program of atmospheric monitoring shall be undertaken throughout the earth works. The extent of required monitoring is described following:

Dusts – Realtime Particulate Monitoring

Assessment of realtime levels of dusts shall be undertaken by appropriately qualified personnel observing site boundaries. Where visible dusts are observable on the site boundaries then actual site measurements shall be undertaken by a 'DUSTTRAK' Aerosol Monitor at the downwind site boundary. The averaged level of PM_{10} (particulate matter less than 10 microns in diameter) over a period of 30s shall be required to be less than 50µg/m^3 at the downwind portion of the site boundary.

Where the acceptable level of dust is exceeded by real-time aerosol monitoring, then the measures prescribed in AQMP03 Dust and Airborne Hazard Control shall be reviewed for adequacy in relation to site activities. Improvements or recommendations arising out of the review shall be incorporated into a revised AQMP for the site as per AQMP08 AQMP Review.

All measurements shall be recorded in Form AQMP07.1.

Dusts – Deposition Monitoring

Dust deposition monitoring shall be undertaken by dust deposition gauges maintained permanently at three locations identified on Figure AQMP7.1. These locations have been determined on the basis of siting requirements in AS2922-1997 'Ambient Air – Guide for Siting of Sampling Units' to the extent possible. Collection and analysis of samples shall be undertaken in accordance with AS3580.10.1-2003 'Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method'. Samples shall be collected and analysed on a monthly basis throughout the works.

Where the level of dust deposition exceeds 2g/m^2/month the implementation of AQMP03 Dust and Airborne Hazard Control shall be reviewed.

Dusts – Laboratory Analysis of Particulates

Confirmatory sampling shall be undertaken of the realtime particulate measurements being generated by the monitoring. This shall be undertaken by the fortnightly collection of an ambient air sample by a high volume sampling method. A high volume sampler shall be operated for a minimum period of 8 hours during site operation at a downwind location on the site boundary. Sample collection and analysis shall be in accordance with AS3580.9.6-1990 'Ambient Air – Determination of Suspended Particulate Matter PM_{10} – High Volume Sampler with Size Selective Inlet Gravimetric Method'.

Realtime measurements shall be taken at hourly intervals adjoining the sampler. The laboratory reported result of the high volume sampler shall be compared to the average of the realtime measurements. Where a significant discrepancy is identified (RPD>50% as calculated in accordance with AS4482.1-2005) the calibration of the Dusttrak (dust monitor) shall be confirmed by manufacturer service.

Repeated significant discrepancies in measurements will require revision of the AQMP in accordance with AQMP9 Review.

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Air Monitoring – Dusts / Particulates	Form AQMP07.1

Date:_____

Dusts Visible at Site Boundaries?

7-8am	◇ No	◇ Yes	_____
8-9am	◇ No	◇ Yes	_____
9-10am	◇ No	◇ Yes	_____
10-11am	◇ No	◇ Yes	_____
11-12am	◇ No	◇ Yes	_____
12am-1pm	◇ No	◇ Yes	_____
1-2pm	◇ No	◇ Yes	_____
2-3pm	◇ No	◇ Yes	_____
3-4pm	◇ No	◇ Yes	_____
4-5pm	◇ No	◇ Yes	_____
5-6pm	◇ No	◇ Yes	_____

Dust-Trak Measurements

Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s
Time:_____	Wind Direction & Speed:_____m/s	Time:_____	Wind Direction & Speed:_____m/s

Completed by:_____

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AQMP Review	AQMP8
Responsibility:	Head Contractor Site Auditor Environmental Consultant RailCorp
Frequency:	Subsequent to environment incidents. Subsequent to changes in program of works.
Location:	Not applicable
Objective:	To ensure that the AQMP is current and appropriate for the site

Procedure

The Air Quality Management Plan shall be reviewed by the Environmental Consultant subsequent to either of the following:

- any environmental incident on the site;
- repeated exceedances of daily monitoring criteria for dust (AQMP 07), VOCs (AQMP 06) and/or odours (AQMP 05); or
- a significant modification to the implemented scope of works.

All new copies of Air Quality Management Plans shall be re-distributed to all parties by the Environmental Consultant. The Environmental Management Plan will require to be updated with the provisions of the revised Air Quality Management Plan.

On finalisation of revision, the Air Quality Management Plan shall be provided to the RailCorp for review / approval. The Authority shall advise acceptability of revisions (or otherwise) within seven days of receipt.

