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FORMER SOUTH MELBOURNE GASWORKS, GRAHAM STREET, ALBERT PARK

Summary Human Health Risk Assessment (HHRA) Report

Submitted to:
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REPORT

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1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder Associates) was engaged by City of Port Phillip (CoPP) to conduct a human health risk assessment (HHRA) to assist CoPP in managing contamination issues at the former South Melbourne Gasworks site (the site), located at Graham Street in Albert Park (Figure 1). This HHRA was undertaken in general accordance with the Golder Associates proposal P47613090-001-P-Rev0 dated 14 July 2014. This report, consistent with the proposal, relates to the potential for soil and groundwater concentrations to impact the health of current (and anticipated future) onsite users including workers, contractors, staff and community member users of the Gasworks Arts Park.

The site is currently managed in accordance with two Interim Contamination Management Plans (ICMPs); one applicable to the Southport Nursing Home and the other to the Gasworks Arts Park. The site is currently undergoing a two stage 53V Environmental Audit commissioned by CoPP to assess potential risks of harm posed by the site.

1.1 Background

The Gasworks Arts Park site represents a challenging site with regard to contamination and stakeholder management. The site and its associated risks have been assessed and managed by CoPP over a number of years. However, increasing pressure from community use and ongoing environmental investigation works have provided triggers for CoPP to undertake a review of the contamination management plans for the site.

A previous consultant, Meinhardt (Vic) Pty Ltd (Meinhardt), undertook a quantitative HHRA for the site in 2003. The 2003 HHRA was limited to soil contaminants identified on-site. Risks posed by soil contaminants impacting upon groundwater were outside the scope of the assessment and were not considered. Consideration of environmental risks posed by soil contaminants impacting upon ecological receptors was also outside the scope of the assessment.

Based on information provided by CoPP Golder understands that the key risks are soil and groundwater contaminants onsite, with groundwater contamination issues offsite being influenced by the presence of a sewer system that intercepts much of the groundwater contamination from the site.

For the purposes of this HHRA, Golder have considered that the site represents the property bounded by Richardson Street, Pickles Street, Graham Street and Foote Street, excluding the “Alinta” property (Gas & Fuel Workshops) and the nature reserve area to the north west (corner Richardson Street and Pickles Street).

The assessment area includes the Gasworks Arts Park, associated buildings and Southport Nursing Home.

This Summary HHRA report presents the principal health risk assessment works, including review of previous data; details of the methodology and conclusions regarding potential human health risks, as well as exposure management strategies that would be appropriate to reduce risks to acceptable levels.

Additional details are to be provided in a Supporting HHRA Report, which includes the Summary HHRA Report and additional appendices regarding toxicological review, collated site data and exposure modelling calculations.

1.2 Objective

The primary objective was to provide CoPP with an updated HHRA report:

- for consideration in the revision of the Contaminant Management Plans (listed below in section 1.3),
- which includes quantification of potential human health risks posed to on-site receptors by the soil and groundwater contaminants identified on site.

1.3 Scope of Works

This Summary HHRA includes completion of the following scope of works:

Background Data Review & Collation

A review of works and data collected at the site since the previous HHRA (January 2003). CoPP have provided copies of the following documents for review and consideration in the updated HHRA:

- Quantitative Human Health Risk Assessment, Proposed Administration Building, Gasworks Theatre, Graham Street, Albert Park, Victoria. Final Report. Meinhardt (Vic) Pty Ltd, January 2003.
- Interim Contamination Management Plan for Current Site Use, Southport Nursing Home, Richardson Street, Albert Park. Golder Associates May 2004.
- Interim Contamination Management Plan for Current Site Use, Gasworks Park, Graham Street, Albert Park. Golder Associates May 2004.
- Section 53V Environmental Audit – Interim Report, Gasworks Site, Albert Park. GHD, December 2008.
- Indoor Ambient Air Vapour Investigation at Former South Melbourne Gasworks. Environmental Earth Sciences, November 2012.
- April 2011 Groundwater Investigations at Former South Melbourne Gasworks. Environmental Earth Sciences, September 2013.
- Supplementary Groundwater Investigation at Former South Melbourne Gasworks. Environmental Earth Sciences, April 2014.

Golder are also aware that further investigation works have been undertaken into the extent and nature of existing contaminated site soil and 'capping' layers as reported in:

- Site Capping Investigation at Former South Melbourne Gasworks. Environmental Earth Sciences, March 2014.

Since the original HHRA (January 2003), Golder have also undertaken a range of soil and groundwater investigation and health risk assessment works for the site and adjacent areas.

A review of the information as provided by CoPP and other relevant reports where publicly available was undertaken.

Identification of Chemicals of Interest

Selection of soil and groundwater chemicals of interest (COI) based on comparison of reported chemical concentrations with adopted screening guideline criteria.

Issue Definition

Development of a schedule of 'issues of interest' including definition of potentially affected human users of the site (receptors) and source-pathway-receptor linkages.

Quantitative Health Risk Assessment

- Hazard assessment for the COIs, using available toxicity and chemical data from sources in accordance with the enHealth (2012) and NEPC (2013) guidelines.
- Exposure assessment using scenario and behavioural factors consistent with Australian guidance, where available.
- Human contact and intake calculations utilising algorithms consistent with Australian guidance (i.e. enHealth and NEPC[1]) and US EPA[2]/ASTM[3] guidance; where available.
- Health risk characterisation, including production of numerical estimates of risk and evaluation against defined 'acceptable' magnitudes.
- Evaluation and consideration of management options.
- Incorporation of works and data collected at the site since the previous HHRA (completed January 2003).

[1] National Environment Protection Council

[2] United States Environment Protection Agency

[3] American Society for Testing and Materials

2.0 HUMAN HEALTH RISK ASSESSMENT METHEDOLOGY

Australian and international guidance on the conduct of HHRAs for environmental contamination has changed significantly since the previous risk assessment by Meinhardt (2003). In addition to ongoing refinement of toxicological studies and modelling practices, the following represent the primary guidance in Australia:

- National Environment Protection (Assessment of Site Contamination) Measure 1999. The "ASC NEPM". National Environment Protection Council / Standing Council on Environment and Water. The ASC NEPM was substantially revised and amended in 2013.
- Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards. enHealth Council, September 2012.

In addition to prevailing national guidance, consideration is also made of local direction from EPA Victoria and relevant Victorian State Environment Protection Policies.

2.1 Approach

The risk assessment framework adopted for the updated HHRA is in general accordance with the Australian guidance (enHealth 2012) model for site-specific health risk assessment as presented in Table 1. The key components for the HHRA include:

- Issues Identification (or Problem Formulation)
- Hazard Assessment
- Exposure Assessment
- Risk Characterisation, and
- Uncertainty Assessment.

Table 1: Principle Steps Involved in Human Health Risk Assessment

Steps	Description
Issues Identification (also known as Problem Formulation)	Identifies issues that can be assessed through a risk assessment and assists in establishing a context for the risk assessment. It includes assessing: ■ What is the concern? ■ What is causing the identified concern? ■ Why is the concern an issue? ■ How the concern was initially identified? ■ How the concerns were raised? ■ Whether the issue is amenable to risk assessment? ■ Whether risk assessment is appropriate? Issues have dimensions related to perception, science, economics and social factors that are important to establish the context of risk assessment and help in the process of risk management. There is a need to distinguish between "hazards" and "issues".
Hazard Assessment	The dose response assessment characterises the relationship between magnitude of exposure and adverse health effects and assesses the conditions under which the adverse effects may to occur.

Steps	Description
Exposure Assessment	Assesses the amount, frequency, duration and routes of exposure to substances present in environmental media. In this assessment, exposure is estimated as the concentration of a compound to which a receptor may be exposed over long-term (i.e. chronic) exposure periods.
Risk Characterisation	Risk is a function of the hazard and the exposure or the dose i.e. the probability of the hazard being realised. A hazardous substance may pose a health risk at sufficiently high exposure. Conversely, a highly hazardous substance may not pose a health risk if exposure is very low. Risk characterisation combines the information from the exposure and hazard assessment steps to estimate the potential health risks associated with length of exposure.
Uncertainty and variability Assessment	Identifies potential sources of uncertainty and qualitative discussion of the magnitude of uncertainty and expected effects on risk estimates.

Figure 1 displays the relationship between the HHRA process and other aspects of environmental contaminant investigation.

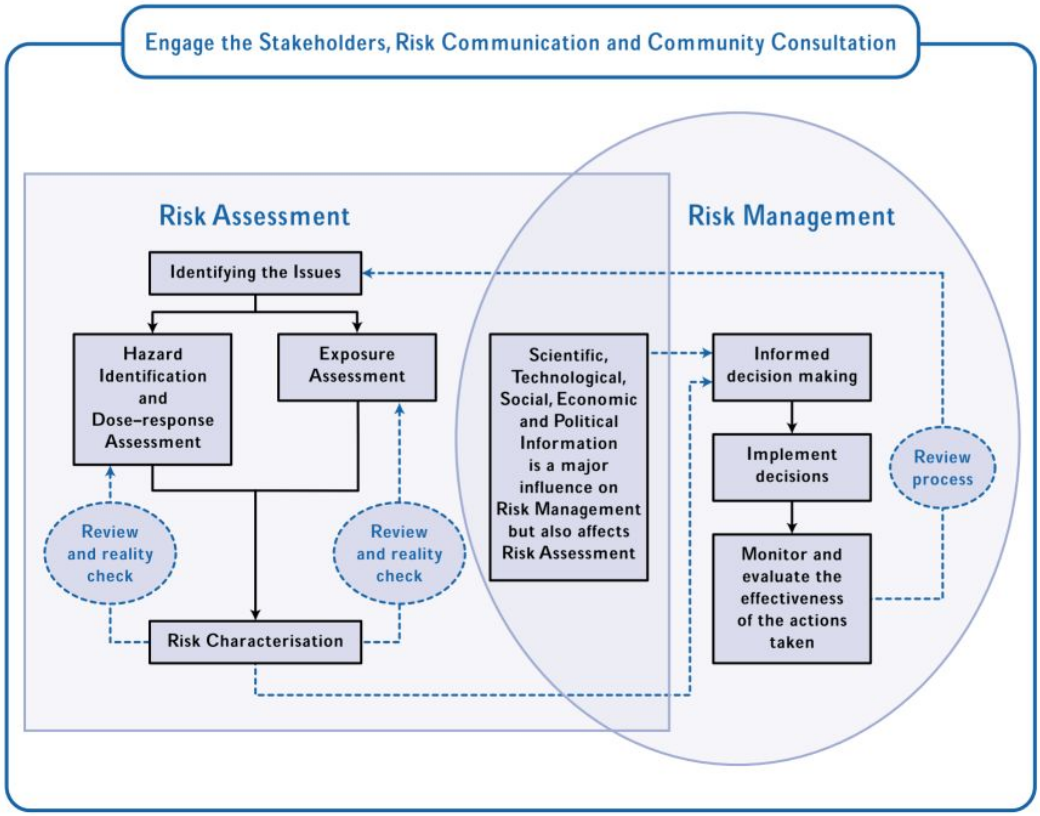

Figure 1: Australian Frameworks for Human Health Risk Assessment (from enHealth 2004)

In the problem formulation step (Section 3.0) the issues relevant to the risk assessment are assessed. The problem formulation step includes the development of a preliminary risk assessment conceptual site model (CSM). The CSM describes three elements: sources, receptors and pathway(s) by which stressors (e.g., chemicals) can move from the source to the receptor. These three elements need to be integrated to characterise the risk, as described in Figure 2.

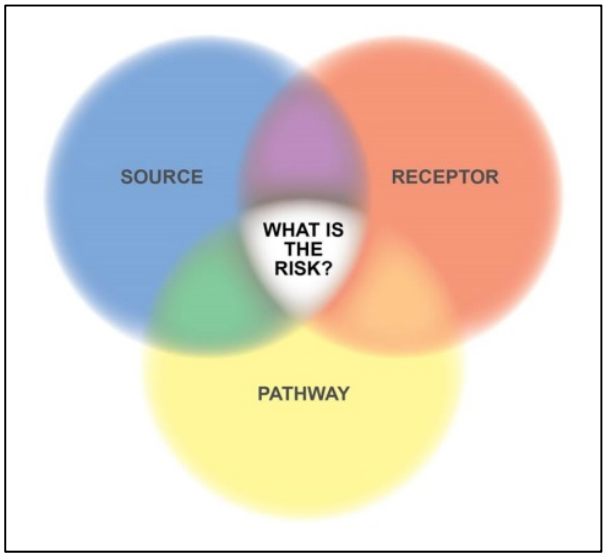

Figure 2: Three Elements of Risk

In Section 4.0 the hazard (or toxicity) assessment, the current scientific knowledge regarding the toxicity of the COI is summarised. The objective of the hazard assessment is to evaluate the hazard(s) associated with a particular chemical/substance (hazard is the intrinsic capacity to cause adverse effects) and the conditions under which the hazard may manifest, or, the dose response relationship. This information can come from occupational or environmental epidemiological studies, experimental toxicological studies in animals including "*in vivo*" or "*in vitro*" studies. The major outcomes of the hazard assessment are an appreciation of the toxicology of the COI and estimates of doses or concentrations that are acceptable or tolerable (toxicity or reference values).

Exposure assessment (Section 5.0) is the estimation of the magnitude, frequency, extent, character and duration of potential future exposures. There is also the identification of exposed populations and potential exposure pathways (enHealth 2012).

In Section 6.0, risk characterisation, the results of the toxicity and exposure assessments from the HHRA are combined to calculate estimates of risk magnitude for the identified human receptors in and around the site. This section also includes an uncertainty analysis and discussion of limitations within the process.

Prior to reporting the specifics of the HHRA, a discussion of "risk" and "acceptable" risk is presented in Section 2.2, which puts the results of the HHRA (the risk characterisation) into context.

2.2 What is an Acceptable Risk?

To assess whether or not an estimated or measured concentration indicates that a population may be at risk, a reference concentration (or reference value)[4] or an acceptable risk against which the exposure information can be compared, needs to be established. Typically, reference values and acceptable risk levels are derived by regulatory agencies based on scientific evidence available at the time.

The term "*acceptable risk*" can be an emotive one, since "*acceptable*" may mean different things to different people and in different circumstances. In this report, acceptable risk means a level of risk established by a regulatory agency.

For community members who may be unintentionally exposed to chemicals such as from emissions to air from an industrial facility, the most important question is "is it safe?" The concept, as well as the perception,

[4] Reference values are named variably by different jurisdictions as Tolerable Concentration (TC), Reference Concentration (RfC), Minimum Risk Levels (MRL), and also as probabilistic estimates of impacts, such as Unit Risk (UR, the impact associated with exposure to a unit concentration, such as 1 µg/m^3).

of safety or risk are subjective and will vary between individuals and circumstances. Safety does not necessarily mean the absence of risk, nor does risk mean the absence of safety. The HHRA is a measure of the possible effects of a substance expressed in a consistent and verifiable way that reflects a judgement based on the available information at the time. It provides a tool for comparing the estimates of safety or risk between substances and circumstances and assigning priorities when developing management options.

2.2.1 Assessment of Non-carcinogenic Chemicals

For non-carcinogenic effects, the toxicity reference values (TRVs) are derived using a threshold dose response model (threshold model), i.e. there is a dose below which adverse health effects have not been observed. For ingestion and dermal exposures, TRVs are reference doses (RfDs) in units of milligrams-chemical per kilogram body weight per day (mg/kg/d). For inhalation exposures, TRVs are in the form of reference concentrations (RfCs) in units of milligrams-chemical per cubic metre of air (mg/m^3).

The ratio of the TRV to the exposure concentration (or dose) of a chemical (EC) is known as the hazard quotient (HQ) and provides a verifiable measure of the safety or risk under a particular set of conditions. The HQ is calculated as follows:

Hazard Quotient: $$HQ = \frac{EC}{TRV} \quad (1)$$

Where TRV = Toxicity Reference Value ($mg/kg/d$ or mg/m^3)

EC = Exposure dose ($mg/kg/d$ or mg/m^3)

The HQ is a measure of the margin of safety, which is reflected in the size of the HQ - the smaller the HQ the larger the margin of safety.

- If the HQ is equal to one, the exposure concentration (or dose) is equal to the TRV, suggesting that the chemical may not cause adverse health effects.
- If the HQ is less than one, the exposure concentration is less than the TRV, suggesting that the chemical may not cause adverse health effects.
- If the HQ value is greater than one, the exposure concentration is greater than the TRV. This may be interpreted to present an “unacceptable risk”. However, a breach of the TRV does not necessarily mean that adverse health effects are imminent or that there is a high potential for adverse effects.

In cases where the HQ is greater than one, the assessment requires further review. Pertinent data will include the mode of action of the COI, the degree of conservatism introduced in the exposure assessment and the TRV. A judgement can then be made as to whether or not the exposure may lead to adverse effects. For example, in cases where conservative assumptions have been made about exposure, the exposure assessment may then be refined to a more realistic scenario or additional site data may be obtained to remove conservative assumptions made in the modelling process.

The numerical value generated in calculating HQ is a useful tool for assigning priorities to risks and assessing the need for more in depth investigations and assessment. Generally, further action is not warranted for HQ values that only marginally exceed (scenario specific, nominally by less than 50%) the target a value of 1 because of the degree of conservatism in the TRV and the HHRA.

2.2.2 Assessment of Carcinogenic Chemicals

For some types of carcinogenic substances, the risk of cancer (determined as a probability) is measured as the excess lifetime cancer risk (ELCR). TRV for carcinogenic effects are the “cancer slope factor” for ingestion and dermal exposures, in units of $(mg/kg/d)^{-1}$ and the “inhalation unit risk”, for inhalation exposures, in units of $(mg/m^3)^{-1}$. The ELCR is then calculated as follows:

Excess Lifetime Cancer Risk:	$ELCR = TRV * EC$		*(2)*
Where	TRV	=	Toxicity reference value $(mg/kg/d)^{-1}$ or $(mg/m^3)^{-1}$
	EC	=	Exposure concentration of a chemical (mg/kg/d or mg/m^3)

When more than one carcinogenic chemical is present, the ELCR for each chemical is added.

National guidance in Australia on acceptable risk levels for carcinogenic contaminants has not yet been developed.

The Victorian Environment Protection Authority (EPA Victoria) currently recommends that *"an excess incremental life time cancer risk of 1 x 10^{-5} is to be applied in the risk assessment of carcinogenic substances as long as a single compound is present/ assessed. However, when multiple carcinogenic substances are present, EPA recommends/expects the sum of individual risks should not exceed 1 x 10^{-5}."* (EPA, 2007).

The target acceptable risk levels indicated by EPA Victoria have been adopted in this HHRA.

3.0 PROBLEM FORMULATION

3.1 Site Area and Layout

The Gasworks Arts Park precinct comprises the former Gas Manufacturing Plant of the South Melbourne Gasworks. The precinct comprises, Gasworks Arts Park, the Southport Nursing Home in the eastern corner and 11 buildings located along the northern, western and southern boundaries (refer to Figure 1). The precinct is bounded by Graham Street to the south; Pickles Street to the west; Richardson Street to the north and Foote Street/Bridport Street to the east. The South Melbourne Gas Regulator site (Alinta Site) is located adjacent the northern corner but is outside the site boundary.

Gasworks Arts Park is 2.67 hectares in area and consists of grassed and landscaped areas with a playground, BBQ area, small wetlands and various seating areas. The perimeter of the site contains landscaped garden areas traversed by gravel access tracks. Many of the existing buildings are former Gasworks buildings which were retained as part of the redevelopment. A few buildings, including the administration building, have been constructed since the redevelopment. The buildings are used for arts related activities including sculpture, ceramics, a bookshop and a theatre.

The Southport Nursing Home site, covering an area of 0.54 hectares, is surrounded by low density residential houses (across Richardson Street to the north and Bridport Street West to the East) and parkland on the other boundaries (Gasworks Arts Park). The majority of the site is covered by a brick building which is the Community Residential Home. At the rear of the existing building the site is covered by open grass, brick paving and landscaped gardens. A garden and shed for staff is also present on the grass cover behind the building.

The CoPP has advised that the future land use of Gasworks Arts Park will remain 'Open Space Parkland', and the Southport Nursing Home site will continue as a nursing home, and may be developed for other community use sometime in the future subject to Council approval.

3.2 Geological Setting

Information related to the geological and hydrogeological setting of the site is provided in detail in the Groundwater Conceptual Model report for the site undertaken by Golder (Golder 2006a). In summary, the site is located within a layered sequence of Quaternary and Tertiary age deposits. The expected sequence of geological units in the area is shown in Table 2 below with youngest units at the top.

Table 2: Regional Geological Units

	Geological Age	Unit	Description
Older < > Younger	Quaternary	Port Melbourne Sands	Stratified sands and shells
		Coode Islands Silt*	Soft dark grey silty clay with marine molluscs
	Tertiary	Brighton Group	Stiff red-grey sandy clays and clayey sands
		Newport Formation	Grey and greenish-grey silts, clayey silts and fine sandy silts
		Older Volcanics	Dense basalt, frequently highly weathered
	Palaeozoic	Silurian Siltstone	Siltstone with lesser interbedded fine sandstone

Note: * Material referred to as Coode Island Silt may be estuarine deposits associated with the lagoon area previously existing to the west of Esplanade East.

The geological units encountered during site investigation works as reported by EES (2013) included:

- Port Melbourne Sands (PMS) – the upper geological formation at the site, which discontinuously underlies the fill material, and has been identified in lenses up to 2.6 m thick in the southern portion of Gasworks Arts Park.

- Brighton Group – encountered underlying fill material and, where present, the PMS. Brighton Group sediments have been identified extending to a maximum depth of 22 m below ground level (bgl)
- Older Volcanics basalt (OVB) – identified underlying Brighton Group sediments at approximately 18 m bgl in the north-eastern portion of the site.

Although the site is located in an area that potentially contains acid sulfate soil (ASS) (DPI, 2003) the only estuarine deposits where ASS are likely have been identified to the west of the site (as cited in EES 2013).

3.3 Hydrogeological Setting

The hydrogeology of the region comprises two aquifers: a perched water table in the Port Melbourne Sands above the Brighton Group clays; and the deeper regional water table which is influenced predominantly by sea level in Port Phillip Bay. The regional groundwater flow direction is generally in a south to south east direction toward Port Phillip Bay. Local discharge from the aquifer occurs to Port Phillip Bay (Golder 2006a).

Whilst the regional water table is dependent on the sea level, past assessments in the area indicate that the local water table is influenced by drawdown from the South Yarra Main Sewer which runs along Bridport Street and the Hobsons Bay Main Sewer which runs along Graham Street to the south of the site. These brick-barrel sewers, owned by Melbourne Water, were installed in the late 1800s, and the drawdown in the area indicates that they are leaking allowing inflow of groundwater. The sewer invert is at a level between RL -11.73 to -11.80 m AHD in the vicinity of the site, which is a depth of approximately 14 m below ground level and approximately 11 to 12 m below sea level. The Pickles Street sewer is owned by South East Water and is also understood to be of brick construction with a diameter in the vicinity of the site of between 0.525 m and 0.6 m (Graham Street end). The invert of the sewer is understood to be approximately RL -8.1 m AHD near the confluence with the Hobsons Bay Main sewer at Graham Street (Golder 2006b).

In addition to the above hydrogeological information provided in Golder reports (2006a, 2006b) the following has also been noted by EES (2013):

- *The Brighton Group, being the shallowest aquifer on site is underlain by the OVB, which is considered to be an aquitard due to its high clay content. As such it hydraulically insulates but does not isolate the deeper geological units from the Brighton Group sediments.*
- *Groundwater levels in the Brighton Group beneath Gasworks Park are all below sea level due to the drawdown caused by the sewers. Therefore, the vertical gradient between the OVB and the Brighton Group is upwards, potentially contributing inflow to the groundwater system beneath the site… An upward hydraulic gradient would prevent the downward migration of any contaminants of potential concern from the water table aquifer in the Brighton Group.*
- *This local groundwater flow system is dependent on the leakage of groundwater into the sewers. If leakage to the sewers were reduced significantly, the flow regime would change*.

3.4 Contamination Assessment

3.4.1 Sources

The South Melbourne Gas Company was formed in 1871 with a gas manufacturing plant built in 1873. The site manufactured gas until 1955 with the exception of a temporary closure during the Depression. Some parts of the site never reopened after the closure in the Depression but other areas continued some form of operation until 1971. During its operation, three gas manufacturing processes are believed to have been active on this site:

- Coal Carbonisation Plant (CCP)
- Carburetted Water Gas Plant (CWGP)
- Oil Gas Plant (OGP)

These manufacturing processes generate a range of products/wastes with the potential for chemical release to local soil and groundwater. The Golder Site History Report (2004a) provides further information on these manufacturing processes. Golder (2004a) identified the following potential COI from the various manufacturing processes identified during the site history review:

- Polycyclic aromatic hydrocarbons (PAHs) from tar and oil wastes
- General hydrocarbons (i.e. total recoverable hydrocarbon, "TRHs") from tar and oil wastes and storages
- Various metals including arsenic from concentrations of coal minerals
- Cyanide, sulphates and sulphides from gas purification and waste water treatment
- Phenols from tar wastes
- Monocyclic aromatic hydrocarbons (MAHs) including but not limited to benzene, toluene, ethylbenzene and xylenes
- Polychlorinated biphenyls (PCBs) associated with the substations
- Solvents associated with maintenance.

3.4.2 Previous Investigation Works

Since 1988, numerous soil and groundwater investigation works have been undertaken at the site by various consultants. An outline of some of the earlier assessments conducted has been summarised in the Golder Site History Review Report (Golder 2004a) and includes the following:

- The Gas & Fuel Corporation commenced site assessment on 18 May 1988 and between that time and 1992 various soil and groundwater investigation works were undertaken, as outlined in the Golder Site History Review Report (Golder 2004a).
- In November 2002, Kilpatrick and Associates Pty Ltd undertook a preliminary contamination assessment of soil for a new administration building and landscaping in the south of the park. Meinhardt were subsequently commissioned to undertake a HHRA using the soil data (Meinhardt, 2003). In November 2003, Kilpatrick & Associates completed a report on the assessment of three areas of Gasworks Arts Park for a playground.

The Golder Site History Review Report (Golder 2004a) provides a summary of further details regarding these initial assessment works and their findings.

From 2004 to 2007, Golder undertook a number of reviews and assessments for the site including:

- Site History Review, Gasworks Park, Richardson Street, Albert Park, Report 04613504/003
- Further Recommendations for Action, Gasworks Park, Albert Park, Document No. 04613504/006
- Interim Contamination Management Plan for Current Site Use, Southport Nursing Home, Richardson Street, Albert Park, Report 04613504/026
- Interim Contamination Management Plan for Current Site Use, Gasworks Park, Graham Street, Albert Park, Report 04613504/025
- Interim Contamination Management Plan for Current Site Use, Gasworks Park, Graham Street, Albert Park, Report 04613504/025
- Vapour And Edible Vegetation Risk Assessment, Gasworks Park and Southport Nursing Home, Albert Park, Report 04613504/010

- Review of Contamination Status, Southport Nursing Home, Richardson Street, Albert Park, Victoria, Report 05613732/022
- Installation and Sampling of Additional Groundwater Wells, Gasworks Park Precinct, Former South Melbourne Gasworks, Graham Street, Albert Park, Victoria, Report 05613732/021
- Assessment of Groundwater Risks, Gasworks Park Precinct, Former South Melbourne Gasworks, Graham Street, Albert Park, Victoria, Report 05613732/019
- Hydrogeological Conceptual Model, Gasworks Park Precinct, Former South Melbourne Gasworks, Graham Street, Albert Park, Victoria, Report 05613732/018
- Further Groundwater Investigation, North East of the Former South Melbourne Gasworks, Gasworks Precinct, Graham Street, Albert Park, Victoria, Report 05613732/039
- Further Groundwater Investigation, Pickle Street Sewer, West of the Former South Melbourne Gasworks, Gasworks Precinct, Graham Street, Albert Park, Victoria, Report 05613732/059

A summary of the listed Golder reports, including their objectives and findings, has been provided in the Interim Audit Report (GHD, 2008).

3.4.3 Recent Investigation Works

More recent soil, groundwater and ambient air investigation works have been undertaken by Environmental Earth Services (EES). Golder has been provided with the following EES reports:

- Site Capping Investigation at Former South Melbourne Gasworks. Environmental Earth Sciences, March 2014 (EES 2014a).
- April 2011 Groundwater Investigations at Former South Melbourne Gasworks. Environmental Earth Sciences, September 2013 (EES 2013).
- Supplementary Groundwater Investigation at Former South Melbourne Gasworks. Environmental Earth Sciences, April 2014 (EES 2014b).
- Indoor Ambient Air Vapour Investigation at Former South Melbourne Gasworks. Environmental Earth Sciences, November 2012 (EES 2012).
- Remediation Action Plan for the Former South Melbourne Gasworks, Albert Park, Victoria. Environmental Earth Sciences, March 2014 (EES 2014c).

Relevant details from the above listed reports and they key findings with respect to contamination and health risk have been summarised below in discussion of soil, groundwater and indoor ambient air.

3.4.4 Soil

EES (2014a) undertook soil investigation works to characterise the site capping and extent of contamination in soil. The works were conducted from 18 to 28 January 2011 and involved 26 test pit locations and 15 boreholes. The test-pits generally ceased at a depth of 3.0 m bgl and the borehole sampling was undertaken to a maximum depth of 3.0 m bgl. A total of 129 discrete soil samples (83 test pit samples and 46 borehole samples) were analysed for a range of heavy metals (As, Cd, Cr, Cu, Pb, Ni, Hg and Zn), PAHs, total petroleum hydrocarbons (TPHs / TRHs), cyanide, phenols, ammonia, sulphates and sulphides; and benzene, toluene, ethyl benzene and xylene (BTEX). Select samples were also submitted for further laboratory analysis including: TPH speciation into aliphatic and aromatic species (11 samples), leachate potential testing for select heavy metals (Pb, Hg, As, Ni, Zn), and leachate potential testing for PAHs (14 samples).

With regard to the capping layer, EES (2014a) concluded that '*In general, the capping layer was found to be irregular (less than 0.5 m deep) and contaminated with gasworks waste including polycyclic aromatic hydrocarbons and therefore the existing site capping can be considered in-adequate*.'

Non-aqueous phase liquid (NAPL), characterized as viscous tar, was located in three sampling locations (1 bore hole and 2 test-pits), at depths ranging from 0.9 to 2.7 m bgl. The potential presence of perched groundwater with hydrocarbon sheen was encountered in one test-pit at 2.4 m bgl. Solid tar was encountered at 1 borehole and 2 test-pits at depths ranging from 0.5 to 1.6 m bgl. Blue spent oxide materials were observed mixed with other fill and gasworks waste in five sampling locations (EES 2014a).

A preliminary assessment into the potential for acid sulfate soil occurrence concluded that the potential existed for coastal acid sulfate soils (CASS) to occur on-site.

In terms of site remediation the following is noted in the EES (2014a) report: *'It is understood that little remediation of on-site soil has been conducted, aside from excavation of 0.5 m of contaminated fill material and replacement with "clean soil" in the south-eastern corner of the site. Other remedial works have been limited to landscaping and the placement of topsoil and clay (capping layer) over the site (of unknown depth). No record has been made available documenting these works, and the origin of the imported soil is not known*.'

Table 3 summarises the maximum soil concentrations reported for the various depths across the Gasworks Arts Park and Southport Nursing Home areas. The reported concentrations for some of the PAHs including acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene and pyrene were selected from the soil sample which reported the highest concentration of total PAHs.

Table 3: Maximum Reported Soil Concentrations

Chemical	Max. soil concentration at Southport Nursing Home in mg/kg			Max. soil concentration at Gasworks Arts Park in mg/kg		
m below ground level (bgl)	0 - 0.3	0.3 - 1.0	1.0 - 3.0	0 - 0.3	0.3 - 1.0	1.0 - 3.0
Metals						
Arsenic (As)	136	63	20	43	63	26
Cadmium (Cd)	1	<LOR	<LOR	<LOR	<LOR	<LOR
Total Chromium (Cr)	95	113	21	41	116	123.0
Copper (Cu)	456	56	340	113	67	50
Lead (Pb)	686	332	11	222	6720	537
Nickel (Ni)	60	70	26	47	96	41
Zinc (Zn)	124	81	84	285	556	251
Mercury (Hg)	5.5	5.9	0	0.4	3.8	1.6
PAHs						
Naphthalene	28.9	7.0	<LOR	6.3	6600	2440
Acenaphthylene	44.1	18.6	<LOR	6.1	1170	473
Acenaphthene	9.6	3.4	<LOR	2.2	136	161
Fluorene	75.4	13.9	<LOR	4.9	1400	948
Phenanthrene	388	124	2.4	36.3	5370	2370
Anthracene	102	29.2	0.8	12.5	1340	889
Fluoranthene	303	158	3.3	52.2	3690	1600
Pyrene	263	148	2.9	48	3250	1490
Benzo(a)pyrene (BaP)	97.6	60.9	1.1	21.4	1040	570
Total PAH	1744	813	15	284	28597	13486
MAHs						
Benzene	<LOR	<LOR	<LOR	<LOR	13.7	21.6
Toluene	<LOR	<LOR	<LOR	<LOR	1.5	3.1

Chemical	Max. soil concentration at Southport Nursing Home in mg/kg			Max. soil concentration at Gasworks Arts Park in mg/kg		
Ethylbenzene	<LOR	<LOR	<LOR	<LOR	10.4	18.1
Total Xylene	<LOR	<LOR	<LOR	<LOR	24.2	23.4
TRHs						
C6–C10 Fraction	<LOR	<LOR	<LOR	<LOR	67	83
>C10–C16 Fraction	480	310	<LOR	80	7320	8230
>C16–C34 Fraction	4390	4880	110	1150	24100	29500
>C34–C40 Fraction	950	1640	<LOR	570	3770	4460
Other						
Total Cyanide (CN)	676	540	7	45	4240	68.7
Phenol	3.5	19.0	<LOR	0.8	702	-
Ammonia	-	50	<LOR	-	20	500
Sulphate (NEPM)	120	15500	<LOR	<LOR	14300	6170
Total sulphate	180	162000	<LOR	800	213000	16200
Sulphide (total)	600	7400	<LOR	500	18400	5100
Calculated in-organic Sulphide	544	6963	-	555	5848	3784

'-' Chemical not analysed

<LOR, analyte reported below limit of reporting

Whilst Table 3 summarises the maximum soil concentrations from the most recent investigation works conducted on the site, review of earlier soil investigation works undertaken by Golder and by Kilpatrick & Associates was also undertaken:

- For the Gasworks Arts Park site the following historical data was reviewed:
  - Collection and sampling of 10 surface soil samples with analysis for arsenic, lead, cyanide and PAHs (Golder 2004c). In 2003, six soil sample results were also collected by Kilpatrick & Associates with the results reported in the Golder (2004c) report. These six samples were also analysed for arsenic, lead, cyanide and PAHs.
  - Twenty one soil boreholes were drilled, nine of which were onsite (Golder 2006d). The soil samples were analysed for a range of chemicals including metals, TPHs, MAHs, PAHs, volatile organic compounds (VOCs), PCBs, cyanide, sulphate, phenols, cresols and organochlorine pesticides (OCP).
- For the Southport Nursing Home site the following historical data was reviewed (Golder 2006c):
  - Collection and sampling of seven soil bores and two hand auger holes. The collected soil samples were analysed for a range of analytes including metals, TPHs, PAHs, MAHs, OCPs and PCBs.

Table 4 presents the maximum soil concentrations of analytes reported from the above investigations works (Golder 2004c, 2006c, 2006d). The values in bold indicate that chemical concentrations higher than reported during more recent investigations (as presented in Table 3).

