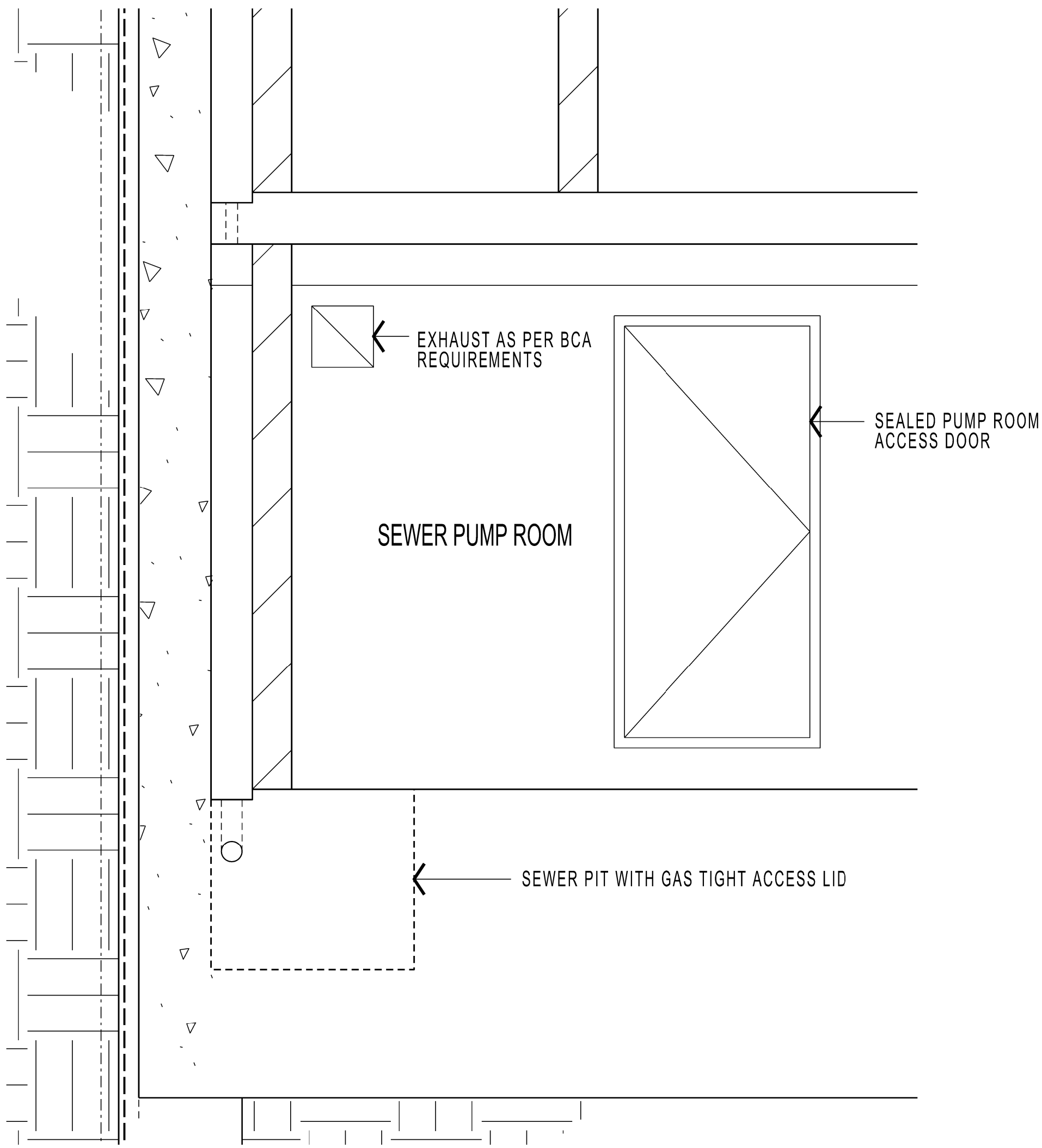
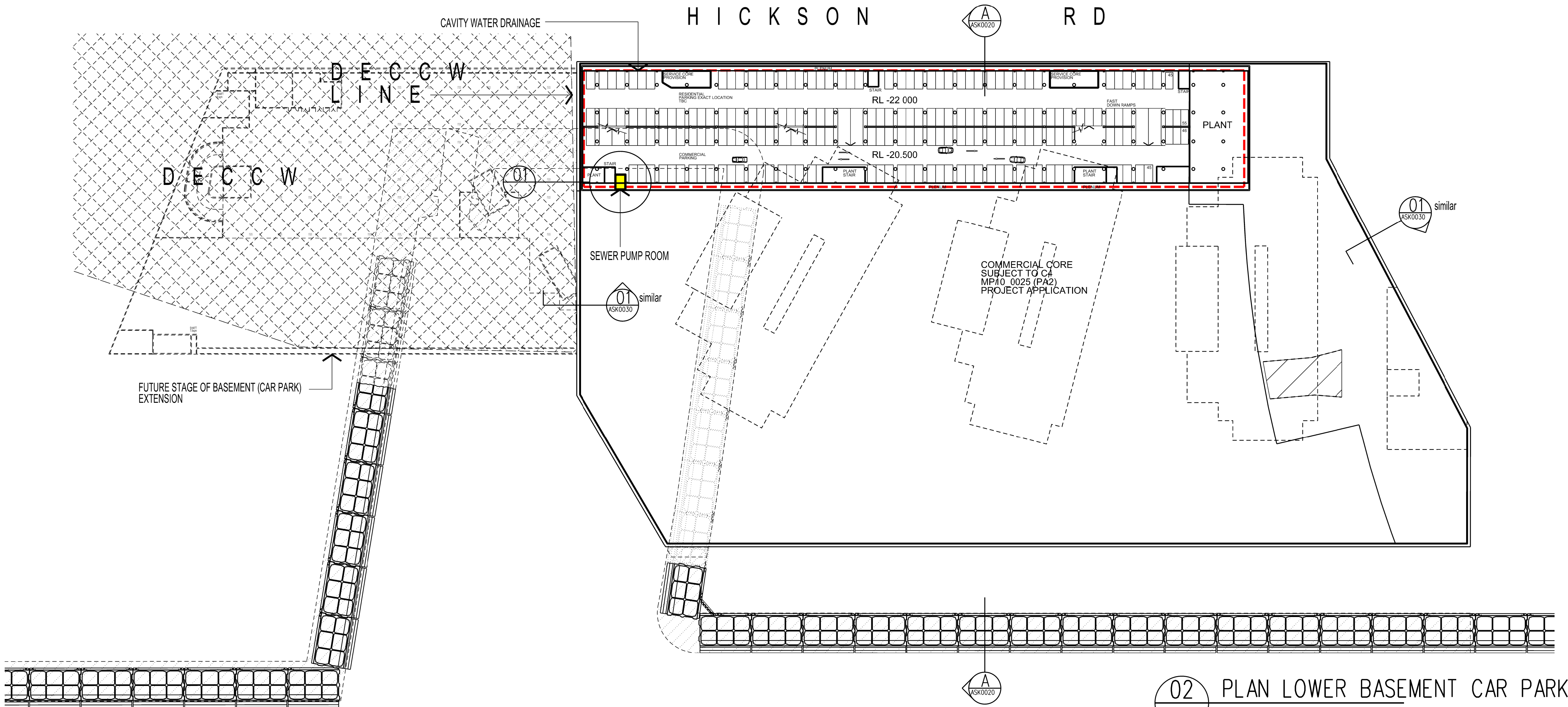
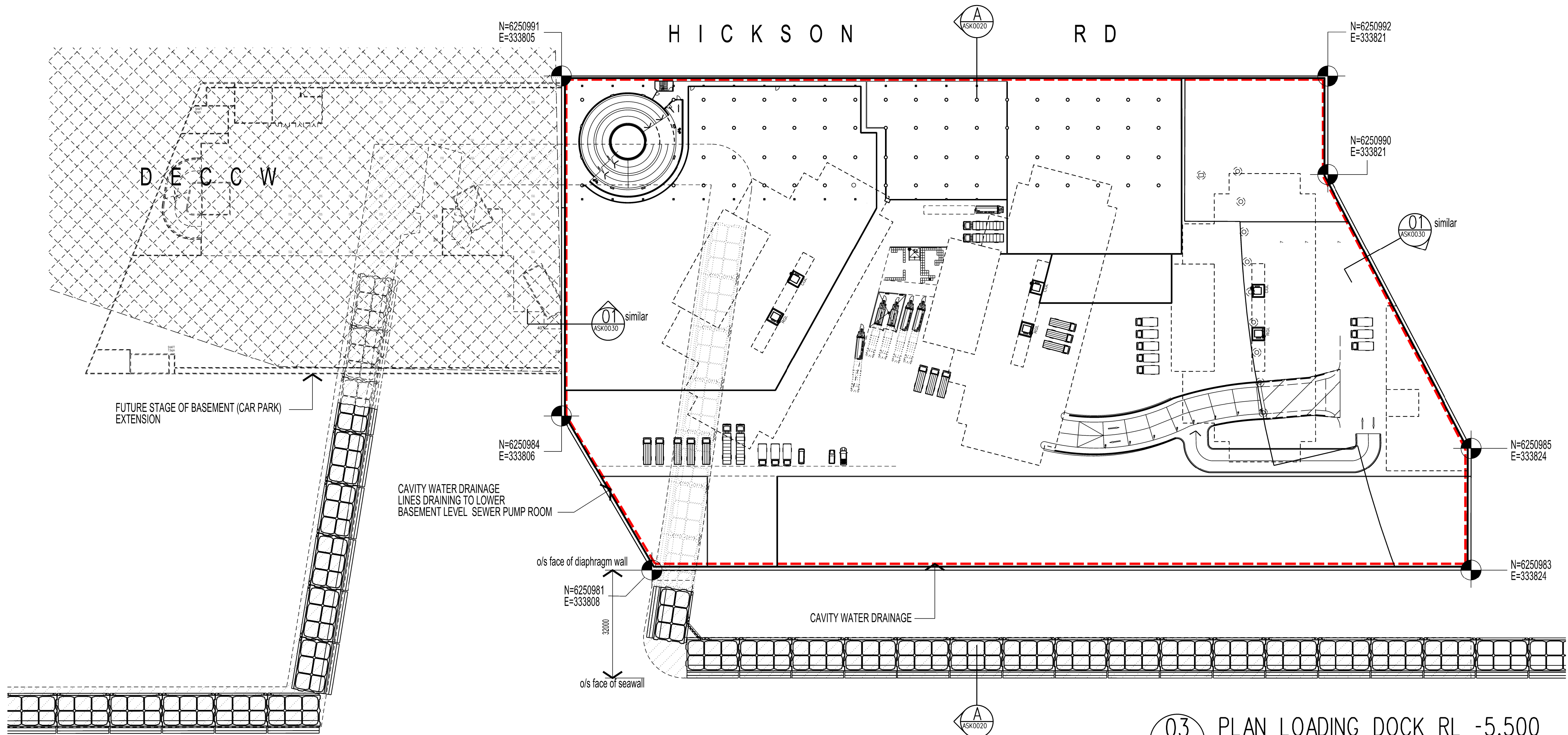