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Training	AQMP9
Responsibility:	Head Contractor Environmental Consultant
Frequency:	Throughout implementation of Environmental Management Plan and AQMP
Location:	-
Objective:	To ensure that persons responsible for preparation of the AQMP are competent.

Procedure

Any person who is required to be responsible for technical / monitoring activities in relation to the implementation of the Air Quality Management Plan shall:

- Be inducted as the requirement and method of the specific activity by the Environmental Consultant or their nominated representative;
- Have undertaken the 24 hour Health and Safety Training for Hazardous Waste / Materials under OSHA 29 CFR 1910:120 or equivalent;
- Have an adequately acute sense of smell to allow operation of a nasal ranger (as confirmed by ability to detect n-butanol odour at a level of 40ppb by dynamic olfactometry in accordance with AS/NZS 4323.3:2001; CEN EN 13725:2003); and
- Have completed a Workcover approved Asbestos Removal Supervisor course or equivalent.

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Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Matt Parkinson/ Sumi Dorairaj		Draft for client review		26/11/2010
B	Sumi Dorairaj				14/12/10
C	Sumi Dorairaj	Matthew Bennett			05/08/11

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Appendix C

Calculation of Speciated Constituent Emission Rates

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Appendix C – Calculation of Emissions of Speciated Constituents

Chemical specific estimates are required for the following potential emissions of constituents present in soil underlying the site:

- Chemical constituents that are sorbed to particulates released from the remediation works; and
- Potentially volatile constituents that volatilise from soils handled on the remediation site.

Chemicals Sorbed to Particulates

The release of chemical constituents sorbed to soils has been estimated by simply multiplying the result for dust released by the percentage of impact of the particular constituent that is present in the source soils.

Estimates of constituents as present sorbed to dust particles are required for:

- Assessment to DECCW speciated criteria as provided for 1 hour duration;
- For use in risk calculations to determine levels of risk and hazard as may be posed to surrounding receptors.

Levels of chemical constituents have been assessed for the worse case scenario of air emissions from the site only, as detailed in Section 7.4 and Table 7.5. This has been undertaken by calculation of the product of maximum levels of constituents (as based on data collected from the impacted soils in the former operational gasworks area on the Macdonaldtown site) and maximum 1 hour levels of total suspended particulates to allow comparison to DECCW 1 hour criteria.

Volatilisation During Soil Handling and Stockpiling

The flux of volatile constituents as will potentially volatilise from soils stockpiled and handled on the Barangaroo Headland Park has been required to be estimated. The potential emissions of constituents from contaminated soils into outdoor air can be predicted by the RISC modelling package. RISC provides estimates of vapour emission on the basis of:

- The depth at which the volatile constituents occur;
- The levels at which volatile constituents present;
- Soil properties; and
- Chemical parameters related to the potential volatility of the constituents.

It has been assumed that all constituents are present at a depth of 0.1m. This is a conservative assumption, as the rates of vapour migration and discharge from the soil increase with increasing depth of the constituents from the soil surface. Similar modelling as performed in NZ Ministry for the Environment (1999) 'Users Guide Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand' has recommended a minimum diffusion distance of 0.1m be used in this modelling.

Modelling scenarios have been undertaken on the basis of maximum and average levels of constituents as per a similar logic described for the assessment of chemicals released with particulates. Maximum levels have been used for comparison to DECCW 1 hour criteria. Average levels have been used for comparison to DECCW annual chemical criteria (for the case of lead) and as a premise for risk and hazard calculations.

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Vapour flux rates are reported by RISC from the source of impact in units of $g/cm^2/s$. A unit rate of flux, based on an area of $1m^2$ has been developed for a unit concentration (1mg/kg) of benzene and benzo(a)pyrene by modelling in RISC.

Soil properties for the modelling have been adopted as per the recommended soil properties provided to US EPA (19 June 2003) 'User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings'. The values as provided for sand have been used. Noting the site watering as required with the proposed dust controls, the highest of the recommended range of water filled porosities has been adopted in the modelling to characterise emissions from the site bas subject to dust controls. Standard dry values have been used for the worse case modelling. The soil properties as used in the modelling are summarised in **Table C1** following.