Table 4: Maximum Historical Reported Soil Concentrations

Chemical	Max. soil concentration at Southport Nursing Home in mg/kg (Golder 2006c)			Max. soil concentration at Gasworks Arts Park in mg/kg (Golder 2004c*, 2006d**)		
metres below ground level (m bgl)	0 - 0.3	0.3 - 1.0	1.0 - 3.0	0 - 0.3	0.3 - 1.0	1.0 - 3.0
Arsenic (As)	10	**86**	20	8	23	10

Chemical	Max. soil concentration at Southport Nursing Home in mg/kg (Golder 2006c)			Max. soil concentration at Gasworks Arts Park in mg/kg (Golder 2004c*, 2006d**)		
metres below ground level (m bgl)	0 - 0.3	0.3 - 1.0	1.0 - 3.0	0 - 0.3	0.3 - 1.0	1.0 - 3.0
Lead (Pb)	120	**660**	**380**	140	21	70
Cyanide Total	30	460	4700	620	<LOR	1400
Benzo[a]Pyrene	2.5	**640**	**210**	7.2	0.3	**970**
Total PAHs	128.9	11278	7381	120	2.9	37000
TPH C6-C9	<LOR	**31**	**1600**	<LOR	<LOR	**4600**
TPH C9-C36	<LOR	45300	47800	460	<LOR	116000
Benzene	<LOR	**1.1**	<LOR	<LOR	<LOR	**1400**
Toluene	<LOR	**0.95**	<LOR	<LOR	<LOR	**1200**
Ethylbenzene	<LOR	<LOR	<LOR	<LOR	<LOR	**59**
Total Xylene	<LOR	<LOR	<LOR	<LOR	<LOR	**680**
Sulphate	1900	1300	4000	-	72	1500

* includes six samples collected by Kilpatrick & Associates in 2003 as reported in Golder (2004c)

** data included only from the 9 onsite bores

bold values indicate chemical concentrations higher than more recently reported (EES 2014a)

3.4.4.1 Tier 1 Soil Screening

Table 5 below includes chemicals reported in soil for which NEPC (2013) Health Investigation Levels (HILs) guidelines are available. The chemicals have been screened against both Residential (HIL-A) and Recreational (HIL-C) criteria.

Table 5: Screening of Soil Data

Chemical	Max. soil concentration at Southport Nursing Home in mg/kg			Max. soil concentration at Gasworks Arts Park in mg/kg			Health Investigation Levels (HILs) NEPC (2014)	
Sample depth (m bgl)	0 - 0.3	0.3 - 1.0	1.0 - 3.0	0 - 0.3	0.3 - 1.0	1.0 - 3.0	Residential HIL-A	Recreational HIL-C
Metals								
Arsenic (As)	**136**	63	20	43	63	26	100	300
Cadmium (Cd)	1	<LOR	<LOR	<LOR	<LOR	<LOR	90	900
Total Chromium (Cr)	95	**113**	21	41	116	123.0	100*	300*
Copper (Cu)	456	56	340	113	67	50	6000	17000
Lead (Pb)	**686**	**332**	11	222	**6720**	**537**	300	600
Nickel (Ni)	60	70	26	47	96	41	400	1200
Zinc (Zn)	124	81	84	285	556	251	7400	30000
Mercury (Hg) inorganic	5.5	5.9	0	0.4	3.8	1.6	40	80
PAHs								
Total PAH	**1744**	**813**	15	284	**28597**	**13486**	300	300
Other								
Total Cyanide	**676**	**540**	7	45	4240	68.7	250**	1500**
Phenol	3.5	19.0	<LOR	0.8	702	-	3000	40000

* Criteria for Cr VI adopted for total Cr. Although total Cr consists of both Cr III and Cr VI, the more toxic of these forms is Cr VI.

** these criteria are for free cyanide but have conservatively been used for screening purposes

The following chemicals exceed the HIL-A Residential criteria: arsenic, total chromium, lead, total PAHs and total cyanide. Of these chemicals, lead is the only chemical that also exceeds the HIL-C Recreational criteria.

The maximum concentration of 136 mg/kg for arsenic reported at the Southport Nursing Home area is not considered to be representative of soil conditions. The remaining soil data from this area was reviewed (both historical and recent) and the maximum concentration of 136 mg/kg is the only soil sample above the HIL-A Residential criteria of 100 mg/kg. As the HIL guidelines values are derived for assessing the average soil concentrations across the site rather than maximum, the single reported exceedance was not considered to represent concentrations of interest and arsenic has not be assessed further in this HHRA.

For chromium VI, the maximum concentration of 113 mg/kg at the Southport Nursing Home exceeds the HIL-A Residential criteria of 100 mg/kg. Other Southport Nursing Home soil data reported one other sample (105 mg/kg) exceeding HIL-A criteria. As both of the reported concentrations represent marginal exceedance of the HIL-A, and the remaining samples results are below the criteria, chromium VI has not been considered as a COI and has not been assessed further in this HHRA.

Carcinogenic PAHs are assessed in accordance with NEPC (2013) guidance where the concentration of the primary eight carcinogenic PAHs and their TEFs (toxic equivalence factors, potency relative to B(a)P) are used to calculate a B(a)P TEQ (toxic equivalence). Table 6 summarises the concentrations of each of these eight chemicals and the calculated B(a)P TEQ for each respective depth.

For calculation purposes, the sample that reported the highest benzo(a)pyrene and total PAHs results at each depth interval was used to calculate the B(a)P TEQ. Where the highest B(a)P and total PAH concentrations did not occur in the same sample, a B(a)P TEQ was calculated for both samples. The sample generating the higher B(a)P TEQ was then adopted in Table 6 below.

The derived B(a)P TEQ was compared against the NEPC (2013) HIL-A Residential and HIL-C Recreational Criteria. Both of the areas (Southport Nursing Home and Gasworks Arts Park) exceeded the criteria.

Table 6: B(a)P TEQ for carcinogenic PAHs

Chemical	**Derived B(a)P TEQ for Southport nursing home in mg/kg (m bgl)**			**Derived B(a)P TEQ for Gasworks Arts Park in mg/kg (m bgl)**			**Health Investigation Levels (HILs) NEPC (2014)**	
	0 - 0.3	0.3 - 1.0	1.0 - 3.0	0 - 0.3	0.3 - 1.0	1.0 - 3.0	Residential HIL-A	Recreational HIL-C
Soil Sample Location and Depth	BH8 (0-0.1 m bgl)	BH7 (0.6-0.7 m bgl)	BH1 (1.0-1.1 m bgl)	TP22 (0 – 0.1 m bgl)	BH11 (0.5-0.6 m bgl)	TP7 (1.75-1.8 m bgl)		
Benz(a)anthracene	11.6	7.15	0.13	2.31	120	64.4		
Chrysene	0.917	0.523	0.012	0.207	9.24	5.3		
Benzo(b)fluoranthene	11.9	7.19	0.09	1.78	116	42.4		
Benzo(k)fluoranthene	3.54	1.47	0.08	1.67	37.2	40.2		
Benzo(a)pyrene	97.6	60.9	1.1	20.8	1040	570		
Indeno(1.2.3.cd)pyrene	3	1.67	<LOR*	0.83	39.6	21.9		
Dibenz(a.h)anthracene	9	5.8	<LOR*	2.8	78	73.5		
Benzo(g.h.i)perylene	0.311	0.168	0.006	0.087	4.71	2.52		
TOTAL B(a)P TEQ	**137.9**	**84.9**	1.4	**30.5**	**1444.8**	**820.2**	**3**	**3**

* reported below LOR and excluded from the B(a)P TEQ calculation

TRH (or TPH) have not been included as COI in this HHRA. EES (2014a) submitted selected samples from across the subject sites for TPH speciation analysis. The results indicated that for all samples analysed, the TPH C16+ fractions were dominated by aromatic hydrocarbons, and aliphatic hydrocarbons were not detected. Direct assessment of BTEX and PAHs was therefore considered to characterise potential risks from aromatic hydrocarbons.

Sulphate and sulfide have not been adopted as COI in this HHRA. Whilst these analytes can be associated with health effects, they are primary of concern with regard to aesthetics, environmental impact and impact upon subsurface buildings and structures.

Ammonia was not analysed in historical soil samples. In the absence of health based soil investigation guidelines, concentrations of ammonia reported in the EES capping assessment (EES, 2014a) have been adopted as COI for the HHRA.

3.4.4.2 Soil Chemicals of Interest (COI)

The Interim Audit Report (GHD 2008) had identified "limiting contaminants" for the site, defined as '*the contaminant that can be expected to determine the requirements for control; this will generally be the contaminant with the greatest exceedence of criteria*'. The following "limiting contaminants" were identified for the fill and soil: lead, benzo(a)pyrene, total PAHs, TPHs Fraction >C9, benzene and total cyanide (GHD 2008). Based on this, and the soil screening undertaken in Section 3.4.4.1 the following soil COIs are identified:

- Lead
- PAHs: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1.2.3.cd)pyrene, dibenz(a.h)anthracene, benzo(g.h.i)perylene
- BTEX
- Total cyanide
- Ammonia

The listed chemicals are considered COI for the direct contact exposure pathways (e.g. dermal contact and ingestion of soil). For the vapour intrusion pathways only the volatile chemicals from the above list have been considered for assessment (ammonia, total cyanide, BTEX and naphthalene, as representative of the volatile PAHs). The selection of volatile chemicals was based on the volatile screening undertaken for the groundwater Section 3.4.5.2 (discussed further below).

Lead

Lead in soil was indicated as a COI. However, the assessment of potential health risks due to exposure to lead is undertaken using a different methodology to other COI. A recent (February 2014) draft paper on the health effects of lead was released by the National Health and Medical Research Council (NHMRC) in July 2014. This paper proposes a lower blood lead levels than has been adopted in current national guidance. At this time, the paper is in draft, and no approach has been adopted by regulatory authorities.

Given the potential uncertainty around lead health risks methodologies, lead was not included in the exposure and risk modelling of the HHRA. However, it is anticipated that:

- The maximum concentrations of lead in soil at the site have the potential to result in unacceptable health risks to receptors in the event of direct and regular exposure.
- The management of exposure to other COI in soil at the Southport Nursing Home and Gasworks Arts Park sites would also be anticipated to reduce exposure to lead contamination to an 'acceptable' level of risk.

3.4.5 Groundwater

The two most recent groundwater sampling events undertaken on the site occurred in April 2011 (EES 2013) and June 2013 (EES 2014b). Groundwater samples were collected both from onsite and off-site wells and analysed for ionic balance parameters, dissolved heavy metals, total, free and weak acid dissociable (WAD) cyanide, TPHs and TRHs, MAHs including BTEX, PAHs and VOCs.

3.4.5.1 Direct Contact

EES (2013 and 2014b) screened the site groundwater results from the April 2011 and June 2013 monitoring against the following direct contact and extractive uses guidelines:

- Potable water supply (acceptable) – those specified for health in the National Health and Medical Research Council (NHMRC), 2004 and 2011, Australian Drinking Water Guidelines.
- Agriculture, parks and gardens – those specified in ANZECC (2000) for irrigation.
- Stock watering – those specified for livestock in the ANZECC (2000) guidelines.
- Primary contact recreation – those specified for primary contact recreation in the NHMRC and ARMCANZ (2008) Australian drinking water guidelines.

The groundwater results from the two most recent monitoring events reported exceedences of each of the listed guidelines (EES 2013 and 2014b). Therefore, groundwater is not suitable for drinking, irrigation, stock watering or primary contact recreation (e.g. swimming) purposes.

3.4.5.2 Groundwater Vapour

The primary groundwater exposure pathway assessed in this HHRA is vapour migration from groundwater into indoor and outdoor air. Therefore only those chemicals that are considered as volatiles have been considered as COIs. An assessment of the potential for groundwater contamination to result in a vapour intrusion risk to the site occupants and maintenance workers has been undertaken based on the groundwater analytical data collected by EES in the two most recent sampling events (April 2011 and June 2013). For the purposes of this HHRA, only those wells located within the site boundary were considered. The onsite wells considered in this HHRA have been split into two categories:

- Gasworks Arts Park wells: GW18, GW19, GW20, GW21, GW22, GW23, GW24, GW40, GW41
- Southport Nursing Home: GW03, GW04, GW39

All of the listed wells above are inferred to be screened into the upper part of the Brighton Group (EES 2013). Two deeper onsite wells, GW42 and GW43 have been installed by EES and screened at the base of the Brighton Group unit. Although the deeper wells have reported higher concentrations for some of the volatile chemicals (e.g. ammonia) and there are also some chemicals (e.g. chlorobenzene) which have only been detected in the deeper wells, the data from the two deeper onsite wells will not be adopted for assessment. As the primary exposure pathway of interest for groundwater is vapour migration to surface occupants, groundwater in shallow portions of the aquifer would be expected to act as a barrier to volatiles chemicals within deeper portions of the aquifer.

Both of the most recent sampling round (EES 2013, EES 2014b), indicate no evidence of either dense or light non-aqueous phase liquids (DNAPL and LNAPL) in existing onsite groundwater wells.

Table 7 summarises the range of groundwater depths encountered at the two onsite areas from the two most recent gauging evens undertaken by EES. This information is used for the assessment of volatile chemical migration from groundwater to indoor air (refer Section 5.2).

Table 7: Groundwater Depths

Site Area	Depth to Water below ground levels (mbgl)	
	April 2011 (EES 2013)	June 2013 (EES 2014a)
Gasworks Arts Park wells (GW18 – GW24, GW40-GW41)	7.68 – 8.89	7.94 – 9.39
Southport Nursing Home wells (GW3, GW4, GW39)	8.06 – 8.68	8.42 – 8.78

For the assessment of volatile migration from groundwater to surface receptors, the depth to groundwater (length of vapour migration pathway) was adopted as 7.6 metres for the Gasworks Arts Park and as 8.0 metres for Southport Nursing Home sites.

Chemicals that were identified above the limit of reporting (LOR) were assessed for potential volatility. The assessment of volatility of a chemical was undertaken in accordance with the methodology outlined in NEPC (2013), which involved comparing the Henry's Law Constants for each chemical against an indicative value of $1x10^{-5}$ atm-m^3/mol (0.00001 atm-m^3/mol). Chemicals with a published Henry's Law constant greater than $1x10^{-5}$ atm-m^3/mol were assessed as being sufficiently volatile from groundwater as to justify further assessment.

For TPHs, fraction C6-C15 was considered to be volatile and fractions C16-34 and C34-C40 were considered to be non-volatile or semi-volatile due to their physical properties (CRC Care, 2011). Groundwater physio-chemical parameters and heavy metals were excluded on the same basis as being non-volatile.

The volatile screening undertaken is presented in Table 8. Those chemicals marked in bold 'screen in' as being sufficiently volatile as to require further assessment.

Table 8: Groundwater Volatile Screening

Chemical	CAS RN	Carcinogenic Classification (c=carcinogen, n=non-carcinogen)	Henry's Law Constant (atm-m^3/mol)	Reference	Henry's Law Constant > 0.00001 (atm-m^3/mol)
Ammonia	7664-41-7	n	0.0000161	USEPA (2014)	yes
Cyanide (Total)	57-12-5	n	0.000133	USEPA (2014)	yes
Naphthalene (VOC)*	91-20-3	n	0.00044	USEPA (2014)	yes
Chlorobenzene	108-90-7	n	0.00311	USEPA (2014)	yes
Acenaphthylene	208-96-8	n	0.00014	SRC Physprop	yes
Acenaphthene	83-32-9	n	0.000184	USEPA (2014)	yes
Fluorene	86-73-7	n	0.0000962	USEPA (2014)	yes
Phenanthrene	85-01-8	n	0.0000423	SRC Physprop	yes
Anthracene	120-12-7	n	0.0000556	USEPA (2014)	yes
Fluoranthene	206-44-0	n	0.00000886	USEPA (2014)	no
Pyrene	129-00-0	n	0.0000119	USEPA (2014)	yes
Benz(a)anthracene	56-55-3	c	0.000012	USEPA (2014)	yes
Chrysene	218-01-9	c	0.00000523	USEPA (2014)	no
Benzo(b)fluoranthene	205-99-2	c	0.000000657	USEPA (2014)	no
Benzo(k)fluoranthene	207-08-9	c	0.000000584	USEPA (2014)	no
Benzo(a)pyrene**	50-32-8	c	0.000000457	USEPA (2014)	no
Indeno(1.2.3.cd)pyrene	193-39-5	c	0.0000016046	USEPA (2014)	no
Dibenz(a.h)anthracene	53-70-3	c	0.000000141	USEPA (2014)	no
Benzo(g.h.i)perylene	191-24-2	c	0.000000331	SRC Physprop	no
isopropylbenzene	98-82-8	n	0.0115	USEPA (2014)	yes
Styrene	100-42-5	n	0.00275	USEPA (2014)	yes
1,2,4-Trimethylbenzene	95-63-6	n	0.00616	USEPA (2014)	yes
Benzene	71-43-2	c	0.00555	USEPA (2014)	yes
Toluene	108-88-3	n	0.00664	USEPA (2014)	yes
Ethylbenzene	100-41-4	n	0.00788	USEPA (2014)	yes

Chemical	CAS RN	Carcinogenic Classification (c=carcinogen, n=non-carcinogen)	Henry's Law Constant (atm-m^3/mol)	Reference	Henry's Law Constant > 0.00001 (atm-m^3/mol)
Total Xylenes	1330-20-7	n	0.00518	USEPA (2014)	yes
TRH C6 – C10	NA	n	0.0103	CRC-Care (2011)	yes
>TRH C10 – C16	NR	n	0.0083	CRC-Care (2011)	yes

*Naphthalene was analysed using both VOC and SVOC methods. The Naphthalene VOC data was adopted for assessment.
CAS RN - Chemical Abstracts Service Registry Number

3.4.5.3 Groundwater Chemicals of Interest (COI)

The following "limiting contaminants" were identified for groundwater: low pH, ammonia and BTEX (GHD 2008). In addition to the ammonia and BTEX identified by the Auditor, additional chemicals 'screened in' as volatile in Section 3.4.5.2 have been adopted as groundwater COI. In summary, the initial groundwater COI for this HHRA are:

- Ammonia and total cyanide
- BTEX
- TRH Fractions C6-C10 and >C10-C16
- PAHs including naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, pyrene, benz(a)anthracene and styrene.
- 1.2.4-trimethylbenzene and isopropylbenzene

3.4.5.4 Maximum concentrations

Table 9 summarises the maximum concentrations reported for the Gasworks Arts Park wells and the Southport Nursing Home wells for the selected COI outlined in the above section. The higher of the two maximum concentrations (from either April 2011 or June 2013 sampling), is noted in bold to indicate the concentration adopted for this HHRA.

Not all of the wells were sampled in both the April 2011 and June 2013 round (for example, GW03 and GW04 were not sampled in June 2013). Also, not all chemicals identified in the above analytical suite were sampled in both of the sampling rounds (for example, while a PAH suite was analysed for in April 2011 only naphthalene was analysed for in June 2013).

Table 9: Maximum Groundwater Concentrations

Chemical	Gasworks Arts Park wells – maximum reported concentrations				Southport Nursing Home wells - maximum reported concentrations			
	April 2011 Sampling		June 2013 Sampling		April 2011 Sampling		June 2013 Sampling	
	µg/L	Well	µg/L	Well	µg/L	Well	µg/L	Well
Ammonia as N	**660000**	GW3	290000	GW39	854000	GW24	**947000**	GW24
Cyanide Total	**320**	GW4	116	GW39	**219**	GW24	209	GW24
Naphthalene (VOC)*	18	GW39	**19**	GW39	4530	GW24	**6470**	GW24
Acenaphthylene	**1**	GW4	-	-	**58.1**	GW24	-	-
Acenaphthene	**4.1**	GW39	-	-	**5***	GW24	-	-
Phenanthrene	**6.2**	GW4	-	-	**5***	GW24	-	-
Anthracene	**2.1**	GW4	-	-	**5***	GW24	-	-
Fluoranthene	**8.4**	GW4	-	-	**8.3**	GW41	-	-

Chemical	Gasworks Arts Park wells – maximum reported concentrations				Southport Nursing Home wells - maximum reported concentrations			
	April 2011 Sampling		June 2013 Sampling		April 2011 Sampling		June 2013 Sampling	
Pyrene	**7.8**	GW4	-	-	**8.5**	GW41	-	-
Benz(a)anthracene	**2.8**	GW4	-	-	**5***	GW24	-	-
Styrene	<LOR		<LOR		**193**	GW24	<LOR	
1.2.4-Trimethylbenzene	<LOR		<LOR		**185**	GW24	160	GW24
Benzene	28	GW39	**72**	GW39	**6350**	GW24	3380	GW24
Toluene	4	GW39	**7**	GW39	**318**	GW24	50**	GW24
Ethylbenzene	2	GW39	**4**	GW39	**111**	GW24	52	GW23
Total Xylenes	8	GW39	**13**	GW39	**2290**	GW24	1635	GW24
TRH C6 – C10	**30**	GW39	14***	GW39	**650*****	GW24	260	GW23
>TRH C10 – C16	690	GW39	**940**	GW39	**14600**	GW24	10200	GW24

* a higher LOR (<10 µg/L) was used at the onsite well GW24 for some of the chemicals compared to the other onsite wells (<1.0 µg/L). Where this was the case and if half the LOR at GW24 (i.e. 5 µg/L) was higher than the maximum concentration detected at other wells than half the LOR reported at GW24, that is 5 µg/L, was adopted.

** a higher LOR (<100 µg/L) was used at GW24 for some of the chemicals compared to the other onsite wells (<1.0 or <5 µg/L). Where this was the case and if half the LOR at GW24 (i.e. 50 µg/L) was higher than the maximum concentration detected at other wells than half the LOR reported at GW24, that is 50 µg/L, was adopted.

*** The laboratory reported the 'TRH C6-C10 Fraction minus BTEX' as <LOR. The reported total BTEX concentration was therefore subtracted from the reported TRH C6-C10 Fraction to obtain this value.

<LOR results reported below the reporting limit

- Chemical has not been analysed for during the event.

As discussed for soil COI, analytical results inferred that TPH/TRH fractions were dominated by aromatic hydrocarbons including PAH and BTEX. TPH/TRH fractions were therefore not adopted as COI for the assessment of groundwater.

For assessment of volatile PAH, naphthalene was indicated to be both the most volatile PAH and had reported the highest concentrations in groundwater. Consistent with the approach adopted by CRC-CARE (2011), naphthalene was therefore adopted as representative of the volatile and semi-volatile PAHs.

3.4.6 Indoor Ambient Air

Two ambient air sampling events were undertaken by EES (2012) during different seasonal conditions including:

- Round 1 - cloudy skies and low temperatures (winter conditions) between 17 and 19 July 2011.
- Round 2 - clear skies and high temperatures (summer conditions) between 29 January and 01 February 2012.

A total of 13 sampling locations were selected in Gasworks Arts Park and two in the Southport Nursing Home. The sampling methodology selected was USEPA Method TO-15, which involves sampling of ambient air over a defined period of time. All samples were analysed for the USEPA TO-15 comprehensive 84 Component Suite.

Based on the results of the indoor air assessment EES (2012) considered that '*any sub-surface vapour intrusion at the site appears to be negligible and unlikely to result in a chronic unacceptable health risk to building users. On this basis, remedial options and / or management systems are not considered necessary at this time to manage vapour intrusion into site buildings. This conclusion is provisional upon site land use and buildings remaining unaltered*'.

Notwithstanding the findings of EES (2012), exposure to volatile chemicals in indoor ambient air from migration from soil and groundwater was considered in this HHRA in order to provide assessment of potential impacts from identified soil and groundwater contamination and to allow for assessment of the potential for variability (uncertainty) in the ambient air monitoring data.

3.4.7 Soil Vapour Assessment

Golder previously undertook direct assessment of the potential for generation of vapour from the soil and groundwater on the site and therefore potential risks to adults and children involved in recreational activities and adult maintenance workers on the Park (Golder 2004b).

The outdoor air vapour risk assessment involved sampling four soil gas bores installed at various locations around the Gasworks Arts Park. Twenty COI were identified, although not all COI were detected at all of the soil gas bore locations, and soil gas concentrations varied significantly between locations. A quantitative risk assessment of the highest measured concentrations of the COI concluded that vapour concentrations did not indicate a potential for unacceptable health risks to child and adult recreational users of the Park or outdoor maintenance workers on the Park.

Golder (2004b) noted that the outdoor vapour risk assessment used measurement data collected from soil gas bores that were sampled on one occasion and therefore the results from the vapour risk assessment should be considered a point-in-time assessment only, with the finding that current vapour risks on the site were acceptable for the modeled receptors and using the measurement data collected. It is understood that no further soil gas bore sampling has been undertaken on the site since the Golder assessment (2004b).

The historical soil vapour sampling results have not been used for assessment of vapour risk in this HHRA. Due to the timeframe since sampling and the fact that data from only a single sampling event are available, the results have been used for comparative purposes only.

3.5 Receptors and Pathways

3.5.1 Receptors

The primary receptors for assessment of health risks include the range of occupants of both the Gasworks Arts Park site and the Southport Nursing Home facility. These include both permanent occupants (residents at the Southport Nursing Home), regular occupational occupants (staff at Southport Nursing Home and at the Gasworks Arts Park), and a wide range of infrequent or semi-regular users of the sites such as recreational members of the public, users of the artists workshops and stall-holders at farmers markets.

In order to assess potential health risks, a range of ‘representative’ receptors have been defined in this HHRA to either match the usage patterns of known occupants or to provide a conservative estimate of exposure for less frequent site occupants.

Potential human health receptors for this HHRA have been defined as follows:

- Contractors, consisting of excavation/utility workers, maintenance workers, landscape workers and gardeners who would have direct contact with the soil at different depths and different occupancy durations.
- Commercial workers/staff, this includes the staff working inside the various buildings (sculpture studio, arts and craft studio, ceramic studio etc.) as well as those staff working inside the Southport Nursing Home. It is also acknowledged that there may be contractors employed to undertake maintenance works inside the buildings. However, provided they would be spending less time inside the building than the full-time staff, the assessment of the staff receptors will conservatively assess potential risks to building contractor workers.
- Residents living inside the Southport Nursing Home.
- Adult recreational users of Gasworks Arts Park.

- Child recreational users of Gasworks Arts Park.
- Infant recreational users of Gasworks Arts Park.

Further details regarding the adopted potential receptors are provided in Table 10.

Table 10: Human Health Receptor Categories

Receptor Category	Description
Commercial/Staff (Office, Studio, Nursing home and other onsite buildings) Personnel (Adult)	Nominally present 8 hours per day indoors over occupational lifetime (up to 30 years). Predominantly in indoors environments but with some occasional access to outdoors environments. Assumed up to 2 hours per day spent in outdoor environment during travel and work breaks, with reduced soil ingestion/contact rates to account for period of time spend outdoors.
Users of Outdoor Passive or Active Recreation Space (Adult, Child and Infant)	Nominally present on a regular basis, 2 hours per day; 5 days per week; over lifetime as local resident (up to 35 years). Including access during early childhood (0-5 years age), childhood (5-15 years age), and adulthood (15 years+ age). Predominantly outdoors environments for regular users.
Maintenance or Gardener Personnel (Adult)	Nominally present 8 hours per day; 1 day per week; 52 weeks per year; over occupational lifetime (up to 30 years). Predominantly outdoors environments with higher proportion of access and exposure to site soil.
Construction, Utility Maintenance, Excavation Personnel (Adult)	Nominally present 8 hours per day; 10 days per year; over occupational lifetime (up to 30 years). Predominantly outdoors environments with higher proportion of access and exposure to site soil, in consideration of repairs/maintenance of underground infrastructure or building projects.
Nursing Home Residents (Adult)	Nominally present 24 hours per day, 7 days per week, over a nominal period of 20 years (assuming residential aged care). Predominantly indoors environmental with periods of outdoor exposure time, nominally assumed to be 2 hours per day.

The adopted receptor categories contain a degree of conservatism in order to account for individual variability in personnel and work/recreation activities. The categories are not intended to provide an indication of the types of risks that specific personnel may be exposed to and are not intended to strictly define the personnel present at the site or to impose any limit on the type and manner of activities being undertaken.

3.5.2 Exposure Pathways

The exposure pathways considered for the site are:

- Dermal absorption from direct contact with contaminated soil, e.g. from areas of exposed soil such as garden beds or during recreational play.
- Ingestion and inhalation of soil and dust particles such as from airborne material or soil that has been tracked indoors, incidental ingestion from hands during eating and smoking.
- Inhalation of airborne soil dusts e.g. from areas of exposed soil such as garden beds during work duties.
- Inhalation of vapours emanating from contaminated surface or subsurface soil. Volatile gases could be inhaled by people outdoors at the site and indoors where a building opening is located adjacent to contaminated soil or where the building is located overlying an area of contaminated soil.

- Inhalation of vapours emanating from contaminated groundwater. Volatile gases could be inhaled by people outdoors at the site and indoors where a building is located overlying an area of contaminated groundwater.

The exposure pathways identified above are in-line with those exposure pathways outlined as presenting a 'higher risk' for the onsite receptors in the GHD Interim Audit Report (2008). Although onsite extraction of contaminated groundwater is identified as a higher risk in the GHD Interim Audit Report (2008), the report states that '…*it is understood that CoPP would not allow extractive use of groundwater at the site (CoPP being the Committee of Management for the site)*…' and therefore extractive uses or direct contact of groundwater will not be assessed in this HHRA. However, as discussed in Section 3.4.5.1 extractive uses of groundwater (e.g. for irrigation or filling a swimming pool) are not suitable based on the groundwater screening assessment undertaken by EES (2013 and 2014b).'

Another potential pathway previously assessed by Golder (2004b) was the potential for exposure during consumption of edible vegetation grown on the site. As some of the vegetation may be growing in soil containing gasworks waste, contaminants may be taken up into the edible portions of the plants. The qualitative assessment undertaken by Golder considered that at the time (2004), the consumption of vegetation on the site was infrequent for both recreational park users and workers on the site. In addition, the assessment found that uptake of PAHs (the main soil contaminants on the site) into plant tissues is low. Overall, the assessment found that risks posed by consumption of edible vegetation on the site are likely to be negligible to very low. On this basis, the exposure pathway involving ingestion of produce grown on the site was not assessed further in this HHRA.

The exposure pathways and receptors considered in the HHRA are summarised in Table 11.

Table 11: Exposure Pathways Evaluated

Receptor Category	Contaminated Soil				Groundwater
	Ingestion	Airborne Dusts	Direct Contact	Inhalation Vapours	Inhalation of Vapours
Outdoor Gardening Personnel (Adult)	●	●	●	●	●
Commercial/Staff Personnel (Adult)	●	●	●	●	●
Utility-Pits Maintenance Worker (Adult)	●	●	●	●	●
Recreational Park Users (Adult)	●	●	●	●	●
Recreational Park Users (Child)	●	●	●	●	●
Recreational Park Users (Infant)	●	●	●	●	●
Nursing Home Residents (Adult)	●	●	●	●	●

As different receptor categories may be exposed to soil in different ways, soil data was split into three depths ranges: 0.0-0.3 m, 0.3-1.0 m and 1.0-3.0 m.

The 0.0-0.3 m soil data was applied to assess the ingestion, airborne dusts and direct contact soil pathways for all of the receptors other than Utility-Pits Maintenance workers.

The 0.3 – 1.0 m soil data was applied to the Utility-Pits Maintenance workers for direct contact exposure as it was assumed that shallow utility services would typically be at depths of around 1 metre or greater.

For exposure to soil vapour, the maximum soil concentrations from all depths were adopted for all receptor categories.

4.0 HAZARD ASSESSMENT

The hazard or toxicity assessment provides the basis for evaluating what is an acceptable exposure and what level of exposure may adversely affect people's health. The hazard assessment involves identification of the potentially toxic effects of chemicals and the amount of chemicals that a receptor can be exposed to without experiencing adverse health effects. The latter is often referred to as a toxicity reference value (TRV) or toxicity benchmark. TRV are based on critical effects observed from studies in exposed human populations or animal species and consideration of the following:

- The exposure mechanisms of concern and types of hazards posed by the chemical, such as skin irritation, respiratory effects from inhalation of vapour and organ effects from ingestion of solid material.
- The toxicological behaviour of the chemical and the dose-response relationship, including an assessment of the potential for the chemical to be carcinogenic.

Applicable TRVs are as guidelines for assessing the numerical magnitude of risk posed by the chemicals.

The adopted TRVs in this HHRA were based upon the nature of the hazard presented by the chemical (typically chronic carcinogenic effects or chronic non-carcinogenic effects).

For non genotoxic carcinogenic effects, the scientific community has established thresholds below which the person/receptor is considered unlikely to experience an adverse health effect. As indicated in Section 2.2.1, non-carcinogenic TRV for inhalation pathways are expressed as an RfC or air quality guidelines based on chronic health effects in units of concentration such as mg/m^3. Ingestion or dermal pathways TRV are expressed as a RfD in units of mg/kg-bodyweight/day. The inhalation RfC and ingestion/dermal RfD also need to take into account any additional background intake of the chemical that may occur due to sources other than the site, e.g, normal dietary intake of metals. The adopted inhalation and ingestion/dermal threshold values are therefore taken as the RfC or RfD minus the estimated background concentrations or intake.

For carcinogenic chemicals, there is considered no defined level below which adverse effects do not occur to some degree, and that any exposure to the chemical may increase the potential for adverse effects. For carcinogenic effects, the scientific community has established Unit Risk (UR) factors that are used in calculating the excess lifetime cancer risk (ELCR) associated with exposure to 1 mg/m^3 (refer section 2.2.2).

The COI adopted for the HHRA were all reviewed and assessed as being appropriate for consideration as non-carcinogenic with the exception of benzene and benzo(a)pyrene, which are carcinogenic. The adopted TRV for each COI, and allowance for background intake have been summarised in the exposure modelling tables in Appendix A (Gasworks Arts Park) and Appendix B (Southport Nursing Home).

The Supporting HHRA will contain details of the adopted TRVs and allowances made for exposure to background concentrations.

5.0 EXPOSURE ASSESSMENT

The exposure assessment phase involves the definition and assessment of the amount, frequency, duration and type (route) of exposure to the COI. This process included the preparation of an exposure scenario (Appendix A and Appendix B) that include consideration of:

- Definition of potentially affected receptors (site personnel and public users).
- Definition of workplace and recreational exposure conditions for each receptor group, including physical location, environmental factors, hours of occupancy and types of activities undertaken.

The potential exposure pathways (mechanisms) were defined by the following approaches:

- Direct (Soil) Ingestion: derived from adopted maximum concentrations in soil and assumed soil ingestion rates based upon incidental consumption from hands during eating and smoking and deposition of dusts within the mouth.
- Soil Airborne Dust Inhalation: derived from a calculated ambient air concentration of dust and adopted inhalation rates for each type of receptor.
- Dermal Absorption: derived from the adopted proportion of exposed skin (typically hands, face, head and forearms) and skin adherence and absorption rates.
- Vapour Inhalation: derived from airborne concentrations of volatile COI calculated from soil and groundwater concentrations and volatility parameters. The receptor was assumed to be in outdoor air, or working within a shallow maintenance trench or in a site building with vapour migration through the foundation.

Further details of the fate and transport modelling approaches adopted for each exposure pathway have been provided in Section 5.2.

5.1 Human Exposure Parameters

The approach to the exposure assessment has been to adopt reasonable ‘maximum’ exposure parameters which are reflective of the typical experiences or expectations of the population, where possible, and to combine these with TRV which aim to protect sensitive members of the population. Thus, average and median exposure parameters have been adopted and, where possible, these parameters are based on Australian data (NEPC 2013 and enHealth 2004, 2012). Where factors were not specified by the NEPC or enHealth, data consistent with other Australian (enHealth 2004, CRC CARE 2011) or US EPA (1989, 1991, 1997) guidelines have been adopted.