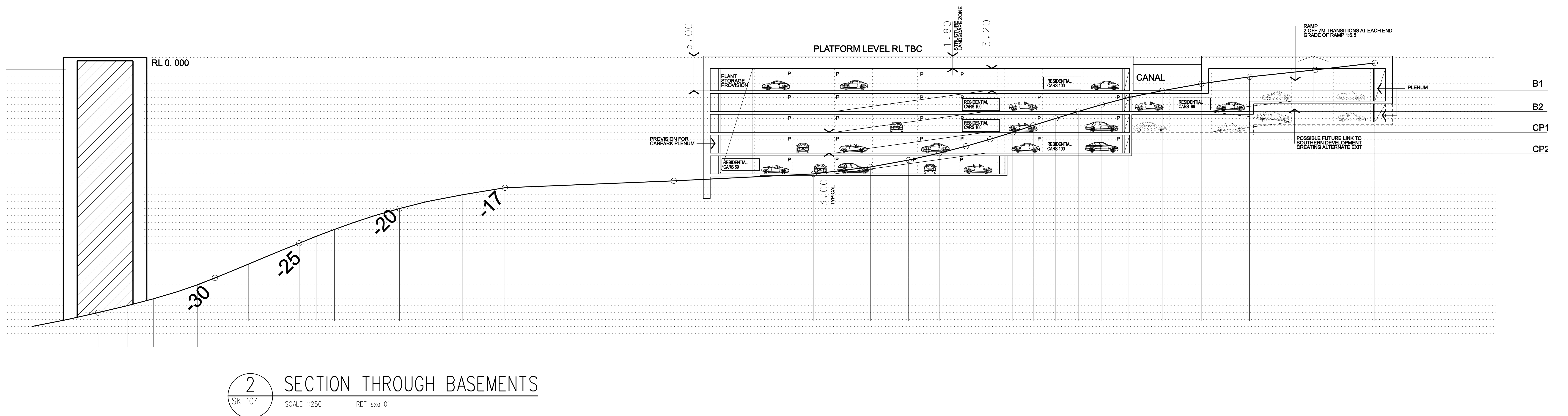
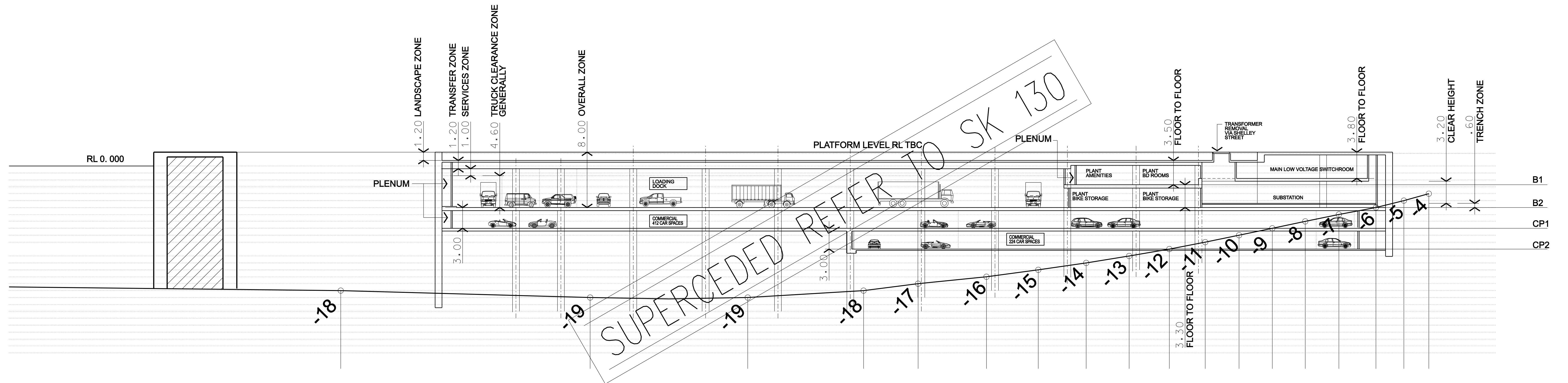
01 PART SECTION SEWER PUMP ROOM
SCALE 1: REF



02 PLAN LOWER BASEMENT CAR PARK
SCALE 1: REF

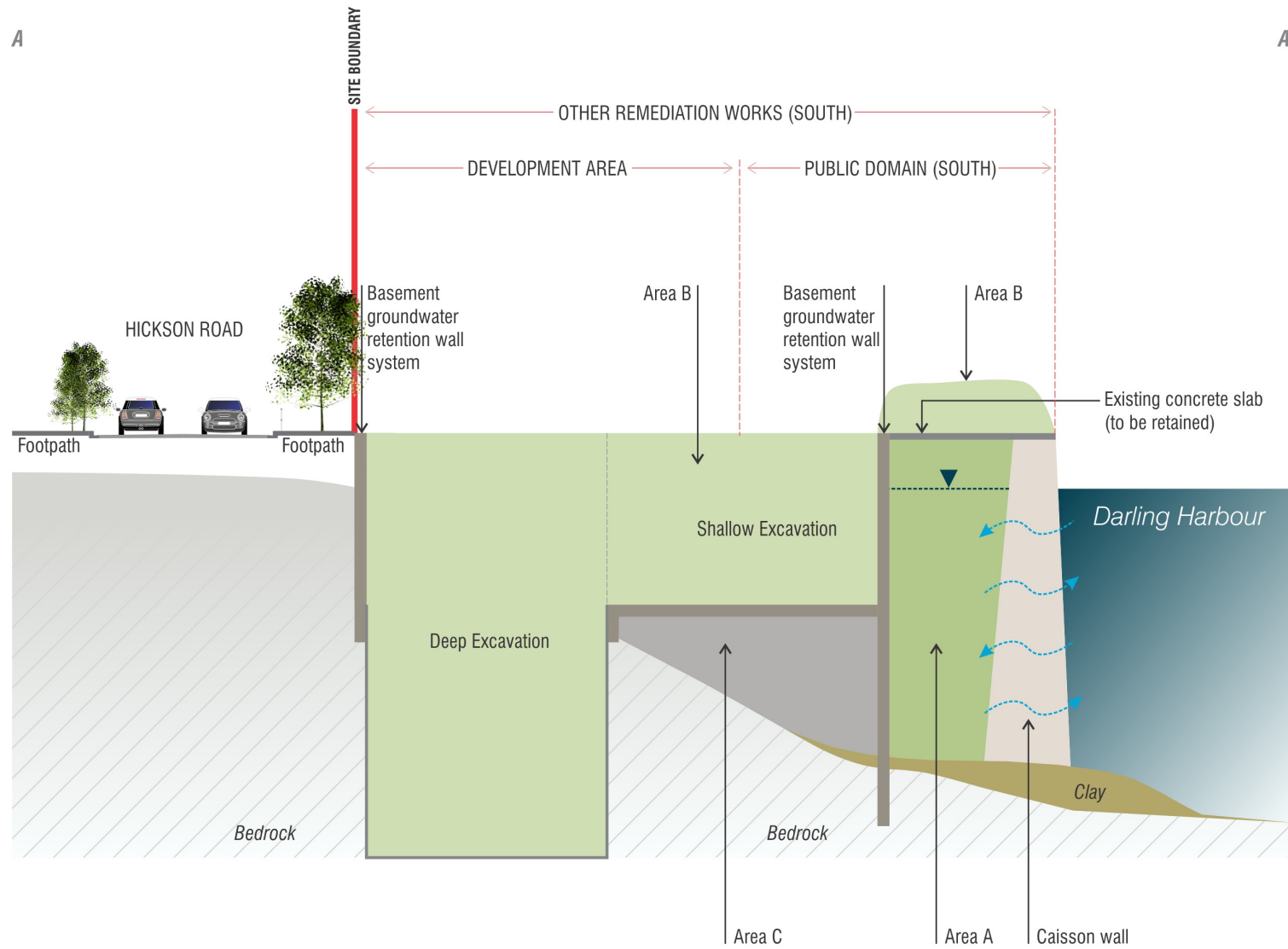


03 PLAN LOADING DOCK RL -5.500
SCALE 1: REF



Appendix A - Figure 7

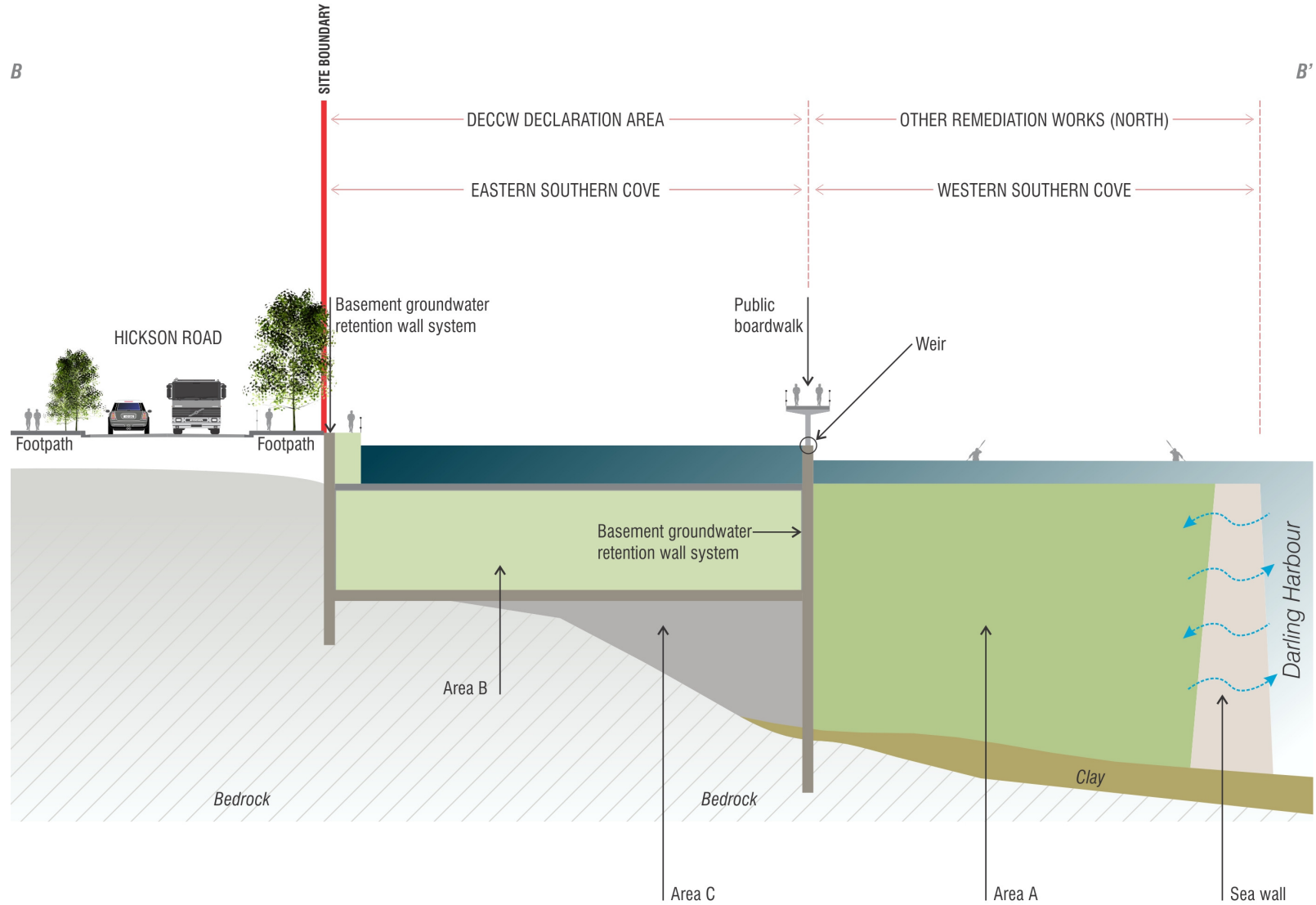
SCHEMATIC CROSS SECTION A-A'