Table C1: Summary of Soil Properties Adopted for Modelling

Soil Property	Adopted Value	Comments
Total porosity	0.375	Sand, as per US EPA (2003)
Water filled porosity – dry sand	0.053	
Water filled porosity – with dust controls	0.253	Value for capillary fringe sands adopted on the basis of stockpile surface being regularly watered in model assumptions. Value as per US EPA (2003)
Fraction organic carbon	0.3	Assumed, consistent with site measurements
Soil bulk density	1.66	Sand, as per US EPA (2003)

A range of chemical parameters are required to characterise the potential volatilisation of soil constituents and movement of soil vapour. The most significant of these are summarised in **Table C2** following.

Table C2: Summary of Physical Properties of COPCs

COPC	Diffusivity in air	Diffusivity in water	Henry's Law constant	Soil-water partition coefficient	Organic carbon partition coefficient	Log of octonal water partition coefficient
	Da (cm2/s)	Dw (cm2/s)	H	KD (cm3/g)	KOC (L/kg)	Log KOW
Benzene	8.95*10-2	1.03*10-5	0.227	-	146	2.13
Benzo(a)pyrene	4.3*10-2	9.0*10-6	1.87*10-5	-	5.87*105	6.13

Model outputs as determine for dry sand and wet sand scenarios have been attached. Results are summarised following:

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Table C3: Summary of Predicted Fluxes of Constituent Vapours ($g/m^2/s$ per mg/kg)

Constituent	Unit Flux from Dry Sands	Unit Flux from Wet Sands
Benzene	$6.43*10^{-6}$	$2.16*10^{-7}$
Benzo(a)pyrene	$7.63*10^{-14}$	$3.75*10^{-13}$

The unit flux rates require to be adjusted by the relevant concentration of the constituent for each area of the site where modelling is required. Environmental data for the impacted soils in the former operational gasworks area of the Macdonaldtown site has been summarised in **Table C4**.

Table C4: Summary of Chemical Data

Parameter / Concentration	Benzene	Benzo(a)pyrene
C_{soil} Maximum, Operational Gasworks Area (mg/kg)	20	339
C_{soil} Average, Operational Gasworks Area (mg/kg)	1.4	21

The calculated vapour emission rates for soils handled with the soil handling works on the Chullora Site are summarised in **Table C5**.

Table C5: Estimated Emission Rates –Impacted Soils in Former Operational Gasworks Area

Constituent	Soil Vapour – Maximum ($\mu g/m^2/s$)	Soil Vapour – Average ($\mu g/m^2/s$)
Benzene (dry sand)	1.29E-04	9.00E-06
Benzene (moist sand)	4.32E-06	3.02E-07
Benzo(a)pyrene (dry sand)	3.39E-11	1.60E-12
Benzo(a)pyrene (moist sand)	1.67E-10	7.88E-12

The benzo(a)pyrene estimates of volatilisation and vapour generation are observed to be insignificant in relation to the benzo(a)pyrene criteria and the emissions of benzene. On this basis, the potential emissions of benzo(a)pyrene as soil vapours from soils have not been considered further in the modelling.

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Dry Sands Flux Estimates

FATE AND TRANSPORT MODEL OUTPUT FOR: Benzene

Start of model output for:
Johnson and Ettinger model for outdoor air
with volatile emissions from soil

Calculating Vapor Phase Concentration at Source:
(Using Equilibrium Partitioning Equation)

Inputs:

Total concentration in soil [mg/kg].....	1.0
Total porosity [-].....	0.38
Air content [-].....	0.32
Moisture content [-].....	5.30E-02
Fraction organic carbon [-].....	3.00E-03
Organic carbon partitioning coeff. [ml/g]...	1.46E+02
Soil bulk density [g/cm3].....	1.7
Henrys Law coeff. [-].....	0.23
Chemical solubility [mg/l].....	1.79E+03

Outputs:

Calculated dissolved phase conc. [mg/l].....	1.9
Effective solubility [mg/l].....	1.79E+03

Source concentration is BELOW residual limit
because calculated dissolved phase conc.
is LESS than the effective solubility.

Dissolved phase conc. at source [mg/l].....	1.9
Source vapor concentration [g/cm^3].....	4.42E-07
Source vapor concentration [mg/m^3].....	4.42E+02
Residual level [mg/kg].....	9.20E+02

(assuming pure chemical solubility)

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VAPOR TRANSPORT FROM SOIL TO OUTDOOR AIR

Effective Diffusion Coefficient for Vadose zone

Total thickness of subunit [cm]..... 10.