It is noted that the majority of adopted exposure parameters, and source chemical concentrations, have been based on conservative ‘high’ degrees of exposure in the first instance, with subsequent discussion of conservatism and the influence of actual (averaged) exposure conditions (Section 6.2).

Reasonable default values for exposure parameters were adopted when site specific information was unavailable. Exposure assumptions used for risk assessments in Australia are available in enHealth (2004 and 2012). These documents were used as the primary references as they contain a compilation of the recommended default assumptions and sources of default exposure assumptions for use in Australia, such as Langley (1993), Langley and Sabordo (1996) and Langley and Taylor (1998). The exposure assumptions for the receptors adopted for the site are included in Appendix A and Appendix B for each specific receptor group.

5.2 Exposure Modelling

The quantity of each COI to which the receptors (site occupants) may be exposed was estimated by a combination of numerical modelling and application of standard exposure equations. The equations adopted for each of the exposure pathways are provided below.

Ingestion: $$EDI_i = C_{soil} \times \frac{ED \times EF \times IR_{soil} \times BF \times CF}{BW \times AT \times DIY} \quad (1)$$

Dust inhalation: $$EC_{du} = C_{soil} \times \frac{PEF \times ED \times EF \times ET}{AT \times DIY \times HID} \quad (2)$$

Dermal: $$EDI_{da} = C_{soil} \times \frac{ED \times EF \times CF \times SSA \times SSAF \times DAF}{BW \times AT \times DIY} \quad (3)$$

Inhalation: $$EC_{inh} = C_{air} \times \frac{ED \times EF \times ET}{HID \times AT \times DIY} \quad (4)$$

Where:

AT	=	Averaging Time (years) – lifetime (70 yrs) for carcinogens or duration of exposure (ED) for non-carcinogens
BF	=	Relative oral bioavailability factor (unitless, chemical specific)
BW	=	Average body weight (kg)
C air	=	Concentration in air from soil contamination or groundwater (estimated from vapour model) (mg/m^3)
CF	=	Conversion factor (1×10^{-6} kg/mg for dermal and ingestion pathways)
C soil	=	Concentration in soil (mg/kg)
DAF	=	Dermal Absorption Factor (unitless, chemical specific)
DIY	=	Conversion factor for days in a year (365 days/year)
EC inh	=	Estimated inhalation exposure concentration in air (mg/m^3)
EC du	=	Estimated dust inhalation exposure concentration in air (mg/m^3)
EDI	=	Estimated daily intake (mg/kg-day) for each exposure pathway (subscript inh = vapour inhalation, i = ingestion, da = dermal contact, du = dust inhalation).
ED	=	Exposure duration (years)
EF	=	Exposure frequency, days of exposure per year (days/year)
ET	=	Exposure time, hours of exposure per day (hours/day)
HID	=	Conversion factor for hours in a day (24 hours/day)
IR soil	=	Soil ingestion rate (mg/ d)
IR air	=	Air inhalation rate (m^3/hr)
PEF	=	Particulate Emission Factor, ratio of concentration in particulates to soil concentration (mg/m^3 per mg/kg)
SSA	=	Skin surface area available for contact (cm^2)
SSAF	=	Soil skin adherence factor (mg/cm^2.day)

Details of the fate, transport and exposure modelling undertaken for each exposure pathway have been provided in the following sections.

5.2.1 Soil Ingestion

Soil ingestion exposures were derived from direct comparison of contaminant concentrations, with ingestion rates and consideration of chemical-specific bioavailability.

It was assumed that the maximum reported soil contaminant concentrations in the top 0.3 m of soil (for park users) and in the 0.3 m to1 m depth (for utility-pits maintenance workers and gardening personnel) would be available for intake, on the basis that maintenance or gardening personnel may be exposed during excavation works and that future site occupants may be exposed to soil at the surface or airborne dusts.

5.2.2 Dust Inhalation

Exposure to airborne dusts was modelled using default dust emission factors in accordance with the following:

- Site soil was assumed to contain approximately 30% silt fraction with moisture content of 10% by mass based on inferred sandy clay dominant material.
- Particulate emission factors (PEFs) were derived from the NPI manual (NPI, 2012) wind-eroded dusts generated from bare ground during non-construction phases of occupancy. i.e. it was assumed that dust generation would be controlled by an environmental management plan during any large-scale excavation or re-development works.
- An ambient wind speed for the site was adopted from the 3 pm annual average reported for the Melbourne Weather Monitoring Station. The 3 pm value was adopted to be representative of busy (afternoon) public occupancy periods at the Gasworks Arts Park site.

5.2.3 Dermal Absorption

Dermal exposure from soil was derived on the assumption that residents, site personnel and visitors would have a proportion of exposed skin and opportunity for soil or dusts to remain in contact with skin for a period of time. The adopted parameters allowed for the possibility of exposure to the head, face, hands, forearms and lower legs.

5.2.4 Vapour Inhalation

Exposure to vapour was estimated for soil and groundwater. Volatilisation factors, the ratio between COI concentrations in soil or groundwater and a theoretical COI concentration in air were calculated using the RISC5 software (Spence Environmental Engineering, 2011) with the following scenario:

- Outdoor air exposure occurring in the immediate vicinity of contaminated soil or groundwater on a repeated basis.
  - Contaminated soil present at the surface and extending to a depth of 3.0 metres. The maximum soil concentration at any depth was adopted and modelled for exposure.
  - Contaminated groundwater assumed to be at a depth of 8.0 metres below surface at Southport Nursing Home and at 7.6 metres depth at Gasworks Arts Park.
  - Vapour migration into or from a trench excavated for construction or utility maintenance purposes.
- Office, residence, studio or café occupants, indoor air exposure within a slab-on-ground building.
  - Modelled as a single-level building with no basement as consistent with indicated site structures.
  - Depth to soil source 0.5 metres, on the basis that contaminated soil may potentially be present below existing site buildings.
  - Diffusive and convective flows through a building foundation were considered.
  - Southport Nursing Home adopted as a residential building with parameters referenced from CRC-CARE (2011).
  - Gasworks Arts Park buildings adopted as commercial buildings with parameters referenced from CRC-CARE (2011).
- For all vapour models the soil properties were adopted on the basis of a sandy material consistent with the sand-dominant natural soil at the site.

Vapour diffusion from the vadose zone was assumed to be steady-state and biodegradation of the chemical vapours was not considered.

The model for vapour migration to outdoor air uses a 'box' model to estimate a concentration in the breathing zone directly overlying contaminated soil. The concentration of chemical in the 'box' is assumed to be fully mixed and is diluted by wind. Vertical dispersion of the chemicals out of the box is ignored. The receptor is assumed to be at the downwind edge of the source and the wind is assumed to blow in the direction of the receptor.

Copies of RISC5 detailed input parameters and derived volatilisation factors for each receptor group have been provided in Appendix A and Appendix B and include the following:

- Groundwater source – vapour migration to indoor air and outdoor air (residential and commercial buildings).
- Groundwater source – vapour migration to an excavated trench.
- Soil Source – vapour migration to indoor air (residential and commercial buildings).
- Soil Source – vapour migration to outdoor air.
- Soil Source – vapour migration to an excavated trench.

6.0 RISK CHARACTERISATION

6.1 Summary of Results

The risk characterisation phase combines the exposure assessment with the hazard assessment to estimate the potential health risks arising from exposure to the COI.

A magnitude of risk has been defined for each COI (e.g. naphthalene), each exposure pathway (e.g. inhalation of dusts), and each category of receptor (e.g. child recreational park users). An assessment of the 'acceptability' of the magnitude of risk was then made.

The resulting risk magnitudes have therefore been defined in terms of:

- A numerical value (e.g. Hazard Quotient = 1.5); and
- A descriptive assessment of whether the target risk has been exceeded or not (e.g. Yes).

The calculated risk magnitudes for each receptor group have been provided in Appendix A (Gasworks Arts Park) and Appendix B (Southport Nursing Home). A summary of key risk outcomes (i.e. chemicals exceeding the target risk) has been provided in Table 12 (Gasworks Arts Park) and Table 14 (Southport Nursing Home).

6.1.1 Gasworks Arts Park

Table 12: Summary of Potential Risks – Gasworks Arts Park (Maximum concentrations)

Receptor Category and COI	Risk Targets Exceeded?		
	Soil Direct Exposures	Soil Vapour Inhalation	Groundwater Vapour Inhalation
Outdoor Gardening Personnel (Adult)			
Naphthalene	No	***Yes***	No
Commercial (Office/Cafe) Personnel (Adult)			
Ammonia	No	***Yes***	***Yes***
Benzene	No	***Yes***	No
Ethylbenzene	No	***Yes***	No
Xylene	No	***Yes***	No
Naphthalene	No	***Yes***	No
Benzo(a)pyrene (TEQ)	***Yes****	No	No
Public Users of Building Facilities (Adult)			
Ammonia	No	***Yes***	No
Benzene	No	***Yes***	No
Ethylbenzene	No	***Yes***	No
Xylene	No	***Yes***	No
Naphthalene	No	***Yes***	No
Recreational Park Users (Adult)			
Naphthalene	No	***Yes***	No
Benzo(a)pyrene (TEQ)	***Yes****	No	No
Recreational Park Users (Child)			
Naphthalene	No	***Yes***	No
Recreational Park Users (Infant)			
Naphthalene	No	***Yes***	No
Benzo(a)pyrene (TEQ)	***Yes****	No	No
Utility Maintenance Worker (Adult)			
Cyanide (Total)	***Yes****	No	No

Receptor Category and COI	Risk Targets Exceeded?		
	Soil Direct Exposures	Soil Vapour Inhalation	Groundwater Vapour Inhalation
Naphthalene	No	***Yes***	No
Benzo(a)pyrene (TEQ)	***Yes***	No	No

* Individual pathway did not exceed risk targets, but total exposure for combined pathways exceeded risk targets.

Note that chemicals which did not exceed risk targets for any exposure pathway have been excluded from the table for clarity.

For scenarios such as those assessed for the Gasworks Arts Park, receptors would typically be exposed to a range of site locations and different concentrations (and compositions) of environmental chemicals. The use of site average concentrations may therefore provide an estimate of exposure and risk that is closer to what may occur under actual site use.

A range of calculated average (mean) soil concentrations at different depths arising from the capping study works are presented by EES (2014a).

As a comparative assessment, the exposure and risk estimates for the Gasworks Arts Park were also calculated using the average soil concentrations presented by EES. The exposure and risk assessment was undertaken for total cyanide, naphthalene and benzo(a)pyrene as the primary COI present in soil and driving potential health risks. The exposure modelling and risk characterisation details are provided in Appendix C and a summary of the key risk outcomes (i.e. chemicals exceeding the target risk) has been provided in Table 13.

Table 13: Summary of Potential Risks – Gasworks Arts Park – Average Soil Concentrations

Receptor Category and COI	Risk Targets Exceeded?		
	Soil Direct Exposures	Soil Vapour Inhalation	Groundwater Vapour Inhalation
Outdoor Gardening Personnel (Adult)			
Benzo(a)pyrene	***Yes***	No	No
Commercial (Office/Cafe) Personnel (Adult)			
Cyanide (Total)	***Yes***	No	No
Naphthalene	No	***Yes***	No
Benzo(a)pyrene	***Yes***	No	No
Public Users of Building Facilities (Adult)			
Naphthalene	No	***Yes***	No
Recreational Park Users (Adult)			
Cyanide (Total)	***Yes***	No	No
Benzo(a)pyrene	***Yes***	No	No
Recreational Park Users (Child)			
Cyanide (Total)	***Yes***	No	No
Benzo(a)pyrene	***Yes***	No	No
Recreational Park Users (Infant)			
Cyanide (Total)	***Yes***	No	No
Benzo(a)pyrene	***Yes***	No	No
Utility Maintenance Worker (Adult)			
None	No	No	No

* Individual pathway did not exceed risk targets, but total exposure for combined pathways exceeded risk targets.

Note that chemicals which did not exceed risk targets for any exposure pathway have been excluded from the table for clarity.

The use of average soil concentrations (as opposed to site maximum concentration) still resulted in exposure and risk estimates that exceeded targets. However, the magnitude of the exceedences was typically several orders of magnitude lower than when maximum concentrations were adopted.

It is noted that the cyanide (total) exposures and some benzo(a)pyrene exposures are *higher* when using the estimated average concentrations because the EES (2014a) calculated average includes the results of one deeper sample result for cyanide (4,240 mg/kg) and a number of deeper sample results for benzo(a)pyrene that were below the depth adopted by Golder for assessment of direct contact and ingestion exposures. Excluding these sample results was anticipated to provide similar conclusions as for naphthalene – with exposure estimates lower by several orders of magnitude.

Whilst the exceedance of risk targets was indicated for the maximum site concentrations in soil and groundwater, an assessment of estimated average soil concentrations also indicated potential unacceptable health risks although at significantly lower (orders of magnitude) exposure concentrations.

The results of historical indoor air, outdoor air and soil gas sampling had indicated that unacceptable health risks were not anticipated due to volatile chemicals at the site. Whilst the modelling indicated that the vapour inhalation pathways presented the higher risk magnitudes, the exposure and risk modelling for volatiles undertaken for this HHRA is anticipated to be highly conservative. The vapour inhalation pathway is not anticipated to be the primary driver of risk for site users.

However, further assessment of potential vapour issues may be justified on the basis that apparent NAPL or tar materials had been reported in soil at the site and the general condition of soil below existing buildings is not known.

Direct dermal contact and ingestion are anticipated to present the primary driving exposure pathways for unacceptable risk at the Gasworks Arts Park site.

6.1.2 Southport Nursing Home

Table 14: Summary of Potential Risks – Southport Nursing Home (Maximum Concentrations)

Receptor Category and COI	Risk Targets Exceeded?		
	Soil Direct Exposures	Soil Vapour Inhalation	Groundwater Vapour Inhalation
Outdoor Gardening Personnel (Adult)			
Cyanide (Total)	***Yes***	No	No
Benzo(a)pyrene (TEQ)	***Yes***	No	No
Commercial (Office/Staff) Personnel (Adult)			
Cyanide (Total)	***Yes***	No	No
Ammonia	No	***Yes***	***Yes***
Benzene	No	No	***Yes***
Naphthalene	No	***Yes***	***Yes***
Benzo(a)pyrene (TEQ)	***Yes***	No	No
Residents at Nursing Home (Adult)			
Cyanide (Total)	***Yes***	No	No
Ammonia	No	***Yes***	***Yes***
Benzene	No	No	***Yes***
Naphthalene	No	***Yes***	***Yes***
Benzo(a)pyrene (TEQ)	***Yes***	No	No
Utility Maintenance Worker (Adult)			
None	No	No	No

* Individual pathway did not exceed risk targets, but total exposure for combined pathways exceeded risk targets.

Note that chemicals which did not exceed risk targets for any exposure pathway have been excluded from the table for clarity.

For scenarios such as those assessed for the Southport Nursing Home, receptors would typically be exposed to a range of site locations and different concentrations (and compositions) of environmental chemicals. The use of site average concentrations may therefore provide an estimate of exposure and risk that is closer to what may occur under actual site use. It is anticipated that assessment of average site concentrations would provide similar conclusions to those indicated for the Gasworks Arts Park site (Section 6.1.1).

Whilst the exceedance of risk targets was indicated for the maximum site concentrations in soil and groundwater, an assessment of estimated average soil concentrations would also be anticipated to indicate potential unacceptable health risks although at significantly lower (orders of magnitude) exposure concentrations.

The results of historical indoor air, outdoor air and soil gas sampling had indicated that unacceptable health risks were not anticipated due to volatile chemicals at the site. Whilst the modelling indicated that the vapour inhalation pathways presented the higher risk magnitudes, the exposure and risk modelling for volatiles undertaken for this HHRA is anticipated to be highly conservative. The vapour inhalation pathway is not anticipated to be the primary driver of risk for site users.

However, further assessment of potential vapour issues may be justified on the basis that apparent NAPL or tar materials had been reported in soil at the Gasworks Arts Park site and the general condition of soil below existing buildings is not known.

Direct dermal contact and ingestion are anticipated to present the primary driving exposure pathways for unacceptable risk at the Southport Nursing Home site.

6.2 Conservatism in Risk Characterisation

The results noted in Table 12 and Table 14 represent the potential for health risks under 'high' exposure concentrations (adopting maximum concentrations of COI) and under conservative receptor scenarios, such as the assumption that a staff member at the Southport Nursing Home is present at the site for the majority of their working career (30 years).

A variety of conservative assumptions and approaches were adopted in order to account for uncertainties and potential variability in site data and exposure scenario. In general, a conservative approach was undertaken for the following reasons:

- To account for uncertainties in site specific data or due to absence of site data, the approach therefore allows an estimated 'maximum' exposure scenario to be adequately assessed. These data gaps and uncertainties are present in all environmental contamination assessments.
- To provide an assessment that would be acceptable to typical third-party stakeholders, including regulators, Auditors or legal reviewers. The approach and opinion of such third-parties can vary significantly and can range from highly-precautionary to 'real-world'.
- To ensure compliance with published guidelines and standards, in the absence of a definitive methodology approved by all authorities, adopting the more conservative aspects of each available guideline will be required.

Actual, 'real-world' exposure conditions are anticipated to be significantly lower (by up to several orders of magnitude) than those estimated for the 'high' exposure conditions.

6.3 Risk Assessment Summary

The results of the data review and HHRA allow the following general summary:

- Overall, groundwater does not present a vapour risk to the modelled receptors at Gasworks Arts Park. The only instance where potential risks were noted was for commercial (office/café) workers exposed to ammonia vapours at maximum reported concentrations. Given that the hazard quotient for ammonia in this exposure was low (0.267), and the maximum reported concentration was used in the modelling, the data indicate a low potential for unacceptable risks from groundwater vapours to the identified receptors.
- Volatile COI in groundwater were indicated to pose a potential for risk at Southport Nursing Home.
- Direct exposure to groundwater (i.e. through extractive uses such as irrigation and filling a pool) were not assessed in this HHRA on the basis that groundwater is not suitable for these uses.
- Dusts do not present unacceptable risks in any of the modelled exposure scenarios at either Gasworks Arts Park or at Southport Nursing Home.
- The modelling indicates that direct soil contact and inhalation of soil vapours are the driving risks at both Gasworks Arts Park and Southport Nursing Home.
- The risks from direct soil contact and inhalation of soil vapours are driven by benzene, naphthalene, carcinogenic PAHs (e.g., benzo(a)pyrene) and to a lesser extent ammonia and cyanide.

7.0 CONCLUSIONS

The results of the exposure modelling and human health risk assessment indicated that concentrations of chemicals in soil and groundwater have the potential to pose an unacceptable risk under 'high' exposure scenarios. e.g. for a regular site user who is exposed to the highest concentrations on a regular basis.

The results of human health risk assessment were in general agreement with the previous Meinhardt (2003) human health risk assessment noting that benzo(a)pyrene is a limiting chemical of interest for direct contact exposures to soil and naphthalene is a limiting chemical of interest for vapour inhalation exposures.

The risk outcomes noted in Section 6.1 are intended to highlight the potential areas that may require further assessment or management. The outcomes should be considered as conservative and have typically assumed:

- A 'high' degree of potential exposure, i.e. highest concentrations of contaminant present will be in a position sufficient to cause exposure. It is unlikely that individuals would be exposed to the maximum concentration from all media because for the assumed exposure periods:
  - The maximum will occur in different locations for the same media or different media (i.e. the maximum concentration of PAHs may not co-occur with the maximum concentration of cyanide).
  - The adopted maximum concentrations substantially overestimate the chemicals of interest concentration over the majority of the assessment area. Whilst an average media concentration may be adopted (as applied for soil in Section 6.2), historical sampling works had indicated that contamination levels were both discontinuous in area and variable in concentration over short distances therefore a statistical assessment may be unreliable without significant additional sampling and analysis.
- The model assumes uncontrolled exposure with no protective measures in place such as personnel protective equipment for excavation workers, dust suppression or surface covering of contaminated media such as via topsoil and vegetation plantings.
- The model adopts conservative input parameters, such as inhalation rates and building design, and conservative behavioural assumptions such as, that office personnel will be exposed to un-paved soil and dusts or that a recreational site user will undertake similar activities in the same site area on a regular basis.

Whilst the exceedance of risk targets was indicated for the maximum site concentrations in soil and groundwater, an assessment of estimated average soil concentrations also indicated potential unacceptable health risks although at significantly lower (orders of magnitude) exposure concentrations.

The results of historical indoor air, outdoor air and soil gas sampling had indicated that unacceptable health risks were not anticipated due to volatile chemicals at the site. Whilst the modelling indicated that the vapour inhalation pathways presented the higher risk magnitudes, the exposure and risk modelling for volatiles undertaken for this human health risk assessment is anticipated to be highly conservative. The vapour inhalation pathway is not anticipated to be the primary driver of risk for site users.

However, further assessment of potential vapour issues may be justified on the basis that apparent NAPL or tar materials had been reported in soil at the site and the general condition of soil below existing buildings is not known.

Direct dermal contact with and ingestion of soil are anticipated to present the primary driving exposure pathways for unacceptable risk at both the Southport Nursing Home and the Gasworks Arts Park sites.

8.0 MANAGEMENT CONSIDERATIONS

Risks were identified for the maximum reported concentrations of chemicals of interest in soil and groundwater at the site that require management to prevent or reduce exposure. In consideration of the magnitude of potential health risks indicated by the assessment and the distribution and frequency of reported contamination at the site, it is unlikely that staff, residents or public users of the sites would be exposed to consistently high levels of contamination or associated risk on a routine basis. Exposure would typically be to an averaged concentration as people moved through various areas of the site and therefore actual risks are likely to be lower than the calculated risk.

However, management of the potential for exposure and risk to receptor due to soil and groundwater conditions at the sites is recommended. Appropriate management controls are anticipated to consist of barrier or separation strategies to prevent or reduce exposure to contaminated soil and may consider the following:

- Placement of additional capping or separation layer materials in areas of high-wear and public use and application of passive barrier or re-direction approaches in areas of contaminated soil where further capping is not practical, e.g. restrictive/barrier plant species.
- Placement of barrier or separation infrastructure over the root systems of existing significant trees, to prevent erosion of soil, i.e. surround grating, permeable matting, geocell and gravel bedding layers.
- The potential for short-term (acute) and longer-term (chronic) exposure risks to construction, maintenance or gardening personnel may be mitigated through the use of standard personnel protective equipment and health, safety and occupational hygiene management practices.

Prevention or reduction of exposure to soil at both sites represents an appropriate means to manage potential health risks. The existing Interim Contamination Management Plans for the sites present a management strategy to reduce exposure to soil, by requiring maintenance of ‘capping’ or ‘separation’ layers over contaminated soil, and control of works involving excavation of soil or generation of dusts.

Based on the current configurations and land uses of the both Gasworks Arts Park and Southport Community Nursing Home, the requirements of the Interim Contamination Management Plans are considered appropriate for managing exposure to contaminated soil to an acceptable level. However, a longer term, more robust strategy for managing the contaminated soil and groundwater at the sites is recommended to satisfy likely requirements of the Section 53V audit currently being completed for the site, reduce the amount of monitoring required, reduce the potential exposure to the contamination by site users and reduce maintenance costs associated with the current interim management regime.

The results of the human health risk assessment should be considered a conservative estimate of potential exposure and risk. Where the results of the assessment potentially lead to a significant management or remedial cost implication, it is recommended that a cost-benefit analysis be completed to assess if additional confirmation sampling, assessment or review should be conducted to further inform the management approach. For example, the conservatism in the estimates of risk may be reduced by additional sampling to confirm (or otherwise) exposure concentrations in particular areas or depths of soil. The costs of the additional sampling (and the potential benefit of more refined risk estimates) should be weighed against the costs of management or remedial actions, based on the current dataset.

9.0 LIMITATIONS

Your attention is drawn to the document - “Limitations”, which is included in Appendix D of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

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Report Signature Page

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APPENDIX A

Exposure Model and Risk Estimation Gasworks Arts Park

August 2014
Report No. 147613068-001-R-Rev1

Golder Associates

SUBJECT	EXPOSURE SCENARIO CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR CATEGORY		EXISTING & POTENTIAL FUTURE EXPOSURES			EXPOSURE TO MEDIA								ACCEPTABLE RISK TARGET		
					Soil				Groundwater			Other			
		OUTDOOR	INDOOR		Ingestion	Airborne Dusts	Direct Contact	Vapours	Ingestion	Direct Contact	Vapours	--	Carcinogen	Non-Carcinogen Individual	Non-Carcinogen Cumulative
Personnel Within Impacted Area															
1	Outdoor Gardening Personnel (Adult)	●	○		●	●	●	●	○	○	●		5.00E-06	0.2	1
2	Commercial/Staff Personnel (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
3	Public Users of Building Facilities (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
4	Recreational Park Users (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
5	Recreational Park Users (Child)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
6	Recreational Park Users (Infant)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
7	Utility / Maintenance Workers (Adult)	●	○		●	●	●	●	○	○	●		5.00E-06	0.2	1
8															
9															
10															

NOTES

1	Gardening Personnel assumed direct exposure to soil 0.0 to 0.3 m depth
	Utilty / Maintenance Workers assumed direct exposure to soil 0.0 to 1.0 m depth
	All receptors assumed vapour exposure to soil 0.0 to 3.0 m depth

SUBJECT	CHEMICALS OF INTEREST CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

CHEMICAL CONCENTRATIONS

CHEMICALS	Concentration in Soil 0.0-0.3	0.3-1.0	1.0-3.0	Max 0.0-1.0	Max 0.0-3.0	Reference	Concentration in Groundwater	Reference
	mg/kg						mg/L	
Cyanide Total	45	4240	68.7	4240	4240	--	0.32	--
Lead** (Refer Discussion in Report)	222	6720	537	6720	6720	--	0	--
Ammonia	0	20	500	20	500	--	660	--
Benzene	0	13.7	21.6	13.7	21.6	--	0.072	--
Ethylbenzene	0	10.4	18.1	10.4	18.1	--	0.004	--
Toluene	0	1.5	3.1	1.5	3.1	--	0.007	--
Xylenes	0	24.2	23.4	24.2	24.2	--	0.013	--
Naphthalene	6.3	6600	2440	6600	6600	--	0.019	--
Acenaphthylene	6.1	1170	473	1170	1170	--	0	--
Acenaphthene	2.2	136	161	136	161	--	0	--
Fluorene	4.9	1400	948	1400	1400	--	0	--
Phenanthrene	36.3	5370	2370	5370	5370	--	0	--
Anthracene	12.5	1340	889	1340	1340	--	0	--
Fluoranthene	52.2	3690	1600	3690	3690	--	0	--
Pyrene	48	3250	1490	3250	3250	--	0	--
Benzo(a)Pyrene equivalents	30.5	1444.8	820.2	1444.8	1444.8	--	0	--
	0	0	0	0	0	--	0	--
	0	0	0	0	0	--	0	--

VOLATILISATION FACTORS - OUTDOOR AIR (FROM TRENCH MODEL)

CHEMICALS	Volatilisation Factor Soil	Groundwater
	$(mg/m^3) / (mg/kg)$	$(mg/m^3) / (mg/L)$
Cyanide Total	0.00E+00	0.00E+00
Lead** (Refer Discussion in Report)	0.00E+00	0.00E+00
Ammonia	4.77E-05	3.27E-07
Benzene	1.23E-03	1.11E-05
Ethylbenzene	6.19E-04	1.15E-05
Toluene	9.11E-04	1.17E-05
Xylenes	4.74E-04	1.04E-05
Naphthalene	7.86E-06	1.35E-06
Acenaphthylene	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	0.00E+00
Fluorene	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	0.00E+00
Anthracene	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	0.00E+00
Pyrene	0.00E+00	0.00E+00
Benzo(a)Pyrene equivalents	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00

CHEMICAL PROPERTIES

CHEMICALS	Oral Bioavailability Factor	Reference	Dermal Absorption Factor	Reference	Dermal Permeability Coefficient	Reference
	BF		DAF		Kp	
Cyanide Total	1	US EPA (2004)	0.1	NEPC (2013)	0.001	US EPA (2004)
Lead** (Refer Discussion in Report)	0.5	NEPM (2013)	0.001	ATSDR (2007)	0.0001	US EPA (2004)
Ammonia	0.04	US EPA (2004)	0.005	UK EA (2009)	0.0002	US EPA (2004)
Benzene	1	US EPA (2004)	0.08	CCME (2008)	0.015	US EPA (RSL)
Ethylbenzene	1	US EPA (2004)	0.2	CCME (2008)	0.0493	US EPA (RSL)
Toluene	1	US EPA (2004)	0.12	CCME (2008)	0.0311	US EPA (RSL)
Xylenes	1	US EPA (2004)	0.12	CCME (2008)	0.05	US EPA (RSL)
Naphthalene	1	US EPA (2004)	0.1	CCME (2008)	0.0466	US EPA (RSL)
Acenaphthylene	1	US EPA (2004)	0.18	CCME (2008)	0.096	--
Acenaphthene	1	US EPA (2004)	0.2	CCME (2008)	0.086	US EPA (RSL)
Fluorene	1	US EPA (2004)	0.2	CCME (2008)	0.11	US EPA (RSL)
Phenanthrene	1	US EPA (2004)	0.18	CCME (2008)	0.27	--
Anthracene	1	US EPA (2004)	0.29	CCME (2008)	0.142	US EPA (RSL)
Fluoranthene	1	US EPA (2004)	0.2	CCME (2008)	0.308	US EPA (RSL)
Pyrene	1	US EPA (2004)	0.2	CCME (2008)	0.201	US EPA (RSL)
Benzo(a)Pyrene equivalents	1	US EPA (2004)	0.026	CCME (2008)	0.713	US EPA (RSL)
0	0		0		0	
0	0		0		0	

VOLATILISATION FACTORS - INDOOR AIR (COMMERCIAL BUILDING)

CHEMICALS	Volatilisation Factor Soil	Groundwater
	$(mg/m^3) / (mg/kg)$	$(mg/m^3) / (mg/L)$
Cyanide Total	0.00E+00	0.00E+00
Lead** (Refer Discussion in Report)	0.00E+00	0.00E+00
Ammonia	3.85E-02	1.47E-04
Benzene	2.67E+00	5.37E-03
Ethylbenzene	8.11E-01	5.57E-03
Toluene	1.36E+00	5.68E-03
Xylenes	5.54E-01	5.01E-03
Naphthalene	8.70E-03	6.42E-04
Acenaphthylene	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	0.00E+00
Fluorene	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	0.00E+00
Anthracene	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	0.00E+00
Pyrene	0.00E+00	0.00E+00
Benzo(a)Pyrene equivalents	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00

DUST EMISSION FACTOR DERIVATION

Particulate Emission Factor = (Pe x W x 1000) / (Uair x δair)

SCENARIO	Silt Content	Moisture Content	Emission Factor PM_{10}	NPI Default Emission Factor	Adopted Emission Factor	Nominal Workspace Area	PM_{10} Emission Rate	PM_{10} Emission Rate [Pe]	Width of Exposed Surface Area [W]	Average Wind Speed [Uair]	Breathing Zone Height [δair]	Particulate Emission Factor
	%	%				m2	mg/m2/hr	g/cm2/s	m	m/s	m	(mg/m3) / (mg/kg)
Developed Site - Unpaved Areas												
Ambient Wind Erosion	30	10	NA	0.2 kg/ha/hr	0.2 kg/ha/hr	400	20	5.56E-10	20	3.90	2	1.42E-08

Asumptions

A media concentration of "0" indicates that chemical was not of concern (or less than laboratory limit of reporting) and the value (0) was adopted for calculation purposes - although site concentration may be in excess of "0".

Emission Factor PM10, (where applicable) derived from NPI Emission Estimation Technique Manual for Mining Version 3.1, Table 2.

Workspace adopted as a nominal 20 x 20 m area assuming the presence of up-paved garden, partially grassed or area where surface cover/grass has been worn or eroded.

Particulate Emission Factor derived from ASTM method.

Average wind speed adopted from Bureau of Meteorology 3pm annual average, Melbourne monitoring station.