NOT TO SCALE

Appendix A - Figure 8

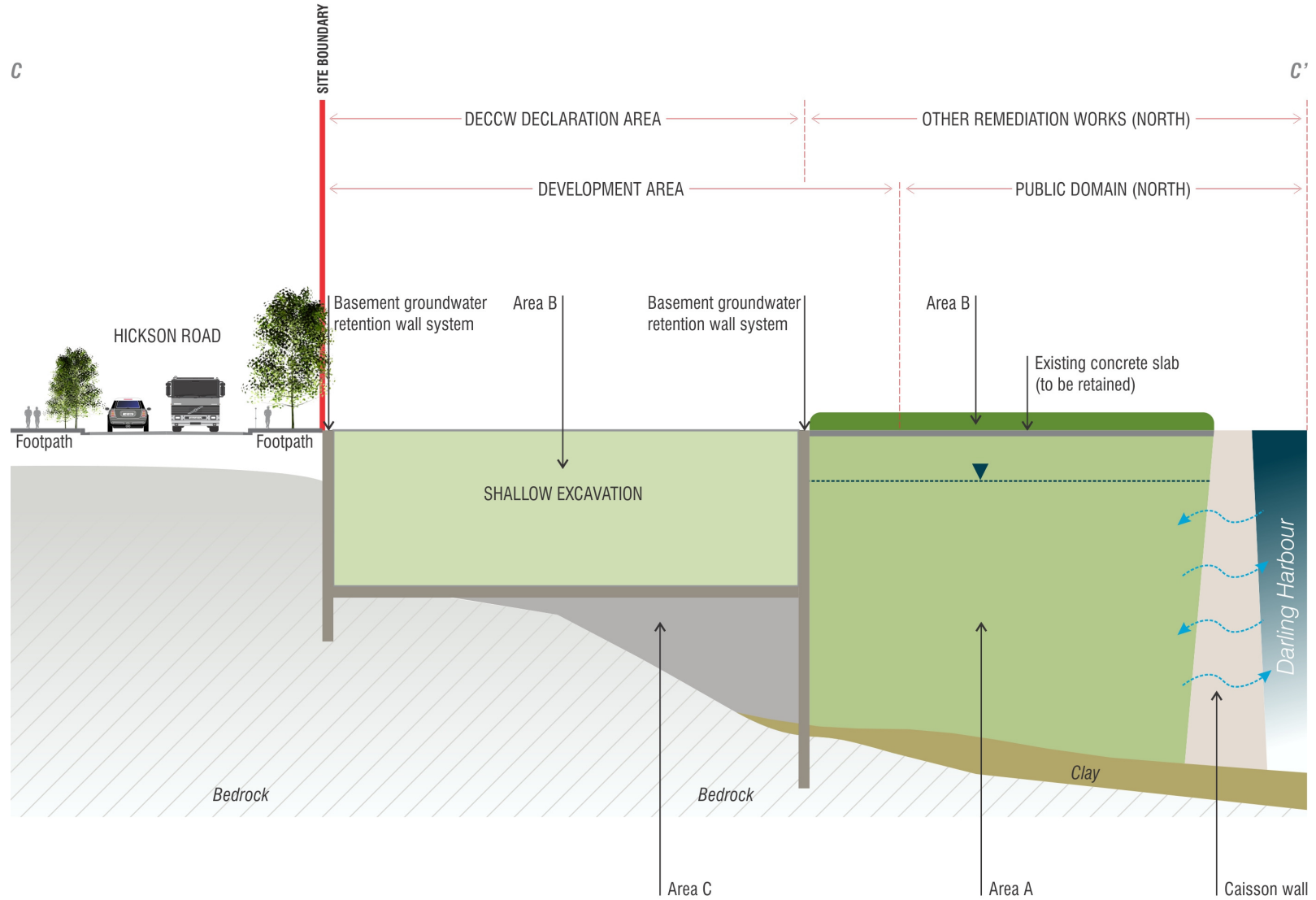
SCHEMATIC CROSS SECTION B-B'



NOT TO SCALE

Appendix A - Figure 9

SCHEMATIC CROSS SECTION C-C'



NOT TO SCALE

Appendix B

Risk Algorithms Updated

Appendix B – Vapour Intrusion Model Algorithms

Vapour Emissions in Indoor Air

The algorithms used to predict indoor air vapour concentrations are those described by Johnson and Ettinger (1991). The algorithms estimate a unitless 'vapour attenuation coefficient' (α), which represents the ratio of the indoor vapour concentration (C_{indoor}) to the vapour concentration at the source (C_{source}) found at some depth (L_T) below a foundation. The attenuation coefficient is then used to calculate a volatilization factor (VF), which represents the ratio of concentration of vapour phase hydrocarbon in indoor air to that in the source media (soil, groundwater or PSH), i.e.:

$$VF = \frac{C_{\text{vapour}(m)}}{C_m} \alpha$$

where $C_{\text{vapour}(m)}$ indicates the vapour phase concentration at source media m (soil, groundwater and/or PSH), and C_m indicates the concentration in source media m .

The estimated air concentration is then given by:

$$C_{\text{air}(m)} = C_m VF$$

where $C_{\text{air}(m)}$ is the chemical concentration associated with vapours derived from media m .

Parameter definitions used in the equations below can be found in **Table 1**.

The attenuation coefficient, α , is estimated by:

$$\alpha = \frac{\left[\frac{D_T^{\text{eff}} A_B}{Q_B L_T} \right] \exp\left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}}^{\text{eff}} \eta A_B} \right)}{\exp\left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}}^{\text{eff}} \eta A_B} \right) + \left[\frac{D_T^{\text{eff}} A_B}{Q_B L_T} \right] + \left[\frac{D_T^{\text{eff}} A_B}{Q_{\text{soil}} L_T} \right] \left(\exp\left(\frac{Q_{\text{soil}} L_{\text{crack}}}{D_{\text{crack}}^{\text{eff}} \eta A_B} \right) - 1 \right)}$$

where $\alpha = C_{\text{indoor}}/C_{\text{source}}$ and other parameters are as listed in **Table 1**.

Q_{soil} can be specified directly, or can be calculated using the following analytical solution of Nazaroff (1988):

$$Q_{\text{soil}} = \frac{2\pi\Delta P k_v X_{\text{crack}}}{\mu \ln(2Z_{\text{crack}}/r_{\text{crack}})}$$

Where r_{crack} is equal to:

$$r_{\text{crack}} = \eta(A_B / X_{\text{crack}})$$

For cases where Q_{soil} is zero, the above equation simplifies to:

$$\alpha = \frac{\left[\frac{D_T^{eff} A_B}{Q_B L_T} \right]}{1 + \left[\frac{D_T^{eff} A_B}{Q_B L_T} \right] + \left[\frac{D_T^{eff} L_{crack}}{D_{crack}^{eff} L_T \eta} \right]}$$

In the case of a groundwater source, the vapour phase concentration at the source ($C_{source(gw)}$) (mg/cm^3) is estimated by:

$$C_{source(gw)} = C_{gw} H \cdot 10^3 \frac{L}{m^3}$$

If the dissolved phase concentration entered in the model exceeds the pure component aqueous solubility for the chemical, residual phase chemical is considered to be present in the groundwater sample, and the vapour phase concentration is limited to that in equilibrium with the aqueous solubility limit. In this case, the model calculates the vapour source term based on the chemical-specific aqueous solubility, rather than on the groundwater concentration entered in the model.

In the case of a soil source, the vapour phase concentration at the source ($C_{source(s)}$) in mg/m^3 is estimated by:

$$C_{source(s)} = C_{soil} \frac{H \rho_s}{\theta_{ws} + k_{oc} f_{oc} \rho_s + H \theta_{as}} 10^6 \frac{cm^3}{m^3} \frac{kg}{g}$$

When calculating the vapour phase concentration in equilibrium with a soil source, the bulk soil concentration entered in the model is compared to the estimated concentration at which dissolved pore water and vapour phases become saturated (C_{sat}). Where the soil concentration is greater than C_{sat} , residual liquid phase chemical is considered to be present in the soil source area, and the vapour phase concentration is limited to that at C_{sat} . In this case, the model calculates the vapour source term based on C_{sat} , rather than on the bulk soil concentration entered in the model.

In the case of PSH, the vapour phase concentration at the source ($C_{source(P)}$) is estimated from weight fractions in the hydrocarbon source applying Raoult's law, as follows:

$$C_{source(P)} = \left(\frac{\frac{wt. \frac{frac_{i,L}}{MW_i}}{wt. \frac{frac_{i,L}}{MW_i} + \frac{(1 - wt. \frac{frac_{i,L}}{MW_i})}{MW_T}}}{\left(\frac{VP \cdot MW}{P_T MV} \right)} \right) 10^6 \frac{mg}{g} \frac{L}{m^3}$$

For groundwater, L_T is equal to the thickness of the capillary fringe (h_{cap}) plus the thickness of the vadose zone (h_v). In practice, the thickness of the vadose zone for the groundwater to indoor air model is estimated based on reported depth to groundwater, less the assumed h_{cap} (typically obtained from literature sources). For soil, L_T is equal to the depth to the subsurface soil contamination source.

For a subsurface soil source, the effective vapour phase diffusion coefficient between the contaminated soil source and the building foundation ($D_{T(s)}^{eff}$) is estimated by:

$$D_{T(s)}^{eff} = D^{air} \frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat} \frac{1}{H} \frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

For groundwater, the effective vapour phase diffusion coefficient between the groundwater source and the building foundation ($D_{T(gw)}^{eff}$) is estimated by:

$$D_{T(gw)}^{eff} = \frac{(h_{cap} + h_v)}{\frac{h_{cap}}{D_{cap}^{eff}} + \frac{h_v}{D_s^{eff}}}$$

with

$$D_{cap}^{eff} = D^{air} \frac{\theta_{acap}^{3.33}}{\theta_T^2} + D^{wat} \frac{1}{H} \frac{\theta_{wcap}^{3.33}}{\theta_T^2}$$

For both soil and groundwater sources, the effective diffusion through foundation cracks (D_{crack}^{eff}) is estimated by:

$$D_{crack}^{eff} = D^{air} \frac{\theta_{acrack}^{3.33}}{\theta_T^2} + D^{wat} \frac{1}{H} \frac{\theta_{wcrack}^{3.33}}{\theta_T^2}$$

The algorithms used to predict outdoor vapour concentrations which may results from a surface soil, subsurface soil or groundwater source are those described by ASTM (2002; Table X2.5).

Vapour Emissions with a Wet Basement

The algorithms used to predict indoor air vapour concentrations from a basement with walls saturated with contaminated groundwater or an impoundment are those described for quiescent surfaces with flow in *Air Emissions Models for Waste and Wastewater* (US EPA 1994).

For aqueous systems, the relationship describing the mass transfer of volatile chemicals from the open liquid surface to the air is:

$$E = KAC_L$$

Where:

E = air emissions from the liquid surface (g/s);

K = overall mass transfer coefficient (m/s);

A = liquid surface area (m²);

C_L = concentration of constituent in the liquid phase g/m³;

The overall mass transfer coefficient (K) is estimated from a two-phase resistance model that is based on the liquid- phase mass transfer coefficient (k_L in m/s), the gas-phase mass transfer coefficient (k_G in m/s), and Henry's law constant (Keq) and is expressed as:

$$\frac{1}{K} = \frac{1}{k_L} + \frac{1}{k_G * Keq}$$

Where:

K = overall mass transfer coefficient (m/s)

k_L = liquid phase mass transfer coefficient (m/s)

k_G = gas phase mass transfer coefficient (m/s)

Keq = equilibrium constant or partition coefficient, concentration in gas phase/ concentration in liquid phase

Henry's Law constant is temperature adjusted and converts the unitless value to atm.m³/g mol with the following equation:

$$\text{Henry's Law (atm.m}^3/\text{g mol)} = \frac{T}{12186} * HL(\text{unitless})$$

Where:

12186 is a conversion factor to adjust unitless Henry's law to (atm.m³/g mol)

T = temperature of water (degrees Kelvin): assumed to be 20 degrees C/ 293 K.