Air-filled porosity [-]..... 0.32

Water-filled porosity [-]..... 5.30E-02

Total porosity [-]..... 0.38

Effective diff. coeff. for subunit....[cm^2/s] 1.46E-02

Overall Effective Diffusion Coefficient (for all layers)

Overall diffusion path length [cm]..... 10.

Overall effective diffusion coefficient [cm^2/s]... 1.46E-02

Vapor Concentration and Flux at Source

Initial vapor conc. at source [g/cm^3]..... 4.42E-07

Initial vapor conc. at source [mg/m^3]..... 4.42E+02

Initial vapor flux rate [g/cm^2/s]..... 6.43E-10

Soil gas flow rate is zero (advection not considered in this model).

OUTDOOR AIR CONCENTRATION

Benzene

Time (yr)	Concentration Outdoors (mg/m^3)
1.0	1.61E-02

This is a steady-state model.

FATE AND TRANSPORT MODEL OUTPUT FOR: Benzo(a)pyrene

Start of model output for:

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Johnson and Ettinger model for outdoor air
with volatile emissions from soil

Calculating Vapor Phase Concentration at Source:
(Using Equilibrium Partitioning Equation)

Inputs:

Total concentration in soil [mg/kg]..... 1.0
Total porosity [-]..... 0.38
Air content [-]..... 0.32
Moisture content [-]..... 5.30E-02
Fraction organic carbon [-]..... 3.00E-03
Organic carbon partitioning coeff. [ml/g]... 5.87E+05
Soil bulk density [g/cm3]..... 1.7
Henrys Law coeff. [-]..... 1.87E-05
Chemical solubility [mg/l]..... 1.62E-03

Outputs:

Calculated dissolved phase conc. [mg/l]..... 5.68E-04
Effective solubility [mg/l]..... 1.62E-03
Source concentration is BELOW residual limit
because calculated dissolved phase conc.
is LESS than the effective solubility.

Dissolved phase conc. at source [mg/l]..... 5.68E-04
Source vapor concentration [g/cm^3]..... 1.06E-14
Source vapor concentration [mg/m^3]..... 1.06E-05
Residual level [mg/kg]..... 2.9
(assuming pure chemical solubility)

VAPOR TRANSPORT FROM SOIL TO OUTDOOR AIR

Effective Diffusion Coefficient for Vadose zone

Total thickness of subunit [cm]..... 10.
Air-filled porosity [-]..... 0.32
Water-filled porosity [-]..... 5.30E-02
Total porosity [-]..... 0.38

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Effective diff. coeff. for subunit....[cm^2/s] 7.19E-03

Overall Effective Diffusion Coefficient (for all layers)

Overall diffusion path length [cm]..... 10.

Overall effective diffusion coefficient [cm^2/s]... 7.19E-03

Vapor Concentration and Flux at Source

Initial vapor conc. at source [g/cm^3]..... 1.06E-14

Initial vapor conc. at source [mg/m^3]..... 1.06E-05

Initial vapor flux rate [g/cm^2/s]..... 7.63E-18

Soil gas flow rate is zero (advection not considered in this model).

OUTDOOR AIR CONCENTRATION

Benzo(a)pyrene

Time (yr)	Concentration Outdoors (mg/m^3)
1.0	1.91E-10

This is a steady-state model.

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Moist Sands (Dust Controls) Flux Estimates

FATE AND TRANSPORT MODEL OUTPUT FOR: Benzene

Start of model output for:
Johnson and Ettinger model for outdoor air
with volatile emissions from soil

Calculating Vapor Phase Concentration at Source:
(Using Equilibrium Partitioning Equation)

Inputs:

Total concentration in soil [mg/kg].....	1.0
Total porosity [-].....	0.38
Air content [-].....	0.12
Moisture content [-].....	0.25
Fraction organic carbon [-].....	3.00E-03
Organic carbon partitioning coeff. [ml/g]...	1.46E+02
Soil bulk density [g/cm3].....	1.7
Henrys Law coeff. [-].....	0.23
Chemical solubility [mg/l].....	1.79E+03

Outputs:

Calculated dissolved phase conc. [mg/l].....	1.6
Effective solubility [mg/l].....	1.79E+03

Source concentration is BELOW residual limit
because calculated dissolved phase conc.
is LESS than the effective solubility.