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Depth to groundwater (from ground surface)	m	7.6E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Cyanide	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

Lens Parameters		
Thickness of lens	m	2.0E+00
Total porosity in lens	cm3/cm3	3.8E-01
Water content in lens	cm3/cm3	5.4E-02

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+01
Wind speed	m/s	1.7E+00

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Air content	cm3/cm3	1.9E-01
Distance from groundwater to building	m	7.6E+00
Bioattenuation factor	-	1.0E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	5.0E+00
Air content	-	3.0E-02
Water content	-	3.6E-01

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.5E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	2.6E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	1.0E+01
Enclosed space height	m	3.0E+00
Volume of building	m3	3.0E+02
Number of air changes per hour	1/hr	8.3E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	5.0E-03

Dissolved Source for Groundwater Model [mg/l]		
Ammonia	mg/l	1.0E+00
Benzene	mg/l	1.0E+00
Cyanide	mg/l	1.0E+00
Ethylbenzene	mg/l	1.0E+00
Naphthalene	mg/l	1.0E+00
Toluene	mg/l	1.0E+00
Xylenes (total)	mg/l	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Cyanide	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	ND	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	ND	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.0E+06	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	ND	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	(m3-H2O)/(m3-air	6.6E-04	2.3E-01	0.0E+00	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	2.7E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Indoor air concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	1.5E-04	5.4E-03	0.0E+00	5.6E-03	6.4E-04	5.7E-03	5.0E-03

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	3.1E-07	1.1E-05	0.0E+00	1.1E-05	1.3E-06	1.2E-05	1.0E-05

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Depth to groundwater (from ground surface)	m	6.6E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Cyanide	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

Lens Parameters		
Thickness of lens	m	1.0E+00
Total porosity in lens	cm3/cm3	3.8E-01
Water content in lens	cm3/cm3	5.4E-02

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+00
Wind speed	m/s	1.7E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	5.0E+00
Air content	-	3.0E-02
Water content	-	3.6E-01

Dissolved Source for Groundwater Model [mg/l]		
Ammonia	mg/l	1.0E+00
Benzene	mg/l	1.0E+00
Cyanide	mg/l	1.0E+00
Ethylbenzene	mg/l	1.0E+00
Naphthalene	mg/l	1.0E+00
Toluene	mg/l	1.0E+00
Xylenes (total)	mg/l	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Cyanide	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	ND	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	ND	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.0E+06	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	ND	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	(m3-H2O)/(m3-air	6.6E-04	2.3E-01	0.0E+00	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	2.7E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	3.3E-07	1.1E-05	0.0E+00	1.1E-05	1.3E-06	1.2E-05	1.0E-05

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil (depleting source)
Depleting source
Onsite exposure models:

Soil to outdoor air model

Unsaturated Zone Soil Source		
Depth to top of contamination	m	5.0E-01
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.8E-01
Residual water content	cm3/cm3	5.3E-02
Fraction organic carbon	g oc/g soil	2.0E-03
Soil bulk density	g/cm3	1.7E+00
Infiltration rate	cm/yr	3.0E+01
Saturated conductivity	m/d	6.4E+00
Van Genuchten's n	-	2.7E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

*** Lens not used

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+00
Wind speed	m/s	1.7E+00

Source Concentration for Unsaturated Zone Model (mg/kg)		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.1	4.8E-05	1.2E-03	6.2E-04	7.9E-06	9.1E-04	4.7E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil (depleting source)
Depleting source
Onsite exposure models:

Soil to outdoor air model

Unsaturated Zone Soil Source		
Depth to top of contamination	m	5.0E-01
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.8E-01
Residual water content	cm3/cm3	5.3E-02
Fraction organic carbon	g oc/g soil	2.0E-03
Soil bulk density	g/cm3	1.7E+00
Infiltration rate	cm/yr	3.0E+01
Saturated conductivity	m/d	6.4E+00
Van Genuchten's n	-	2.7E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

*** Lens not used

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+01
Wind speed	m/s	1.7E+00

Source Concentration for Unsaturated Zone Model (mg/kg)		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.1	4.8E-05	1.2E-03	6.2E-04	7.9E-06	9.1E-04	4.7E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil beneath a building
Johnson and Ettinger Indoor air model
Volatilization from unsaturated soil source to indoor air (onsite)

Unsaturated Zone Soil Source		
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01
Soil bulk density	g/cm3	1.7E+00
Fraction organic carbon	g/g	2.0E-03

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.8E-01
Water content	cm3/cm3	5.4E-02
Air content	cm3/cm3	3.2E-01
Distance from source to building	m	5.0E-01
Bioattenuation factor	-	1.0E+00

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.5E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	2.6E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	1.0E+01
Enclosed space height	m	3.0E+00
Volume of building	m3	3.0E+02
Number of air changes per hour	1/hr	8.3E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	5.0E-03

Unsaturated Zone Soil Source for Vapor Model		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Indoor air concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	3.8E-02	2.7E+00	8.1E-01	8.7E-03	1.4E+00	5.5E-01

SUBJECT	TOXICITY REFERENCE VALUES (TRVs) CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

ORAL / DERMAL **Tolerable Daily Intake (TDI), Carcinogenic Slope Factors (CSF)**

CHEMICALS	Oral TDI	Reference	Estimated Background Exposure (%)	Oral TDI - Background	Oral CSF	Reference
	mg/kg.d			mg/kg.d	$(mg/kg.d)^{-1}$	
Cyanide Total	0.006	NHMRC (2011)	50	0.003	n/a	n/a
Lead** (Refer Discussion in Report)	n/a	n/a	0	n/a	n/a	n/a
Ammonia	2	1% of WHO (2003)	0	2	n/a	n/a
Benzene	0.004	US EPA (2004)	0	0.004	0.03	WHO (2004)
Ethylbenzene	0.097	NHMRC (2004)	0	0.097	n/a	n/a
Toluene	0.22	NHMRC (2004)	0	0.22	n/a	n/a
Xylenes	0.18	NHMRC (2004)	0	0.18	n/a	n/a
Naphthalene	0.02	US EPA (2004)	20	0.016	n/a	n/a
Acenaphthylene	n/a	None Identified	0	n/a	n/a	n/a
Acenaphthene	0.06	US EPA (1994)	20	0.048	n/a	n/a
Fluorene	0.04	US EPA (1990)	20	0.032	n/a	n/a
Phenanthrene	n/a	None Identified	0	n/a	n/a	n/a
Anthracene	0.3	US EPA (1994)	20	0.24	n/a	n/a
Fluoranthene	0.04	US EPA (1990)	20	0.032	n/a	n/a
Pyrene	0.03	US EPA (1993)	20	0.024	n/a	n/a
Benzo(a)Pyrene equivalents	n/a	n/a	0	n/a	0.43	WHO (2003)
0	n/a	n/a	0	n/a	n/a	n/a
0	n/a	n/a	0	n/a	n/a	n/a

INHALATION **Inhalation Reference Concentrations (RfC), Inhalation Unit Risk (UR)**

CHEMICALS	Inhalation RfC	Reference	Estimated Background Exposure (%)	Inhalation RfC - Background	Inhalation UR	Reference
	mg/m^3			mg/m^3	$(mg/m^3)^{-1}$	
Cyanide Total	0.0008	US EPA (2010)	0	0.0008	n/a	n/a
Lead** (Refer Discussion in Report)	n/a	n/a	0	n/a	n/a	n/a
Ammonia	0.1	US EPA (1991)	20	0.08	n/a	n/a
Benzene	0.03	US EPA (2010)	20	0.024	6.00E-03	WHO (2000)
Ethylbenzene	1.3	ATSDR (2007)	0	1.3	n/a	n/a
Toluene	5	US EPA (2010)	0	5	n/a	n/a
Xylenes	0.87	WHO (2000)	0	0.87	n/a	n/a
Naphthalene	0.003	US EPA (2010)	67	0.00099	n/a	n/a
Acenaphthylene	n/a	n/a	0	n/a	n/a	n/a
Acenaphthene	n/a	n/a	0	n/a	n/a	n/a
Fluorene	n/a	n/a	0	n/a	n/a	n/a
Phenanthrene	n/a	n/a	0	n/a	n/a	n/a
Anthracene	n/a	n/a	0	n/a	n/a	n/a
Fluoranthene	n/a	n/a	0	n/a	n/a	n/a
Pyrene	n/a	n/a	0	n/a	n/a	n/a
Benzo(a)Pyrene equivalents	n/a	n/a	0	n/a	n/a	n/a
0	n/a	n/a	0	n/a	n/a	n/a
0	n/a	n/a	0	n/a	n/a	n/a

ACUTE TOXICITY **Acute and Subcohronic Oral and Inhalation Toxicity Reference Values**

CHEMICALS	Oral Acute / Subchronic TRV	Reference	Inhalation Acute / Subchronic TRV	Reference
	mg/kg.d		mg/m^3	
Cyanide Total	n/a		n/a	
Lead** (Refer Discussion in Report)	n/a		n/a	
Ammonia	n/a		n/a	
Benzene	n/a		n/a	
Ethylbenzene	n/a		n/a	
Toluene	n/a		n/a	
Xylenes	n/a		n/a	
Naphthalene	n/a		n/a	
Acenaphthylene	n/a		n/a	
Acenaphthene	n/a		n/a	
Fluorene	n/a		n/a	
Phenanthrene	n/a		n/a	
Anthracene	n/a		n/a	
Fluoranthene	n/a		n/a	
Pyrene	n/a		n/a	
Benzo(a)Pyrene equivalents	n/a		n/a	
0	n/a		n/a	
0	n/a		n/a	

TARGET RISK LEVELS

Target Indivdual Hazard Quotient	0.2
Target Hazard Index	1
Target Individual ELCR	5.E-06
Target Total ELCR	1.E-05

NOTES

1	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **1 Outdoor Gardening Personnel (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
1 Outdoor Gardening Personnel (Adult)	8	52	30	30	262800	70	15-70	1.5	200	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
1 Outdoor Gardening Personnel (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	200	1	1.00E-06	52	30	75	365	30	1.71E-05	3.00E-03	0.006
Lead** (Refer Discussion in Report)	222	200	0.5	1.00E-06	52	30	75	365	30	4.22E-05	n/a	0.000
Ammonia	0	200	0.04	1.00E-06	52	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	200	1	1.00E-06	52	30	75	365	30	2.39E-06	1.60E-02	0.000
Acenaphthylene	6.1	200	1	1.00E-06	52	30	75	365	30	2.32E-06	n/a	0.000
Acenaphthene	2.2	200	1	1.00E-06	52	30	75	365	30	8.36E-07	4.80E-02	0.000
Fluorene	4.9	200	1	1.00E-06	52	30	75	365	30	1.86E-06	3.20E-02	0.000
Phenanthrene	36.3	200	1	1.00E-06	52	30	75	365	30	1.38E-05	n/a	0.000
Anthracene	12.5	200	1	1.00E-06	52	30	75	365	30	4.75E-06	2.40E-01	0.000
Fluoranthene	52.2	200	1	1.00E-06	52	30	75	365	30	1.98E-05	3.20E-02	0.001
Pyrene	48	200	1	1.00E-06	52	30	75	365	30	1.82E-05	2.40E-02	0.001
Benzo(a)Pyrene equivalents	30.5	200	1	1.00E-06	52	30	75	365	30	1.16E-05	n/a	0.000
0	0	200	0	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000
0	0	200	0	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	200	1	1.00E-06	52	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	200	1	1.00E-06	52	30	75	365	70	4.97E-06	4.30E-01	2.14E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	45	1.42E-08	6.41E-07		8	52	30		365	30	3.04E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	222	1.42E-08	3.16E-06		8	52	30		365	30	1.50E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	6.3	1.42E-08	8.97E-08		8	52	30		365	30	4.26E-09	9.90E-04	0.000
Acenaphthylene	6.1	1.42E-08	8.69E-08		8	52	30		365	30	4.13E-09	n/a	0.000
Acenaphthene	2.2	1.42E-08	3.13E-08		8	52	30		365	30	1.49E-09	n/a	0.000
Fluorene	4.9	1.42E-08	6.98E-08		8	52	30		365	30	3.31E-09	n/a	0.000
Phenanthrene	36.3	1.42E-08	5.17E-07		8	52	30		365	30	2.46E-08	n/a	0.000
Anthracene	12.5	1.42E-08	1.78E-07		8	52	30		365	30	8.46E-09	n/a	0.000
Fluoranthene	52.2	1.42E-08	7.44E-07		8	52	30		365	30	3.53E-08	n/a	0.000
Pyrene	48	1.42E-08	6.84E-07		8	52	30		365	30	3.25E-08	n/a	0.000
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		8	52	30		365	30	2.06E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	52	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		8	52	30		365	70	8.84E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	6300	0.5	1.00E-06	0.1	52	30	75	365	30	2.69E-05	3.00E-03	0.009
Lead** (Refer Discussion in Report)	222	6300	0.5	1.00E-06	0.001	52	30	75	365	30	1.33E-06	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	52	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	52	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	52	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	52	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	6300	0.5	1.00E-06	0.1	52	30	75	365	30	3.77E-06	1.60E-02	0.000
Acenaphthylene	6.1	6300	0.5	1.00E-06	0.18	52	30	75	365	30	6.57E-06	n/a	0.000
Acenaphthene	2.2	6300	0.5	1.00E-06	0.2	52	30	75	365	30	2.63E-06	4.80E-02	0.000
Fluorene	4.9	6300	0.5	1.00E-06	0.2	52	30	75	365	30	5.86E-06	3.20E-02	0.000
Phenanthrene	36.3	6300	0.5	1.00E-06	0.18	52	30	75	365	30	3.91E-05	n/a	0.000
Anthracene	12.5	6300	0.5	1.00E-06	0.29	52	30	75	365	30	2.17E-05	2.40E-01	0.000
Fluoranthene	52.2	6300	0.5	1.00E-06	0.2	52	30	75	365	30	6.25E-05	3.20E-02	0.002
Pyrene	48	6300	0.5	1.00E-06	0.2	52	30	75	365	30	5.74E-05	2.40E-02	0.002
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	52	30	75	365	30	4.74E-06	n/a	0.000
0	0	6300	0.5	1.00E-06	0	52	30	75	365	30	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	52	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	52	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	52	30	75	365	70	2.03E-06	4.30E-01	8.74E-07

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: 1 Outdoor Gardening Personnel (Adult)

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	8	52	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	500	4.77E-05	8	52	30	365	30	1.13E-03	8.00E-02	0.014	1
Benzene	21.6	1.23E-03	8	52	30	365	30	1.27E-03	2.40E-02	0.053	1
Ethylbenzene	18.1	6.19E-04	8	52	30	365	30	5.32E-04	1.30E+00	0.000	1
Toluene	3.1	9.11E-04	8	52	30	365	30	1.34E-04	5.00E+00	0.000	1
Xylenes	24.2	4.74E-04	8	52	30	365	30	5.45E-04	8.70E-01	0.001	1
Naphthalene	6600	7.86E-06	8	52	30	365	30	2.46E-03	9.90E-04	2.490	1
Acenaphthylene	1170	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	1.23E-03	8	52	30	365	70	5.42E-04	6.00E-03	3.25E-06	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	52	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	8	52	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Ammonia	660	3.27E-07	8	52	30	365	30	1.02E-05	8.00E-02	0.000
Benzene	0.072	1.11E-05	8	52	30	365	30	3.80E-08	2.40E-02	0.000
Ethylbenzene	0.004	1.15E-05	8	52	30	365	30	2.18E-09	1.30E+00	0.000
Toluene	0.007	1.17E-05	8	52	30	365	30	3.89E-09	5.00E+00	0.000
Xylenes	0.013	1.04E-05	8	52	30	365	30	6.41E-09	8.70E-01	0.000
Naphthalene	0.019	1.35E-06	8	52	30	365	30	1.22E-09	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	1.11E-05	8	52	30	365	70	1.63E-08	6.00E-03	9.76E-11
Benzo(a)Pyrene equivalents	0	0.00E+00	8	52	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.006		0.000	0.009		0.000	0.000	**0.015**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.014	0.000	**0.014**	0.2	**No**
Benzene	0.000		0.000	0.000		0.053	0.000	**0.053**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Naphthalene	0.000		0.000	0.000		2.490	0.000	**2.490**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.001		0.000	0.002		0.000	0.000	**0.003**	0.2	**No**
Pyrene	0.001		0.000	0.002		0.000	0.000	**0.003**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**2.579**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.015		0.000	
0.000		0.000	
0.014		0.000	
0.053		0.000	
0.000		0.000	
0.000		0.000	
0.001		0.000	
2.490		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.003		0.000	
0.003		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		3.25E-06	9.76E-11	**3.25E-06**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	2.14E-06		0.00E+00	8.74E-07		0.00E+00	0.00E+00	**3.01E-06**	5.00E-06	**No**
							TOTAL	**6.26E-06**	1.00E-05	**No**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
3.25E-06		9.76E-11	
3.01E-06		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **2 Commercial/Staff Personnel (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
2 Commercial/Staff Personnel (Adult)	8	240	30	30	262800	70	15-70	1.2	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
2 Commercial/Staff Personnel (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	25	1	1.00E-06	240	30	75	365	30	9.86E-06	3.00E-03	0.003
Lead** (Refer Discussion in Report)	222	25	0.5	1.00E-06	240	30	75	365	30	2.43E-05	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	240	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	25	1	1.00E-06	240	30	75	365	30	1.38E-06	1.60E-02	0.000
Acenaphthylene	6.1	25	1	1.00E-06	240	30	75	365	30	1.34E-06	n/a	0.000
Acenaphthene	2.2	25	1	1.00E-06	240	30	75	365	30	4.82E-07	4.80E-02	0.000
Fluorene	4.9	25	1	1.00E-06	240	30	75	365	30	1.07E-06	3.20E-02	0.000
Phenanthrene	36.3	25	1	1.00E-06	240	30	75	365	30	7.96E-06	n/a	0.000
Anthracene	12.5	25	1	1.00E-06	240	30	75	365	30	2.74E-06	2.40E-01	0.000
Fluoranthene	52.2	25	1	1.00E-06	240	30	75	365	30	1.14E-05	3.20E-02	0.000
Pyrene	48	25	1	1.00E-06	240	30	75	365	30	1.05E-05	2.40E-02	0.000
Benzo(a)Pyrene equivalents	30.5	25	1	1.00E-06	240	30	75	365	30	6.68E-06	n/a	0.000
0	0	25	0	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000
0	0	25	0	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	240	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	25	1	1.00E-06	240	30	75	365	70	2.86E-06	4.30E-01	1.23E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	45	1.42E-08	6.41E-07		8	240	30		365	30	1.40E-07	8.00E-04	0.000
Lead** (Refer Discussion in Report)	222	1.42E-08	3.16E-06		8	240	30		365	30	6.93E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	6.3	1.42E-08	8.97E-08		8	240	30		365	30	1.97E-08	9.90E-04	0.000
Acenaphthylene	6.1	1.42E-08	8.69E-08		8	240	30		365	30	1.90E-08	n/a	0.000
Acenaphthene	2.2	1.42E-08	3.13E-08		8	240	30		365	30	6.87E-09	n/a	0.000
Fluorene	4.9	1.42E-08	6.98E-08		8	240	30		365	30	1.53E-08	n/a	0.000
Phenanthrene	36.3	1.42E-08	5.17E-07		8	240	30		365	30	1.13E-07	n/a	0.000
Anthracene	12.5	1.42E-08	1.78E-07		8	240	30		365	30	3.90E-08	n/a	0.000
Fluoranthene	52.2	1.42E-08	7.44E-07		8	240	30		365	30	1.63E-07	n/a	0.000
Pyrene	48	1.42E-08	6.84E-07		8	240	30		365	30	1.50E-07	n/a	0.000
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		8	240	30		365	30	9.52E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	240	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		8	240	30		365	70	4.08E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	6300	0.5	1.00E-06	0.1	240	30	75	365	30	1.24E-04	3.00E-03	0.041
Lead** (Refer Discussion in Report)	222	6300	0.5	1.00E-06	0.001	240	30	75	365	30	6.13E-06	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	240	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	240	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	240	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	240	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	6300	0.5	1.00E-06	0.1	240	30	75	365	30	1.74E-05	1.60E-02	0.001
Acenaphthylene	6.1	6300	0.5	1.00E-06	0.18	240	30	75	365	30	3.03E-05	n/a	0.000
Acenaphthene	2.2	6300	0.5	1.00E-06	0.2	240	30	75	365	30	1.22E-05	4.80E-02	0.000
Fluorene	4.9	6300	0.5	1.00E-06	0.2	240	30	75	365	30	2.71E-05	3.20E-02	0.001
Phenanthrene	36.3	6300	0.5	1.00E-06	0.18	240	30	75	365	30	1.80E-04	n/a	0.000
Anthracene	12.5	6300	0.5	1.00E-06	0.29	240	30	75	365	30	1.00E-04	2.40E-01	0.000
Fluoranthene	52.2	6300	0.5	1.00E-06	0.2	240	30	75	365	30	2.88E-04	3.20E-02	0.009
Pyrene	48	6300	0.5	1.00E-06	0.2	240	30	75	365	30	2.65E-04	2.40E-02	0.011
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	240	30	75	365	30	2.19E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	240	30	75	365	30	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	240	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	240	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	240	30	75	365	70	9.39E-06	4.30E-01	4.04E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **2 Commercial/Staff Personnel (Adult)**

VAPOUR INHALATION - SOIL (INDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	8	240	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	500	3.85E-02	8	240	30	365	30	4.22E+00	8.00E-02	52.722	1
Benzene	21.6	2.67E+00	8	240	30	365	30	1.26E+01	2.40E-02	525.868	1
Ethylbenzene	18.1	8.11E-01	8	240	30	365	30	3.22E+00	1.30E+00	2.475	1
Toluene	3.1	1.36E+00	8	240	30	365	30	9.25E-01	5.00E+00	0.185	1
Xylenes	24.2	5.54E-01	8	240	30	365	30	2.94E+00	8.70E-01	3.378	1
Naphthalene	6600	8.70E-03	8	240	30	365	30	1.26E+01	9.90E-04	12712.329	1
Acenaphthylene	1170	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	2.67E+00	8	240	30	365	70	5.41E+00	6.00E-03	3.25E-02	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	240	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (INDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	8	240	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Ammonia	660	1.47E-04	8	240	30	365	30	2.13E-02	8.00E-02	0.267
Benzene	0.072	5.37E-03	8	240	30	365	30	8.48E-05	2.40E-02	0.004
Ethylbenzene	0.004	5.57E-03	8	240	30	365	30	4.88E-06	1.30E+00	0.000
Toluene	0.007	5.68E-03	8	240	30	365	30	8.71E-06	5.00E+00	0.000
Xylenes	0.013	5.01E-03	8	240	30	365	30	1.43E-05	8.70E-01	0.000
Naphthalene	0.019	6.42E-04	8	240	30	365	30	2.67E-06	9.90E-04	0.003
Acenaphthylene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	5.37E-03	8	240	30	365	70	3.63E-05	6.00E-03	2.18E-07
Benzo(a)Pyrene equivalents	0	0.00E+00	8	240	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.003		0.000	0.041		0.000	0.000	**0.045**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		52.722	0.267	**52.988**	0.2	**YES**
Benzene	0.000		0.000	0.000		525.868	0.004	**525.872**	0.2	**YES**
Ethylbenzene	0.000		0.000	0.000		2.475	0.000	**2.475**	0.2	**YES**
Toluene	0.000		0.000	0.000		0.185	0.000	**0.185**	0.2	**No**
Xylenes	0.000		0.000	0.000		3.378	0.000	**3.378**	0.2	**YES**
Naphthalene	0.000		0.000	0.001		12712.329	0.003	**12712.333**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.009		0.000	0.000	**0.009**	0.2	**No**
Pyrene	0.000		0.000	0.011		0.000	0.000	**0.011**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**13297.298**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.045		0.000	
0.000		0.000	
52.722		0.267	
525.868		0.004	
2.475		0.000	
0.185		0.000	
3.378		0.000	
12712.330		0.003	
0.000		0.000	
0.000		0.000	
0.001		0.000	
0.000		0.000	
0.000		0.000	
0.009		0.000	
0.011		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		3.25E-02	2.18E-07	**3.25E-02**	5.00E-06	**YES**
Benzo(a)Pyrene equivalents	1.23E-06		0.00E+00	4.04E-06		0.00E+00	0.00E+00	**5.27E-06**	5.00E-06	**YES**
							TOTAL	**3.25E-02**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
3.25E-02		2.18E-07	
5.27E-06		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.: 147613068	Made by JH/AB	Date AUGUST 2014	
Ref.	Checked by CMB	Sheet 1 of 1	

RECEPTOR: **3 Public Users of Building Facilities (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
3 Public Users of Building Facilities (Adult)	8	48	10	10	87600	70	15-70	1.2	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
3 Public Users of Building Facilities (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	25	1	1.00E-06	48	10	75	365	10	1.97E-06	3.00E-03	0.001
Lead** (Refer Discussion in Report)	222	25	0.5	1.00E-06	48	10	75	365	10	4.87E-06	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	48	10	75	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	25	1	1.00E-06	48	10	75	365	10	2.76E-07	1.60E-02	0.000
Acenaphthylene	6.1	25	1	1.00E-06	48	10	75	365	10	2.67E-07	n/a	0.000
Acenaphthene	2.2	25	1	1.00E-06	48	10	75	365	10	9.64E-08	4.80E-02	0.000
Fluorene	4.9	25	1	1.00E-06	48	10	75	365	10	2.15E-07	3.20E-02	0.000
Phenanthrene	36.3	25	1	1.00E-06	48	10	75	365	10	1.59E-06	n/a	0.000
Anthracene	12.5	25	1	1.00E-06	48	10	75	365	10	5.48E-07	2.40E-01	0.000
Fluoranthene	52.2	25	1	1.00E-06	48	10	75	365	10	2.29E-06	3.20E-02	0.000
Pyrene	48	25	1	1.00E-06	48	10	75	365	10	2.10E-06	2.40E-02	0.000
Benzo(a)Pyrene equivalents	30.5	25	1	1.00E-06	48	10	75	365	10	1.34E-06	n/a	0.000
0	0	25	0	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000
0	0	25	0	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	48	10	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	25	1	1.00E-06	48	10	75	365	70	1.91E-07	4.30E-01	8.21E-08

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	45	1.42E-08	6.41E-07		8	48	10		365	10	2.81E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	222	1.42E-08	3.16E-06		8	48	10		365	10	1.39E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	8.70E-01	0.000
Naphthalene	6.3	1.42E-08	8.97E-08		8	48	10		365	10	3.93E-09	9.90E-04	0.000
Acenaphthylene	6.1	1.42E-08	8.69E-08		8	48	10		365	10	3.81E-09	n/a	0.000
Acenaphthene	2.2	1.42E-08	3.13E-08		8	48	10		365	10	1.37E-09	n/a	0.000
Fluorene	4.9	1.42E-08	6.98E-08		8	48	10		365	10	3.06E-09	n/a	0.000
Phenanthrene	36.3	1.42E-08	5.17E-07		8	48	10		365	10	2.27E-08	n/a	0.000
Anthracene	12.5	1.42E-08	1.78E-07		8	48	10		365	10	7.81E-09	n/a	0.000
Fluoranthene	52.2	1.42E-08	7.44E-07		8	48	10		365	10	3.26E-08	n/a	0.000
Pyrene	48	1.42E-08	6.84E-07		8	48	10		365	10	3.00E-08	n/a	0.000
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		8	48	10		365	10	1.90E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	48	10		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		8	48	10		365	70	2.72E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	6300	0.5	1.00E-06	0.1	48	10	75	365	10	2.49E-05	3.00E-03	0.008
Lead** (Refer Discussion in Report)	222	6300	0.5	1.00E-06	0.001	48	10	75	365	10	1.23E-06	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	48	10	75	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	48	10	75	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	48	10	75	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	48	10	75	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	48	10	75	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	6300	0.5	1.00E-06	0.1	48	10	75	365	10	3.48E-06	1.60E-02	0.000
Acenaphthylene	6.1	6300	0.5	1.00E-06	0.18	48	10	75	365	10	6.06E-06	n/a	0.000
Acenaphthene	2.2	6300	0.5	1.00E-06	0.2	48	10	75	365	10	2.43E-06	4.80E-02	0.000
Fluorene	4.9	6300	0.5	1.00E-06	0.2	48	10	75	365	10	5.41E-06	3.20E-02	0.000
Phenanthrene	36.3	6300	0.5	1.00E-06	0.18	48	10	75	365	10	3.61E-05	n/a	0.000
Anthracene	12.5	6300	0.5	1.00E-06	0.29	48	10	75	365	10	2.00E-05	2.40E-01	0.000
Fluoranthene	52.2	6300	0.5	1.00E-06	0.2	48	10	75	365	10	5.77E-05	3.20E-02	0.002
Pyrene	48	6300	0.5	1.00E-06	0.2	48	10	75	365	10	5.30E-05	2.40E-02	0.002
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	48	10	75	365	10	4.38E-06	n/a	0.000
0	0	6300	0.5	1.00E-06	0	48	10	75	365	10	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	48	10	75	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	48	10	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	48	10	75	365	70	6.26E-07	4.30E-01	2.69E-07

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: 3 **Public Users of Building Facilities (Adult)**

VAPOUR INHALATION - SOIL (INDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	8	48	10	365	10	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Ammonia	500	3.85E-02	8	48	10	365	10	8.44E-01	8.00E-02	10.544	1
Benzene	21.6	2.67E+00	8	48	10	365	10	2.52E+00	2.40E-02	105.174	1
Ethylbenzene	18.1	8.11E-01	8	48	10	365	10	6.44E-01	1.30E+00	0.495	1
Toluene	3.1	1.36E+00	8	48	10	365	10	1.85E-01	5.00E+00	0.037	1
Xylenes	24.2	5.54E-01	8	48	10	365	10	5.88E-01	8.70E-01	0.676	1
Naphthalene	6600	8.70E-03	8	48	10	365	10	2.52E+00	9.90E-04	2542.466	1
Acenaphthylene	1170	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	2.67E+00	8	48	10	365	70	3.61E-01	6.00E-03	2.16E-03	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	48	10	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (INDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	8	48	10	365	10	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Ammonia	660	1.47E-04	8	48	10	365	10	4.27E-03	8.00E-02	0.053
Benzene	0.072	5.37E-03	8	48	10	365	10	1.70E-05	2.40E-02	0.001
Ethylbenzene	0.004	5.57E-03	8	48	10	365	10	9.76E-07	1.30E+00	0.000
Toluene	0.007	5.68E-03	8	48	10	365	10	1.74E-06	5.00E+00	0.000
Xylenes	0.013	5.01E-03	8	48	10	365	10	2.86E-06	8.70E-01	0.000
Naphthalene	0.019	6.42E-04	8	48	10	365	10	5.35E-07	9.90E-04	0.001
Acenaphthylene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	5.37E-03	8	48	10	365	70	2.42E-06	6.00E-03	1.45E-08
Benzo(a)Pyrene equivalents	0	0.00E+00	8	48	10	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.001		0.000	0.008		0.000	0.000	**0.009**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		10.544	0.053	**10.598**	0.2	**YES**
Benzene	0.000		0.000	0.000		105.174	0.001	**105.174**	0.2	**YES**
Ethylbenzene	0.000		0.000	0.000		0.495	0.000	**0.495**	0.2	**YES**
Toluene	0.000		0.000	0.000		0.037	0.000	**0.037**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.676	0.000	**0.676**	0.2	**YES**
Naphthalene	0.000		0.000	0.000		2542.466	0.001	**2542.467**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.002		0.000	0.000	**0.002**	0.2	**No**
Pyrene	0.000		0.000	0.002		0.000	0.000	**0.002**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**2659.460**	1	**YES**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		2.16E-03	1.45E-08	**2.16E-03**	5.00E-06	**YES**
Benzo(a)Pyrene equivalents	8.21E-08		0.00E+00	2.69E-07		0.00E+00	0.00E+00	**3.51E-07**	5.00E-06	**No**
							TOTAL	**2.16E-03**	1.00E-05	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.009		0.000	
0.000		0.000	
10.544		0.053	
105.174		0.001	
0.495		0.000	
0.037		0.000	
0.676		0.000	
2542.466		0.001	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.002		0.000	
0.002		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
2.16E-03		1.45E-08	
3.51E-07		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **4 Recreational Park Users (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
4 Recreational Park Users (Adult)	2	260	29	29	254040	70	15-70	1.33	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
4 Recreational Park Users (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	25	1	1.00E-06	260	29	75	365	29	1.07E-05	3.00E-03	0.004
Lead** (Refer Discussion in Report)	222	25	0.5	1.00E-06	260	29	75	365	29	2.64E-05	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	260	29	75	365	29	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	25	1	1.00E-06	260	29	75	365	29	1.50E-06	1.60E-02	0.000
Acenaphthylene	6.1	25	1	1.00E-06	260	29	75	365	29	1.45E-06	n/a	0.000
Acenaphthene	2.2	25	1	1.00E-06	260	29	75	365	29	5.22E-07	4.80E-02	0.000
Fluorene	4.9	25	1	1.00E-06	260	29	75	365	29	1.16E-06	3.20E-02	0.000
Phenanthrene	36.3	25	1	1.00E-06	260	29	75	365	29	8.62E-06	n/a	0.000
Anthracene	12.5	25	1	1.00E-06	260	29	75	365	29	2.97E-06	2.40E-01	0.000
Fluoranthene	52.2	25	1	1.00E-06	260	29	75	365	29	1.24E-05	3.20E-02	0.000
Pyrene	48	25	1	1.00E-06	260	29	75	365	29	1.14E-05	2.40E-02	0.000
Benzo(a)Pyrene equivalents	30.5	25	1	1.00E-06	260	29	75	365	29	7.24E-06	n/a	0.000
0	0	25	0	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000
0	0	25	0	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	260	29	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	25	1	1.00E-06	260	29	75	365	70	3.00E-06	4.30E-01	1.29E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	45	1.42E-08	6.41E-07		2	260	29		365	29	3.81E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	222	1.42E-08	3.16E-06		2	260	29		365	29	1.88E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	8.70E-01	0.000
Naphthalene	6.3	1.42E-08	8.97E-08		2	260	29		365	29	5.33E-09	9.90E-04	0.000
Acenaphthylene	6.1	1.42E-08	8.69E-08		2	260	29		365	29	5.16E-09	n/a	0.000
Acenaphthene	2.2	1.42E-08	3.13E-08		2	260	29		365	29	1.86E-09	n/a	0.000
Fluorene	4.9	1.42E-08	6.98E-08		2	260	29		365	29	4.14E-09	n/a	0.000
Phenanthrene	36.3	1.42E-08	5.17E-07		2	260	29		365	29	3.07E-08	n/a	0.000
Anthracene	12.5	1.42E-08	1.78E-07		2	260	29		365	29	1.06E-08	n/a	0.000
Fluoranthene	52.2	1.42E-08	7.44E-07		2	260	29		365	29	4.41E-08	n/a	0.000
Pyrene	48	1.42E-08	6.84E-07		2	260	29		365	29	4.06E-08	n/a	0.000
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		2	260	29		365	29	2.58E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		2	260	29		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		2	260	29		365	70	1.07E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	6300	0.5	1.00E-06	0.1	260	29	75	365	29	1.35E-04	3.00E-03	0.045
Lead** (Refer Discussion in Report)	222	6300	0.5	1.00E-06	0.001	260	29	75	365	29	6.64E-06	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	260	29	75	365	29	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	260	29	75	365	29	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	260	29	75	365	29	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	260	29	75	365	29	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	260	29	75	365	29	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	6300	0.5	1.00E-06	0.1	260	29	75	365	29	1.88E-05	1.60E-02	0.001
Acenaphthylene	6.1	6300	0.5	1.00E-06	0.18	260	29	75	365	29	3.28E-05	n/a	0.000
Acenaphthene	2.2	6300	0.5	1.00E-06	0.2	260	29	75	365	29	1.32E-05	4.80E-02	0.000
Fluorene	4.9	6300	0.5	1.00E-06	0.2	260	29	75	365	29	2.93E-05	3.20E-02	0.001
Phenanthrene	36.3	6300	0.5	1.00E-06	0.18	260	29	75	365	29	1.95E-04	n/a	0.000
Anthracene	12.5	6300	0.5	1.00E-06	0.29	260	29	75	365	29	1.08E-04	2.40E-01	0.000
Fluoranthene	52.2	6300	0.5	1.00E-06	0.2	260	29	75	365	29	3.12E-04	3.20E-02	0.010
Pyrene	48	6300	0.5	1.00E-06	0.2	260	29	75	365	29	2.87E-04	2.40E-02	0.012
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	260	29	75	365	29	2.37E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	260	29	75	365	29	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	260	29	75	365	29	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	260	29	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	6300	0.5	1.00E-06	0.026	260	29	75	365	70	9.83E-06	4.30E-01	4.23E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: 4 Recreational Park Users (Adult)