HL = unitless Henry's law constant

To calculate the equilibrium partitioning coefficient (Keq), the following equation is used (based on a standard temperature of 25 degrees Celsius):

$$Keq = 40.9 * H$$

Where H = Henry's Law constant (atm.m³/g mol)

The liquid phase mass transfer coefficient (k_L) has been shown to be a function of the constituent's diffusivity in water, the windspeed/ air circulation rate, and liquid depth as is estimated by the equation:

$$k_L = 2.611 \times 10^{-7} * U_{10}^2 \left[\frac{D_w}{D_{ether}} \right]^{2/3}$$

Where:

U_{10} = windspeed at 10 m above the liquid surface (m/s), default of 4.47 m/s

D_w = diffusivity of constituent in water (cm²/s)

D_{ether} = diffusivity of ether in water (cm²/s), adopted 8.5×10^{-5} cm²/s

Note: equation valid only for windspeeds greater than 3.25 m/s and fetch to depth (F/D) ratios greater than 51.2.

The gas coefficient (k_G) is estimated from the correlation of MacKay and Matasugu and expresses k_G as a function of windspeed, fetch and effective diameter of the liquid surface (where fetch is defined as the linear distance across the liquid surface in the direction of wind flow, and depth is the depth of water in the impoundment / on the surface).

$$k_G = 4.82 \times 10^{-3} * U^{0.78} * Sc_G^{-0.67} * d_e^{-0.11}$$

Where:

U = windspeed (m/s)

$$Sc_G = \text{Schmidt number on gas side: } Sc_G = \frac{\mu_G}{\rho_G * D_a}$$

Where: μ_G = viscosity of air (g/cm sec): 1.86×10^{-4}

ρ_G = density of air (g/cm³): 1.29×10^{-3}

D_a = diffusivity of constituent in air (cm²/s), typically adopted from RAIS, 1994.

$$D_e = \text{effective diameter of impoundment: } D_e = \left| \frac{4A}{\pi} \right|^{0.5}$$

Where: A = area of impoundment (m²)

π = (pi): mathematical constant for the ratio of a circles circumference to its diameter (3.14592)

The concentration of the constituent in the liquid phase is the driving force for mass transfer and it is assumed the system is well mixed and undergoes no biodegradation; therefore the bulk concentration of the constituent equals the effluent concentrations. The relationship equation yields:

$$C_L = \frac{QC_i}{KA + Q}$$

Where:

Q = volumetric flow rate (m³/s)

C_i = initial concentration in waste (g/m³)

C_L = equilibrium of bulk concentration in the impoundment (g/m³)

K = overall mass transfer coefficient (m/s)

A = liquid surface area (m^2)

Using the first equation an air emission rate from the liquid surface is calculated (E) which can be adjusted to account for the volume of air in a basement and the air exchange rate (per day) using the equation:

$$AirConc_{Basement} = E * \frac{1}{Vol_B} * \frac{1}{Air_{Exc}} \text{ mg/m}^3$$

Where:

Vol_B = Volume of the basement (m^3)

Air_{Exc} = Air exchange rate in basement (exchanges per day)

Table 1: Vapour Model Parameter Definitions

Parameter/Symbol	Definition
A_B	surface area of the enclosed space in contact with soil (cm^2)
$C_{source(m)}$	vapour phase concentration at the media (m) source (mg/m^3)
$C_{source(gw)}$	vapour phase concentration at the groundwater source (mg/m^3)
$C_{source(s)}$	vapour phase concentration at the soil source (mg/m^3)
$C_{source(P)}$	vapour phase concentration at the PSH source (mg/m^3)
C_{soil}	Chemical concentration in bulk soil (mg/kg)
C_{gw}	Chemical concentration in groundwater (mg/L)
D^{air}	Chemical-specific diffusion coefficient in air (cm^2/s)
D^{wat}	Chemical-specific diffusion coefficient in water (cm^2/s)
D_{cap}^{eff}	effective overall vapour-phase diffusion coefficient through capillary fringe (cm^2/s)
D_{crack}^{eff}	effective overall vapour-phase diffusion coefficient through walls and foundation cracks (cm^2/s)
D_T^{eff}	effective overall vapour-phase diffusion coefficient in soil between the foundation and the depth L_T (cm^2/s)
E_B	Indoor air exchange rate with outdoor air (1/s)
f_{oc}	weight fraction of organic carbon in soil (unitless)
H or HL	unitless Henry's law constant
K_{oc}	Chemical-specific carbon-water sorption coefficient (cm^3/g)
k_v	soil vapour permeability (cm^2)
L_{crack}	the enclosed space foundation thickness (cm)
L_T	the distance (depth) to the vapour source or other point of interest below foundation (cm) (equal to $h_{cap}+h_v$ for groundwater-derived vapour, or the depth of soil contamination for soil-derived vapour)

Parameter/Symbol	Definition
MV	gas molar volume (22.4 L/mole at standard temperature and pressure)
MW _i	molecular weight of component <i>i</i>
MW _T	molecular weight of the total mixture
P _T	total pressure of system (assumed to be atmospheric pressure, or 760 mm Hg)
Q _B	the enclosed space volumetric air flow rate (cm ³ /s) of fresh air; usually estimated to be the product of the enclosed space volume (V _B) and the indoor air exchange rate with outdoor air (E _B)
Q _{soil}	the pressure-driven soil gas flow rate from the subsurface into the enclosed space (cm ³ /s)
V _B	Enclosed space volume (cm ³)
VP	Chemical specific vapour pressure of pure liquid chemical <i>i</i> (mm Hg)
Wt.frac. _{i,L}	weight fraction of component <i>i</i> in the liquid (PSH) source
X _{crack}	Building perimeter (cm)
X _{i,g}	mole fraction of component <i>i</i> in the vapour phase
X _{i,L}	mole fraction of component <i>i</i> in the liquid (PSH) source
Z _{crack}	Depth to bottom of slab (cm)
ΔP	pressure differential between soil surface and the enclosed space (g/cm ² -s)
η	the fraction of the enclosed space surface area open for vapour intrusion (unitless), i.e., the areal fraction of cracks in the foundation/slab
μ	viscosity of air (1.81 x 10 ⁻⁴ g/cm-s)
ρ _s	soil bulk density (g/cm ³)
θ _{as}	volumetric air content in vadose zone soils (unitless)
θ _{ws}	volumetric water content in vadose zone soils (unitless)
θ _{as}	volumetric air content in vadose zone soils (unitless)
θ _{ws}	volumetric water content in vadose zone soils (unitless)
θ _T	total soil porosity (unitless)
θ _{acap}	volumetric air content in capillary zone soils (unitless)
θ _{wcap}	volumetric water content in capillary zone soils (unitless)
θ _{acrack}	volumetric air content in foundation/wall cracks (unitless)
θ _{wcrack}	volumetric water content in foundation/wall cracks (unitless)
E	air emissions from the liquid surface (g/s)
K	overall mass transfer coefficient (m/s)
A	liquid surface area (m ²)
C _L	concentration of constituent in the liquid phase

Parameter/Symbol	Definition
U_{10}	windspeed at 10 m above the liquid surface (m/s)
D_w	diffusivity of constituent in water (cm^2/s)
D_{ether}	diffusivity of ether in water (cm^2/s), adopted $8.5 \times 10^{-5} \text{ cm}^2/\text{s}$
K	overall mass transfer coefficient (m/s)
k_L	liquid phase mass transfer coefficient (m/s)
k_G	gas phase mass transfer coefficient (m/s)
K_{eq}	equilibrium constant or partition coefficient, concentration in gas phase/ concentration in liquid phase
U	windspeed (m/s)
Sc_G	Schmidt number on gas side
μ_G	viscosity of air ($\text{g}/\text{cm sec}$): 1.86×10^{-4}
ρ_G	density of air (g/cm^3): 1.29×10^{-3}
D_a	diffusivity of constituent in air (cm^2/s)
D_e	effective diameter of impoundment
A	area of impoundment (m^2)
Q	volumetric flow rate (m^3/s)
C_i	initial concentration in waste (g/m^3)
C_L	equilibrium of bulk concentration in the impoundment (g/m^3)
K	overall mass transfer coefficient (m/s)
A	liquid surface area (m^2)
Vol_B	Volume of the basement (m^3)
Air_{Exc}	Air exchange rate in basement (exchanges per day)

REFERENCES

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Nazaroff, W.W., 1988. *Predicting the rate of ^{222}Rn entry from soil into the basement of dwelling due to pressure-driven air flow*. Radiation Protection Dosimetry. 24:199-202.

RAIS, 2008. *Risk Assessment Information System*. <http://rais.ornl.gov>. U.S. Department of Energy Office of Environmental Management, Oak Ridge Operations Office. Accessed August 2008.

US EPA, 1994. *Air Emissions Models for Waste and Wastewater*. EPA-453/R-94-080A. November 1994.

Appendix C

Risk Scenario 1 Lower Basement

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Lend Lease
Scenario: Scenario 1 - Lower Basement (Risk Based Calculations)

Header Colour (Defaults = Blue):
Blue

2. Select Receptor:

Commercial/Industrial

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways	
☐	Incidental Ingestion of Soil
☐	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐	Inhalation of Soil-Derived Vapours From Excavation (USEPA 2002 method)
☐	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air
Groundwater Pathways	
☐	Inhalation of Groundwater-Derived Vapours in Indoor Air
☐	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☐	Incidental Ingestion of Groundwater (Bathing or Excavation)
☐	Dermal Contact with Groundwater (Bathing or Excavation)
☐	Inhalation of Groundwater Vapours during Irrigation/ Showering
☐	Ingestion of Vegetables Irrigated with Groundwater
☐	Inhalation of Groundwater Vapours (Where GW Enters Trench)
☒	Inhalation of vapour emissions from flowing water (groundwater in basement)
☐	Inhalation of Soil Vapour-Derived Vapours in Indoor Air
☐	Inhalation of Soil Vapour-Derived Vapours in Outdoor Air

☐	Soil RBSLs saturation limited?
☐	Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (If only calculating RBSLs, enter 1 for media for which you want RBSLs):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁶ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