Dissolved phase conc. at source [mg/l].....	1.6
Source vapor concentration [g/cm^3].....	3.74E-07
Source vapor concentration [mg/m^3].....	3.74E+02
Residual level [mg/kg].....	1.09E+03

(assuming pure chemical solubility)

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VAPOR TRANSPORT FROM SOIL TO OUTDOOR AIR

Effective Diffusion Coefficient for Vadose zone

Total thickness of subunit [cm]..... 10.

Air-filled porosity [-]..... 0.12

Water-filled porosity [-]..... 0.25

Total porosity [-]..... 0.38

Effective diff. coeff. for subunit....[cm^2/s] 5.76E-04

Overall Effective Diffusion Coefficient (for all layers)

Overall diffusion path length [cm]..... 10.

Overall effective diffusion coefficient [cm^2/s]... 5.76E-04

Vapor Concentration and Flux at Source

Initial vapor conc. at source [g/cm^3]..... 3.74E-07

Initial vapor conc. at source [mg/m^3]..... 3.74E+02

Initial vapor flux rate [g/cm^2/s]..... 2.16E-11

Soil gas flow rate is zero (advection not considered in this model).

OUTDOOR AIR CONCENTRATION

Benzene

Time (yr)	Concentration Outdoors (mg/m^3)
1.0	5.39E-04

This is a steady-state model.

FATE AND TRANSPORT MODEL OUTPUT FOR: Benzo(a)pyrene

Start of model output for:

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Johnson and Ettinger model for outdoor air
with volatile emissions from soil

Calculating Vapor Phase Concentration at Source:
(Using Equilibrium Partitioning Equation)

Inputs:

Total concentration in soil [mg/kg]..... 1.0
Total porosity [-]..... 0.38
Air content [-]..... 0.12
Moisture content [-]..... 0.25
Fraction organic carbon [-]..... 3.00E-03
Organic carbon partitioning coeff. [ml/g]... 5.87E+05
Soil bulk density [g/cm3]..... 1.7
Henrys Law coeff. [-]..... 1.87E-05
Chemical solubility [mg/l]..... 1.62E-03

Outputs:

Calculated dissolved phase conc. [mg/l]..... 5.68E-04
Effective solubility [mg/l]..... 1.62E-03
Source concentration is BELOW residual limit
because calculated dissolved phase conc.
is LESS than the effective solubility.

Dissolved phase conc. at source [mg/l]..... 5.68E-04
Source vapor concentration [g/cm^3]..... 1.06E-14
Source vapor concentration [mg/m^3]..... 1.06E-05
Residual level [mg/kg]..... 2.9
(assuming pure chemical solubility)

VAPOR TRANSPORT FROM SOIL TO OUTDOOR AIR

Effective Diffusion Coefficient for Vadose zone

Total thickness of subunit [cm]..... 10.
Air-filled porosity [-]..... 0.12
Water-filled porosity [-]..... 0.25
Total porosity [-]..... 0.38

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Effective diff. coeff. for subunit....[cm^2/s] 3.53E-02

Overall Effective Diffusion Coefficient (for all layers)

Overall diffusion path length [cm]..... 10.

Overall effective diffusion coefficient [cm^2/s]... 3.53E-02

Vapor Concentration and Flux at Source

Initial vapor conc. at source [g/cm^3]..... 1.06E-14

Initial vapor conc. at source [mg/m^3]..... 1.06E-05

Initial vapor flux rate [g/cm^2/s]..... 3.75E-17

Soil gas flow rate is zero (advection not considered in this model).

OUTDOOR AIR CONCENTRATION

Benzo(a)pyrene

Time (yr)	Concentration Outdoors (mg/m^3)
1.0	9.38E-10

This is a steady-state model.

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Appendix D

AUSPLUME Modelling Results and Modelling Files Outputs Controlled Conditions

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Conversion of Generic emission rate to activtiy specific emission factor