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	2	260	29	365	29	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Ammonia	500	4.77E-05	2	260	29	365	29	1.42E-03	8.00E-02	0.018	1
Benzene	21.6	1.23E-03	2	260	29	365	29	1.58E-03	2.40E-02	0.066	1
Ethylbenzene	18.1	6.19E-04	2	260	29	365	29	6.65E-04	1.30E+00	0.001	1
Toluene	3.1	9.11E-04	2	260	29	365	29	1.68E-04	5.00E+00	0.000	1
Xylenes	24.2	4.74E-04	2	260	29	365	29	6.82E-04	8.70E-01	0.001	1
Naphthalene	6600	7.86E-06	2	260	29	365	29	3.08E-03	9.90E-04	3.112	1
Acenaphthylene	1170	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	1.23E-03	2	260	29	365	70	6.55E-04	6.00E-03	3.93E-06	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	2	260	29	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	2	260	29	365	29	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Ammonia	660	3.27E-07	2	260	29	365	29	1.28E-05	8.00E-02	0.000
Benzene	0.072	1.11E-05	2	260	29	365	29	4.75E-08	2.40E-02	0.000
Ethylbenzene	0.004	1.15E-05	2	260	29	365	29	2.72E-09	1.30E+00	0.000
Toluene	0.007	1.17E-05	2	260	29	365	29	4.87E-09	5.00E+00	0.000
Xylenes	0.013	1.04E-05	2	260	29	365	29	8.01E-09	8.70E-01	0.000
Naphthalene	0.019	1.35E-06	2	260	29	365	29	1.52E-09	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	1.11E-05	2	260	29	365	70	1.97E-08	6.00E-03	1.18E-10
Benzo(a)Pyrene equivalents	0	0.00E+00	2	260	29	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.004		0.000	0.045		0.000	0.000	**0.048**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.018	0.000	**0.018**	0.2	**No**
Benzene	0.000		0.000	0.000		0.066	0.000	**0.066**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Naphthalene	0.000		0.000	0.001		3.112	0.000	**3.113**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.010		0.000	0.000	**0.010**	0.2	**No**
Pyrene	0.000		0.000	0.012		0.000	0.000	**0.012**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**3.271**	1	**YES**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		3.93E-06	1.18E-10	**3.93E-06**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	1.29E-06		0.00E+00	4.23E-06		0.00E+00	0.00E+00	**5.52E-06**	5.00E-06	**YES**
							TOTAL	**9.45E-06**	1.00E-05	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.048		0.000	
0.000		0.000	
0.018		0.000	
0.066		0.000	
0.001		0.000	
0.000		0.000	
0.001		0.000	
3.113		0.000	
0.000		0.000	
0.000		0.000	
0.001		0.000	
0.000		0.000	
0.000		0.000	
0.010		0.000	
0.012		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
3.93E-06		1.18E-10	
5.52E-06		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **5 Recreational Park Users (Child)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
5 Recreational Park Users (Child)	2	260	10	10	87600	70	5-15	0.89	50	5080	0.5	Variable	56
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
5 Recreational Park Users (Child)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	50	1	1.00E-06	260	10	56	365	10	2.86E-05	3.00E-03	0.010
Lead** (Refer Discussion in Report)	222	50	0.5	1.00E-06	260	10	56	365	10	7.06E-05	n/a	0.000
Ammonia	0	50	0.04	1.00E-06	260	10	56	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	50	1	1.00E-06	260	10	56	365	10	4.01E-06	1.60E-02	0.000
Acenaphthylene	6.1	50	1	1.00E-06	260	10	56	365	10	3.88E-06	n/a	0.000
Acenaphthene	2.2	50	1	1.00E-06	260	10	56	365	10	1.40E-06	4.80E-02	0.000
Fluorene	4.9	50	1	1.00E-06	260	10	56	365	10	3.12E-06	3.20E-02	0.000
Phenanthrene	36.3	50	1	1.00E-06	260	10	56	365	10	2.31E-05	n/a	0.000
Anthracene	12.5	50	1	1.00E-06	260	10	56	365	10	7.95E-06	2.40E-01	0.000
Fluoranthene	52.2	50	1	1.00E-06	260	10	56	365	10	3.32E-05	3.20E-02	0.001
Pyrene	48	50	1	1.00E-06	260	10	56	365	10	3.05E-05	2.40E-02	0.001
Benzo(a)Pyrene equivalents	30.5	50	1	1.00E-06	260	10	56	365	10	1.94E-05	n/a	0.000
0	0	50	0	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000
0	0	50	0	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	50	1	1.00E-06	260	10	56	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	50	1	1.00E-06	260	10	56	365	70	2.77E-06	4.30E-01	1.19E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	45	1.42E-08	6.41E-07		2	260	10		365	10	3.81E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	222	1.42E-08	3.16E-06		2	260	10		365	10	1.88E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	8.70E-01	0.000
Naphthalene	6.3	1.42E-08	8.97E-08		2	260	10		365	10	5.33E-09	9.90E-04	0.000
Acenaphthylene	6.1	1.42E-08	8.69E-08		2	260	10		365	10	5.16E-09	n/a	0.000
Acenaphthene	2.2	1.42E-08	3.13E-08		2	260	10		365	10	1.86E-09	n/a	0.000
Fluorene	4.9	1.42E-08	6.98E-08		2	260	10		365	10	4.14E-09	n/a	0.000
Phenanthrene	36.3	1.42E-08	5.17E-07		2	260	10		365	10	3.07E-08	n/a	0.000
Anthracene	12.5	1.42E-08	1.78E-07		2	260	10		365	10	1.06E-08	n/a	0.000
Fluoranthene	52.2	1.42E-08	7.44E-07		2	260	10		365	10	4.41E-08	n/a	0.000
Pyrene	48	1.42E-08	6.84E-07		2	260	10		365	10	4.06E-08	n/a	0.000
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		2	260	10		365	10	2.58E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		2	260	10		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		2	260	10		365	70	3.68E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	5080	0.5	1.00E-06	0.1	260	10	56	365	10	1.45E-04	3.00E-03	0.048
Lead** (Refer Discussion in Report)	222	5080	0.5	1.00E-06	0.001	260	10	56	365	10	7.17E-06	n/a	0.000
Ammonia	0	5080	0.5	1.00E-06	0.005	260	10	56	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	5080	0.5	1.00E-06	0.08	260	10	56	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	5080	0.5	1.00E-06	0.2	260	10	56	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	5080	0.5	1.00E-06	0.12	260	10	56	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	5080	0.5	1.00E-06	0.12	260	10	56	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	5080	0.5	1.00E-06	0.1	260	10	56	365	10	2.04E-05	1.60E-02	0.001
Acenaphthylene	6.1	5080	0.5	1.00E-06	0.18	260	10	56	365	10	3.55E-05	n/a	0.000
Acenaphthene	2.2	5080	0.5	1.00E-06	0.2	260	10	56	365	10	1.42E-05	4.80E-02	0.000
Fluorene	4.9	5080	0.5	1.00E-06	0.2	260	10	56	365	10	3.17E-05	3.20E-02	0.001
Phenanthrene	36.3	5080	0.5	1.00E-06	0.18	260	10	56	365	10	2.11E-04	n/a	0.000
Anthracene	12.5	5080	0.5	1.00E-06	0.29	260	10	56	365	10	1.17E-04	2.40E-01	0.000
Fluoranthene	52.2	5080	0.5	1.00E-06	0.2	260	10	56	365	10	3.37E-04	3.20E-02	0.011
Pyrene	48	5080	0.5	1.00E-06	0.2	260	10	56	365	10	3.10E-04	2.40E-02	0.013
Benzo(a)Pyrene equivalents	30.5	5080	0.5	1.00E-06	0.026	260	10	56	365	10	2.56E-05	n/a	0.000
0	0	5080	0.5	1.00E-06	0	260	10	56	365	10	0.00E+00	n/a	0.000
0	0	5080	0.5	1.00E-06	0	260	10	56	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	5080	0.5	1.00E-06	0.08	260	10	56	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	5080	0.5	1.00E-06	0.026	260	10	56	365	70	3.66E-06	4.30E-01	1.57E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **5 Recreational Park Users (Child)**

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	2	260	10	365	10	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Ammonia	500	4.77E-05	2	260	10	365	10	1.42E-03	8.00E-02	0.018	1
Benzene	21.6	1.23E-03	2	260	10	365	10	1.58E-03	2.40E-02	0.066	1
Ethylbenzene	18.1	6.19E-04	2	260	10	365	10	6.65E-04	1.30E+00	0.001	1
Toluene	3.1	9.11E-04	2	260	10	365	10	1.68E-04	5.00E+00	0.000	1
Xylenes	24.2	4.74E-04	2	260	10	365	10	6.82E-04	8.70E-01	0.001	1
Naphthalene	6600	7.86E-06	2	260	10	365	10	3.08E-03	9.90E-04	3.112	1
Acenaphthylene	1170	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	1.23E-03	2	260	10	365	70	2.26E-04	6.00E-03	1.36E-06	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	2	260	10	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	2	260	10	365	10	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Ammonia	660	3.27E-07	2	260	10	365	10	1.28E-05	8.00E-02	0.000
Benzene	0.072	1.11E-05	2	260	10	365	10	4.75E-08	2.40E-02	0.000
Ethylbenzene	0.004	1.15E-05	2	260	10	365	10	2.72E-09	1.30E+00	0.000
Toluene	0.007	1.17E-05	2	260	10	365	10	4.87E-09	5.00E+00	0.000
Xylenes	0.013	1.04E-05	2	260	10	365	10	8.01E-09	8.70E-01	0.000
Naphthalene	0.019	1.35E-06	2	260	10	365	10	1.52E-09	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	1.11E-05	2	260	10	365	70	6.78E-09	6.00E-03	4.07E-11
Benzo(a)Pyrene equivalents	0	0.00E+00	2	260	10	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.010		0.000	0.048		0.000	0.000	**0.058**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.018	0.000	**0.018**	0.2	**No**
Benzene	0.000		0.000	0.000		0.066	0.000	**0.066**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Naphthalene	0.000		0.000	0.001		3.112	0.000	**3.113**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.001**	0.2	**No**
Fluoranthene	0.001		0.000	0.011		0.000	0.000	**0.012**	0.2	**No**
Pyrene	0.001		0.000	0.013		0.000	0.000	**0.014**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**3.284**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.058		0.000	
0.000		0.000	
0.018		0.000	
0.066		0.000	
0.001		0.000	
0.000		0.000	
0.001		0.000	
3.113		0.000	
0.000		0.000	
0.000		0.000	
0.001		0.000	
0.000		0.000	
0.001		0.000	
0.012		0.000	
0.014		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		1.36E-06	4.07E-11	**1.36E-06**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	1.19E-06		0.00E+00	1.57E-06		0.00E+00	0.00E+00	**2.77E-06**	5.00E-06	**No**
							TOTAL	**4.12E-06**	1.00E-05	**No**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
1.36E-06		4.07E-11	
2.77E-06		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **6 Recreational Park Users (Infant)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
6 Recreational Park Users (Infant)	2	260	5	5	43800	70	0-5	0.72	50	2700	0.5	Variable	11
					SUBCHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
6 Recreational Park Users (Infant)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	50	1	1.00E-06	260	5	11	365	5	1.46E-04	3.00E-03	0.049
Lead** (Refer Discussion in Report)	222	50	0.5	1.00E-06	260	5	11	365	5	3.59E-04	n/a	0.000
Ammonia	0	50	0.04	1.00E-06	260	5	11	365	5	0.00E+00	2.00E+00	0.000
Benzene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	9.70E-02	0.000
Toluene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	2.20E-01	0.000
Xylenes	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	50	1	1.00E-06	260	5	11	365	5	2.04E-05	1.60E-02	0.001
Acenaphthylene	6.1	50	1	1.00E-06	260	5	11	365	5	1.98E-05	n/a	0.000
Acenaphthene	2.2	50	1	1.00E-06	260	5	11	365	5	7.12E-06	4.80E-02	0.000
Fluorene	4.9	50	1	1.00E-06	260	5	11	365	5	1.59E-05	3.20E-02	0.000
Phenanthrene	36.3	50	1	1.00E-06	260	5	11	365	5	1.18E-04	n/a	0.000
Anthracene	12.5	50	1	1.00E-06	260	5	11	365	5	4.05E-05	2.40E-01	0.000
Fluoranthene	52.2	50	1	1.00E-06	260	5	11	365	5	1.69E-04	3.20E-02	0.005
Pyrene	48	50	1	1.00E-06	260	5	11	365	5	1.55E-04	2.40E-02	0.006
Benzo(a)Pyrene equivalents	30.5	50	1	1.00E-06	260	5	11	365	5	9.88E-05	n/a	0.000
0	0	50	0	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000
0	0	50	0	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	50	1	1.00E-06	260	5	11	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	50	1	1.00E-06	260	5	11	365	70	7.05E-06	4.30E-01	3.03E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	45	1.42E-08	6.41E-07		2	260	5		365	5	3.81E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	222	1.42E-08	3.16E-06		2	260	5		365	5	1.88E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	8.70E-01	0.000
Naphthalene	6.3	1.42E-08	8.97E-08		2	260	5		365	5	5.33E-09	9.90E-04	0.000
Acenaphthylene	6.1	1.42E-08	8.69E-08		2	260	5		365	5	5.16E-09	n/a	0.000
Acenaphthene	2.2	1.42E-08	3.13E-08		2	260	5		365	5	1.86E-09	n/a	0.000
Fluorene	4.9	1.42E-08	6.98E-08		2	260	5		365	5	4.14E-09	n/a	0.000
Phenanthrene	36.3	1.42E-08	5.17E-07		2	260	5		365	5	3.07E-08	n/a	0.000
Anthracene	12.5	1.42E-08	1.78E-07		2	260	5		365	5	1.06E-08	n/a	0.000
Fluoranthene	52.2	1.42E-08	7.44E-07		2	260	5		365	5	4.41E-08	n/a	0.000
Pyrene	48	1.42E-08	6.84E-07		2	260	5		365	5	4.06E-08	n/a	0.000
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		2	260	5		365	5	2.58E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		2	260	5		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	30.5	1.42E-08	4.34E-07		2	260	5		365	70	1.84E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	45	2700	0.5	1.00E-06	0.1	260	5	11	365	5	3.93E-04	3.00E-03	0.131
Lead** (Refer Discussion in Report)	222	2700	0.5	1.00E-06	0.001	260	5	11	365	5	1.94E-05	n/a	0.000
Ammonia	0	2700	0.5	1.00E-06	0.005	260	5	11	365	5	0.00E+00	2.00E+00	0.000
Benzene	0	2700	0.5	1.00E-06	0.08	260	5	11	365	5	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	2700	0.5	1.00E-06	0.2	260	5	11	365	5	0.00E+00	9.70E-02	0.000
Toluene	0	2700	0.5	1.00E-06	0.12	260	5	11	365	5	0.00E+00	2.20E-01	0.000
Xylenes	0	2700	0.5	1.00E-06	0.12	260	5	11	365	5	0.00E+00	1.80E-01	0.000
Naphthalene	6.3	2700	0.5	1.00E-06	0.1	260	5	11	365	5	5.51E-05	1.60E-02	0.003
Acenaphthylene	6.1	2700	0.5	1.00E-06	0.18	260	5	11	365	5	9.60E-05	n/a	0.000
Acenaphthene	2.2	2700	0.5	1.00E-06	0.2	260	5	11	365	5	3.85E-05	4.80E-02	0.001
Fluorene	4.9	2700	0.5	1.00E-06	0.2	260	5	11	365	5	8.57E-05	3.20E-02	0.003
Phenanthrene	36.3	2700	0.5	1.00E-06	0.18	260	5	11	365	5	5.71E-04	n/a	0.000
Anthracene	12.5	2700	0.5	1.00E-06	0.29	260	5	11	365	5	3.17E-04	2.40E-01	0.001
Fluoranthene	52.2	2700	0.5	1.00E-06	0.2	260	5	11	365	5	9.13E-04	3.20E-02	0.029
Pyrene	48	2700	0.5	1.00E-06	0.2	260	5	11	365	5	8.39E-04	2.40E-02	0.035
Benzo(a)Pyrene equivalents	30.5	2700	0.5	1.00E-06	0.026	260	5	11	365	5	6.93E-05	n/a	0.000
0	0	2700	0.5	1.00E-06	0	260	5	11	365	5	0.00E+00	n/a	0.000
0	0	2700	0.5	1.00E-06	0	260	5	11	365	5	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	2700	0.5	1.00E-06	0.08	260	5	11	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	30.5	2700	0.5	1.00E-06	0.026	260	5	11	365	70	4.95E-06	4.30E-01	2.13E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **6 Recreational Park Users (Infant)**

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	2	260	5	365	5	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Ammonia	500	4.77E-05	2	260	5	365	5	1.42E-03	8.00E-02	0.018	1
Benzene	21.6	1.23E-03	2	260	5	365	5	1.58E-03	2.40E-02	0.066	1
Ethylbenzene	18.1	6.19E-04	2	260	5	365	5	6.65E-04	1.30E+00	0.001	1
Toluene	3.1	9.11E-04	2	260	5	365	5	1.68E-04	5.00E+00	0.000	1
Xylenes	24.2	4.74E-04	2	260	5	365	5	6.82E-04	8.70E-01	0.001	1
Naphthalene	6600	7.86E-06	2	260	5	365	5	3.08E-03	9.90E-04	3.112	1
Acenaphthylene	1170	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	1.23E-03	2	260	5	365	70	1.13E-04	6.00E-03	6.78E-07	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	2	260	5	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	2	260	5	365	5	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Ammonia	660	3.27E-07	2	260	5	365	5	1.28E-05	8.00E-02	0.000
Benzene	0.072	1.11E-05	2	260	5	365	5	4.75E-08	2.40E-02	0.000
Ethylbenzene	0.004	1.15E-05	2	260	5	365	5	2.72E-09	1.30E+00	0.000
Toluene	0.007	1.17E-05	2	260	5	365	5	4.87E-09	5.00E+00	0.000
Xylenes	0.013	1.04E-05	2	260	5	365	5	8.01E-09	8.70E-01	0.000
Naphthalene	0.019	1.35E-06	2	260	5	365	5	1.52E-09	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	1.11E-05	2	260	5	365	70	3.39E-09	6.00E-03	2.03E-11
Benzo(a)Pyrene equivalents	0	0.00E+00	2	260	5	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.049		0.000	0.131		0.000	0.000	**0.180**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.018	0.000	**0.018**	0.2	**No**
Benzene	0.000		0.000	0.000		0.066	0.000	**0.066**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.001	0.000	**0.001**	0.2	**No**
Naphthalene	0.001		0.000	0.003		3.112	0.000	**3.117**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Fluorene	0.000		0.000	0.003		0.000	0.000	**0.003**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Fluoranthene	0.005		0.000	0.029		0.000	0.000	**0.034**	0.2	**No**
Pyrene	0.006		0.000	0.035		0.000	0.000	**0.041**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**3.462**	1	**YES**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		6.78E-07	2.03E-11	**6.78E-07**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	3.03E-06		0.00E+00	2.13E-06		0.00E+00	0.00E+00	**5.16E-06**	5.00E-06	**YES**
							TOTAL	**5.84E-06**	1.00E-05	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.180		0.000	
0.000		0.000	
0.018		0.000	
0.066		0.000	
0.001		0.000	
0.000		0.000	
0.001		0.000	
3.117		0.000	
0.000		0.000	
0.001		0.000	
0.003		0.000	
0.000		0.000	
0.001		0.000	
0.034		0.000	
0.041		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
6.78E-07		2.03E-11	
5.16E-06		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **7 Utility / Maintenance Workers (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
7 Utility / Maintenance Workers (Adult)	8	10	30	30	262800	70	15-70	2.1	200	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
7 Utility / Maintenance Workers (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	4240	200	1	1.00E-06	10	30	75	365	30	3.10E-04	3.00E-03	0.103
Lead** (Refer Discussion in Report)	6720	200	0.5	1.00E-06	10	30	75	365	30	2.45E-04	n/a	0.000
Ammonia	20	200	0.04	1.00E-06	10	30	75	365	30	5.84E-08	2.00E+00	0.000
Benzene	13.7	200	1	1.00E-06	10	30	75	365	30	1.00E-06	4.00E-03	0.000
Ethylbenzene	10.4	200	1	1.00E-06	10	30	75	365	30	7.60E-07	9.70E-02	0.000
Toluene	1.5	200	1	1.00E-06	10	30	75	365	30	1.10E-07	2.20E-01	0.000
Xylenes	24.2	200	1	1.00E-06	10	30	75	365	30	1.77E-06	1.80E-01	0.000
Naphthalene	6600	200	1	1.00E-06	10	30	75	365	30	4.82E-04	1.60E-02	0.030
Acenaphthylene	1170	200	1	1.00E-06	10	30	75	365	30	8.55E-05	n/a	0.000
Acenaphthene	136	200	1	1.00E-06	10	30	75	365	30	9.94E-06	4.80E-02	0.000
Fluorene	1400	200	1	1.00E-06	10	30	75	365	30	1.02E-04	3.20E-02	0.003
Phenanthrene	5370	200	1	1.00E-06	10	30	75	365	30	3.92E-04	n/a	0.000
Anthracene	1340	200	1	1.00E-06	10	30	75	365	30	9.79E-05	2.40E-01	0.000
Fluoranthene	3690	200	1	1.00E-06	10	30	75	365	30	2.70E-04	3.20E-02	0.008
Pyrene	3250	200	1	1.00E-06	10	30	75	365	30	2.37E-04	2.40E-02	0.010
Benzo(a)Pyrene equivalents	1444.8	200	1	1.00E-06	10	30	75	365	30	1.06E-04	n/a	0.000
0	0	200	0	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000
0	0	200	0	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	13.7	200	1	1.00E-06	10	30	75	365	70	4.29E-07	3.00E-02	1.29E-08
Benzo(a)Pyrene equivalents	1444.8	200	1	1.00E-06	10	30	75	365	70	4.52E-05	4.30E-01	1.95E-05

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	4240	1.42E-08	6.04E-05		8	10	30		365	30	5.52E-07	8.00E-04	0.001
Lead** (Refer Discussion in Report)	6720	1.42E-08	9.57E-05		8	10	30		365	30	8.74E-07	n/a	0.000
Ammonia	20	1.42E-08	2.85E-07		8	10	30		365	30	2.60E-09	8.00E-02	0.000
Benzene	13.7	1.42E-08	1.95E-07		8	10	30		365	30	1.78E-09	2.40E-02	0.000
Ethylbenzene	10.4	1.42E-08	1.48E-07		8	10	30		365	30	1.35E-09	1.30E+00	0.000
Toluene	1.5	1.42E-08	2.14E-08		8	10	30		365	30	1.95E-10	5.00E+00	0.000
Xylenes	24.2	1.42E-08	3.45E-07		8	10	30		365	30	3.15E-09	8.70E-01	0.000
Naphthalene	6600	1.42E-08	9.40E-05		8	10	30		365	30	8.59E-07	9.90E-04	0.001
Acenaphthylene	1170	1.42E-08	1.67E-05		8	10	30		365	30	1.52E-07	n/a	0.000
Acenaphthene	136	1.42E-08	1.94E-06		8	10	30		365	30	1.77E-08	n/a	0.000
Fluorene	1400	1.42E-08	1.99E-05		8	10	30		365	30	1.82E-07	n/a	0.000
Phenanthrene	5370	1.42E-08	7.65E-05		8	10	30		365	30	6.99E-07	n/a	0.000
Anthracene	1340	1.42E-08	1.91E-05		8	10	30		365	30	1.74E-07	n/a	0.000
Fluoranthene	3690	1.42E-08	5.26E-05		8	10	30		365	30	4.80E-07	n/a	0.000
Pyrene	3250	1.42E-08	4.63E-05		8	10	30		365	30	4.23E-07	n/a	0.000
Benzo(a)Pyrene equivalents	1444.8	1.42E-08	2.06E-05		8	10	30		365	30	1.88E-07	n/a	0.000
0	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	13.7	1.42E-08	1.95E-07		8	10	30		365	70	7.64E-10	6.00E-03	4.58E-12
Benzo(a)Pyrene equivalents	1444.8	1.42E-08	2.06E-05		8	10	30		365	70	8.06E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	4240	6300	0.5	1.00E-06	0.1	10	30	75	365	30	4.88E-04	3.00E-03	0.163
Lead** (Refer Discussion in Report)	6720	6300	0.5	1.00E-06	0.001	10	30	75	365	30	7.73E-06	n/a	0.000
Ammonia	20	6300	0.5	1.00E-06	0.005	10	30	75	365	30	1.15E-07	2.00E+00	0.000
Benzene	13.7	6300	0.5	1.00E-06	0.08	10	30	75	365	30	1.26E-06	4.00E-03	0.000
Ethylbenzene	10.4	6300	0.5	1.00E-06	0.2	10	30	75	365	30	2.39E-06	9.70E-02	0.000
Toluene	1.5	6300	0.5	1.00E-06	0.12	10	30	75	365	30	2.07E-07	2.20E-01	0.000
Xylenes	24.2	6300	0.5	1.00E-06	0.12	10	30	75	365	30	3.34E-06	1.80E-01	0.000
Naphthalene	6600	6300	0.5	1.00E-06	0.1	10	30	75	365	30	7.59E-04	1.60E-02	0.047
Acenaphthylene	1170	6300	0.5	1.00E-06	0.18	10	30	75	365	30	2.42E-04	n/a	0.000
Acenaphthene	136	6300	0.5	1.00E-06	0.2	10	30	75	365	30	3.13E-05	4.80E-02	0.001
Fluorene	1400	6300	0.5	1.00E-06	0.2	10	30	75	365	30	3.22E-04	3.20E-02	0.010
Phenanthrene	5370	6300	0.5	1.00E-06	0.18	10	30	75	365	30	1.11E-03	n/a	0.000
Anthracene	1340	6300	0.5	1.00E-06	0.29	10	30	75	365	30	4.47E-04	2.40E-01	0.002
Fluoranthene	3690	6300	0.5	1.00E-06	0.2	10	30	75	365	30	8.49E-04	3.20E-02	0.027
Pyrene	3250	6300	0.5	1.00E-06	0.2	10	30	75	365	30	7.48E-04	2.40E-02	0.031
Benzo(a)Pyrene equivalents	1444.8	6300	0.5	1.00E-06	0.026	10	30	75	365	30	4.32E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	10	30	75	365	30	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	10	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	13.7	6300	0.5	1.00E-06	0.08	10	30	75	365	70	5.40E-07	3.00E-02	1.62E-08
Benzo(a)Pyrene equivalents	1444.8	6300	0.5	1.00E-06	0.026	10	30	75	365	70	1.85E-05	4.30E-01	7.97E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **7 Utility / Maintenance Workers (Adult)**

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	4240	0.00E+00	8	10	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	6720	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	500	4.77E-05	8	10	30	365	30	2.18E-04	8.00E-02	0.003	1
Benzene	21.6	1.23E-03	8	10	30	365	30	2.43E-04	2.40E-02	0.010	1
Ethylbenzene	18.1	6.19E-04	8	10	30	365	30	1.02E-04	1.30E+00	0.000	1
Toluene	3.1	9.11E-04	8	10	30	365	30	2.58E-05	5.00E+00	0.000	1
Xylenes	24.2	4.74E-04	8	10	30	365	30	1.05E-04	8.70E-01	0.000	1
Naphthalene	6600	7.86E-06	8	10	30	365	30	4.74E-04	9.90E-04	0.479	1
Acenaphthylene	1170	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	161	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	1400	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	5370	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	1340	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	3690	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	3250	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	21.6	1.23E-03	8	10	30	365	70	1.04E-04	6.00E-03	6.26E-07	1
Benzo(a)Pyrene equivalents	1444.8	0.00E+00	8	10	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.32	0.00E+00	8	10	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Ammonia	660	3.27E-07	8	10	30	365	30	1.97E-06	8.00E-02	0.000
Benzene	0.072	1.11E-05	8	10	30	365	30	7.30E-09	2.40E-02	0.000
Ethylbenzene	0.004	1.15E-05	8	10	30	365	30	4.19E-10	1.30E+00	0.000
Toluene	0.007	1.17E-05	8	10	30	365	30	7.49E-10	5.00E+00	0.000
Xylenes	0.013	1.04E-05	8	10	30	365	30	1.23E-09	8.70E-01	0.000
Naphthalene	0.019	1.35E-06	8	10	30	365	30	2.34E-10	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0.072	1.11E-05	8	10	30	365	70	3.13E-09	6.00E-03	1.88E-11
Benzo(a)Pyrene equivalents	0	0.00E+00	8	10	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.103		0.001	0.163		0.000	0.000	**0.267**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.003	0.000	**0.003**	0.2	**No**
Benzene	0.000		0.000	0.000		0.010	0.000	**0.011**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.030		0.001	0.047		0.479	0.000	**0.557**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Fluorene	0.003		0.000	0.010		0.000	0.000	**0.013**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.002		0.000	0.000	**0.002**	0.2	**No**
Fluoranthene	0.008		0.000	0.027		0.000	0.000	**0.035**	0.2	**No**
Pyrene	0.010		0.000	0.031		0.000	0.000	**0.041**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.930**	1	**No**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	1.29E-08		4.58E-12	1.62E-08		6.26E-07	1.88E-11	**6.55E-07**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	1.95E-05		0.00E+00	7.97E-06		0.00E+00	0.00E+00	**2.74E-05**	5.00E-06	**YES**
							TOTAL	**2.81E-05**	1.00E-05	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.267		0.000	
0.000		0.000	
0.003		0.000	
0.011		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.557		0.000	
0.000		0.000	
0.001		0.000	
0.013		0.000	
0.000		0.000	
0.002		0.000	
0.035		0.000	
0.041		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
6.55E-07		1.88E-11	
2.74E-05		0.00E+00	

APPENDIX B

Exposure Model and Risk Estimation Southport Nursing Home

August 2014
Report No. 147613068-001-R-Rev1

Golder Associates

SUBJECT	EXPOSURE SCENARIO CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR CATEGORY		EXISTING & POTENTIAL FUTURE EXPOSURES			EXPOSURE TO MEDIA								ACCEPTABLE RISK TARGET		
					Soil				Groundwater			Other			
		OUTDOOR	INDOOR		Ingestion	Airborne Dusts	Direct Contact	Vapours	Ingestion	Direct Contact	Vapours	--	Carcinogen	Non-Carcinogen Individual	Non-Carcinogen Cumulative
Personnel Within Impacted Area															
1	Outdoor Gardening Personnel (Adult)	●	○		●	●	●	●	○	○	●		5.00E-06	0.2	1
2	Commercial/Staff Personnel (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
3	Residents at Southport Nursing Home (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
4															
5															
6															
7	Utility / Maintenance Workers (Adult)	●	○		●	●	●	●	○	○	●		5.00E-06	0.2	1
8															
9															
10															

NOTES

1	Gardening Personnel assumed direct exposure to soil 0.0 to 0.3 m depth
	Utilty / Maintenance Workers assumed direct exposure to soil 0.0 to 1.0 m depth
	All receptors assumed vapour exposure to soil 0.0 to 3.0 m depth

SUBJECT	CHEMICALS OF INTEREST CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

CHEMICAL CONCENTRATIONS

CHEMICALS	Concentration in Soil 0.0-0.3	0.3-1.0	1.0-3.0	Max 0.0-1.0	Max 0.0-3.0	Reference	Concentration in Groundwater	Reference
	mg/kg						mg/L	
Cyanide Total	676	540	7	676	676	--	0.219	--
Lead** (Refer Discussion in Report)	686	332	11	686	686	--	0	--
Ammonia	0	50	0	50	50	--	947	--
Benzene	0	0	0	0	0	--	6.35	--
Ethylbenzene	0	0	0	0	0	--	0.111	--
Toluene	0	0	0	0	0	--	0.318	--
Xylenes	0	0	0	0	0	--	2.29	--
Naphthalene	28.9	7	0	28.9	28.9	--	6.47	--
Acenaphthylene	44.1	18.6	0	44.1	44.1	--	0	--
Acenaphthene	9.6	3.4	0	9.6	9.6	--	0	--
Fluorene	75.4	13.9	0	75.4	75.4	--	0	--
Phenanthrene	388	124	2.4	388	388	--	0	--
Anthracene	102	29.2	0.8	102	102	--	0	--
Fluoranthene	303	158	3.3	303	303	--	0	--
Pyrene	263	148	2.9	263	263	--	0	--
Benzo(a)Pyrene equivalents	137.9	84.9	1.4	137.9	137.9	--	0	--
Styrene	0	0	0	0	0	--	0.193	--
1,2,4-trimethylbenzene	0	0	0	0	0	--	0.185	--

VOLATILISATION FACTORS - OUTDOOR AIR (FROM TRENCH MODEL)

CHEMICALS	Volatilisation Factor Soil	Groundwater
	(mg/m^3) / (mg/kg)	(mg/m^3) / (mg/L)
Cyanide Total	0.00E+00	0.00E+00
Lead** (Refer Discussion in Report)	0.00E+00	0.00E+00
Ammonia	4.77E-05	3.06E-07
Benzene	1.23E-03	1.08E-05
Ethylbenzene	6.19E-04	1.12E-05
Toluene	9.11E-04	1.14E-05
Xylenes	4.74E-04	1.01E-05
Naphthalene	7.86E-06	1.27E-06
Acenaphthylene	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	0.00E+00
Fluorene	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	0.00E+00
Anthracene	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	0.00E+00
Pyrene	0.00E+00	0.00E+00
Benzo(a)Pyrene equivalents	0.00E+00	0.00E+00
Styrene	0.00E+00	5.51E-06
1,2,4-trimethylbenzene	0.00E+00	2.55E-06

CHEMICAL PROPERTIES

CHEMICALS	Oral Bioavailability Factor	Reference	Dermal Absorption Factor	Reference	Dermal Permeability Coefficient	Reference
	BF		DAF		Kp	
Cyanide Total	1	US EPA (2004)	0.1	NEPC (2013)	0.001	US EPA (2004)
Lead** (Refer Discussion in Report)	0.5	NEPM (2013)	0.001	ATSDR (2007)	0.0001	US EPA (2004)
Ammonia	0.04	US EPA (2004)	0.005	UK EA (2009)	0.0002	US EPA (2004)
Benzene	1	US EPA (2004)	0.08	CCME (2008)	0.015	US EPA (RSL)
Ethylbenzene	1	US EPA (2004)	0.2	CCME (2008)	0.0493	US EPA (RSL)
Toluene	1	US EPA (2004)	0.12	CCME (2008)	0.0311	US EPA (RSL)
Xylenes	1	US EPA (2004)	0.12	CCME (2008)	0.05	US EPA (RSL)
Naphthalene	1	US EPA (2004)	0.1	CCME (2008)	0.0466	US EPA (RSL)
Acenaphthylene	1	US EPA (2004)	0.18	CCME (2008)	0.096	--
Acenaphthene	1	US EPA (2004)	0.2	CCME (2008)	0.086	US EPA (RSL)
Fluorene	1	US EPA (2004)	0.2	CCME (2008)	0.11	US EPA (RSL)
Phenanthrene	1	US EPA (2004)	0.18	CCME (2008)	0.27	--
Anthracene	1	US EPA (2004)	0.29	CCME (2008)	0.142	US EPA (RSL)
Fluoranthene	1	US EPA (2004)	0.2	CCME (2008)	0.308	US EPA (RSL)
Pyrene	1	US EPA (2004)	0.2	CCME (2008)	0.201	US EPA (RSL)
Benzo(a)Pyrene equivalents	1	US EPA (2004)	0.026	CCME (2008)	0.713	US EPA (RSL)
Styrene	1	US EPA (2004)	0.2	CCME (2008)	0.0372	US EPA (RSL)
1,2,4-trimethylbenzene	1	US EPA (2004)	0.2	Nominal Value	0.0857	US EPA (RSL)

VOLATILISATION FACTORS - INDOOR AIR (RESIDENTIAL BUILDING)

CHEMICALS	Volatilisation Factor Soil	Groundwater
	(mg/m^3) / (mg/kg)	(mg/m^3) / (mg/L)
Cyanide Total	0.00E+00	0.00E+00
Lead** (Refer Discussion in Report)	0.00E+00	0.00E+00
Ammonia	4.39E-02	2.33E-04
Benzene	3.47E+00	9.00E-03
Ethylbenzene	1.08E+00	9.37E-03
Toluene	1.77E+00	9.54E-03
Xylenes	7.25E-01	8.39E-03
Naphthalene	1.20E-02	1.04E-03
Acenaphthylene	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	0.00E+00
Fluorene	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	0.00E+00
Anthracene	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	0.00E+00
Pyrene	0.00E+00	0.00E+00
Benzo(a)Pyrene equivalents	0.00E+00	0.00E+00
Styrene	0.00E+00	4.57E-03
1,2,4-trimethylbenzene	0.00E+00	2.12E-03

DUST EMISSION FACTOR DERIVATION

Particulate Emission Factor = (Pe x W x 1000) / (Uair x ðair)

SCENARIO	Silt Content	Moisture Content	Emission Factor PM_{10}	NPI Default Emission Factor	Adopted Emission Factor	Nominal Workspace Area	PM_{10} Emission Rate	PM_{10} Emission Rate [Pe]	Width of Exposed Surface Area [W]	Average Wind Speed [Uair]	Breathing Zone Height [ðair]	Particulate Emission Factor
	%	%				m2	mg/m2/hr	g/cm2/s	m	m/s	m	(mg/m3) / (mg/kg)
Developed Site - Unpaved Areas												
Ambient Wind Erosion	30	10	NA	0.2 kg/ha/hr	0.2 kg/ha/hr	400	20	5.56E-10	20	3.90	2	1.42E-08

Asumptions

A media concentration of "0" indicates that chemical was not of concern (or less than laboratory limit of reporting) and the value (0) was adopted for calculation purposes - although site concentration may be in excess of "0".

Emission Factor PM10, (where applicable) derived from NPI Emission Estimation Technique Manual for Mining Version 3.1, Table 2.