6. Confirm/Modify Exposure Parameters:

		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child
General receptor parameters:					
Body weight	kg	70	13	70	13
Exposure duration	yr	64	6	64	6
Averaging time (carcinogens)	yr	70	70	70	70
Averaging time (non-carcinogens)	yr	64	6	64	6
Incidental Soil Ingestion					
Daily soil ingestion rate	mg/day				
Exposure frequency for soil ingestion	days/yr				
Fraction of daily soil intake from site	unitless				
Dermal Absorption of Soil					
Exposed skin surface area for soil contact	cm2				
Soil to skin adherence factor	mg/cm2				
Exposure frequency for dermal contact with soil	days/yr				
Indoor Inhalation					
Exposure time (indoor air)	hrs/day				
Exposure frequency (indoor air)	days/yr				
Particulate emission factor (indoor air)	m3/kg				
Outdoor Inhalation					
Exposure time (outdoor air)	hrs/day				
Exposure frequency (outdoor air)	days/yr				
Particulate emission factor (outdoor air)	m3/kg				
Potable Water Ingestion					
Potable water intake rate	L/day				
Exposure frequency for potable water intake	days/yr				
Incidental Water Ingestion					
Incidental ingestion rate	L/day				
Exposure frequency for incidental water ingestion	days/yr				
Dermal Contact with Water					
Exposed skin surface for water contact	cm2				
Exposure time for dermal water contact	hr/day				
Exposure frequency for dermal water contact	days/yr				
Vapour Inhalation Shower/ Sprinkler					
Exposure frequency	days/yr				
Exposure time	min/ day				
Inhalation rate	m3/hr				
Inhalation Absorption Adjustment Factor	mg/mg				
Lung retention factor	unitless				
Ingestion of Home Grown Produce					
Proportion of homegrown produce ingested					
Exposure frequency	days/year				
Inhalation of Vapours from Flowing Water					
Exposure time	hrs/day	1	1	1	1
Exposure frequency	days/year	350	350	350	350

7. Enter Target Risk Levels for RBSL Calculation (per chemical)		
	Target Hazard Index	Target Cancer Risk
Default Values:	1	1.00E-05
Site specific value (optional):		
Value Used in Calculations:	1	1.00E-05

Links to Model Setup:
[Groundwater to Air Vapour Model Setup](#)
[Soil to Air Vapour Model Setup](#)
[Soil Vapour to Air Model Setup](#)
[Calculation of source vapour concentrations from NAPL](#)
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Links to Risk Calculation
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[Soil Dermal Contact](#)
[Soil-Derived Dust Inhalation - Indoors](#)
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[Inhalation of Surface Soil Derived Vapours - Outdoors](#)
[Inhalation of Soil Derived Vapours - Excavation](#)
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GROUNDWATER:
[Potable Groundwater Ingestion](#)
[Incidental Groundwater Ingestion](#)
[Dermal Contact with Groundwater](#)
[Inhalation of GW Derived Vapours - Indoors](#)
[Inhalation of GW Derived Vapours - Outdoors](#)
[Inhalation of GW Derived Vapour- Shower/Sprinkler](#)
[Ingestion of homegrown produce](#)
[Inhalation of GW Vapours - Trench with Pooled Water](#)
[Inhalation of vapour emissions from water with flow](#)
SOIL VAPOUR:
[Inhalation of SV Derived Vapours - Indoors](#)
[Inhalation of SV Derived Vapours - Outdoors](#)

Links to RBSL Detail:
[Soil - Adult Threshold](#)
[Soil - Child Threshold](#)
[Soil - Non-Threshold](#)
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Calculation of Vapour Emissions from Water with Flow
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement (Residential Receptor) (Risk Based Calculations)

PARAMETERS

Concrete permeability	(select from drop down list)	High permeability
Permeability Rate (m/day)		8.6.E-02
Water Temperature (deg. C)		18.0
Dimensions of Basement / Impoundment		
Height (m)		2.5
Width (m)		30.0
Depth (m)		30.0
Volume total basement/ impoundment (m3)		2250

Dimensions of Wet Section of Basement/ Impoundment

Length (m)	35.0
Width (m)	15.0
Depth of Water (m)	0.01
Fetch/ Depth (m) ratio of Wet Basement Section	1500
Volume of wet basement/ impoundment (m3)	5.3
Area covered in water (m2)	525
Effective diameter of impoundment/ basement (m)	25.9
Volume of water entering basement (m³/sec)	5.25E-06

Air exchange rate (exchanges/day)

Windspeed (m/s)	if < 3.5 m/sec
	if = or > 3.5 m/sec

9.60E+01
3.00E-02

Parameter Definition	Volatile	Chemical Concentration in Water (mg/L)	Molecular weight (g/mol)	Vapour Pressure (mmHg)	Vapour Pressure (atm)	Henry's Law Coefficient (unitless)	Henry's Law Coefficient (calculated)	Equilibrium Coefficient (at 25 deg C)	Diffusivity in Water (cm²/sec)	Schmidt Number on Gas Side (*)	Gas Phase Mass Transfer Coefficient (m/sec)	Schmidt Number on Liquid Side #	Liquid Phase Mass Transfer Coefficient (m/s) <3.5 m/s	Overall Mass Transfer Coefficient (m/s) (windspeed <3.5 m/s)	Adopted Liquid Mass Transfer Coefficient (m/s)	Overall Mass Transfer Coefficient (m/s)	Diffusivity in Air (cm²/sec)	Equilibrium Concentration of water in Basement/ Impoundment (g/m³)	Air Emission Rate from Liquid Surface (g/sec)	Air Emission Rate from Liquid Surface (mg/day)	Adjusted Concentration in Basement Air (includes air exchange) (mg/m3)
		C	MW	Vap	Vap	unitless	atm.m3/g mol	K _{ow}	D _{water}	Sc _G	k _G	Sc _L	K _L	K	K _L	K	D _{air}	C _L	E	E	
Acenaphthene	Y	4.48	154	2.15E-03	2.83E-06	7.52E-03	1.80E-04	7.345E-03	8.33E-06	3.0E+00	1.052E-04	1.08E+03	2.7E-07	2.0E-07	2.7E-07	2.0E-07	0.0506	1.6E-01	1.67E-05	1.45E+03	6.70E-03
Acenaphthylene	Y	43.2	152	6.68E-03	8.79E-06	4.66E-03	1.11E-04	4.551E-03	6.98E-06	3.4E+00	9.725E-05	1.29E+03	2.4E-07	1.6E-07	2.4E-07	1.6E-07	0.045	1.7E+00	1.40E-04	1.21E+04	5.62E-02
Ammonia	Y	348	17	-	-	6.58E-04	1.57E-05	6.427E-04	1.10E-05	6.6E-01	2.884E-04	8.18E+02	3.3E-07	1.2E-07	3.3E-07	1.2E-07	0.228	1.0E+01	6.88E-04	5.51E+04	2.55E-01
Aniline	N	0.212	93.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	Y	15.4	178	6.53E-06	8.59E-09	2.27E-03	5.42E-05	2.217E-03	7.85E-06	3.9E+00	8.836E-05	1.15E+03	2.6E-07	1.1E-07	2.6E-07	1.1E-07	0.039	5.6E-01	3.32E-05	2.87E+03	1.33E-02
Arsenic, Inorganic	N	0.024	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	N	2.23	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	N	12.6	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	Y	40.2	78.1	9.48E+01	1.25E-01	2.27E-01	5.42E-03	2.217E-01	1.03E-05	1.7E+00	1.542E-04	8.74E+02	3.2E-07	3.1E-07	3.2E-07	3.1E-07	0.0895	1.2E+00	2.03E-04	1.75E+04	8.11E-02
Benzo(a)pyrene	N	9.26	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	N	8.33	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	N	4.22	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	N	2.93	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	N	0.03	391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	N	0.108	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	N	9.78	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	N	0.057	58.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m- & p-	N	436	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	N	182	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	N	0.822	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	Y	10.2	168	2.48E-03	3.26E-06	8.71E-03	2.08E-04	8.507E-03	7.38E-06	3.7E+00	9.137E-05	1.22E+03	2.5E-07	1.9E-07	2.5E-07	1.9E-07	0.041	3.9E-01	3.89E-05	3.38E+03	1.55E-02
Dimethylphenol, 2,4-	N	38	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	Y	3.02	106	9.60E+00	1.26E-02	3.22E-01	7.69E-03	3.145E-01	8.46E-06	2.2E+00	1.289E-04	1.06E+03	2.8E-07	2.8E-07	2.8E-07	2.8E-07	0.0685	1.1E-01	1.52E-05	1.31E+03	6.08E-03
Fluoranthene	N	25.9	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	Y	21.1	166	6.00E-04	7.90E-07	3.93E-03	9.38E-05	3.838E-03	7.89E-06	3.4E+00	9.580E-05	1.14E+03	2.6E-07	1.5E-07	2.6E-07	1.5E-07	0.044	7.7E-01	6.21E-05	5.36E+03	2.48E-02
Indeno(1,2,3-cd)pyrene	N	3.05	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	N	187	55.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	N	0.555	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	N	4.89	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	Y	105	142	5.50E-02	7.24E-05	2.12E-02	5.06E-04	2.071E-02	7.78E-06	2.9E+00	1.077E-04	1.16E+03	2.6E-07	2.3E-07	2.6E-07	2.3E-07	0.0524	3.9E+00	4.75E-04	4.11E+04	1.90E-01
Naphthalene	Y	283	128	8.50E-02	1.12E-04	1.80E-02	4.30E-04	1.758E-02	8.38E-06	2.5E+00	1.186E-04	1.07E+03	2.8E-07	2.4E-07	2.8E-07	2.4E-07	0.0605	9.9E+00	1.27E-03	1.09E+05	5.07E-01
Nickel Soluble Salts	N	0.303	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	Y	74.1	178	1.21E-04	1.59E-07	1.73E-03	4.13E-05	1.690E-03	6.69E-06	4.4E+00	8.139E-05	1.35E+03	2.4E-07	8.7E-08	2.4E-07	8.7E-08	0.0345	3.0E+00	1.37E-04	1.18E+04	5.48E-02
Phenol	N	249	94.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	Y	27.9	202	4.50E-06	5.92E-09	4.87E-04	1.16E-05	4.756E-04	7.25E-06	5.4E+00	7.043E-05	1.24E+03	2.5E-07	3.0E-08	2.5E-07	3.0E-08	0.0278	1.1E+00	1.66E-05	1.44E+03	6.66E-03
Styrene	Y	0.194	104	6.40E+00	8.42E-03	1.12E-01	2.67E-03	1.094E-01	1.08E-06	2.1E+00	1.321E-04	1.03E+03	2.9E-07	2.9E-07	2.8E-07	2.8E-07	0.0711	6.9E-03	9.85E-07	8.34E+01	3.89E-04
Toluene	Y	17.6	92.1	2.84E+01	3.74E-02	2.71E-01	6.47E-03	2.647E-01	9.20E-06	1.9E+00	1.403E-04	9.78E+02	2.9E-07	2.9E-07	2.9E-07	2.9E-07	0.0778	5.8E-01	8.87E-05	7.66E+03	3.55E-02
TPH C06-C09 aliphatic	Y	6.08	103	9.18E+01	1.21E-01	5.05E+01	1.21E+00	4.932E+01	1.00E-05	1.5E+00	1.660E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	3.09E-05	2.67E+03	1.24E-02
TPH C10-C14 aliphatic	Y	1730	170	1.16E+00	1.53E-03	6.26E+01	1.49E+00	6.114E+01	1.00E-05	1.5E+00	1.660E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	8.80E-03	7.60E+05	3.52E+00
TPH C10-C14 aromatic	Y	1730	136	1.16E+00	1.53E-03	1.41E-01	3.37E-03	1.377E-01	1.00E-05	1.5E+00	1.660E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	8.88E-03	7.50E+05	3.47E+00
TPH C15-C28 aliphatic	n	1520	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	n	1520	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	n	332	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	n	332	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	Y	0.92	120	2.10E+00	2.76E-03	2.52E-01	6.02E-03	2.461E-01	7.92E-06	2.5E+00	1.188E-04	1.14E+03	2.7E-07	2.6E-07	2.7E-07	2.6E-07	0.0607	3.3E-02	4.61E-06	3.99E+02	1.85E-03
Vanadium and compounds	N	0.0228	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	Y	6.7	106	7.99E+00	1.05E-02	2.12E-01	5.06E-03	2.071E-01	9.90E-06	1.8E+00	1.486E-04	9.09E+02	3.1E-07	3.0E-07	3.1E-07	3.0E-07	0.0847	2.1E-01	3.37E-05	2.91E+03	1.35E-02

Notes:

Assumes viscosity of air at 25 deg C

(*) Adopted density and viscosity of air values are those published in USEPA Air Emissions for Wast and Waste Water Nov 1994. (viscosity = 1.81 x 10⁻⁴, density = 1.2 x 10⁻³)

** where windspeeds are greater than 3.25 m/s, F/D ratios greater than 51.2 and diffusivity of ether is 8.5 x 10⁻⁵

where viscosity of water is assumed to be 9 x 10⁻³ g/cm per sec and density of water 1g/cm³.