	parameter	Simulation ID	Source type	length	width	Angle	Easting	Northing	elevation	worst case emission factor (kg/tonne unless otherwise specified)	m3/day	tonnes/day	kg/m2/sec	g/m2/sec uncontrolled	g/m2/sec controlled
Soils, handling and stockpiling	TSP	VEXT	Area	10	15	15	320767	6248927	29	$2.81*10^{-2}*U^{1.3}$	200	330	1.7E-06	1.7E-03	4.5E-04
	PM_{10}	VEXP	Area	10	15	15	320767	6248927	29	$1.33*10^{-2}*U^{1.3}$	200	330	8.1E-07	8.1E-04	2.1E-04
	Benzene (max)	VEXBE	Area	10	15	15	320767	6248927	29	$5.62*10^{-7}*U^{1.3}$	200	330	3.4E-11	3.4E-08	8.9E-09
	B(a)P (max)	VEXBP	Area	10	15	15	320767	6248927	29	$1.25*10^{-5}*U^{1.3}$	200	330	7.6E-10	7.6E-07	2.0E-07
	Odour	VEXOU	Area	10	15	15	320767	6248927	29	-	200	330	1.7E-06	1.7E-03	4.5E-04
Soils, fugitive emissions from stockpiles	TSP	FT	Area	10	15	15	320767	6248927	29	0.85 tonnes/ha/year	200	330	2.4E-09	2.4E-06	6.1E-07
	PM_{10}	FP	Area	10	15	15	320767	6248927	29	0.43 tonnes/ha/year	200	330	1.2E-09	1.2E-06	3.1E-07
	Benzene (max)	FBEP	Area	10	15	15	320767	6248927	29	$1.7*10^{-5}$ tonnes/ha/year	200	330	4.7E-14	4.7E-11	1.2E-11
		FBEV								-	200	330	-	-	-
	B(a)P (max)	FBPP	Area	10	15	15	320767	6248927	29	$3.77*10^{-4}$ tonnes/ha/year	200	330	1.0E-12	1.0E-09	2.7E-10
	Odour	FOU	Area	10	15	15	320767	6248927	29	$2.81*10^{-2}*U^{1.13}$	200	330	1.0E-12	1.0E-09	2.7E-10
Haulage Roads	TSP	HAT	Area	5	200	0	320767	6248850	29	0.177 kg/km	200	330	5.1E-08	5.1E-05	1.3E-05
	PM_{10}	HAP	Area	5	200	0	320767	6248850	29	0.105 kg/km	100	165	3.0E-08	3.0E-05	7.9E-06
Stabilisation / immobilisation soils	TSP	TT[1]	Area	35	50	0	320720	6248875	29	$4.8*10^{-2}+2.81*10^{-2}*U^{1.3}$	100	165	1.3E-07	1.3E-04	1.3E-06
		VTT								$4.8*10^{-2}+2.81*10^{-2}*U^{1.3}$	100	165	7.4E-08	7.4E-05	7.4E-07
	PM_{10}	TPM[1]	Area	35	50	0	320720	6248875	29	$2.4*10^{-2}+1.33*10^{-2}*U^{1.3}$	100	165	6.3E-08	6.3E-05	6.3E-07
		VTPM								$2.4*10^{-2}+1.33*10^{-2}*U^{1.3}$	100	165	3.5E-08	3.5E-05	3.5E-07
	Benzene (max)	VTBEP	Area	35	50	0	320720	6248875	29	$1.25*10^{-5}*U^{1.3}$	100	165	3.3E-11	3.3E-08	3.3E-10
	B(a)P (max)	VTBP	Area	35	50	0	320720	6248875	29	$1.25*10^{-5}*U^{1.3}$	100	165	3.3E-11	3.3E-08	3.3E-10
	Odour	TOU	Area	35	50	0	320720	6248875	29	-	100	165	7.4E-08	7.4E-05	7.4E-07