Workspace adopted as a nominal 20 x 20 m area assuming the presence of up-paved garden, partially grassed or area where surface cover/grass has been worn or eroded.

Particulate Emission Factor derived from ASTM method.

Average wind speed adopted from Bureau of Meteorology 3pm annual average, Melbourne monitoring station.

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)

Saturated zone model (dissolved phase source)

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Depth to groundwater (from ground surface)	m	8.0E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Cyanide	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Styrene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Trimethylbenzene (1,2,4)	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

Lens Parameters		
Thickness of lens	m	2.0E+00
Total porosity in lens	cm3/cm3	3.8E-01
Water content in lens	cm3/cm3	5.4E-02

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+01
Wind speed	m/s	1.7E+00

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Air content	cm3/cm3	1.9E-01
Distance from groundwater to building	m	8.0E+00
Bioattenuation factor	-	1.0E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	5.0E+00
Air content	-	3.0E-02
Water content	-	3.6E-01

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.0E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	2.6E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	1.5E+01
Enclosed space height	m	2.4E+00
Volume of building	m3	3.6E+02
Number of air changes per hour	1/hr	6.0E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	5.0E-03

Dissolved Source for Groundwater Model [mg/l]		
Ammonia	mg/l	1.0E+00
Benzene	mg/l	1.0E+00
Cyanide	mg/l	1.0E+00
Ethylbenzene	mg/l	1.0E+00
Naphthalene	mg/l	1.0E+00
Styrene	mg/l	1.0E+00
Toluene	mg/l	1.0E+00
Trimethylbenzene (1,2,4)	mg/l	1.0E+00
Xylenes (total)	mg/l	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Cyanide	Ethylbenzene	Naphthalene	Styrene	Toluene	Trimethylbenzene (1,2,4)	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	ND	7.5E-02	5.9E-02	7.1E-02	8.7E-02	1.0E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	ND	7.8E-06	7.5E-06	8.0E-06	8.6E-06	1.0E-05	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.0E+06	1.7E+02	3.1E+01	3.1E+02	5.3E+02	5.7E+01	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	ND	3.6E+02	2.0E+03	7.8E+02	1.8E+02	6.1E+02	3.8E+02
Henry's Law coefficient	(m3-H2O)/(m3-air	6.6E-04	2.3E-01	0.0E+00	3.2E-01	2.0E-02	1.1E-01	2.7E-01	2.5E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	2.7E+01	1.1E+02	1.3E+02	1.0E+02	9.2E+01	1.0E+02	1.1E+02

Indoor air concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Styrene (mg/m3)	Toluene (mg/m3)	Trimethylbenzene (1,2,4) (mg/m3)	Xylenes (total) (mg/m3)
0	2.3E-04	9.0E-03	0.0E+00	9.4E-03	1.0E-03	4.6E-03	9.5E-03	2.1E-03	8.4E-03

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Styrene (mg/m3)	Toluene (mg/m3)	Trimethylbenzene (1,2,4) (mg/m3)	Xylenes (total) (mg/m3)
0	2.9E-07	1.1E-05	0.0E+00	1.1E-05	1.2E-06	5.4E-06	1.1E-05	2.5E-06	9.9E-06

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)

Saturated zone model (dissolved phase source)

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Depth to groundwater (from ground surface)	m	7.0E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Cyanide	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Styrene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Trimethylbenzene (1,2,4)	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

Lens Parameters		
Thickness of lens	m	1.0E+00
Total porosity in lens	cm3/cm3	3.8E-01
Water content in lens	cm3/cm3	5.4E-02

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+00
Wind speed	m/s	1.7E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	5.0E+00
Air content	-	3.0E-02
Water content	-	3.6E-01

Dissolved Source for Groundwater Model [mg/l]		
Ammonia	mg/l	1.0E+00
Benzene	mg/l	1.0E+00
Cyanide	mg/l	1.0E+00
Ethylbenzene	mg/l	1.0E+00
Naphthalene	mg/l	1.0E+00
Styrene	mg/l	1.0E+00
Toluene	mg/l	1.0E+00
Trimethylbenzene (1,2,4)	mg/l	1.0E+00
Xylenes (total)	mg/l	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Cyanide	Ethylbenzene	Naphthalene	Styrene	Toluene	Trimethylbenzene (1,2,4)	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	ND	7.5E-02	5.9E-02	7.1E-02	8.7E-02	1.0E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	ND	7.8E-06	7.5E-06	8.0E-06	8.6E-06	1.0E-05	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.0E+06	1.7E+02	3.1E+01	3.1E+02	5.3E+02	5.7E+01	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	ND	3.6E+02	2.0E+03	7.8E+02	1.8E+02	6.1E+02	3.8E+02
Henry's Law coefficient	(m3-H2O)/(m3-air	6.6E-04	2.3E-01	0.0E+00	3.2E-01	2.0E-02	1.1E-01	2.7E-01	2.5E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	2.7E+01	1.1E+02	1.3E+02	1.0E+02	9.2E+01	1.0E+02	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Styrene (mg/m3)	Toluene (mg/m3)	Trimethylbenzene (1,2,4) (mg/m3)	Xylenes (total) (mg/m3)
0	3.1E-07	1.1E-05	0.0E+00	1.1E-05	1.3E-06	5.5E-06	1.1E-05	2.6E-06	1.0E-05

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil (depleting source)
Depleting source
Onsite exposure models:

Soil to outdoor air model

Unsaturated Zone Soil Source		
Depth to top of contamination	m	5.0E-01
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.8E-01
Residual water content	cm3/cm3	5.3E-02
Fraction organic carbon	g oc/g soil	2.0E-03
Soil bulk density	g/cm3	1.7E+00
Infiltration rate	cm/yr	3.0E+01
Saturated conductivity	m/d	6.4E+00
Van Genuchten's n	-	2.7E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

*** Lens not used

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+00
Wind speed	m/s	1.7E+00

Source Concentration for Unsaturated Zone Model (mg/kg)		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.1	4.8E-05	1.2E-03	6.2E-04	7.9E-06	9.1E-04	4.7E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil (depleting source)
Depleting source
Onsite exposure models:

Soil to outdoor air model

Unsaturated Zone Soil Source		
Depth to top of contamination	m	5.0E-01
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.8E-01
Residual water content	cm3/cm3	5.3E-02
Fraction organic carbon	g oc/g soil	2.0E-03
Soil bulk density	g/cm3	1.7E+00
Infiltration rate	cm/yr	3.0E+01
Saturated conductivity	m/d	6.4E+00
Van Genuchten's n	-	2.7E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

*** Lens not used

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+01
Wind speed	m/s	1.7E+00

Source Concentration for Unsaturated Zone Model (mg/kg)		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.1	4.8E-05	1.2E-03	6.2E-04	7.9E-06	9.1E-04	4.7E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil beneath a building
Johnson and Ettinger Indoor air model
Volatilization from unsaturated soil source to indoor air (onsite)

Unsaturated Zone Soil Source		
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01
Soil bulk density	g/cm3	1.7E+00
Fraction organic carbon	g/g	2.0E-03

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.8E-01
Water content	cm3/cm3	5.4E-02
Air content	cm3/cm3	3.2E-01
Distance from source to building	m	5.0E-01
Bioattenuation factor	-	1.0E+00

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.0E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	2.6E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	1.5E+01
Enclosed space height	m	2.4E+00
Volume of building	m3	3.6E+02
Number of air changes per hour	1/hr	6.0E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	5.0E-03

Unsaturated Zone Soil Source for Vapor Model		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Indoor air concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	4.4E-02	3.5E+00	1.1E+00	1.2E-02	1.8E+00	7.2E-01

SUBJECT	TOXICITY REFERENCE VALUES (TRVs) CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME		
Job No.: 147613068	Made by JH/AB	Date AUGUST 2014	
Ref.	Checked by CMB	Sheet 1 of 1	

ORAL / DERMAL **Tolerable Daily Intake (TDI), Carcinogenic Slope Factors (CSF)**

CHEMICALS	Oral TDI	Reference	Estimated Background Exposure	Oral TDI - Background	Oral CSF	Reference
	mg/kg.d		(%)	mg/kg.d	$(mg/kg.d)^{-1}$	
Cyanide Total	0.006	NHMRC (2011)	50	0.003	n/a	n/a
Lead** (Refer Discussion in Report)	n/a	--	0	n/a	n/a	n/a
Ammonia	2	1% of WHO (2003)	0	2	n/a	n/a
Benzene	0.004	US EPA (2004)	0	0.004	0.03	WHO (2004)
Ethylbenzene	0.097	NHMRC (2004)	0	0.097	n/a	n/a
Toluene	0.22	NHMRC (2004)	0	0.22	n/a	n/a
Xylenes	0.18	NHMRC (2004)	0	0.18	n/a	n/a
Naphthalene	0.02	US EPA (2004)	20	0.016	n/a	n/a
Acenaphthylene	n/a	None Identified	0	n/a	n/a	n/a
Acenaphthene	0.06	US EPA (1994)	20	0.048	n/a	n/a
Fluorene	0.04	US EPA (1990)	20	0.032	n/a	n/a
Phenanthrene	n/a	None Identified	0	n/a	n/a	n/a
Anthracene	0.3	US EPA (1994)	20	0.24	n/a	n/a
Fluoranthene	0.04	US EPA (1990)	20	0.032	n/a	n/a
Pyrene	0.03	US EPA (1993)	20	0.024	n/a	n/a
Benzo(a)Pyrene equivalents	n/a	n/a	0	n/a	0.43	WHO (2003)
Styrene	0.0077	WHO (2003)	0	0.0077	n/a	n/a
1,2,4-trimethylbenzene	0.05	US EPA R6 (2006)	0	0.05	n/a	n/a

INHALATION **Inhalation Reference Concentrations (RfC), Inhalation Unit Risk (UR)**

CHEMICALS	Inhalation RfC	Reference	Estimated Background Exposure	Inhalation RfC - Background	Inhalation UR	Reference
	mg/m^3		(%)	mg/m^3	$(mg/m^3)^{-1}$	
Cyanide Total	0.0008	US EPA (2010)	0	0.0008	n/a	n/a
Lead** (Refer Discussion in Report)	n/a	n/a	0	n/a	n/a	n/a
Ammonia	0.1	US EPA (1991)	20	0.08	n/a	n/a
Benzene	0.03	US EPA (2010)	20	0.024	6.00E-03	WHO (2000)
Ethylbenzene	1.3	ATSDR (2007)	0	1.3	n/a	n/a
Toluene	5	US EPA (2010)	0	5	n/a	n/a
Xylenes	0.87	WHO (2000)	0	0.87	n/a	n/a
Naphthalene	0.003	US EPA (2010)	67	0.00099	n/a	n/a
Acenaphthylene	n/a	n/a	0	n/a	n/a	n/a
Acenaphthene	n/a	n/a	0	n/a	n/a	n/a
Fluorene	n/a	n/a	0	n/a	n/a	n/a
Phenanthrene	n/a	n/a	0	n/a	n/a	n/a
Anthracene	n/a	n/a	0	n/a	n/a	n/a
Fluoranthene	n/a	n/a	0	n/a	n/a	n/a
Pyrene	n/a	n/a	0	n/a	n/a	n/a
Benzo(a)Pyrene equivalents	n/a	n/a	0	n/a	n/a	n/a
Styrene	0.26	WHO (2000)	0	0.26	n/a	n/a
1,2,4-trimethylbenzene	0.007	US EPA (2007)	8	0.00644	n/a	n/a

ACUTE TOXICITY **Acute and Subcohronic Oral and Inhalation Toxicity Reference Values**

CHEMICALS	Oral Acute / Subchronic TRV	Reference	Inhalation Acute / Subchronic TRV	Reference
	mg/kg.d		mg/m^3	
Cyanide Total	n/a		n/a	
Lead** (Refer Discussion in Report)	n/a		n/a	
Ammonia	n/a		n/a	
Benzene	n/a		n/a	
Ethylbenzene	n/a		n/a	
Toluene	n/a		n/a	
Xylenes	n/a		n/a	
Naphthalene	n/a		n/a	
Acenaphthylene	n/a		n/a	
Acenaphthene	n/a		n/a	
Fluorene	n/a		n/a	
Phenanthrene	n/a		n/a	
Anthracene	n/a		n/a	
Fluoranthene	n/a		n/a	
Pyrene	n/a		n/a	
Benzo(a)Pyrene equivalents	n/a		n/a	
Styrene	n/a		n/a	
1,2,4-trimethylbenzene	n/a		n/a	

TARGET RISK LEVELS

Target Indivdual Hazard Quotient	0.2
Target Hazard Index	1
Target Individual ELCR	5.E-06
Target Total ELCR	1.E-05

NOTES

1	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **1 Outdoor Gardening Personnel (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
1 Outdoor Gardening Personnel (Adult)	8	52	30	30	262800	70	15-70	1.5	200	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
1 Outdoor Gardening Personnel (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	200	1	1.00E-06	52	30	75	365	30	2.57E-04	3.00E-03	0.086
Lead** (Refer Discussion in Report)	686	200	0.5	1.00E-06	52	30	75	365	30	1.30E-04	n/a	0.000
Ammonia	0	200	0.04	1.00E-06	52	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	200	1	1.00E-06	52	30	75	365	30	1.10E-05	1.60E-02	0.001
Acenaphthylene	44.1	200	1	1.00E-06	52	30	75	365	30	1.68E-05	n/a	0.000
Acenaphthene	9.6	200	1	1.00E-06	52	30	75	365	30	3.65E-06	4.80E-02	0.000
Fluorene	75.4	200	1	1.00E-06	52	30	75	365	30	2.86E-05	3.20E-02	0.001
Phenanthrene	388	200	1	1.00E-06	52	30	75	365	30	1.47E-04	n/a	0.000
Anthracene	102	200	1	1.00E-06	52	30	75	365	30	3.88E-05	2.40E-01	0.000
Fluoranthene	303	200	1	1.00E-06	52	30	75	365	30	1.15E-04	3.20E-02	0.004
Pyrene	263	200	1	1.00E-06	52	30	75	365	30	9.99E-05	2.40E-02	0.004
Benzo(a)Pyrene equivalents	137.9	200	1	1.00E-06	52	30	75	365	30	5.24E-05	n/a	0.000
Styrene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	200	1	1.00E-06	52	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	200	1	1.00E-06	52	30	75	365	70	2.25E-05	4.30E-01	9.65E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	676	1.42E-08	9.63E-06		8	52	30		365	30	4.57E-07	8.00E-04	0.001
Lead** (Refer Discussion in Report)	686	1.42E-08	9.77E-06		8	52	30		365	30	4.64E-07	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	28.9	1.42E-08	4.12E-07		8	52	30		365	30	1.96E-08	9.90E-04	0.000
Acenaphthylene	44.1	1.42E-08	6.28E-07		8	52	30		365	30	2.98E-08	n/a	0.000
Acenaphthene	9.6	1.42E-08	1.37E-07		8	52	30		365	30	6.49E-09	n/a	0.000
Fluorene	75.4	1.42E-08	1.07E-06		8	52	30		365	30	5.10E-08	n/a	0.000
Phenanthrene	388	1.42E-08	5.53E-06		8	52	30		365	30	2.62E-07	n/a	0.000
Anthracene	102	1.42E-08	1.45E-06		8	52	30		365	30	6.90E-08	n/a	0.000
Fluoranthene	303	1.42E-08	4.32E-06		8	52	30		365	30	2.05E-07	n/a	0.000
Pyrene	263	1.42E-08	3.75E-06		8	52	30		365	30	1.78E-07	n/a	0.000
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		8	52	30		365	30	9.33E-08	n/a	0.000
Styrene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	2.60E-01	0.000
1,2,4-trimethylbenzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	6.44E-03	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	52	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		8	52	30		365	70	4.00E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	6300	0.5	1.00E-06	0.1	52	30	75	365	30	4.04E-04	3.00E-03	0.135
Lead** (Refer Discussion in Report)	686	6300	0.5	1.00E-06	0.001	52	30	75	365	30	4.10E-06	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	52	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	52	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	52	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	52	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	6300	0.5	1.00E-06	0.1	52	30	75	365	30	1.73E-05	1.60E-02	0.001
Acenaphthylene	44.1	6300	0.5	1.00E-06	0.18	52	30	75	365	30	4.75E-05	n/a	0.000
Acenaphthene	9.6	6300	0.5	1.00E-06	0.2	52	30	75	365	30	1.15E-05	4.80E-02	0.000
Fluorene	75.4	6300	0.5	1.00E-06	0.2	52	30	75	365	30	9.02E-05	3.20E-02	0.003
Phenanthrene	388	6300	0.5	1.00E-06	0.18	52	30	75	365	30	4.18E-04	n/a	0.000
Anthracene	102	6300	0.5	1.00E-06	0.29	52	30	75	365	30	1.77E-04	2.40E-01	0.001
Fluoranthene	303	6300	0.5	1.00E-06	0.2	52	30	75	365	30	3.63E-04	3.20E-02	0.011
Pyrene	263	6300	0.5	1.00E-06	0.2	52	30	75	365	30	3.15E-04	2.40E-02	0.013
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	52	30	75	365	30	2.15E-05	n/a	0.000
Styrene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	52	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	52	30	75	365	70	9.19E-06	4.30E-01	3.95E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	676	0.00E+00	8	52	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	686	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	50	4.77E-05	8	52	30	365	30	1.13E-04	8.00E-02	0.001	1
Benzene	0	1.23E-03	8	52	30	365	30	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	8	52	30	365	30	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	8	52	30	365	30	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	8	52	30	365	30	0.00E+00	8.70E-01	0.000	1
Naphthalene	28.9	7.86E-06	8	52	30	365	30	1.08E-05	9.90E-04	0.011	1
Acenaphthylene	44.1	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	9.6	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	75.4	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	388	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	102	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	303	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	263	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Styrene	0	0.00E+00	8	52	30	365	30	0.00E+00	2.60E-01	0.000	1
1,2,4-trimethylbenzene	0	0.00E+00	8	52	30	365	30	0.00E+00	6.44E-03	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	8	52	30	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	8	52	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.219	0.00E+00	8	52	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Ammonia	947	3.06E-07	8	52	30	365	30	1.37E-05	8.00E-02	0.000
Benzene	6.35	1.08E-05	8	52	30	365	30	3.25E-06	2.40E-02	0.000
Ethylbenzene	0.111	1.12E-05	8	52	30	365	30	5.90E-08	1.30E+00	0.000
Toluene	0.318	1.14E-05	8	52	30	365	30	1.72E-07	5.00E+00	0.000
Xylenes	2.29	1.01E-05	8	52	30	365	30	1.09E-06	8.70E-01	0.000
Naphthalene	6.47	1.27E-06	8	52	30	365	30	3.90E-07	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Styrene	0.193	5.51E-06	8	52	30	365	30	5.05E-08	2.60E-01	0.000
1,2,4-trimethylbenzene	0.185	2.55E-06	8	52	30	365	30	2.24E-08	6.44E-03	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	6.35	1.08E-05	8	52	30	365	70	1.39E-06	6.00E-03	8.37E-09
Benzo(a)Pyrene equivalents	0	0.00E+00	8	52	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.086		0.001	0.135		0.000	0.000	**0.221**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.001	0.000	**0.002**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.001		0.000	0.001		0.011	0.000	**0.013**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.001		0.000	0.003		0.000	0.000	**0.004**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Fluoranthene	0.004		0.000	0.011		0.000	0.000	**0.015**	0.2	**No**
Pyrene	0.004		0.000	0.013		0.000	0.000	**0.017**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Styrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
1,2,4-trimethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.273**	1	**No**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	8.37E-09	**8.37E-09**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	9.65E-06		0.00E+00	3.95E-06		0.00E+00	0.00E+00	**1.36E-05**	5.00E-06	**YES**
							TOTAL	**1.36E-05**	1.00E-05	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.221		0.000	
0.000		0.000	
0.001		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.013		0.000	
0.000		0.000	
0.000		0.000	
0.004		0.000	
0.000		0.000	
0.001		0.000	
0.015		0.000	
0.017		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		8.37E-09	
1.36E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
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RECEPTOR: **2 Commercial/Staff Personnel (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
2 Commercial/Staff Personnel (Adult)	8	240	30	30	262800	70	15-70	1.2	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
2 Commercial/Staff Personnel (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	25	1	1.00E-06	240	30	75	365	30	1.48E-04	3.00E-03	0.049
Lead** (Refer Discussion in Report)	686	25	0.5	1.00E-06	240	30	75	365	30	7.52E-05	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	240	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	25	1	1.00E-06	240	30	75	365	30	6.33E-06	1.60E-02	0.000
Acenaphthylene	44.1	25	1	1.00E-06	240	30	75	365	30	9.67E-06	n/a	0.000
Acenaphthene	9.6	25	1	1.00E-06	240	30	75	365	30	2.10E-06	4.80E-02	0.000
Fluorene	75.4	25	1	1.00E-06	240	30	75	365	30	1.65E-05	3.20E-02	0.001
Phenanthrene	388	25	1	1.00E-06	240	30	75	365	30	8.50E-05	n/a	0.000
Anthracene	102	25	1	1.00E-06	240	30	75	365	30	2.24E-05	2.40E-01	0.000
Fluoranthene	303	25	1	1.00E-06	240	30	75	365	30	6.64E-05	3.20E-02	0.002
Pyrene	263	25	1	1.00E-06	240	30	75	365	30	5.76E-05	2.40E-02	0.002
Benzo(a)Pyrene equivalents	137.9	25	1	1.00E-06	240	30	75	365	30	3.02E-05	n/a	0.000
Styrene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	240	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	25	1	1.00E-06	240	30	75	365	70	1.30E-05	4.30E-01	5.57E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	676	1.42E-08	9.63E-06		8	240	30		365	30	2.11E-06	8.00E-04	0.003
Lead** (Refer Discussion in Report)	686	1.42E-08	9.77E-06		8	240	30		365	30	2.14E-06	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	28.9	1.42E-08	4.12E-07		8	240	30		365	30	9.02E-08	9.90E-04	0.000
Acenaphthylene	44.1	1.42E-08	6.28E-07		8	240	30		365	30	1.38E-07	n/a	0.000
Acenaphthene	9.6	1.42E-08	1.37E-07		8	240	30		365	30	3.00E-08	n/a	0.000
Fluorene	75.4	1.42E-08	1.07E-06		8	240	30		365	30	2.35E-07	n/a	0.000
Phenanthrene	388	1.42E-08	5.53E-06		8	240	30		365	30	1.21E-06	n/a	0.000
Anthracene	102	1.42E-08	1.45E-06		8	240	30		365	30	3.18E-07	n/a	0.000
Fluoranthene	303	1.42E-08	4.32E-06		8	240	30		365	30	9.46E-07	n/a	0.000
Pyrene	263	1.42E-08	3.75E-06		8	240	30		365	30	8.21E-07	n/a	0.000
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		8	240	30		365	30	4.31E-07	n/a	0.000
Styrene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	2.60E-01	0.000
1,2,4-trimethylbenzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	6.44E-03	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	240	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		8	240	30		365	70	1.85E-07	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	6300	0.5	1.00E-06	0.1	240	30	75	365	30	1.87E-03	3.00E-03	0.622
Lead** (Refer Discussion in Report)	686	6300	0.5	1.00E-06	0.001	240	30	75	365	30	1.89E-05	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	240	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	240	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	240	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	240	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	6300	0.5	1.00E-06	0.1	240	30	75	365	30	7.98E-05	1.60E-02	0.005
Acenaphthylene	44.1	6300	0.5	1.00E-06	0.18	240	30	75	365	30	2.19E-04	n/a	0.000
Acenaphthene	9.6	6300	0.5	1.00E-06	0.2	240	30	75	365	30	5.30E-05	4.80E-02	0.001
Fluorene	75.4	6300	0.5	1.00E-06	0.2	240	30	75	365	30	4.16E-04	3.20E-02	0.013
Phenanthrene	388	6300	0.5	1.00E-06	0.18	240	30	75	365	30	1.93E-03	n/a	0.000
Anthracene	102	6300	0.5	1.00E-06	0.29	240	30	75	365	30	8.17E-04	2.40E-01	0.003
Fluoranthene	303	6300	0.5	1.00E-06	0.2	240	30	75	365	30	1.67E-03	3.20E-02	0.052
Pyrene	263	6300	0.5	1.00E-06	0.2	240	30	75	365	30	1.45E-03	2.40E-02	0.061
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	240	30	75	365	30	9.90E-05	n/a	0.000
Styrene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	240	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	240	30	75	365	70	4.24E-05	4.30E-01	1.82E-05

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
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VAPOUR INHALATION - SOIL (INDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	676	0.00E+00	8	240	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	686	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	50	4.39E-02	8	240	30	365	30	4.81E-01	8.00E-02	6.015	1
Benzene	0	3.47E+00	8	240	30	365	30	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	1.08E+00	8	240	30	365	30	0.00E+00	1.30E+00	0.000	1
Toluene	0	1.77E+00	8	240	30	365	30	0.00E+00	5.00E+00	0.000	1
Xylenes	0	7.25E-01	8	240	30	365	30	0.00E+00	8.70E-01	0.000	1
Naphthalene	28.9	1.20E-02	8	240	30	365	30	7.57E-02	9.90E-04	76.477	1
Acenaphthylene	44.1	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	9.6	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	75.4	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	388	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	102	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	303	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	263	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Styrene	0	0.00E+00	8	240	30	365	30	0.00E+00	2.60E-01	0.000	1
1,2,4-trimethylbenzene	0	0.00E+00	8	240	30	365	30	0.00E+00	6.44E-03	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	3.47E+00	8	240	30	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	8	240	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (INDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.219	0.00E+00	8	240	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Ammonia	947	2.33E-04	8	240	30	365	30	4.83E-02	8.00E-02	0.604
Benzene	6.35	9.00E-03	8	240	30	365	30	1.25E-02	2.40E-02	0.522
Ethylbenzene	0.111	9.37E-03	8	240	30	365	30	2.28E-04	1.30E+00	0.000
Toluene	0.318	9.54E-03	8	240	30	365	30	6.65E-04	5.00E+00	0.000
Xylenes	2.29	8.39E-03	8	240	30	365	30	4.21E-03	8.70E-01	0.005
Naphthalene	6.47	1.04E-03	8	240	30	365	30	1.48E-03	9.90E-04	1.496
Acenaphthylene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Styrene	0.193	4.57E-03	8	240	30	365	30	1.94E-04	2.60E-01	0.001
1,2,4-trimethylbenzene	0.185	2.12E-03	8	240	30	365	30	8.61E-05	6.44E-03	0.013

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	6.35	9.00E-03	8	240	30	365	70	5.37E-03	6.00E-03	3.22E-05
Benzo(a)Pyrene equivalents	0	0.00E+00	8	240	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.049		0.003	0.622		0.000	0.000	**0.674**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		6.015	0.604	**6.618**	0.2	**YES**
Benzene	0.000		0.000	0.000		0.000	0.522	**0.522**	0.2	**YES**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.005	**0.005**	0.2	**No**
Naphthalene	0.000		0.000	0.005		76.477	1.496	**77.979**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Fluorene	0.001		0.000	0.013		0.000	0.000	**0.014**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.003		0.000	0.000	**0.003**	0.2	**No**
Fluoranthene	0.002		0.000	0.052		0.000	0.000	**0.054**	0.2	**No**
Pyrene	0.002		0.000	0.061		0.000	0.000	**0.063**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Styrene	0.000		0.000	0.000		0.000	0.001	**0.001**	0.2	**No**
1,2,4-trimethylbenzene	0.000		0.000	0.000		0.000	0.013	**0.013**	0.2	**No**
							TOTAL	**85.948**	1	**YES**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	3.22E-05	**3.22E-05**	5.00E-06	**YES**
Benzo(a)Pyrene equivalents	5.57E-06		0.00E+00	1.82E-05		0.00E+00	0.00E+00	**2.38E-05**	5.00E-06	**YES**
							TOTAL	**5.60E-05**	1.00E-05	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.674		0.000	
0.000		0.000	
6.015		0.604	
0.000		0.522	
0.000		0.000	
0.000		0.000	
0.000		0.005	
76.483		1.496	
0.000		0.000	
0.001		0.000	
0.014		0.000	
0.000		0.000	
0.003		0.000	
0.054		0.000	
0.063		0.000	
0.000		0.000	
0.000		0.001	
0.000		0.013	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		3.22E-05	
2.38E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **3 Residents at Southport Nursing Home (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
3 Residents at Southport Nursing Home (Adult)	24	365	20	20	175200	70	50-70+	0.83	50	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
3 Residents at Southport Nursing Home (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	50	1	1.00E-06	365	20	75	365	20	4.51E-04	3.00E-03	0.150
Lead** (Refer Discussion in Report)	686	50	0.5	1.00E-06	365	20	75	365	20	2.29E-04	n/a	0.000
Ammonia	0	50	0.04	1.00E-06	365	20	75	365	20	0.00E+00	2.00E+00	0.000
Benzene	0	50	1	1.00E-06	365	20	75	365	20	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	50	1	1.00E-06	365	20	75	365	20	0.00E+00	9.70E-02	0.000
Toluene	0	50	1	1.00E-06	365	20	75	365	20	0.00E+00	2.20E-01	0.000
Xylenes	0	50	1	1.00E-06	365	20	75	365	20	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	50	1	1.00E-06	365	20	75	365	20	1.93E-05	1.60E-02	0.001
Acenaphthylene	44.1	50	1	1.00E-06	365	20	75	365	20	2.94E-05	n/a	0.000
Acenaphthene	9.6	50	1	1.00E-06	365	20	75	365	20	6.40E-06	4.80E-02	0.000
Fluorene	75.4	50	1	1.00E-06	365	20	75	365	20	5.03E-05	3.20E-02	0.002
Phenanthrene	388	50	1	1.00E-06	365	20	75	365	20	2.59E-04	n/a	0.000
Anthracene	102	50	1	1.00E-06	365	20	75	365	20	6.80E-05	2.40E-01	0.000
Fluoranthene	303	50	1	1.00E-06	365	20	75	365	20	2.02E-04	3.20E-02	0.006
Pyrene	263	50	1	1.00E-06	365	20	75	365	20	1.75E-04	2.40E-02	0.007
Benzo(a)Pyrene equivalents	137.9	50	1	1.00E-06	365	20	75	365	20	9.19E-05	n/a	0.000
Styrene	0	50	1	1.00E-06	365	20	75	365	20	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	50	1	1.00E-06	365	20	75	365	20	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	50	1	1.00E-06	365	20	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	50	1	1.00E-06	365	20	75	365	70	2.63E-05	4.30E-01	1.13E-05

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	676	1.42E-08	9.63E-06		24	365	20		365	20	9.63E-06	8.00E-04	0.012
Lead** (Refer Discussion in Report)	686	1.42E-08	9.77E-06		24	365	20		365	20	9.77E-06	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	8.70E-01	0.000
Naphthalene	28.9	1.42E-08	4.12E-07		24	365	20		365	20	4.12E-07	9.90E-04	0.000
Acenaphthylene	44.1	1.42E-08	6.28E-07		24	365	20		365	20	6.28E-07	n/a	0.000
Acenaphthene	9.6	1.42E-08	1.37E-07		24	365	20		365	20	1.37E-07	n/a	0.000
Fluorene	75.4	1.42E-08	1.07E-06		24	365	20		365	20	1.07E-06	n/a	0.000
Phenanthrene	388	1.42E-08	5.53E-06		24	365	20		365	20	5.53E-06	n/a	0.000
Anthracene	102	1.42E-08	1.45E-06		24	365	20		365	20	1.45E-06	n/a	0.000
Fluoranthene	303	1.42E-08	4.32E-06		24	365	20		365	20	4.32E-06	n/a	0.000
Pyrene	263	1.42E-08	3.75E-06		24	365	20		365	20	3.75E-06	n/a	0.000
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		24	365	20		365	20	1.96E-06	n/a	0.000
Styrene	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	2.60E-01	0.000
1,2,4-trimethylbenzene	0	1.42E-08	0.00E+00		24	365	20		365	20	0.00E+00	6.44E-03	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		24	365	20		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		24	365	20		365	70	5.61E-07	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	6300	0.5	1.00E-06	0.1	365	20	75	365	20	2.84E-03	3.00E-03	0.946
Lead** (Refer Discussion in Report)	686	6300	0.5	1.00E-06	0.001	365	20	75	365	20	2.88E-05	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	365	20	75	365	20	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	365	20	75	365	20	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	365	20	75	365	20	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	365	20	75	365	20	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	365	20	75	365	20	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	6300	0.5	1.00E-06	0.1	365	20	75	365	20	1.21E-04	1.60E-02	0.008
Acenaphthylene	44.1	6300	0.5	1.00E-06	0.18	365	20	75	365	20	3.33E-04	n/a	0.000
Acenaphthene	9.6	6300	0.5	1.00E-06	0.2	365	20	75	365	20	8.06E-05	4.80E-02	0.002
Fluorene	75.4	6300	0.5	1.00E-06	0.2	365	20	75	365	20	6.33E-04	3.20E-02	0.020
Phenanthrene	388	6300	0.5	1.00E-06	0.18	365	20	75	365	20	2.93E-03	n/a	0.000
Anthracene	102	6300	0.5	1.00E-06	0.29	365	20	75	365	20	1.24E-03	2.40E-01	0.005
Fluoranthene	303	6300	0.5	1.00E-06	0.2	365	20	75	365	20	2.55E-03	3.20E-02	0.080
Pyrene	263	6300	0.5	1.00E-06	0.2	365	20	75	365	20	2.21E-03	2.40E-02	0.092
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	365	20	75	365	20	1.51E-04	n/a	0.000
Styrene	0	6300	0.5	1.00E-06	0.2	365	20	75	365	20	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	6300	0.5	1.00E-06	0.2	365	20	75	365	20	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	365	20	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	365	20	75	365	70	4.30E-05	4.30E-01	1.85E-05

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME			
Job No.:	147613068	Made by JH/AB	Date	AUGUST 2014
Ref.		Checked by CMB	Sheet 1	of 1

VAPOUR INHALATION - SOIL (INDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	676	0.00E+00	24	365	20	365	20	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	686	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Ammonia	50	4.39E-02	24	365	20	365	20	2.20E+00	8.00E-02	27.443	1
Benzene	0	3.47E+00	24	365	20	365	20	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	1.08E+00	24	365	20	365	20	0.00E+00	1.30E+00	0.000	1
Toluene	0	1.77E+00	24	365	20	365	20	0.00E+00	5.00E+00	0.000	1
Xylenes	0	7.25E-01	24	365	20	365	20	0.00E+00	8.70E-01	0.000	1
Naphthalene	28.9	1.20E-02	24	365	20	365	20	3.45E-01	9.90E-04	348.928	1
Acenaphthylene	44.1	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Acenaphthene	9.6	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Fluorene	75.4	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Phenanthrene	388	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Anthracene	102	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Fluoranthene	303	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Pyrene	263	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000	1
Styrene	0	0.00E+00	24	365	20	365	20	0.00E+00	2.60E-01	0.000	1
1,2,4-trimethylbenzene	0	0.00E+00	24	365	20	365	20	0.00E+00	6.44E-03	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	3.47E+00	24	365	20	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	24	365	20	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (INDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.219	0.00E+00	24	365	20	365	20	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Ammonia	947	2.33E-04	24	365	20	365	20	2.20E-01	8.00E-02	2.754
Benzene	6.35	9.00E-03	24	365	20	365	20	5.71E-02	2.40E-02	2.380
Ethylbenzene	0.111	9.37E-03	24	365	20	365	20	1.04E-03	1.30E+00	0.001
Toluene	0.318	9.54E-03	24	365	20	365	20	3.03E-03	5.00E+00	0.001
Xylenes	2.29	8.39E-03	24	365	20	365	20	1.92E-02	8.70E-01	0.022
Naphthalene	6.47	1.04E-03	24	365	20	365	20	6.76E-03	9.90E-04	6.825
Acenaphthylene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	24	365	20	365	20	0.00E+00	n/a	0.000
Styrene	0.193	4.57E-03	24	365	20	365	20	8.83E-04	2.60E-01	0.003
1,2,4-trimethylbenzene	0.185	2.12E-03	24	365	20	365	20	3.93E-04	6.44E-03	0.061