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Summary of Derived RBSLs

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 1 - Lower Basement (Residential Receptor) (Risk Based Calculations)

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	-	-	-	-	-	-	6.12E+02	6.12E+02	-	6.12E+02	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	3.01E+02	3.01E+02	-	3.01E+02	>Sol	4.32E+01
Ammonia	-	-	-	-	-	-	2.37E+03	2.37E+03	-	2.37E+03	-	3.48E+02
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	-	-	-	-	-	-	1.72E+01	1.72E+01	-	1.72E+01	>Sol	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	2.98E+01	2.98E+01	2.07E+01	2.07E+01	-	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	1.05E+03	1.05E+03	-	1.05E+03	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	4.04E+03	4.04E+03	-	4.04E+03	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	4.77E+01	4.77E+01	-	4.77E+01	>Sol	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	-	-	-	-	-	-	9.07E+01	9.07E+01	-	9.07E+01	>Sol	1.05E+02
Naphthalene	-	-	-	-	-	-	9.19E-01	9.19E-01	-	9.19E-01	-	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	2.20E+01	2.20E+01	-	2.20E+01	>Sol	7.41E+01
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	-	-	-	-	-	-	1.07E+01	1.07E+01	-	1.07E+01	>Sol	2.79E+01
Styrene	-	-	-	-	-	-	3.27E+03	3.27E+03	-	3.27E+03	>Sol	1.94E-01
Toluene	-	-	-	-	-	-	1.55E+04	1.55E+04	-	1.55E+04	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	2.83E+04	2.83E+04	-	2.83E+04	>Sol	6.08E+00
TPH C10-C14 aliphatic	-	-	-	-	-	-	3.13E+00	3.13E+00	-	3.13E+00	>Sol	1.73E+03
TPH C10-C14 aromatic	-	-	-	-	-	-	4.56E+00	4.56E+00	-	4.56E+00	-	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	-	-	-	-	-	-	8.74E+01	8.74E+01	-	8.74E+01	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	-	-	-	-	-	-	6.84E+02	6.84E+02	-	6.84E+02	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

Pathways included in derivation of Soil Vapour RBSL:

Pathways included in derivation of Groundwater RBSL:

Health Risk Calculations - Vapours from Flowing Water
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement (Residential Receptor) (Risk Based Calculations)

Chemical	Vapour Concentration in Basement/ Impoundment	Aqueous Solubility	Threshold Intake and Risk Calculations						
			Inhalation RfC	Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)	Child Exposure Factor (threshold)	Child Exposure Adjusted Air Concentration (threshold)	Hazard Index (Child)
	mg/m ³	(mg/L)	(mg/m3)	(L/m3)	(mg/m3)	(unitless)	(L/m3)	(mg/m3)	(unitless)
Acenaphthene	6.70E-03	3.90E+00	2.10E-01	4.00E-02	2.68E-04	1.27E-03	4.00E-02	2.68E-04	1.27E-03
Acenaphthylene	5.62E-02	1.61E+01	2.10E-01	4.00E-02	2.25E-03	1.07E-02	4.00E-02	2.25E-03	1.07E-02
Ammonia	2.55E-01	4.82E+05	6.95E-02	4.00E-02	1.02E-02	1.47E-01	4.00E-02	1.02E-02	1.47E-01
Aniline	-	3.60E+04	-	-	-	-	-	-	-
Anthracene	1.33E-02	4.34E-02	1.05E+00	4.00E-02	5.31E-04	5.05E-04	4.00E-02	5.31E-04	5.05E-04
Arsenic, Inorganic	-	0.00E+00	-	-	-	-	-	-	-
Barium	-	0.00E+00	-	-	-	-	-	-	-
Benz(a)anthracene	-	9.40E-03	-	-	-	-	-	-	-
Benzene	8.11E-02	1.79E+03	9.60E-03	4.00E-02	3.24E-03	3.37E-01	4.00E-02	3.24E-03	3.37E-01
Benzo(a)pyrene	-	1.62E-03	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	1.50E-03	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	2.60E-04	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	8.00E-04	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	2.70E-01	-	-	-	-	-	-	-
Cadmium (Water)	-	0.00E+00	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Chromium(VI)	-	1.69E+06	-	-	-	-	-	-	-
Chrysene	-	2.00E-03	-	-	-	-	-	-	-
Cobalt	-	0.00E+00	-	-	-	-	-	-	-
Cresol, m-&p-	-	2.27E+04	-	-	-	-	-	-	-
Cresol, o-	-	2.59E+04	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	2.49E-03	-	-	-	-	-	-	-
Dibenzofuran	1.55E-02	3.10E+00	2.10E-01	4.00E-02	6.21E-04	2.96E-03	4.00E-02	6.21E-04	2.96E-03
Dimethylphenol, 2,4-	-	7.87E+03	-	-	-	-	-	-	-
Ethylbenzene	6.08E-03	1.69E+02	1.30E+00	4.00E-02	2.43E-04	1.87E-04	4.00E-02	2.43E-04	1.87E-04
Fluoranthene	-	2.60E-01	-	-	-	-	-	-	-
Fluorene	2.48E-02	1.69E+00	1.40E-01	4.00E-02	9.92E-04	7.09E-03	4.00E-02	9.92E-04	7.09E-03
Indeno(1,2,3-cd)pyrene	-	1.90E-04	-	-	-	-	-	-	-
Iron	-	0.00E+00	-	-	-	-	-	-	-
Lead and Compounds	-	0.00E+00	-	-	-	-	-	-	-
Manganese	-	0.00E+00	-	-	-	-	-	-	-
Methylnaphthalene, 2-	1.90E-01	2.46E+01	1.40E-01	4.00E-02	7.59E-03	5.42E-02	4.00E-02	7.59E-03	5.42E-02
Naphthalene	5.07E-01	3.10E+01	3.00E-03	4.00E-02	2.02E-02	6.75E+00	4.00E-02	2.02E-02	6.75E+00
Nickel Soluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Phenanthrene	5.48E-02	1.15E+00	2.10E-01	4.00E-02	2.19E-03	1.04E-02	4.00E-02	2.19E-03	1.04E-02
Phenol	-	8.28E+04	-	-	-	-	-	-	-
Pyrene	6.66E-03	1.35E-01	1.05E-01	4.00E-02	2.66E-04	2.53E-03	4.00E-02	2.66E-04	2.53E-03
Styrene	3.86E-04	3.10E+02	2.60E-01	4.00E-02	1.54E-05	5.93E-05	4.00E-02	1.54E-05	5.93E-05
Toluene	3.55E-02	5.26E+02	5.00E+00	4.00E-02	1.42E-03	2.83E-04	4.00E-02	1.42E-03	2.83E-04
TPH C06-C09 aliphatic	1.24E-02	1.18E+01	1.84E+01	4.00E-02	4.94E-04	2.69E-05	4.00E-02	4.94E-04	2.69E-05
TPH C10-C14 aliphatic	3.52E+00	9.99E-02	1.00E+00	4.00E-02	3.99E-03	3.99E-03	4.00E-02	3.99E-03	3.99E-03
TPH C10-C14 aromatic	3.47E+00	2.53E+01	2.00E-01	4.00E-02	1.39E-01	6.94E-01	4.00E-02	1.39E-01	6.94E-01
TPH C15-C28 aliphatic	-	1.11E-04	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	1.06E+00	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	2.50E-06	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	6.60E-03	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.85E-03	5.70E+01	7.00E-03	4.00E-02	7.37E-05	1.05E-02	4.00E-02	7.37E-05	1.05E-02
Vanadium and compounds	-	-	-	-	-	-	-	-	-
Xylenes (total)	1.35E-02	1.06E+02	2.20E-01	4.00E-02	5.39E-04	2.45E-03	4.00E-02	5.39E-04	2.45E-03
Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)						8.03E+00		8.03E+00	
TOTAL									

[illegible]

Groundwater RBSL Derivation - Adult Threshold Health Effects
 Barangaroo
 Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Scenario 1 - Lower Basement (Residential Receptor) (Risk Based Calculations)

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW vapours from flowing water	TOTAL (All Pathways)	GW vapours from flowing water	Total Vapour Pathways	TOTAL (All Pathways)					GW vapours from flowing water	TOTAL
			unitless	unitless	unitless	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	1.27E-03	1.27E-03	3.27E-04	3.27E-04	3.27E-04	6.12E+02	1.27E-03	1.27E-03	6.12E+02	0.6%	0.64%
Acenaphthylene	43.2	1.61E+01	1.07E-02	1.07E-02	6.64E-04	6.64E-04	6.64E-04	3.01E+02	1.07E-02	1.07E-02	3.01E+02	5.3%	5.35%
Ammonia	348	4.82E+05	1.47E-01	1.47E-01	4.21E-04	4.21E-04	4.21E-04	2.37E+03	1.00E+00	-	2.37E+03	100.0%	100.00%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	5.05E-04	5.05E-04	1.16E-02	1.16E-02	1.16E-02	1.72E+01	5.05E-04	5.05E-04	1.72E+01	0.3%	0.25%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.37E-01	3.37E-01	8.39E-03	8.39E-03	8.39E-03	2.98E+01	2.50E-01	-	2.98E+01	100.0%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	2.96E-03	2.96E-03	9.54E-04	9.54E-04	9.54E-04	1.05E+03	2.96E-03	2.96E-03	1.05E+03	0.3%	0.30%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.87E-04	1.87E-04	6.19E-05	6.19E-05	6.19E-05	4.04E+03	1.05E-02	1.05E-02	4.04E+03	4.2%	4.18%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	7.09E-03	7.09E-03	4.19E-03	4.19E-03	4.19E-03	4.77E+01	7.09E-03	7.09E-03	4.77E+01	3.5%	3.54%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	5.42E-02	5.42E-02	2.20E-03	2.20E-03	2.20E-03	9.07E+01	5.42E-02	5.42E-02	9.07E+01	27.1%	27.12%
Naphthalene	283	3.10E+01	6.75E+00	6.75E+00	2.18E-01	2.18E-01	2.18E-01	9.19E-01	2.00E-01	-	9.19E-01	100.0%	100.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.04E-02	1.04E-02	9.07E-03	9.07E-03	9.07E-03	2.20E+01	1.04E-02	1.04E-02	2.20E+01	5.2%	5.22%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	2.53E-03	2.53E-03	1.88E-02	1.88E-02	1.88E-02	1.07E+01	2.53E-03	2.53E-03	1.07E+01	1.3%	1.27%
Styrene	0.194	3.10E+02	5.93E-05	5.93E-05	3.06E-04	3.06E-04	3.06E-04	3.27E+03	9.48E-02	9.48E-02	3.27E+03	9.5%	9.48%
Toluene	17.6	5.26E+02	2.83E-04	2.83E-04	1.61E-05	1.61E-05	1.61E-05	1.55E+04	8.47E-03	8.47E-03	1.55E+04	3.4%	3.39%
TPH C06-C09 aliphatic	6.08	1.18E+01	2.69E-05	2.69E-05	4.42E-06	4.42E-06	4.42E-06	2.83E+04	5.21E-05	5.21E-05	2.83E+04	0.0%	0.04%
TPH C10-C14 aliphatic	1730	9.99E-02	3.99E-03	3.99E-03	4.00E-02	4.00E-02	4.00E-02	3.13E+00	3.99E-03	3.99E-03	3.13E+00	3.2%	3.19%
TPH C10-C14 aromatic	1730	2.53E+01	6.94E-01	6.94E-01	2.74E-02	2.74E-02	2.74E-02	4.56E+00	1.25E-01	-	4.56E+00	100.0%	100.00%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.05E-02	1.05E-02	1.14E-02	1.14E-02	1.14E-02	8.74E+01	6.52E-01	6.52E-01	8.74E+01	65.2%	65.25%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	2.45E-03	2.45E-03	3.66E-04	3.66E-04	3.66E-04	6.84E+02	3.88E-02	3.88E-02	6.84E+02	15.5%	15.51%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement (Residential Receptor) (Risk Based Calculations)