Stockpiling Areas - Soil Handling

				Receptor Location						AUSPLUME SOURCE ID
				1	2	3	4	5	6	
TSP	Annual		variable	7.72E-02	6.23E-02	8.85E-02	2.46E-02	4.15E-03	1.15E+01	VEXT
			fugitive	1.36E-02	1.07E-02	1.31E-02	4.22E-03	1.13E-03	1.78E-02	FT
		90	sum	9.08E-02	7.30E-02	1.02E-01	2.88E-02	5.28E-03	1.15E+01	sum
PM_{10}	24 hour		variable	4.54E-01	3.68E-01	8.95E-01	2.15E-01	5.13E-02	2.45E+01	VEXP
			fugitive	3.88E-02	2.77E-02	4.23E-02	1.81E-02	6.14E-03	6.94E-02	FP
		50	sum	4.93E-01	3.96E-01	9.37E-01	2.33E-01	5.74E-02	2.46E+01	sum
PM_{10}	Annual		variable	3.61E-02	2.91E-02	4.13E-02	1.15E-02	1.94E-03	5.43E+00	VEXP
			fugitive	7.01E-02	5.54E-02	6.79E-02	2.18E-02	5.84E-03	9.18E-02	FP
		30	sum	1.06E-01	8.45E-02	1.09E-01	3.33E-02	7.78E-03	5.52E+00	sum
Benzene	1 hour		variable	1.16E-04	7.80E-05	1.92E-04	9.01E-05	1.98E-05	3.47E-04	VEXBE
			fugitive	1.49E-06	9.06E-07	1.89E-06	1.03E-06	1.91E-07	3.96E-06	FBEP+FBEV
		29	sum	1.17E-04	7.89E-05	1.94E-04	9.11E-05	2.00E-05	3.51E-04	sum
Benzo(a)pyrene	1 hour		variable	2.61E-06	1.75E-06	4.32E-06	2.02E-06	4.45E-07	7.79E-06	VEXBP
			fugitive	3.35E-06	2.04E-06	4.25E-06	2.32E-06	4.29E-07	8.90E-06	FBPP
		0.4	sum	5.96E-06	3.79E-06	8.57E-06	4.34E-06	8.74E-07	1.67E-05	sum
Odour	1 second	2 OU		8.83E-01	1.11E+00	1.59E+00	6.14E-01	3.75E-01	7.76E-01	

Haulage Roads

				Receptor Location						AUSPLUME SOURCE ID
				1	2	3	4	5	6	
TSP	Annual	90	fugitive	1.62E+00	1.34E+00	2.70E+00	6.10E-01	1.58E-01	2.83E+00	HAT
PM_{10}	24 hour	50	fugitive	3.08E+00	2.85E+00	1.12E+01	2.48E+00	8.60E-01	6.93E+00	HAP
PM_{10}	Annual	30	fugitive	9.87E-01	8.13E-01	1.64E+00	3.71E-01	9.58E-02	1.72E+00	HAP

Cement Stabilisation of Soils

				Receptor Location						AUSPLUME SOURCE ID
				1	2	3	4	5	6	
TSP	Annual	90	fugitive	2.15E-01	6.21E-02	7.75E-02	8.96E-02	8.67E-03	3.66E+00	VTT
				2.45E-01	2.25E-01	2.90E-01	1.30E-01	3.19E-02	5.84E-01	TT
				4.60E-01	2.87E-01	3.68E-01	2.20E-01	4.06E-02	4.24E+00	sum
PM_{10}	24 hour	50	fugitive	5.83E-02	1.42E-02	3.41E-02	2.80E+00	3.80E-03	9.30E-01	VTPM
				6.26E-01	5.29E-01	9.10E-01	4.62E-01	1.52E-01	1.50E+00	TPM
				6.84E-01	5.43E-01	9.44E-01	3.26E+00	1.56E-01	2.43E+00	sum
PM_{10}	Annual	30	fugitive	1.02E-01	2.94E-02	3.67E-02	4.24E-02	4.10E-03	1.70E+00	VTPM
				1.13E-01	1.04E-01	1.34E-01	6.02E-02	1.47E-02	2.69E-01	TPM
				2.15E-01	1.33E-01	1.71E-01	1.03E-01	1.88E-02	1.97E+00	sum
Benzene	1 hour	29	fugitive	3.14E-02	2.09E-02	1.40E-01	3.02E-03	6.67E-03	7.66E-02	VTBEP
Benzo(a)pyrene	1 hour	0.4	fugitive	2.26E-01	1.58E-01	1.76E-01	9.52E-02	3.71E-03	7.47E-02	VTBP
Odour	1 second	2 OU		6.94E-03	4.63E-03	8.91E-03	6.67E-03	1.48E-03	1.69E-02	TOU

Soils – Variable Stockpiling and Handling

1

Chullora - Soil handling with controls

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1.00E+06
Constant background concentration	0.00E+00
Terrain effects	Egan method
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.300 m

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Briggs Rural
Vertical dispersion curves for sources <100m high	Briggs Rural
Horizontal dispersion curves for sources >100m high	Pasquill-Gifford
Vertical dispersion curves for sources >100m high	Pasquill-Gifford
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.800m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES
1 hour
24 hours
90 days

Chullora - Soil handling with controls

SOURCE GROUPS

Group No.	Members
1	VEXTC
2	VEXPC
3	VEXBEC
4	VEXBPC

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1 _____

Chullora - Soil handling with controls

SOURCE CHARACTERISTICS

_____

INTEGRATED AREA SOURCE: VEXTC

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
320767	6248927	29m	10m	15m	15deg	5m	0m