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	6.35	9.00E-03	24	365	20	365	70	1.63E-02	6.00E-03	9.79E-05
Benzo(a)Pyrene equivalents	0	0.00E+00	24	365	20	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.150		0.012	0.946		0.000	0.000	**1.109**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		27.443	2.754	**30.197**	0.2	**YES**
Benzene	0.000		0.000	0.000		0.000	2.380	**2.380**	0.2	**YES**
Ethylbenzene	0.000		0.000	0.000		0.000	0.001	**0.001**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.001	**0.001**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.022	**0.022**	0.2	**No**
Naphthalene	0.001		0.000	0.008		348.928	6.825	**355.762**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.002		0.000	0.000	**0.002**	0.2	**No**
Fluorene	0.002		0.000	0.020		0.000	0.000	**0.021**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.005		0.000	0.000	**0.005**	0.2	**No**
Fluoranthene	0.006		0.000	0.080		0.000	0.000	**0.086**	0.2	**No**
Pyrene	0.007		0.000	0.092		0.000	0.000	**0.099**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Styrene	0.000		0.000	0.000		0.000	0.003	**0.003**	0.2	**No**
1,2,4-trimethylbenzene	0.000		0.000	0.000		0.000	0.061	**0.061**	0.2	**No**
							TOTAL	**389.749**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
1.109		0.000	
0.000		0.000	
27.443		2.754	
0.000		2.380	
0.000		0.001	
0.000		0.001	
0.000		0.022	
348.937		6.825	
0.000		0.000	
0.002		0.000	
0.021		0.000	
0.000		0.000	
0.086		0.000	
0.099		0.000	
0.000		0.000	
0.000		0.003	
0.000		0.061	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	9.79E-05	**9.79E-05**	5.00E-06	**YES**
Benzo(a)Pyrene equivalents	1.13E-05		0.00E+00	1.85E-05		0.00E+00	0.00E+00	**2.98E-05**	5.00E-06	**YES**
							TOTAL	**1.28E-04**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		9.79E-05	
2.98E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME				
Job No.:	147613068	Made by	JH/AB	Date	AUGUST 2014
Ref.		Checked by	CMB	Sheet	1 of 1

RECEPTOR: **7 Utility / Maintenance Workers (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
7 Utility / Maintenance Workers (Adult)	8	10	30	30	262800	70	15-70	2.1	200	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
7 Utility / Maintenance Workers (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	200	1	1.00E-06	10	30	75	365	30	4.94E-05	3.00E-03	0.016
Lead** (Refer Discussion in Report)	686	200	0.5	1.00E-06	10	30	75	365	30	2.51E-05	n/a	0.000
Ammonia	50	200	0.04	1.00E-06	10	30	75	365	30	1.46E-07	2.00E+00	0.000
Benzene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	200	1	1.00E-06	10	30	75	365	30	2.11E-06	1.60E-02	0.000
Acenaphthylene	44.1	200	1	1.00E-06	10	30	75	365	30	3.22E-06	n/a	0.000
Acenaphthene	9.6	200	1	1.00E-06	10	30	75	365	30	7.01E-07	4.80E-02	0.000
Fluorene	75.4	200	1	1.00E-06	10	30	75	365	30	5.51E-06	3.20E-02	0.000
Phenanthrene	388	200	1	1.00E-06	10	30	75	365	30	2.83E-05	n/a	0.000
Anthracene	102	200	1	1.00E-06	10	30	75	365	30	7.45E-06	2.40E-01	0.000
Fluoranthene	303	200	1	1.00E-06	10	30	75	365	30	2.21E-05	3.20E-02	0.001
Pyrene	263	200	1	1.00E-06	10	30	75	365	30	1.92E-05	2.40E-02	0.001
Benzo(a)Pyrene equivalents	137.9	200	1	1.00E-06	10	30	75	365	30	1.01E-05	n/a	0.000
Styrene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	200	1	1.00E-06	10	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	200	1	1.00E-06	10	30	75	365	70	4.32E-06	4.30E-01	1.86E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	676	1.42E-08	9.63E-06		8	10	30		365	30	8.79E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	686	1.42E-08	9.77E-06		8	10	30		365	30	8.92E-08	n/a	0.000
Ammonia	50	1.42E-08	7.12E-07		8	10	30		365	30	6.50E-09	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	28.9	1.42E-08	4.12E-07		8	10	30		365	30	3.76E-09	9.90E-04	0.000
Acenaphthylene	44.1	1.42E-08	6.28E-07		8	10	30		365	30	5.74E-09	n/a	0.000
Acenaphthene	9.6	1.42E-08	1.37E-07		8	10	30		365	30	1.25E-09	n/a	0.000
Fluorene	75.4	1.42E-08	1.07E-06		8	10	30		365	30	9.81E-09	n/a	0.000
Phenanthrene	388	1.42E-08	5.53E-06		8	10	30		365	30	5.05E-08	n/a	0.000
Anthracene	102	1.42E-08	1.45E-06		8	10	30		365	30	1.33E-08	n/a	0.000
Fluoranthene	303	1.42E-08	4.32E-06		8	10	30		365	30	3.94E-08	n/a	0.000
Pyrene	263	1.42E-08	3.75E-06		8	10	30		365	30	3.42E-08	n/a	0.000
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		8	10	30		365	30	1.79E-08	n/a	0.000
Styrene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	2.60E-01	0.000
1,2,4-trimethylbenzene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	6.44E-03	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	10	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene equivalents	137.9	1.42E-08	1.96E-06		8	10	30		365	70	7.69E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	676	6300	0.5	1.00E-06	0.1	10	30	75	365	30	7.78E-05	3.00E-03	0.026
Lead** (Refer Discussion in Report)	686	6300	0.5	1.00E-06	0.001	10	30	75	365	30	7.89E-07	n/a	0.000
Ammonia	50	6300	0.5	1.00E-06	0.005	10	30	75	365	30	2.88E-07	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	10	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	10	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	10	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	28.9	6300	0.5	1.00E-06	0.1	10	30	75	365	30	3.33E-06	1.60E-02	0.000
Acenaphthylene	44.1	6300	0.5	1.00E-06	0.18	10	30	75	365	30	9.13E-06	n/a	0.000
Acenaphthene	9.6	6300	0.5	1.00E-06	0.2	10	30	75	365	30	2.21E-06	4.80E-02	0.000
Fluorene	75.4	6300	0.5	1.00E-06	0.2	10	30	75	365	30	1.74E-05	3.20E-02	0.001
Phenanthrene	388	6300	0.5	1.00E-06	0.18	10	30	75	365	30	8.04E-05	n/a	0.000
Anthracene	102	6300	0.5	1.00E-06	0.29	10	30	75	365	30	3.40E-05	2.40E-01	0.000
Fluoranthene	303	6300	0.5	1.00E-06	0.2	10	30	75	365	30	6.97E-05	3.20E-02	0.002
Pyrene	263	6300	0.5	1.00E-06	0.2	10	30	75	365	30	6.05E-05	2.40E-02	0.003
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	10	30	75	365	30	4.13E-06	n/a	0.000
Styrene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	7.70E-03	0.000
1,2,4-trimethylbenzene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	5.00E-02	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	10	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene equivalents	137.9	6300	0.5	1.00E-06	0.026	10	30	75	365	70	1.77E-06	4.30E-01	7.60E-07

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - SOUTHPORT NURSING HOME		
Job No.: 147613068	Made by JH/AB	Date	AUGUST 2014
Ref.	Checked by CMB	Sheet 1	of 1

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	676	0.00E+00	8	10	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	686	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	50	4.77E-05	8	10	30	365	30	2.18E-05	8.00E-02	0.000	1
Benzene	0	1.23E-03	8	10	30	365	30	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	8	10	30	365	30	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	8	10	30	365	30	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	8	10	30	365	30	0.00E+00	8.70E-01	0.000	1
Naphthalene	28.9	7.86E-06	8	10	30	365	30	2.08E-06	9.90E-04	0.002	1
Acenaphthylene	44.1	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	9.6	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	75.4	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	388	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	102	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	303	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	263	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Styrene	0	0.00E+00	8	10	30	365	30	0.00E+00	2.60E-01	0.000	1
1,2,4-trimethylbenzene	0	0.00E+00	8	10	30	365	30	0.00E+00	6.44E-03	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	8	10	30	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene equivalents	137.9	0.00E+00	8	10	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0.219	0.00E+00	8	10	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Ammonia	947	3.06E-07	8	10	30	365	30	2.64E-06	8.00E-02	0.000
Benzene	6.35	1.08E-05	8	10	30	365	30	6.26E-07	2.40E-02	0.000
Ethylbenzene	0.111	1.12E-05	8	10	30	365	30	1.13E-08	1.30E+00	0.000
Toluene	0.318	1.14E-05	8	10	30	365	30	3.32E-08	5.00E+00	0.000
Xylenes	2.29	1.01E-05	8	10	30	365	30	2.11E-07	8.70E-01	0.000
Naphthalene	6.47	1.27E-06	8	10	30	365	30	7.50E-08	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene equivalents	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Styrene	0.193	5.51E-06	8	10	30	365	30	9.71E-09	2.60E-01	0.000
1,2,4-trimethylbenzene	0.185	2.55E-06	8	10	30	365	30	4.32E-09	6.44E-03	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	6.35	1.08E-05	8	10	30	365	70	2.68E-07	6.00E-03	1.61E-09
Benzo(a)Pyrene equivalents	0	0.00E+00	8	10	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.016		0.000	0.026		0.000	0.000	**0.043**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.000		0.000	0.000		0.002	0.000	**0.003**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.001		0.000	0.000	**0.001**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.001		0.000	0.002		0.000	0.000	**0.003**	0.2	**No**
Pyrene	0.001		0.000	0.003		0.000	0.000	**0.003**	0.2	**No**
Benzo(a)Pyrene equivalents	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Styrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
1,2,4-trimethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.052**	1	**No**

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	1.61E-09	**1.61E-09**	5.00E-06	**No**
Benzo(a)Pyrene equivalents	1.86E-06		0.00E+00	7.60E-07		0.00E+00	0.00E+00	**2.62E-06**	5.00E-06	**No**
							TOTAL	**2.62E-06**	1.00E-05	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.043		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.002		0.000	
0.000		0.000	
0.000		0.000	
0.001		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.003		0.000	
0.003		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		1.61E-09	
2.62E-06		0.00E+00	

APPENDIX C

Exposure Model and Risk Estimation
Gasworks Arts Park – Averaged Soil Concentrations

August 2014
Report No. 147613068-001-R-Rev1

SUBJECT	EXPOSURE SCENARIO CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR CATEGORY		EXISTING & POTENTIAL FUTURE EXPOSURES			EXPOSURE TO MEDIA								ACCEPTABLE RISK TARGET		
					Soil				Groundwater			Other			
		OUTDOOR	INDOOR		Ingestion	Airborne Dusts	Direct Contact	Vapours	Ingestion	Direct Contact	Vapours	--	Carcinogen	Non-Carcinogen Individual	Non-Carcinogen Cumulative
Personnel Within Impacted Area															
1	Outdoor Gardening Personnel (Adult)	●	○		●	●	●	●	○	○	●		5.00E-06	0.2	1
2	Commercial/Staff Personnel (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
3	Public Users of Building Facilities (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
4	Recreational Park Users (Adult)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
5	Recreational Park Users (Child)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
6	Recreational Park Users (Infant)	●	●		●	●	●	●	○	○	●		5.00E-06	0.2	1
7	Utility / Maintenance Workers (Adult)	●	○		●	●	●	●	○	○	●		5.00E-06	0.2	1
8															
9															
10															

NOTES

1	Gardening Personnel assumed direct exposure to soil 0.0 to 0.3 m depth
	Utilty / Maintenance Workers assumed direct exposure to soil 0.0 to 1.0 m depth
	All receptors assumed vapour exposure to soil 0.0 to 3.0 m depth

SUBJECT	CHEMICALS OF INTEREST CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

CHEMICAL CONCENTRATIONS

CHEMICALS	Concentration in Soil 0.0-0.3	0.3-1.0	1.0-3.0	Max 0.0-1.0	Max 0.0-3.0	Reference	Concentration in Groundwater	Reference
	mg/kg						mg/L	
Cyanide Total	529	0	0	529	529	Est. Mean, EES (2014)	0	--
Lead** (Refer Discussion in Report)	0	0	0	0	0	--	0	--
Ammonia	0	0	0	0	0	--	0	--
Benzene	0	0	0	0	0	--	0	--
Ethylbenzene	0	0	0	0	0	--	0	--
Toluene	0	0	0	0	0	--	0	--
Xylenes	0	0	0	0	0	--	0	--
Naphthalene	29.6	0	0	29.6	29.6	Est. Mean, EES (2014)	0	--
Acenaphthylene	0	0	0	0	0	--	0	--
Acenaphthene	0	0	0	0	0	--	0	--
Fluorene	0	0	0	0	0	--	0	--
Phenanthrene	0	0	0	0	0	--	0	--
Anthracene	0	0	0	0	0	--	0	--
Fluoranthene	0	0	0	0	0	--	0	--
Pyrene	0	0	0	0	0	--	0	--
Benzo(a)Pyrene (NOT equivalents)	111.1	0	0	111.1	111.1	Est. Mean, EES (2014)	0	--
	0	0	0	0	0	--	0	--
	0	0	0	0	0	--	0	--

VOLATILISATION FACTORS - OUTDOOR AIR (FROM TRENCH MODEL)

CHEMICALS	Volatilisation Factor Soil	Groundwater
	(mg/m^3) / (mg/kg)	(mg/m^3) / (mg/L)
Cyanide Total	0.00E+00	0.00E+00
Lead** (Refer Discussion in Report)	0.00E+00	0.00E+00
Ammonia	4.77E-05	3.27E-07
Benzene	1.23E-03	1.11E-05
Ethylbenzene	6.19E-04	1.15E-05
Toluene	9.11E-04	1.17E-05
Xylenes	4.74E-04	1.04E-05
Naphthalene	7.86E-06	1.35E-06
Acenaphthylene	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	0.00E+00
Fluorene	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	0.00E+00
Anthracene	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	0.00E+00
Pyrene	0.00E+00	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00

CHEMICAL PROPERTIES

CHEMICALS	Oral Bioavailability Factor	Reference	Dermal Absorption Factor	Reference	Dermal Permeability Coefficient	Reference
	BF		DAF		Kp	
Cyanide Total	1	US EPA (2004)	0.1	NEPC (2013)	0.001	US EPA (2004)
Lead** (Refer Discussion in Report)	0.5	NEPM (2013)	0.001	ATSDR (2007)	0.0001	US EPA (2004)
Ammonia	0.04	US EPA (2004)	0.005	UK EA (2009)	0.0002	US EPA (2004)
Benzene	1	US EPA (2004)	0.08	CCME (2008)	0.015	US EPA (RSL)
Ethylbenzene	1	US EPA (2004)	0.2	CCME (2008)	0.0493	US EPA (RSL)
Toluene	1	US EPA (2004)	0.12	CCME (2008)	0.0311	US EPA (RSL)
Xylenes	1	US EPA (2004)	0.12	CCME (2008)	0.05	US EPA (RSL)
Naphthalene	1	US EPA (2004)	0.1	CCME (2008)	0.0466	US EPA (RSL)
Acenaphthylene	1	US EPA (2004)	0.18	CCME (2008)	0.096	--
Acenaphthene	1	US EPA (2004)	0.2	CCME (2008)	0.086	US EPA (RSL)
Fluorene	1	US EPA (2004)	0.2	CCME (2008)	0.11	US EPA (RSL)
Phenanthrene	1	US EPA (2004)	0.18	CCME (2008)	0.27	--
Anthracene	1	US EPA (2004)	0.29	CCME (2008)	0.142	US EPA (RSL)
Fluoranthene	1	US EPA (2004)	0.2	CCME (2008)	0.308	US EPA (RSL)
Pyrene	1	US EPA (2004)	0.2	CCME (2008)	0.201	US EPA (RSL)
Benzo(a)Pyrene (NOT equivalents)	1	US EPA (2004)	0.026	CCME (2008)	0.713	US EPA (RSL)
0	0		0		0	
0	0		0		0	

VOLATILISATION FACTORS - INDOOR AIR (COMMERCIAL BUILDING)

CHEMICALS	Volatilisation Factor Soil	Groundwater
	(mg/m^3) / (mg/kg)	(mg/m^3) / (mg/L)
Cyanide Total	0.00E+00	0.00E+00
Lead** (Refer Discussion in Report)	0.00E+00	0.00E+00
Ammonia	3.85E-02	1.47E-04
Benzene	2.67E+00	5.37E-03
Ethylbenzene	8.11E-01	5.57E-03
Toluene	1.36E+00	5.68E-03
Xylenes	5.54E-01	5.01E-03
Naphthalene	8.70E-03	6.42E-04
Acenaphthylene	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	0.00E+00
Fluorene	0.00E+00	0.00E+00
Phenanthrene	0.00E+00	0.00E+00
Anthracene	0.00E+00	0.00E+00
Fluoranthene	0.00E+00	0.00E+00
Pyrene	0.00E+00	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00
0	0.00E+00	0.00E+00

DUST EMISSION FACTOR DERIVATION

Particulate Emission Factor = (Pe x W x 1000) / (Uair x δair)

SCENARIO	Silt Content	Moisture Content	Emission Factor PM_{10}	NPI Default Emission Factor	Adopted Emission Factor	Nominal Workspace Area	PM_{10} Emission Rate	PM_{10} Emission Rate [Pe]	Width of Exposed Surface Area [W]	Average Wind Speed [Uair]	Breathing Zone Height [δair]	Particulate Emission Factor
	%	%				m2	mg/m2/hr	g/cm2/s	m	m/s	m	(mg/m3) / (mg/kg)
Developed Site - Unpaved Areas												
Ambient Wind Erosion	30	10	NA	0.2 kg/ha/hr	0.2 kg/ha/hr	400	20	5.56E-10	20	3.90	2	1.42E-08

Asumptions

A media concentration of "0" indicates that chemical was not of concern (or less than laboratory limit of reporting) and the value (0) was adopted for calculation purposes - although site concentration may be in excess of "0".

Emission Factor PM10, (where applicable) derived from NPI Emission Estimation Technique Manual for Mining Version 3.1, Table 2.

Workspace adopted as a nominal 20 x 20 m area assuming the presence of up-paved garden, partially grassed or area where surface cover/grass has been worn or eroded.

Particulate Emission Factor derived from ASTM method.

Average wind speed adopted from Bureau of Meteorology 3pm annual average, Melbourne monitoring station.

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Depth to groundwater (from ground surface)	m	7.6E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Cyanide	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

Lens Parameters		
Thickness of lens	m	2.0E+00
Total porosity in lens	cm3/cm3	3.8E-01
Water content in lens	cm3/cm3	5.4E-02

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+01
Wind speed	m/s	1.7E+00

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Air content	cm3/cm3	1.9E-01
Distance from groundwater to building	m	7.6E+00
Bioattenuation factor	-	1.0E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	5.0E+00
Air content	-	3.0E-02
Water content	-	3.6E-01

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.5E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	2.6E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	1.0E+01
Enclosed space height	m	3.0E+00
Volume of building	m3	3.0E+02
Number of air changes per hour	1/hr	8.3E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	5.0E-03

Dissolved Source for Groundwater Model [mg/l]		
Ammonia	mg/l	1.0E+00
Benzene	mg/l	1.0E+00
Cyanide	mg/l	1.0E+00
Ethylbenzene	mg/l	1.0E+00
Naphthalene	mg/l	1.0E+00
Toluene	mg/l	1.0E+00
Xylenes (total)	mg/l	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Cyanide	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	ND	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	ND	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.0E+06	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	ND	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	(m3-H2O)/(m3-air	6.6E-04	2.3E-01	0.0E+00	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	2.7E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Indoor air concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	1.5E-04	5.4E-03	0.0E+00	5.6E-03	6.4E-04	5.7E-03	5.0E-03

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	3.1E-07	1.1E-05	0.0E+00	1.1E-05	1.3E-06	1.2E-05	1.0E-05

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Groundwater (dissolved phase concentration)
Saturated zone model (dissolved phase source)

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.9E-01
Water content	cm3/cm3	2.0E-01
Depth to groundwater (from ground surface)	m	6.6E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Cyanide	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

Lens Parameters		
Thickness of lens	m	1.0E+00
Total porosity in lens	cm3/cm3	3.8E-01
Water content in lens	cm3/cm3	5.4E-02

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+00
Wind speed	m/s	1.7E+00

Capillary Fringe		
Thickness of the capillary fringe	cm	5.0E+00
Air content	-	3.0E-02
Water content	-	3.6E-01

Dissolved Source for Groundwater Model [mg/l]		
Ammonia	mg/l	1.0E+00
Benzene	mg/l	1.0E+00
Cyanide	mg/l	1.0E+00
Ethylbenzene	mg/l	1.0E+00
Naphthalene	mg/l	1.0E+00
Toluene	mg/l	1.0E+00
Xylenes (total)	mg/l	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Cyanide	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	ND	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	ND	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.0E+06	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	ND	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	(m3-H2O)/(m3-air	6.6E-04	2.3E-01	0.0E+00	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	2.7E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Cyanide (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	3.3E-07	1.1E-05	0.0E+00	1.1E-05	1.3E-06	1.2E-05	1.0E-05

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil (depleting source)
Depleting source
Onsite exposure models:

Soil to outdoor air model

Unsaturated Zone Soil Source		
Depth to top of contamination	m	5.0E-01
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.8E-01
Residual water content	cm3/cm3	5.3E-02
Fraction organic carbon	g oc/g soil	2.0E-03
Soil bulk density	g/cm3	1.7E+00
Infiltration rate	cm/yr	3.0E+01
Saturated conductivity	m/d	6.4E+00
Van Genuchten's n	-	2.7E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

*** Lens not used

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+00
Wind speed	m/s	1.7E+00

Source Concentration for Unsaturated Zone Model (mg/kg)		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.1	4.8E-05	1.2E-03	6.2E-04	7.9E-06	9.1E-04	4.7E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil (depleting source)
Depleting source
Onsite exposure models:

Soil to outdoor air model

Unsaturated Zone Soil Source		
Depth to top of contamination	m	5.0E-01
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01

Unsaturated Zone Properties		
Total Porosity in vadose zone	cm3/cm3	3.8E-01
Residual water content	cm3/cm3	5.3E-02
Fraction organic carbon	g oc/g soil	2.0E-03
Soil bulk density	g/cm3	1.7E+00
Infiltration rate	cm/yr	3.0E+01
Saturated conductivity	m/d	6.4E+00
Van Genuchten's n	-	2.7E+00

Chemical Degradation Rate in Unsaturated Zone		
Ammonia	1/d	0.0E+00
Benzene	1/d	0.0E+00
Ethylbenzene	1/d	0.0E+00
Naphthalene	1/d	0.0E+00
Toluene	1/d	0.0E+00
Xylenes (total)	1/d	0.0E+00

*** Lens not used

Outdoor Box Model Parameters		
Height of box (breathing zone)	m	2.0E+00
Length of box	m	1.0E+01
Width of box	m	1.0E+01
Wind speed	m/s	1.7E+00

Source Concentration for Unsaturated Zone Model (mg/kg)		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Outdoor air -- volatile concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
0.1	4.8E-05	1.2E-03	6.2E-04	7.9E-06	9.1E-04	4.7E-04

Summary of Input Values Used in Fate and Transport Model

Model Description:

Source media: Unsaturated zone soil beneath a building
Johnson and Ettinger Indoor air model
Volatilization from unsaturated soil source to indoor air (onsite)

Unsaturated Zone Soil Source		
Thickness of contamination	m	1.0E+00
Length of source	m	1.0E+01
Width of source	m	1.0E+01
Soil bulk density	g/cm3	1.7E+00
Fraction organic carbon	g/g	2.0E-03

*** Lens not used

Unsaturated Zone Properties Beneath Building		
Total porosity	cm3/cm3	3.8E-01
Water content	cm3/cm3	5.4E-02
Air content	cm3/cm3	3.2E-01
Distance from source to building	m	5.0E-01
Bioattenuation factor	-	1.0E+00

Building Parameters		
Diffusion and convection considered		
Foundation thickness	cm	1.5E+01
Fraction of cracks	-	1.0E-03
Porosity in cracks	cm3/cm3	2.6E-01
Water content in cracks	cm3/cm3	1.2E-01
Enclosed space floor length	m	1.0E+01
Enclosed space floor width	m	1.0E+01
Enclosed space height	m	3.0E+00
Volume of building	m3	3.0E+02
Number of air changes per hour	1/hr	8.3E-01
Qsoil to Qb ratio (soil gas flux/building flux)	-	5.0E-03

Unsaturated Zone Soil Source for Vapor Model		
Ammonia	mg/kg	1.0E+00
Benzene	mg/kg	1.0E+00
Ethylbenzene	mg/kg	1.0E+00
Naphthalene	mg/kg	1.0E+00
Toluene	mg/kg	1.0E+00
Xylenes (total)	mg/kg	1.0E+00

Chemical Properties	Units	Ammonia	Benzene	Ethylbenzene	Naphthalene	Toluene	Xylenes (total)
Diffusion coefficient in air	cm2/s	2.6E-01	8.8E-02	7.5E-02	5.9E-02	8.7E-02	8.5E-02
Diffusion coefficient in water	cm2/s	6.9E-05	9.8E-06	7.8E-06	7.5E-06	8.6E-06	9.9E-06
Solubility	mg/l	3.3E+05	1.8E+03	1.7E+02	3.1E+01	5.3E+02	1.1E+02
Kd (total soil partition coefficient)	L/kg	ND	ND	ND	ND	ND	ND
KOC (organiChem carbon partition coefficient	L/kg	1.4E+01	5.9E+01	3.6E+02	2.0E+03	1.8E+02	3.8E+02
Henry's Law coefficient	m3-H2O)/(m3-air	6.6E-04	2.3E-01	3.2E-01	2.0E-02	2.7E-01	2.1E-01
Molecular weight	g/mol	1.7E+01	7.8E+01	1.1E+02	1.3E+02	9.2E+01	1.1E+02

Indoor air concentration (mg/m3)

Time (year)	Ammonia (mg/m3)	Benzene (mg/m3)	Ethylbenzene (mg/m3)	Naphthalene (mg/m3)	Toluene (mg/m3)	Xylenes (total) (mg/m3)
0	3.8E-02	2.7E+00	8.1E-01	8.7E-03	1.4E+00	5.5E-01

SUBJECT	TOXICITY REFERENCE VALUES (TRVs) CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.: 147613068	Made by JH/AB	Date AUGUST 2014	
Ref.	Checked by CMB	Sheet 1 of 1	

ORAL / DERMAL **Tolerable Daily Intake (TDI), Carcinogenic Slope Factors (CSF)**

CHEMICALS	Oral TDI	Reference	Estimated Background Exposure (%)	Oral TDI - Background	Oral CSF	Reference
	mg/kg.d			mg/kg.d	$(mg/kg.d)^{-1}$	
Cyanide Total	0.006	NHMRC (2011)	50	0.003	n/a	n/a
Lead** (Refer Discussion in Report)	n/a	n/a	0	n/a	n/a	n/a
Ammonia	2	1% of WHO (2003)	0	2	n/a	n/a
Benzene	0.004	US EPA (2004)	0	0.004	0.03	WHO (2004)
Ethylbenzene	0.097	NHMRC (2004)	0	0.097	n/a	n/a
Toluene	0.22	NHMRC (2004)	0	0.22	n/a	n/a
Xylenes	0.18	NHMRC (2004)	0	0.18	n/a	n/a
Naphthalene	0.02	US EPA (2004)	20	0.016	n/a	n/a
Acenaphthylene	n/a	None Identified	0	n/a	n/a	n/a
Acenaphthene	0.06	US EPA (1994)	20	0.048	n/a	n/a
Fluorene	0.04	US EPA (1990)	20	0.032	n/a	n/a
Phenanthrene	n/a	None Identified	0	n/a	n/a	n/a
Anthracene	0.3	US EPA (1994)	20	0.24	n/a	n/a
Fluoranthene	0.04	US EPA (1990)	20	0.032	n/a	n/a
Pyrene	0.03	US EPA (1993)	20	0.024	n/a	n/a
Benzo(a)Pyrene (NOT equivalents)	n/a	n/a	0	n/a	0.43	WHO (2003)
0	n/a	n/a	0	n/a	n/a	n/a
0	n/a	n/a	0	n/a	n/a	n/a

INHALATION **Inhalation Reference Concentrations (RfC), Inhalation Unit Risk (UR)**

CHEMICALS	Inhalation RfC	Reference	Estimated Background Exposure (%)	Inhalation RfC - Background	Inhalation UR	Reference
	mg/m^3			mg/m^3	$(mg/m^3)^{-1}$	
Cyanide Total	0.0008	US EPA (2010)	0	0.0008	n/a	n/a
Lead** (Refer Discussion in Report)	n/a	n/a	0	n/a	n/a	n/a
Ammonia	0.1	US EPA (1991)	20	0.08	n/a	n/a
Benzene	0.03	US EPA (2010)	20	0.024	6.00E-03	WHO (2000)
Ethylbenzene	1.3	ATSDR (2007)	0	1.3	n/a	n/a
Toluene	5	US EPA (2010)	0	5	n/a	n/a
Xylenes	0.87	WHO (2000)	0	0.87	n/a	n/a
Naphthalene	0.003	US EPA (2010)	67	0.00099	n/a	n/a
Acenaphthylene	n/a	n/a	0	n/a	n/a	n/a
Acenaphthene	n/a	n/a	0	n/a	n/a	n/a
Fluorene	n/a	n/a	0	n/a	n/a	n/a
Phenanthrene	n/a	n/a	0	n/a	n/a	n/a
Anthracene	n/a	n/a	0	n/a	n/a	n/a
Fluoranthene	n/a	n/a	0	n/a	n/a	n/a
Pyrene	n/a	n/a	0	n/a	n/a	n/a
Benzo(a)Pyrene (NOT equivalents)	n/a	n/a	0	n/a	n/a	n/a
0	n/a	n/a	0	n/a	n/a	n/a
0	n/a	n/a	0	n/a	n/a	n/a

ACUTE TOXICITY **Acute and Subcohronic Oral and Inhalation Toxicity Reference Values**

CHEMICALS	Oral Acute / Subchronic TRV	Reference	Inhalation Acute / Subchronic TRV	Reference
	mg/kg.d		mg/m^3	
Cyanide Total	n/a		n/a	
Lead** (Refer Discussion in Report)	n/a		n/a	
Ammonia	n/a		n/a	
Benzene	n/a		n/a	
Ethylbenzene	n/a		n/a	
Toluene	n/a		n/a	
Xylenes	n/a		n/a	
Naphthalene	n/a		n/a	
Acenaphthylene	n/a		n/a	
Acenaphthene	n/a		n/a	
Fluorene	n/a		n/a	
Phenanthrene	n/a		n/a	
Anthracene	n/a		n/a	
Fluoranthene	n/a		n/a	
Pyrene	n/a		n/a	
Benzo(a)Pyrene (NOT equivalents)	n/a		n/a	
0	n/a		n/a	
0	n/a		n/a	

TARGET RISK LEVELS

Target Indivdual Hazard Quotient	0.2
Target Hazard Index	1
Target Individual ELCR	5.E-06
Target Total ELCR	1.E-05

NOTES

1	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **1 Outdoor Gardening Personnel (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
1 Outdoor Gardening Personnel (Adult)	8	52	30	30	262800	70	15-70	1.5	200	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
1 Outdoor Gardening Personnel (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	200	1	1.00E-06	52	30	75	365	30	2.01E-04	3.00E-03	0.067
Lead** (Refer Discussion in Report)	0	200	0.5	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000
Ammonia	0	200	0.04	1.00E-06	52	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	200	1	1.00E-06	52	30	75	365	30	1.12E-05	1.60E-02	0.001
Acenaphthylene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	4.80E-02	0.000
Fluorene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	3.20E-02	0.000
Phenanthrene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000
Anthracene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	2.40E-01	0.000
Fluoranthene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	3.20E-02	0.000
Pyrene	0	200	1	1.00E-06	52	30	75	365	30	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	200	1	1.00E-06	52	30	75	365	30	4.22E-05	n/a	0.000
0	0	200	0	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000
0	0	200	0	1.00E-06	52	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	200	1	1.00E-06	52	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	200	1	1.00E-06	52	30	75	365	70	1.81E-05	4.30E-01	7.78E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		8	52	30		365	30	3.58E-07	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		8	52	30		365	30	2.00E-08	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	52	30		365	30	7.52E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	52	30		365	30	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	52	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	52	30		365	70	3.22E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	6300	0.5	1.00E-06	0.1	52	30	75	365	30	3.17E-04	3.00E-03	0.106
Lead** (Refer Discussion in Report)	0	6300	0.5	1.00E-06	0.001	52	30	75	365	30	0.00E+00	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	52	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	52	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	52	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	52	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	6300	0.5	1.00E-06	0.1	52	30	75	365	30	1.77E-05	1.60E-02	0.001
Acenaphthylene	0	6300	0.5	1.00E-06	0.18	52	30	75	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	4.80E-02	0.000
Fluorene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	3.20E-02	0.000
Phenanthrene	0	6300	0.5	1.00E-06	0.18	52	30	75	365	30	0.00E+00	n/a	0.000
Anthracene	0	6300	0.5	1.00E-06	0.29	52	30	75	365	30	0.00E+00	2.40E-01	0.000
Fluoranthene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	3.20E-02	0.000
Pyrene	0	6300	0.5	1.00E-06	0.2	52	30	75	365	30	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	52	30	75	365	30	1.73E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	52	30	75	365	30	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	52	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	52	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	52	30	75	365	70	7.41E-06	4.30E-01	3.19E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.			
Job No.:	147613068	Made by JH/AB	Date	AUGUST 2014
Ref.		Checked by CMB	Sheet	1 of 1