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapurs from Flowing Water	TOTAL (All Pathways)	GW Vapour from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)					GW Vapours from Flowing Water	TOTAL
			unitless	unitless	unitless	L/mg	L/mg				mg/L	%	%
Acenaphthene	4.48	3.90E+00	1.27E-03	1.27E-03	3.27E-04	3.27E-04	3.27E-04	6.12E+02	1.27E-03	1.27E-03	6.12E+02	0.6%	0.64%
Acenaphthylene	43.2	1.61E+01	1.07E-02	1.07E-02	6.64E-04	6.64E-04	6.64E-04	3.01E+02	1.07E-02	1.07E-02	3.01E+02	5.3%	5.35%
Ammonia	348	4.82E+05	1.47E-01	1.47E-01	4.21E-04	4.21E-04	4.21E-04	2.37E+03	1.00E+00	-	2.37E+03	100.0%	100.00%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	5.05E-04	5.05E-04	1.16E-02	1.16E-02	1.16E-02	1.72E+01	5.05E-04	5.05E-04	1.72E+01	0.3%	0.25%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.37E-01	3.37E-01	8.39E-03	8.39E-03	8.39E-03	2.98E+01	2.50E-01	-	2.98E+01	100.0%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	2.96E-03	2.96E-03	9.54E-04	9.54E-04	9.54E-04	1.05E+03	2.96E-03	2.96E-03	1.05E+03	0.3%	0.30%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.87E-04	1.87E-04	6.19E-05	6.19E-05	6.19E-05	4.04E+03	1.05E-02	1.05E-02	4.04E+03	4.2%	4.18%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	7.09E-03	7.09E-03	4.19E-03	4.19E-03	4.19E-03	4.77E+01	7.09E-03	7.09E-03	4.77E+01	3.5%	3.54%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	5.42E-02	5.42E-02	2.20E-03	2.20E-03	2.20E-03	9.07E+01	5.42E-02	5.42E-02	9.07E+01	27.1%	27.12%
Naphthalene	283	3.10E+01	6.75E+00	6.75E+00	2.18E-01	2.18E-01	2.18E-01	9.19E-01	2.00E-01	-	9.19E-01	100.0%	100.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.04E-02	1.04E-02	9.07E-03	9.07E-03	9.07E-03	2.20E+01	1.04E-02	1.04E-02	2.20E+01	5.2%	5.22%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	2.53E-03	2.53E-03	1.88E-02	1.88E-02	1.88E-02	1.07E+01	2.53E-03	2.53E-03	1.07E+01	1.3%	1.27%
Styrene	0.194	3.10E+02	5.93E-05	5.93E-05	3.06E-04	3.06E-04	3.06E-04	3.27E+03	9.48E-02	9.48E-02	3.27E+03	9.5%	9.48%
Toluene	17.6	5.26E+02	2.83E-04	2.83E-04	1.61E-05	1.61E-05	1.61E-05	1.55E+04	8.47E-03	8.47E-03	1.55E+04	3.4%	3.39%
TPH C06-C09 aliphatic	6.08	1.18E+01	2.69E-05	2.69E-05	4.42E-06	4.42E-06	4.42E-06	2.83E+04	5.21E-05	5.21E-05	2.83E+04	0.0%	0.04%
TPH C10-C14 aliphatic	1730	9.99E-02	3.99E-03	3.99E-03	4.00E-02	4.00E-02	4.00E-02	3.13E+00	3.99E-03	3.99E-03	3.13E+00	3.2%	3.19%
TPH C10-C14 aromatic	1730	2.53E+01	6.94E-01	6.94E-01	2.74E-02	2.74E-02	2.74E-02	4.56E+00	1.25E-01	-	4.56E+00	100.0%	100.00%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.05E-02	1.05E-02	1.14E-02	1.14E-02	1.14E-02	8.74E+01	6.52E-01	6.52E-01	8.74E+01	65.2%	65.25%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	2.45E-03	2.45E-03	3.66E-04	3.66E-04	3.66E-04	6.84E+02	3.88E-02	3.88E-02	6.84E+02	15.5%	15.51%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects
Barangaroo Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement (Residential Receptor) (Risk Based Calculations)

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapours from Flowing Water	TOTAL (All Pathways)	GW Vapours from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)				GW Vapours from Flowing Water	TOTAL
	mg/L	mg/L	unitless	unitless	L/mg	L/mg	L/mg	mg/L		mg/L	%	%
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.94E-05	1.94E-05	4.84E-07	4.84E-07	4.84E-07	2.07E+01	1.00E-05	2.07E+01	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix D

Risk Scenario 2 Upper Basement

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Lend Lease
Scenario: Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations)

Header Colour (Defaults = Blue):
Blue

2. Select Receptor:
Commercial/Industrial

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐ Incidental Ingestion of Soil
☐ Dermal Contact with Soil
☐ Inhalation of Surface Soil-Derived Dust in Indoor Air
☐ Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐ Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐ Inhalation of Soil-Derived Vapours From Excavation (USEPA 2002 method)
☒ Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐ Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐ Inhalation of Groundwater-Derived Vapours in Indoor Air
☐ Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐ Ingestion of Potable Groundwater
☐ Incidental Ingestion of Groundwater (Bathing or Excavation)
☐ Dermal Contact with Groundwater (Bathing or Excavation)
☐ Inhalation of Groundwater Vapours during Irrigation/ Showering
☐ Ingestion of Vegetables Irrigated with Groundwater
☐ Inhalation of Groundwater Vapours (Where GW Enters Trench)
☒ Inhalation of vapour emissions from flowing water (groundwater in basement)

☐ Inhalation of Soil Vapour-Derived Vapours in Indoor Air
☐ Inhalation of Soil Vapour-Derived Vapours in Outdoor Air

☐ Y Soil RBSLs saturation limited?
☐ Y Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1 for media for which you want RBSLs):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁶ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2567	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child

General receptor parameters:

Units

Body weight kg 70 na 70

Exposure duration yr 30 na 30

Averaging time (carcinogens) yr 70 na 70

Averaging time (non-carcinogens) yr 30 na 30

Incidental Soil Ingestion

Daily soil ingestion rate mg/day

Exposure frequency for soil ingestion days/yr

Fraction of daily soil intake from site unitless

Dermal Absorption of Soil

Exposed skin surface area for soil contact cm2

Soil to skin adherence factor mg/cm2

Exposure frequency for dermal contact with soil days/yr

Indoor Inhalation

Exposure time (indoor air) hrs/day 8 8 8 8

Exposure frequency (indoor air) days/yr 240 240 240 240

Particulate emission factor (indoor air) m3/kg

Outdoor Inhalation

Exposure time (outdoor air) hrs/day

Exposure frequency (outdoor air) days/yr

Particulate emission factor (outdoor air) m3/kg

Potable Water Ingestion

Potable water intake rate L/day

Exposure frequency for potable water intake days/yr

Incidental Water Ingestion

Incidental ingestion rate L/day

Exposure frequency for incidental water ingestion days/yr

Dermal Contact with Water

Exposed skin surface for water contact cm2

Exposure time for dermal water contact hr/day

Exposure frequency for dermal water contact days/yr

Vapour Inhalation Shower/ Sprinkler

Exposure frequency days/yr

Exposure time min/ day

Inhalation rate m3/hr

Inhalation Absorption Adjustment Factor mg/mg

Lung retention factor unitless

Ingestion of Home Grown Produce

Proportion of homegrown produce ingested

Exposure frequency days/year

Inhalation of Vapours from Flowing Water

Exposure time hrs/day 8 na 8

Exposure frequency days/year 240 na 240

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	0.001	Autocalculates from layer thicknesses
Vadose Zone Layer 1 (soil type where source is)							
Thickness	cm	100		0.001	HV	0.001	Negligible distance - assumes soil is adjacent building foundation
SCS Soil Type:				Sand and gravel (<12% fines)			Conservative assumption for mixed fill
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning: see text.
Vadose zone biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
Vadose Zone Layer 2 (lens)							
Thickness	cm				Hvtwo		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA			VACS2	NA	
Water-filled porosity (volumetric)	cm3/cm3	NA			wvcvz2	NA	
Total soil porosity	cm3/cm3	NA			TPOR2	NA	
Vadose Zone Layer 3 (lens)							
Thickness	cm				Hvthree		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA			VACS3	NA	
Water-filled porosity (volumetric)	cm3/cm3	NA			Vwcvz3	NA	
Total soil porosity	cm3/cm3	NA			TPOR3	NA	
Building Characteristics							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)	1875	LB	1875	Assumes 25 m by 25 m by 3 m high basement section, with soil vapour infiltration through upper 2m of 2 of 4 walls only, ie volume = 1875 m3 and infiltration area = 100 m2. See text.
Enclosed-space foundation or wall thickness	cm	15		15	Lorack	15	Conservative default
Enclosed-space air exchange rate	1/s	0.000555556		0.001111111	ENCAER	1.11E-03	4 per hour, minimum rate for carpark as per AS1668.2
Areal fraction of cracks in foundations/walls	cm²-cracks/cm²-total area	0.0019	(b)	0.0002	NU	0.0002	USEPA (2004) default for basement foundation.
Volumetric air content in found./wall cracks	co/cc	0.26		0.321	VACF	0.321	Assumes cracks in concrete are filled with sand
Volumetric water content in found./wall cracks	co/cc	0.12		0.054	vwchd	0.054	Assumes cracks in concrete are filled with sand
Convective vapour flow term							
Calculate convective flow term?		Y		Y	Conv	Y	
Convective flow rate (if specified directly)	cm3/sec	10.88		175.2668575	Qs	175.27	
Convective flow through slab (calculated)	cm2	700000		7.25E+06	Ab	7250000	Area through which vapours may enter (conservatively includes floor and all walls)
Slab Area	cm²-cracks/cm²-total area	0.0019		0.0002	Nuc		
Areal fraction of cracks in foundations/walls	cm²	1.00E-08		1.00E-07	kv	1.00E-07	Conservative default for coarse sand/gravel
Soil vapour permeability	g/cm-s²	40		40	dP	40	USEPA (2004b) default
Indoor-outdoor pressure differential	cm	3400		10000	Xcrack	10000	Perimeter of basement footprint.
Slab perimeter	cm	15		200	Zcrack	200	Advection occurring to max depth of 2 m.
Depth below ground to bottom of slab	g/cm-s	1.81E-04		1.81E-04	uair	1.81E-04	Viscosity of air at 20 C
Viscosity of air							