(Constant) emission rate = 4.50E-04 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VEXPC

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
320767	6248927	29m	10m	15m	15deg	5m	0m

(Constant) emission rate = 2.10E-04 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VEXBEC

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
320727	6248927	29m	10m	15m	15deg	5m	0m

(Constant) emission rate = 8.90E-06 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

INTEGRATED AREA SOURCE: VEXBPC

X0(m)	Y0(m)	Ground El	Length X	Length Y	Or. Angle	Ver. spread	Height
320727	6248927	29m	10m	15m	15deg	5m	0m

(Constant) emission rate = 2.00E-07 grams/second per square metre

Hourly multiplicative factors will be used with
this emission factor.
No gravitational settling or scavenging.

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1 _____

Chullora - Soil handling with controls

RECEPTOR LOCATIONS

_____

The Cartesian receptor grid has the following x-values (or eastings):
320665.m 320711.m 320755.m 320800.m 320844.m 320888.m 320931.m
320975.m 321018.m 321062.m 321107.m

and these y-values (or northings):
6248613.m 6248668.m 6248726.m 6248784.m 6248844.m 6248902.m 6248962.m
6249020.m 6249079.m 6249135.m 6249195.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	321026	6248922	35.0	1.5	4	320949	6248674	35.0	1.5
2	321084	6249063	30.0	1.5	5	320208	6248352	30.0	1.5
3	320795	6249157	26.0	1.5	6	320850	6248820	29.0	1.5

METEOROLOGICAL DATA : DECCW Chullora AWS Data BoM SydneyAP Clouds SydneyAP

HOURLY VARIABLE EMISSION FACTOR INFORMATION

The input emission rates specfied above will be multiplied by hourly varying factors entered via the input file:
C:\Users\sdorairaj\Ausplume\superceded 2010\Chulvar.csv
For each stack source, hourly values within this file will be added to each declared exit velocity (m/sec) and temperature (K).

Title of input hourly emission factor file is:
Variable Emissions,,

HOURLY EMISSION FACTOR SOURCE TYPE ALLOCATION

Prefix V allocated: VEXTC VEXPC VEXBEC VEXBPC

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR; SOURCE GROUP No. 1

At the discrete receptors:

1: 7.78E+01 @Hr15,05/07/07 4: 4.77E+01 @Hr13,03/10/07
2: 4.81E+01 @Hr11,17/09/07 5: 9.97E+00 @Hr15,18/11/08
3: 1.03E+02 @Hr14,05/11/07 6: 2.20E+02 @Hr13,03/10/07

---

1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR; SOURCE GROUP No. 2

At the discrete receptors:

1: 3.63E+01 @Hr15,05/07/07 4: 2.23E+01 @Hr13,03/10/07
2: 2.24E+01 @Hr11,17/09/07 5: 4.65E+00 @Hr15,18/11/08
3: 4.79E+01 @Hr14,05/11/07 6: 1.02E+02 @Hr13,03/10/07

---

1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR; SOURCE GROUP No. 3

At the discrete receptors:

1: 1.16E+00 @Hr15,05/07/07 4: 9.01E-01 @Hr13,03/10/07
2: 7.81E-01 @Hr15,17/09/07 5: 1.98E-01 @Hr15,18/11/08
3: 1.92E+00 @Hr10,24/06/07 6: 3.47E+00 @Hr16,15/09/08

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1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 1 HOUR; SOURCE GROUP No. 4

At the discrete receptors:

1: 2.61E-02 @Hr15,05/07/07 4: 2.02E-02 @Hr13,03/10/07
2: 1.75E-02 @Hr15,17/09/07 5: 4.45E-03 @Hr15,18/11/08
3: 4.32E-02 @Hr10,24/06/07 6: 7.79E-02 @Hr16,15/09/08

---

1 HIGHEST RECORDINGS FOR EACH RECEPTOR (in microgram/m3)
AVERAGING TIME = 24 HOURS; SOURCE GROUP No. 1

At the discrete receptors:

1: 1.66E+01 @Hr24,02/07/08 4: 8.09E+00 @Hr24,27/06/07
2: 1.36E+01 @Hr24,17/09/07 5: 1.90E+00 @Hr24,18/11/08
3: 3.35E+01 @Hr24,04/09/07 6: 3.92E+01 @Hr24,27/06/07