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	8	52	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	0	4.77E-05	8	52	30	365	30	0.00E+00	8.00E-02	0.000	1
Benzene	0	1.23E-03	8	52	30	365	30	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	8	52	30	365	30	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	8	52	30	365	30	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	8	52	30	365	30	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	7.86E-06	8	52	30	365	30	1.11E-05	9.90E-04	0.011	1
Acenaphthylene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	8	52	30	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	52	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	8	52	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Ammonia	0	3.27E-07	8	52	30	365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.11E-05	8	52	30	365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.15E-05	8	52	30	365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.17E-05	8	52	30	365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.04E-05	8	52	30	365	30	0.00E+00	8.70E-01	0.000
Naphthalene	0	1.35E-06	8	52	30	365	30	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	52	30	365	30	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.11E-05	8	52	30	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	52	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.067		0.000	0.106		0.000	0.000	**0.173**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.001		0.000	0.001		0.011	0.000	**0.013**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.186**	1	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.173		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.013		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	7.78E-06		0.00E+00	3.19E-06		0.00E+00	0.00E+00	**1.10E-05**	5.00E-06	**YES**
							TOTAL	**1.10E-05**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
1.10E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **2 Commercial/Staff Personnel (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
2 Commercial/Staff Personnel (Adult)	8	240	30	30	262800	70	15-70	1.2	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
2 Commercial/Staff Personnel (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	25	1	1.00E-06	240	30	75	365	30	1.16E-04	3.00E-03	0.039
Lead** (Refer Discussion in Report)	0	25	0.5	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	240	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	25	1	1.00E-06	240	30	75	365	30	6.49E-06	1.60E-02	0.000
Acenaphthylene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	4.80E-02	0.000
Fluorene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	3.20E-02	0.000
Phenanthrene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000
Anthracene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	2.40E-01	0.000
Fluoranthene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	3.20E-02	0.000
Pyrene	0	25	1	1.00E-06	240	30	75	365	30	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	25	1	1.00E-06	240	30	75	365	30	2.44E-05	n/a	0.000
0	0	25	0	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000
0	0	25	0	1.00E-06	240	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	240	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	25	1	1.00E-06	240	30	75	365	70	1.04E-05	4.30E-01	4.49E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		8	240	30		365	30	1.65E-06	8.00E-04	0.002
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		8	240	30		365	30	9.24E-08	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	240	30		365	30	3.47E-07	n/a	0.000
0	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	240	30		365	30	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	240	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	240	30		365	70	1.49E-07	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	6300	0.5	1.00E-06	0.1	240	30	75	365	30	1.46E-03	3.00E-03	0.487
Lead** (Refer Discussion in Report)	0	6300	0.5	1.00E-06	0.001	240	30	75	365	30	0.00E+00	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	240	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	240	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	240	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	240	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	6300	0.5	1.00E-06	0.1	240	30	75	365	30	8.17E-05	1.60E-02	0.005
Acenaphthylene	0	6300	0.5	1.00E-06	0.18	240	30	75	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	4.80E-02	0.000
Fluorene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	3.20E-02	0.000
Phenanthrene	0	6300	0.5	1.00E-06	0.18	240	30	75	365	30	0.00E+00	n/a	0.000
Anthracene	0	6300	0.5	1.00E-06	0.29	240	30	75	365	30	0.00E+00	2.40E-01	0.000
Fluoranthene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	3.20E-02	0.000
Pyrene	0	6300	0.5	1.00E-06	0.2	240	30	75	365	30	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	240	30	75	365	30	7.98E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	240	30	75	365	30	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	240	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	240	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	240	30	75	365	70	3.42E-05	4.30E-01	1.47E-05

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.: 147613068	Made by JH/AB	Date	AUGUST 2014
Ref.	Checked by CMB	Sheet 1	of 1

VAPOUR INHALATION - SOIL (INDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	8	240	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	0	3.85E-02	8	240	30	365	30	0.00E+00	8.00E-02	0.000	1
Benzene	0	2.67E+00	8	240	30	365	30	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	8.11E-01	8	240	30	365	30	0.00E+00	1.30E+00	0.000	1
Toluene	0	1.36E+00	8	240	30	365	30	0.00E+00	5.00E+00	0.000	1
Xylenes	0	5.54E-01	8	240	30	365	30	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	8.70E-03	8	240	30	365	30	5.64E-02	9.90E-04	57.013	1
Acenaphthylene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	2.67E+00	8	240	30	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	240	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (INDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	8	240	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Ammonia	0	1.47E-04	8	240	30	365	30	0.00E+00	8.00E-02	0.000
Benzene	0	5.37E-03	8	240	30	365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	5.57E-03	8	240	30	365	30	0.00E+00	1.30E+00	0.000
Toluene	0	5.68E-03	8	240	30	365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	5.01E-03	8	240	30	365	30	0.00E+00	8.70E-01	0.000
Naphthalene	0	6.42E-04	8	240	30	365	30	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	240	30	365	30	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	5.37E-03	8	240	30	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	240	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.039		0.002	0.487		0.000	0.000	**0.528**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.000		0.000	0.005		57.013	0.000	**57.018**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**57.546**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.528		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
57.018		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	4.49E-06		0.00E+00	1.47E-05		0.00E+00	0.00E+00	**1.92E-05**	5.00E-06	**YES**
							TOTAL	**1.92E-05**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
1.92E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **3 Public Users of Building Facilities (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
3 Public Users of Building Facilities (Adult)	8	48	10	10	87600	70	15-70	1.2	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
3 Public Users of Building Facilities (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	25	1	1.00E-06	48	10	75	365	10	2.32E-05	3.00E-03	0.008
Lead** (Refer Discussion in Report)	0	25	0.5	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	48	10	75	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	25	1	1.00E-06	48	10	75	365	10	1.30E-06	1.60E-02	0.000
Acenaphthylene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	4.80E-02	0.000
Fluorene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	3.20E-02	0.000
Phenanthrene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000
Anthracene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	2.40E-01	0.000
Fluoranthene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	3.20E-02	0.000
Pyrene	0	25	1	1.00E-06	48	10	75	365	10	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	25	1	1.00E-06	48	10	75	365	10	4.87E-06	n/a	0.000
0	0	25	0	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000
0	0	25	0	1.00E-06	48	10	75	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	48	10	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	25	1	1.00E-06	48	10	75	365	70	6.96E-07	4.30E-01	2.99E-07

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		8	48	10		365	10	3.30E-07	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		8	48	10		365	10	1.85E-08	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	48	10		365	10	6.94E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	48	10		365	10	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	48	10		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	48	10		365	70	9.91E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	6300	0.5	1.00E-06	0.1	48	10	75	365	10	2.92E-04	3.00E-03	0.097
Lead** (Refer Discussion in Report)	0	6300	0.5	1.00E-06	0.001	48	10	75	365	10	0.00E+00	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	48	10	75	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	48	10	75	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	48	10	75	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	48	10	75	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	48	10	75	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	6300	0.5	1.00E-06	0.1	48	10	75	365	10	1.63E-05	1.60E-02	0.001
Acenaphthylene	0	6300	0.5	1.00E-06	0.18	48	10	75	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	6300	0.5	1.00E-06	0.2	48	10	75	365	10	0.00E+00	4.80E-02	0.000
Fluorene	0	6300	0.5	1.00E-06	0.2	48	10	75	365	10	0.00E+00	3.20E-02	0.000
Phenanthrene	0	6300	0.5	1.00E-06	0.18	48	10	75	365	10	0.00E+00	n/a	0.000
Anthracene	0	6300	0.5	1.00E-06	0.29	48	10	75	365	10	0.00E+00	2.40E-01	0.000
Fluoranthene	0	6300	0.5	1.00E-06	0.2	48	10	75	365	10	0.00E+00	3.20E-02	0.000
Pyrene	0	6300	0.5	1.00E-06	0.2	48	10	75	365	10	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	48	10	75	365	10	1.60E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	48	10	75	365	10	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	48	10	75	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	48	10	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	48	10	75	365	70	2.28E-06	4.30E-01	9.80E-07

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.			
Job No.:	147613068	Made by JH/AB	Date	AUGUST 2014
Ref.		Checked by CMB	Sheet 1	of 1

VAPOUR INHALATION - SOIL (INDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	8	48	10	365	10	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Ammonia	0	3.85E-02	8	48	10	365	10	0.00E+00	8.00E-02	0.000	1
Benzene	0	2.67E+00	8	48	10	365	10	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	8.11E-01	8	48	10	365	10	0.00E+00	1.30E+00	0.000	1
Toluene	0	1.36E+00	8	48	10	365	10	0.00E+00	5.00E+00	0.000	1
Xylenes	0	5.54E-01	8	48	10	365	10	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	8.70E-03	8	48	10	365	10	1.13E-02	9.90E-04	11.403	1
Acenaphthylene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	2.67E+00	8	48	10	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	48	10	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (INDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	8	48	10	365	10	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Ammonia	0	1.47E-04	8	48	10	365	10	0.00E+00	8.00E-02	0.000
Benzene	0	5.37E-03	8	48	10	365	10	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	5.57E-03	8	48	10	365	10	0.00E+00	1.30E+00	0.000
Toluene	0	5.68E-03	8	48	10	365	10	0.00E+00	5.00E+00	0.000
Xylenes	0	5.01E-03	8	48	10	365	10	0.00E+00	8.70E-01	0.000
Naphthalene	0	6.42E-04	8	48	10	365	10	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	8	48	10	365	10	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	5.37E-03	8	48	10	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	48	10	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.008		0.000	0.097		0.000	0.000	**0.106**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.000		0.000	0.001		11.403	0.000	**11.404**	0.2	**YES**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**11.509**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.106		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
11.404		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	2.99E-07		0.00E+00	9.80E-07		0.00E+00	0.00E+00	**1.28E-06**	5.00E-06	**No**
							TOTAL	**1.28E-06**	1.00E-05	**No**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
1.28E-06		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **4 Recreational Park Users (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
4 Recreational Park Users (Adult)	2	260	29	29	254040	70	15-70	1.33	25	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
4 Recreational Park Users (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	25	1	1.00E-06	260	29	75	365	29	1.26E-04	3.00E-03	0.042
Lead** (Refer Discussion in Report)	0	25	0.5	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000
Ammonia	0	25	0.04	1.00E-06	260	29	75	365	29	0.00E+00	2.00E+00	0.000
Benzene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	9.70E-02	0.000
Toluene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	2.20E-01	0.000
Xylenes	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	25	1	1.00E-06	260	29	75	365	29	7.03E-06	1.60E-02	0.000
Acenaphthylene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000
Acenaphthene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	4.80E-02	0.000
Fluorene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	3.20E-02	0.000
Phenanthrene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000
Anthracene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	2.40E-01	0.000
Fluoranthene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	3.20E-02	0.000
Pyrene	0	25	1	1.00E-06	260	29	75	365	29	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	25	1	1.00E-06	260	29	75	365	29	2.64E-05	n/a	0.000
0	0	25	0	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000
0	0	25	0	1.00E-06	260	29	75	365	29	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	25	1	1.00E-06	260	29	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	25	1	1.00E-06	260	29	75	365	70	1.09E-05	4.30E-01	4.70E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		2	260	29		365	29	4.47E-07	8.00E-04	0.001
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		2	260	29		365	29	2.50E-08	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		2	260	29		365	29	9.39E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	29		365	29	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		2	260	29		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		2	260	29		365	70	3.89E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	6300	0.5	1.00E-06	0.1	260	29	75	365	29	1.58E-03	3.00E-03	0.528
Lead** (Refer Discussion in Report)	0	6300	0.5	1.00E-06	0.001	260	29	75	365	29	0.00E+00	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	260	29	75	365	29	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	260	29	75	365	29	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	260	29	75	365	29	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	260	29	75	365	29	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	260	29	75	365	29	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	6300	0.5	1.00E-06	0.1	260	29	75	365	29	8.86E-05	1.60E-02	0.006
Acenaphthylene	0	6300	0.5	1.00E-06	0.18	260	29	75	365	29	0.00E+00	n/a	0.000
Acenaphthene	0	6300	0.5	1.00E-06	0.2	260	29	75	365	29	0.00E+00	4.80E-02	0.000
Fluorene	0	6300	0.5	1.00E-06	0.2	260	29	75	365	29	0.00E+00	3.20E-02	0.000
Phenanthrene	0	6300	0.5	1.00E-06	0.18	260	29	75	365	29	0.00E+00	n/a	0.000
Anthracene	0	6300	0.5	1.00E-06	0.29	260	29	75	365	29	0.00E+00	2.40E-01	0.000
Fluoranthene	0	6300	0.5	1.00E-06	0.2	260	29	75	365	29	0.00E+00	3.20E-02	0.000
Pyrene	0	6300	0.5	1.00E-06	0.2	260	29	75	365	29	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	260	29	75	365	29	8.64E-05	n/a	0.000
0	0	6300	0.5	1.00E-06	0	260	29	75	365	29	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	260	29	75	365	29	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	260	29	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	260	29	75	365	70	3.58E-05	4.30E-01	1.54E-05

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.: 147613068	Made by JH/AB	Date AUGUST 2014	
Ref.	Checked by CMB	Sheet 1 of 1	

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	2	260	29	365	29	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Ammonia	0	4.77E-05	2	260	29	365	29	0.00E+00	8.00E-02	0.000	1
Benzene	0	1.23E-03	2	260	29	365	29	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	2	260	29	365	29	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	2	260	29	365	29	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	2	260	29	365	29	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	7.86E-06	2	260	29	365	29	1.38E-05	9.90E-04	0.014	1
Acenaphthylene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	2	260	29	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	2	260	29	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	2	260	29	365	29	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Ammonia	0	3.27E-07	2	260	29	365	29	0.00E+00	8.00E-02	0.000
Benzene	0	1.11E-05	2	260	29	365	29	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.15E-05	2	260	29	365	29	0.00E+00	1.30E+00	0.000
Toluene	0	1.17E-05	2	260	29	365	29	0.00E+00	5.00E+00	0.000
Xylenes	0	1.04E-05	2	260	29	365	29	0.00E+00	8.70E-01	0.000
Naphthalene	0	1.35E-06	2	260	29	365	29	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	29	365	29	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.11E-05	2	260	29	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	2	260	29	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.042		0.001	0.528		0.000	0.000	**0.570**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.000		0.000	0.006		0.014	0.000	**0.020**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.590**	1	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.570		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.020		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	4.70E-06		0.00E+00	1.54E-05		0.00E+00	0.00E+00	**2.01E-05**	5.00E-06	**YES**
							TOTAL	**2.01E-05**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
2.01E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **5 Recreational Park Users (Child)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
5 Recreational Park Users (Child)	2	260	10	10	87600	70	5-15	0.89	50	5080	0.5	Variable	56
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
5 Recreational Park Users (Child)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	50	1	1.00E-06	260	10	56	365	10	3.36E-04	3.00E-03	0.112
Lead** (Refer Discussion in Report)	0	50	0.5	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000
Ammonia	0	50	0.04	1.00E-06	260	10	56	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	50	1	1.00E-06	260	10	56	365	10	1.88E-05	1.60E-02	0.001
Acenaphthylene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	4.80E-02	0.000
Fluorene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	3.20E-02	0.000
Phenanthrene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000
Anthracene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	2.40E-01	0.000
Fluoranthene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	3.20E-02	0.000
Pyrene	0	50	1	1.00E-06	260	10	56	365	10	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	50	1	1.00E-06	260	10	56	365	10	7.07E-05	n/a	0.000
0	0	50	0	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000
0	0	50	0	1.00E-06	260	10	56	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	50	1	1.00E-06	260	10	56	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	50	1	1.00E-06	260	10	56	365	70	1.01E-05	4.30E-01	4.34E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		2	260	10		365	10	4.47E-07	8.00E-04	0.001
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		2	260	10		365	10	2.50E-08	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		2	260	10		365	10	9.39E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	10		365	10	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		2	260	10		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		2	260	10		365	70	1.34E-08	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	5080	0.5	1.00E-06	0.1	260	10	56	365	10	1.71E-03	3.00E-03	0.570
Lead** (Refer Discussion in Report)	0	5080	0.5	1.00E-06	0.001	260	10	56	365	10	0.00E+00	n/a	0.000
Ammonia	0	5080	0.5	1.00E-06	0.005	260	10	56	365	10	0.00E+00	2.00E+00	0.000
Benzene	0	5080	0.5	1.00E-06	0.08	260	10	56	365	10	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	5080	0.5	1.00E-06	0.2	260	10	56	365	10	0.00E+00	9.70E-02	0.000
Toluene	0	5080	0.5	1.00E-06	0.12	260	10	56	365	10	0.00E+00	2.20E-01	0.000
Xylenes	0	5080	0.5	1.00E-06	0.12	260	10	56	365	10	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	5080	0.5	1.00E-06	0.1	260	10	56	365	10	9.56E-05	1.60E-02	0.006
Acenaphthylene	0	5080	0.5	1.00E-06	0.18	260	10	56	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	5080	0.5	1.00E-06	0.2	260	10	56	365	10	0.00E+00	4.80E-02	0.000
Fluorene	0	5080	0.5	1.00E-06	0.2	260	10	56	365	10	0.00E+00	3.20E-02	0.000
Phenanthrene	0	5080	0.5	1.00E-06	0.18	260	10	56	365	10	0.00E+00	n/a	0.000
Anthracene	0	5080	0.5	1.00E-06	0.29	260	10	56	365	10	0.00E+00	2.40E-01	0.000
Fluoranthene	0	5080	0.5	1.00E-06	0.2	260	10	56	365	10	0.00E+00	3.20E-02	0.000
Pyrene	0	5080	0.5	1.00E-06	0.2	260	10	56	365	10	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	5080	0.5	1.00E-06	0.026	260	10	56	365	10	9.33E-05	n/a	0.000
0	0	5080	0.5	1.00E-06	0	260	10	56	365	10	0.00E+00	n/a	0.000
0	0	5080	0.5	1.00E-06	0	260	10	56	365	10	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	5080	0.5	1.00E-06	0.08	260	10	56	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	5080	0.5	1.00E-06	0.026	260	10	56	365	70	1.33E-05	4.30E-01	5.73E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.: 147613068	Made by JH/AB	Date AUGUST 2014	
Ref.	Checked by CMB	Sheet 1 of 1	

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	2	260	10	365	10	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Ammonia	0	4.77E-05	2	260	10	365	10	0.00E+00	8.00E-02	0.000	1
Benzene	0	1.23E-03	2	260	10	365	10	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	2	260	10	365	10	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	2	260	10	365	10	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	2	260	10	365	10	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	7.86E-06	2	260	10	365	10	1.38E-05	9.90E-04	0.014	1
Acenaphthylene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	2	260	10	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	2	260	10	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	2	260	10	365	10	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Ammonia	0	3.27E-07	2	260	10	365	10	0.00E+00	8.00E-02	0.000
Benzene	0	1.11E-05	2	260	10	365	10	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.15E-05	2	260	10	365	10	0.00E+00	1.30E+00	0.000
Toluene	0	1.17E-05	2	260	10	365	10	0.00E+00	5.00E+00	0.000
Xylenes	0	1.04E-05	2	260	10	365	10	0.00E+00	8.70E-01	0.000
Naphthalene	0	1.35E-06	2	260	10	365	10	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	10	365	10	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.11E-05	2	260	10	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	2	260	10	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.112		0.001	0.570		0.000	0.000	**0.682**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.001		0.000	0.006		0.014	0.000	**0.021**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.704**	1	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.682		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.021		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	4.34E-06		0.00E+00	5.73E-06		0.00E+00	0.00E+00	**1.01E-05**	5.00E-06	**YES**
							TOTAL	**1.01E-05**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
1.01E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **6 Recreational Park Users (Infant)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
6 Recreational Park Users (Infant)	2	260	5	5	43800	70	0-5	0.72	50	2700	0.5	Variable	11
					SUBCHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
6 Recreational Park Users (Infant)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	50	1	1.00E-06	260	5	11	365	5	1.71E-03	3.00E-03	0.571
Lead** (Refer Discussion in Report)	0	50	0.5	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000
Ammonia	0	50	0.04	1.00E-06	260	5	11	365	5	0.00E+00	2.00E+00	0.000
Benzene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	9.70E-02	0.000
Toluene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	2.20E-01	0.000
Xylenes	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	50	1	1.00E-06	260	5	11	365	5	9.58E-05	1.60E-02	0.006
Acenaphthylene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000
Acenaphthene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	4.80E-02	0.000
Fluorene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	3.20E-02	0.000
Phenanthrene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000
Anthracene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	2.40E-01	0.000
Fluoranthene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	3.20E-02	0.000
Pyrene	0	50	1	1.00E-06	260	5	11	365	5	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	50	1	1.00E-06	260	5	11	365	5	3.60E-04	n/a	0.000
0	0	50	0	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000
0	0	50	0	1.00E-06	260	5	11	365	5	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	50	1	1.00E-06	260	5	11	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	50	1	1.00E-06	260	5	11	365	70	2.57E-05	4.30E-01	1.10E-05

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		2	260	5		365	5	4.47E-07	8.00E-04	0.001
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		2	260	5		365	5	2.50E-08	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		2	260	5		365	5	9.39E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		2	260	5		365	5	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		2	260	5		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		2	260	5		365	70	6.71E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	2700	0.5	1.00E-06	0.1	260	5	11	365	5	4.62E-03	3.00E-03	1.542
Lead** (Refer Discussion in Report)	0	2700	0.5	1.00E-06	0.001	260	5	11	365	5	0.00E+00	n/a	0.000
Ammonia	0	2700	0.5	1.00E-06	0.005	260	5	11	365	5	0.00E+00	2.00E+00	0.000
Benzene	0	2700	0.5	1.00E-06	0.08	260	5	11	365	5	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	2700	0.5	1.00E-06	0.2	260	5	11	365	5	0.00E+00	9.70E-02	0.000
Toluene	0	2700	0.5	1.00E-06	0.12	260	5	11	365	5	0.00E+00	2.20E-01	0.000
Xylenes	0	2700	0.5	1.00E-06	0.12	260	5	11	365	5	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	2700	0.5	1.00E-06	0.1	260	5	11	365	5	2.59E-04	1.60E-02	0.016
Acenaphthylene	0	2700	0.5	1.00E-06	0.18	260	5	11	365	5	0.00E+00	n/a	0.000
Acenaphthene	0	2700	0.5	1.00E-06	0.2	260	5	11	365	5	0.00E+00	4.80E-02	0.000
Fluorene	0	2700	0.5	1.00E-06	0.2	260	5	11	365	5	0.00E+00	3.20E-02	0.000
Phenanthrene	0	2700	0.5	1.00E-06	0.18	260	5	11	365	5	0.00E+00	n/a	0.000
Anthracene	0	2700	0.5	1.00E-06	0.29	260	5	11	365	5	0.00E+00	2.40E-01	0.000
Fluoranthene	0	2700	0.5	1.00E-06	0.2	260	5	11	365	5	0.00E+00	3.20E-02	0.000
Pyrene	0	2700	0.5	1.00E-06	0.2	260	5	11	365	5	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	2700	0.5	1.00E-06	0.026	260	5	11	365	5	2.53E-04	n/a	0.000
0	0	2700	0.5	1.00E-06	0	260	5	11	365	5	0.00E+00	n/a	0.000
0	0	2700	0.5	1.00E-06	0	260	5	11	365	5	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	2700	0.5	1.00E-06	0.08	260	5	11	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	2700	0.5	1.00E-06	0.026	260	5	11	365	70	1.80E-05	4.30E-01	7.76E-06

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.			
Job No.:	147613068	Made by JH/AB	Date	AUGUST 2014
Ref.		Checked by CMB	Sheet	1 of 1

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	2	260	5	365	5	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Ammonia	0	4.77E-05	2	260	5	365	5	0.00E+00	8.00E-02	0.000	1
Benzene	0	1.23E-03	2	260	5	365	5	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	2	260	5	365	5	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	2	260	5	365	5	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	2	260	5	365	5	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	7.86E-06	2	260	5	365	5	1.38E-05	9.90E-04	0.014	1
Acenaphthylene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	2	260	5	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	2	260	5	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	2	260	5	365	5	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Ammonia	0	3.27E-07	2	260	5	365	5	0.00E+00	8.00E-02	0.000
Benzene	0	1.11E-05	2	260	5	365	5	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.15E-05	2	260	5	365	5	0.00E+00	1.30E+00	0.000
Toluene	0	1.17E-05	2	260	5	365	5	0.00E+00	5.00E+00	0.000
Xylenes	0	1.04E-05	2	260	5	365	5	0.00E+00	8.70E-01	0.000
Naphthalene	0	1.35E-06	2	260	5	365	5	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000
0	0	0.00E+00	2	260	5	365	5	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.11E-05	2	260	5	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	2	260	5	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.571		0.001	1.542		0.000	0.000	**2.113**	0.2	**YES**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.006		0.000	0.016		0.014	0.000	**0.036**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**2.149**	1	**YES**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
2.113		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.036		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	1.10E-05		0.00E+00	7.76E-06		0.00E+00	0.00E+00	**1.88E-05**	5.00E-06	**YES**
							TOTAL	**1.88E-05**	1.00E-05	**YES**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
1.88E-05		0.00E+00	

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.:	147613068	Made by JH/AB	Date AUGUST 2014
Ref.		Checked by CMB	Sheet 1 of 1

RECEPTOR: **7 Utility / Maintenance Workers (Adult)**

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Exposure Time (hr/day)	Exposure Frequency (day/year)	Exposure Duration (years)	Averaging Time (years)	Averaging Time (hours)	Lifetime (years)	Nominal Age Range (years)	Inhalation Rate (m^3/hr)	Soil Ingestion Rate (mg/day)	Skin Surface Area (cm^2)	Soil Dermal Adherance (mg/cm^2/day)	Relative Dust Level (mg/m^3)/(mg/kg)	Body Weight (kg)
	ET	EF	ED	AT	AT	LC	--	InhR	IR_{SOIL}	SSA	SSAF	RDL	BW
Personel Within Impacted Area													
7 Utility / Maintenance Workers (Adult)	8	10	30	30	262800	70	15-70	2.1	200	6300	0.5	Variable	75
					CHRONIC								

RECEPTOR CATEGORY	EXPOSURE ASSUMPTIONS												
	Duration Water Dermal Event (hours)	Frequency Water Event (event/day)	Frequency of Water Event (day/year)	Groundwater Ingestion Rate (L/day)									
	Tevent	EV	EFd	IR_{GW}									
Personel Within Impacted Area													
7 Utility / Maintenance Workers (Adult)	0	0	0	0									

SOIL INGESTION

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	200	1	1.00E-06	10	30	75	365	30	3.86E-05	3.00E-03	0.013
Lead** (Refer Discussion in Report)	0	200	0.5	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000
Ammonia	0	200	0.04	1.00E-06	10	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	200	1	1.00E-06	10	30	75	365	30	2.16E-06	1.60E-02	0.000
Acenaphthylene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	4.80E-02	0.000
Fluorene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	3.20E-02	0.000
Phenanthrene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000
Anthracene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	2.40E-01	0.000
Fluoranthene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	3.20E-02	0.000
Pyrene	0	200	1	1.00E-06	10	30	75	365	30	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	200	1	1.00E-06	10	30	75	365	30	8.12E-06	n/a	0.000
0	0	200	0	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000
0	0	200	0	1.00E-06	10	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x IR x BF x CF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	IR_{SOIL}	BF	CF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	mg/d	unitless	kg/mg	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	200	1	1.00E-06	10	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	200	1	1.00E-06	10	30	75	365	70	3.48E-06	4.30E-01	1.50E-06

DUST INHALATION

EC = Media Concentration x PEF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	AT	EC	Inhalation RfC	HQ
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	529	1.42E-08	7.54E-06		8	10	30		365	30	6.88E-08	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Ammonia	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	8.70E-01	0.000
Naphthalene	29.6	1.42E-08	4.22E-07		8	10	30		365	30	3.85E-09	9.90E-04	0.000
Acenaphthylene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Acenaphthene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Fluorene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Phenanthrene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Anthracene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Fluoranthene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Pyrene	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	10	30		365	30	1.45E-08	n/a	0.000
0	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000
0	0	1.42E-08	0.00E+00		8	10	30		365	30	0.00E+00	n/a	0.000

EC = Media Concentration x PEF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	PEF	Particulate Concentration		ET	EF	ED		DIY	LC	EC	Inhalation UR	ELCR
	mg/kg	$(mg/m^3)/(mg/kg)$	mg/m^3		h/d	d/yr	yr		d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.42E-08	0.00E+00		8	10	30		365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	1.42E-08	1.58E-06		8	10	30		365	70	6.19E-09	n/a	0.00E+00

DERMAL ABSORPTION - SOIL

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x AT)

NON-CARCINOGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	AT	EDI	Oral TDI	HQ
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	mg/kg.d	unitless
Cyanide Total	529	6300	0.5	1.00E-06	0.1	10	30	75	365	30	6.09E-05	3.00E-03	0.020
Lead** (Refer Discussion in Report)	0	6300	0.5	1.00E-06	0.001	10	30	75	365	30	0.00E+00	n/a	0.000
Ammonia	0	6300	0.5	1.00E-06	0.005	10	30	75	365	30	0.00E+00	2.00E+00	0.000
Benzene	0	6300	0.5	1.00E-06	0.08	10	30	75	365	30	0.00E+00	4.00E-03	0.000
Ethylbenzene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	9.70E-02	0.000
Toluene	0	6300	0.5	1.00E-06	0.12	10	30	75	365	30	0.00E+00	2.20E-01	0.000
Xylenes	0	6300	0.5	1.00E-06	0.12	10	30	75	365	30	0.00E+00	1.80E-01	0.000
Naphthalene	29.6	6300	0.5	1.00E-06	0.1	10	30	75	365	30	3.41E-06	1.60E-02	0.000
Acenaphthylene	0	6300	0.5	1.00E-06	0.18	10	30	75	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	4.80E-02	0.000
Fluorene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	3.20E-02	0.000
Phenanthrene	0	6300	0.5	1.00E-06	0.18	10	30	75	365	30	0.00E+00	n/a	0.000
Anthracene	0	6300	0.5	1.00E-06	0.29	10	30	75	365	30	0.00E+00	2.40E-01	0.000
Fluoranthene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	3.20E-02	0.000
Pyrene	0	6300	0.5	1.00E-06	0.2	10	30	75	365	30	0.00E+00	2.40E-02	0.000
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	10	30	75	365	30	3.32E-06	n/a	0.000
0	0	6300	0.5	1.00E-06	0	10	30	75	365	30	0.00E+00	n/a	0.000
0	0	6300	0.5	1.00E-06	0	10	30	75	365	30	0.00E+00	n/a	0.000

EDI = Media Concentration x SSFA x CF x SSA x DAF x EF x ED / (BW x DIY x LC)

CARCINIGENIC CHEMICALS	Media Concentration	SSA	SSAF	CF	DAF	EF	ED	BW	DIY	LC	EDI	Oral CSF	ELCR
	mg/kg	cm^2	$mg/cm^2.d$	kg/mg	unitless	d/yr	yr	kg	d/yr	yr	mg/kg.d	$(mg/kg.d)^{-1}$	unitless
Benzene	0	6300	0.5	1.00E-06	0.08	10	30	75	365	70	0.00E+00	3.00E-02	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	111.1	6300	0.5	1.00E-06	0.026	10	30	75	365	70	1.42E-06	4.30E-01	6.13E-07

SUBJECT	EXPOSURE ASSESSMENT CITY OF PORT PHILLIP REVIEW AND UPDATE, HHRA - GASWORKS ARTS PARK - AVG CONC.		
Job No.: 147613068	Made by JH/AB	Date AUGUST 2014	
Ref.	Checked by CMB	Sheet 1 of 1	

VAPOUR INHALATION - SOIL (OUTDOOR AIR)

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless	
Cyanide Total	529	0.00E+00	8	10	30	365	30	0.00E+00	8.00E-04	0.000	1
Lead** (Refer Discussion in Report)	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Ammonia	0	4.77E-05	8	10	30	365	30	0.00E+00	8.00E-02	0.000	1
Benzene	0	1.23E-03	8	10	30	365	30	0.00E+00	2.40E-02	0.000	1
Ethylbenzene	0	6.19E-04	8	10	30	365	30	0.00E+00	1.30E+00	0.000	1
Toluene	0	9.11E-04	8	10	30	365	30	0.00E+00	5.00E+00	0.000	1
Xylenes	0	4.74E-04	8	10	30	365	30	0.00E+00	8.70E-01	0.000	1
Naphthalene	29.6	7.86E-06	8	10	30	365	30	2.13E-06	9.90E-04	0.002	1
Acenaphthylene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Acenaphthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Fluorene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Phenanthrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Anthracene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Fluoranthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Pyrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000	1

EC = Media Concentration x Soil Partitioning Adjustment x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR	Soil Partitioning Adjustment
	mg/kg	$(mg/m^3)/(mg/kg)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless	
Benzene	0	1.23E-03	8	10	30	365	70	0.00E+00	6.00E-03	0.00E+00	1
Benzo(a)Pyrene (NOT equivalents)	111.1	0.00E+00	8	10	30	365	70	0.00E+00	n/a	0.00E+00	1

VAPOUR INHALATION - GROUNDWATER (OUTDOOR AIR)

EC = Media Concentration x VF x ET x EF x ED / (DIY x AT x 24)

NON-CARCINOGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	AT	EC	Inhalation RfC	HQ
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	mg/m^3	unitless
Cyanide Total	0	0.00E+00	8	10	30	365	30	0.00E+00	8.00E-04	0.000
Lead** (Refer Discussion in Report)	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Ammonia	0	3.27E-07	8	10	30	365	30	0.00E+00	8.00E-02	0.000
Benzene	0	1.11E-05	8	10	30	365	30	0.00E+00	2.40E-02	0.000
Ethylbenzene	0	1.15E-05	8	10	30	365	30	0.00E+00	1.30E+00	0.000
Toluene	0	1.17E-05	8	10	30	365	30	0.00E+00	5.00E+00	0.000
Xylenes	0	1.04E-05	8	10	30	365	30	0.00E+00	8.70E-01	0.000
Naphthalene	0	1.35E-06	8	10	30	365	30	0.00E+00	9.90E-04	0.000
Acenaphthylene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Acenaphthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Fluorene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Phenanthrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Anthracene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Fluoranthene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Pyrene	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000
0	0	0.00E+00	8	10	30	365	30	0.00E+00	n/a	0.000

EC = Media Concentration x VF x ET x EF x ED / (DIY x LC x 24)

CARCINIGENIC CHEMICALS	Media Concentration	VF	ET	EF	ED	DIY	LC	EC	Inhalation UR	ELCR
	mg/L	$(mg/m^3)/(mg/L)$	h/d	d/yr	yr	d/yr	yr	mg/m^3	$(mg/m^3)^{-1}$	unitless
Benzene	0	1.11E-05	8	10	30	365	70	0.00E+00	6.00E-03	0.00E+00
Benzo(a)Pyrene (NOT equivalents)	0	0.00E+00	8	10	30	365	70	0.00E+00	n/a	0.00E+00

RISK SUMMARY

NON-CARCINOGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL HQ	TARGET HQ	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Cyanide Total	0.013		0.000	0.020		0.000	0.000	**0.033**	0.2	**No**
Lead** (Refer Discussion in Report)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ammonia	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Ethylbenzene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Toluene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Xylenes	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Naphthalene	0.000		0.000	0.000		0.002	0.000	**0.002**	0.2	**No**
Acenaphthylene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Acenaphthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluorene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Phenanthrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Anthracene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Fluoranthene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Pyrene	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
Benzo(a)Pyrene (NOT equivalents)	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
0	0.000		0.000	0.000		0.000	0.000	**0.000**	0.2	**No**
							TOTAL	**0.036**	1	**No**

DERIVED RISK BASED SCREENING LEVELS (RBSL)

Soil Sources		Groundwater Sources	
Total HQ	RBSL	Total HQ	RBSL
unitless	mg/kg	unitless	mg/L
0.033		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.002		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	
0.000		0.000	

CARCINIGENIC CHEMICALS	Soil Ingestion	Groundwater Ingestion	Dust Inhalation	Soil Dermal	Groundwater Dermal	Soil Inhalation	Groundwater Inhalation	TOTAL ELCR	TARGET ELCR	TARGET RISK EXCEEDED?
	unitless	unitless	unitless	unitless	unitless	unitless	unitless			
Benzene	0.00E+00		0.00E+00	0.00E+00		0.00E+00	0.00E+00	**0.00E+00**	5.00E-06	**No**
Benzo(a)Pyrene (NOT equivalents)	1.50E-06		0.00E+00	6.13E-07		0.00E+00	0.00E+00	**2.11E-06**	5.00E-06	**No**
							TOTAL	**2.11E-06**	1.00E-05	**No**

Soil Sources		Groundwater Sources	
Total ELCR	RBSL	Total ELCR	RBSL
unitless	mg/kg	unitless	mg/L
0.00E+00		0.00E+00	
2.11E-06		0.00E+00	

APPENDIX D

Limitations

LIMITATIONS

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