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

(f) USEPA (2002) default (0.5 acre).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{soil}	D ^{water}	MW	VP	Volatile?
	kg/m ³	m ² /s	kg/m ³ / (cc m ³)	(mg/100ml)	cm ² /s	cm ² /s	kg/mol	mmHg	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Arsenic, Inorganic	-	#VALUE!	-	-	-	-	7.80E+01	-	N
Barium	-	#VALUE!	-	-	-	-	1.37E+02	-	N
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Cadmium (Water)	-	#VALUE!	-	-	-	-	1.12E+02	-	N
Chromium(III), Insoluble Salts	-	#VALUE!	-	-	-	-	5.20E+01	-	N
Chromium(VI)	-	#VALUE!	-	1.69E+06	-	-	5.20E+01	-	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cobalt	-	#VALUE!	-	-	-	-	5.89E+01	-	N
Cresol, m- <i>o</i> -p	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.89E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3- <i>cd</i>)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Iron	-	#VALUE!	-	-	-	-	5.59E+01	-	N
Lead and Compounds	-	#VALUE!	-	-	-	-	2.07E+02	-	N
Manganese	-	#VALUE!	-	-	-	-	5.48E+01	-	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Nickel Soluble Salts	-	#VALUE!	-	-	-	-	5.87E+01	-	N
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.28E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Vanadium and compounds	-	#VALUE!	-	-	-	-	5.09E+01	-	N
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y
	-	-	-	-	-	-	-	-	-

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{soil}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{water}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{soil} (cm ² /s)	D _{crack} (cm ² /s)	D _{soil} (cm ² /s)	D _{crack} (cm ² /s)	D _{soil} (cm ² /s)	C _{sat} (mg/kg)	Convective Factor (unitless)	D _{soil} (cm ² /s)	M _{soil} (g)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	3.94E+01	2.22E+02	3.66E-06	7.25E+04
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	1.63E+02	2.49E+02	2.02E-06	5.38E+04
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	1.87E+04	4.92E+01	3.75E-04	7.34E+05
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV	NV	NV
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	1.42E+00	2.89E+02	2.62E-07	1.94E+04
Arsenic, Inorganic	NV	NV	NV	NV	NV	NV	NV	NV	NV
Barium	NV	NV	NV	NV	NV	NV	NV	NV	NV
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV	NV	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	6.59E+02	1.25E+02	5.35E-03	2.77E+06
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Cadmium (Water)	NV	NV	NV	NV	NV	NV	NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV	NV	NV	NV	NV	NV	NV	NV
Chromium(VI)	NV	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV	NV	NV
Cobalt	NV	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m- &p-	NV	NV	NV	NV	NV	1.44E+04	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	5.69E+01	2.74E+02	1.89E-06	5.21E+04
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV	NV	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	1.67E+02	1.64E+02	2.17E-03	1.77E+06
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	3.10E+01	2.55E+02	9.14E-07	3.62E+04
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV	NV	NV
Iron	NV	NV	NV	NV	NV	NV	NV	NV	NV
Lead and Compounds	NV	NV	NV	NV	NV	NV	NV	NV	NV
Manganese	NV	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	1.23E+02	2.14E+02	2.18E-05	1.76E+05
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	9.66E+01	1.85E+02	3.39E-05	2.21E+05
Nickel Soluble Salts	NV	NV	NV	NV	NV	NV	NV	NV	NV
Phenanthrene	5.88E-03	-	-	5.88E-03	5.88E-03	3.84E+01	3.25E+02	1.73E-07	1.58E+04
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV	NV	NV
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.47E+01	4.03E+02	1.21E-08	4.17E+03
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	2.93E+02	1.58E+02	8.17E-04	1.08E+06
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	2.91E+02	1.44E+02	3.70E-03	2.31E+06
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	2.21E+02	1.12E+02	2.61E-02	6.13E+06
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.11E+02	1.12E+02	5.46E-04	8.86E+05
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.54E+02	1.12E+02	2.24E-04	5.68E+05
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	7.46E+01	1.85E+02	1.13E-03	1.28E+06
Vanadium and compounds	NV	NV	NV	NV	NV	NV	NV	NV	NV
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	8.90E+00	1.32E+02	2.08E-03	1.73E+06

Definition of Parameters

D_e Effective diffusion coefficient in soil based on vapor-phase concentration

D_{crack} Effective diffusion coefficient through foundation cracks

C_{sat} Soil concentration at which dissolved pore-water and vapor phases become saturated

D_a = Apparent diffusivity (for construction scenario Volatilisation Factor)

M_{soil} = Cumulative unit mass emitted from excavation (Eq E-13 in USEPA, 2002).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{soil}	VF _{soil}	VF _{vapor}	VF _{soil/soil}	VF _{trench}	VF _{soil}	VF _{trench}
	(mgm ³ -air / mgkg-soil)	(mgm ³ -air / mgkg-soil)	(mgm ³ -air / mgkg-soil)	(mgm ³ -air / mgkg-soil)	(mgm ³ -air / mgkg-soil)	(mgm ³ -air / mgkg-soil)	(mgm ³ -air / mgkg-soil)
Acenaphthene	1.17E-05	1.75E-05	-	-	3.35E-01	8.64E-06	-3.12E+08
Acenaphthylene	8.66E-06	1.75E-05	-	-	1.94E-01	5.36E-06	-2.32E+08
Ammonia	1.18E-04	1.75E-05	-	-	1.33E+01	1.96E-04	-3.16E+09
Aniline	NV	NV	-	-	NV	NV	NV
Anthracene	3.32E-06	1.75E-05	-	-	2.67E-02	8.02E-07	-8.35E+07
Arsenic, Inorganic	NV	NV	-	-	NV	NV	NV
Barium	NV	NV	-	-	NV	NV	NV
Benz(a)anthracene	NV	NV	-	-	NV	NV	NV
Benzene	4.46E-05	1.75E-05	-	-	3.64E+01	7.15E-04	-1.19E+10
Benzo(a)pyrene	NV	NV	-	-	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	-	-	NV	NV	NV
Benzo(g,h)perylene	NV	NV	-	-	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	-	-	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	-	-	NV	NV	NV
Cadmium (Water)	NV	NV	-	-	NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV	-	-	NV	NV	NV
Chromium(VI)	NV	NV	-	-	NV	NV	NV
Chrysene	NV	NV	-	-	NV	NV	NV
Cobalt	NV	NV	-	-	NV	NV	NV
Cresol, m- & p-	NV	NV	-	-	NV	NV	NV
Cresol, o-	NV	NV	-	-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	-	NV	NV	NV
Dibenzofuran	8.39E-06	1.75E-05	-	-	1.89E-01	5.51E-06	-2.24E+08
Dimethylphenol, 2,4-	NV	NV	-	-	NV	NV	NV
Ethylbenzene	2.84E-05	1.75E-05	-	-	1.71E+01	3.79E-04	-7.61E+09
Fluoranthene	NV	NV	-	-	NV	NV	NV
Fluorene	5.84E-06	1.75E-05	-	-	8.90E-02	2.48E-06	-1.56E+08
Indeno(1,2,3-cd)pyrene	NV	NV	-	-	NV	NV	NV
Iron	NV	NV	-	-	NV	NV	NV
Lead and Compounds	NV	NV	-	-	NV	NV	NV
Manganese	NV	NV	-	-	NV	NV	NV
Methylnaphthalene, 2-	2.63E-05	1.75E-05	-	-	1.95E+00	4.92E-05	-7.59E+08
Naphthalene	3.65E-05	1.75E-05	-	-	3.14E+01	6.70E-05	-9.51E+08
Nickel Soluble Salts	NV	NV	-	-	NV	NV	NV
Phenanthrene	2.54E-06	1.75E-05	-	-	1.85E-02	6.00E-07	-6.80E+07
Phenol	NV	NV	-	-	NV	NV	NV
Pyrene	6.72E-07	1.75E-05	-	-	1.39E-03	5.20E-08	-1.80E+07
Styrene	1.74E-04	1.75E-05	-	-	6.33E+01	1.37E-03	-4.67E+09
Toluene	3.71E-05	1.75E-05	-	-	2.73E+01	5.69E-04	-9.93E+09
TPH C06-C09 aliphatic	9.87E-05	1.75E-05	-	-	1.67E+02	3.13E-03	-2.84E+10
TPH C10-C14 aliphatic	1.43E-05	1.75E-05	-	-	3.48E+00	6.53E-05	-3.82E+09
TPH C10-C14 aromatic	9.14E-06	1.75E-05	-	-	1.43E+00	2.68E-05	-2.45E+09
TPH C15-C28 aliphatic	NV	NV	-	-	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	-	-	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	-	-	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	-	-	NV	NV	NV
Trimethylbenzene, 1,2,4-	2.05E-04	1.75E-05	-	-	1.05E+03	2.23E-03	-5.50E+09
Vanadium and compounds	NV	NV	-	-	NV	NV	NV
Xylenes (total)	2.78E-05	1.75E-05	-	-	1.46E+01	2.93E-04	-7.44E+09

Definition of Parameters

VF_{so} Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values

VF_p Volatilization factor from surficial soils to ambient air (particulates)

VF_{soil} Volatilization factor from subsurface soils to ambient air

VF_{vapor} Volatilization factor from soil to enclosed-space vapors

VF_{soil/soil} Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Calculation of Vapour Emissions from Water with Flow
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

PARAMETERS						Dimensions of Wet Section of Basement/ Impoundment										Air exchange rate (exchanges/day)				9.60E+01	
Concrete permeability		(select from drop down list)	High permeability		Length (m)		5.0		Windspeed (m/s)		if < 3.5 m/sec		3.00E-02								
Permeability Rate (m/day)			8.6.E-02		Width (m)		5.0				if = or > 3.5 m/sec										
Water Temperature (deg. C)			18.0		Depth of Water (m)		0.01														
Dimensions of Basement / Impoundment					Fetch/ Depth (m) ratio of Wet Basement Section		500														
Height (m)			3.0		Volume of wet basement/ impoundment (m3)		0.2500														
Width (m)			25.0		Area covered in water (m2)		25														
Depth (m)			25.0		Effective diameter of impoundment/ basement (m)		5.6														
Volume total basement/ impoundment (m3)			1875		Volume of water entering basement (m³/sec)		2.50E-07														
Parameter Definition	Volatile	Chemical Concentration in Water (mg/L)	Molecular weight (g/mol)	Vapour Pressure (mmHg)	Vapour Pressure (atm)	Henry's Law Coefficient (unitless)	Henry's Law Coefficient (calculated)	Equilibrium Coefficient (at 25 deg C)	Diffusivity in Water (cm²/sec)	Schmidt Number on Gas Side (*)	Gas Phase Mass Transfer Coefficient (m/sec)	Schmidt Number on Liquid Side #	Liquid Phase Mass Transfer Coefficient (m/s) <3.5 m/s	Overall Mass Transfer Coefficient (m/s) (windspeed <3.5 m/s)	Adopted Liquid Mass Transfer Coefficient (m/s)	Overall Mass Transfer Coefficient (m/s)	Diffusivity in Air (cm²/sec)	Equilibrium Concentration of water in Basement/ Impoundment (g/m³)	Air Emission Rate from Liquid Surface (g/sec)	Air Emission Rate from Liquid Surface (mg/day)	Adjusted Concentration in Basement Air (includes air exchange) (mg/m3)
		C	MW	Vap	Vap	unitless	atm.m3/g mol	K _{ow}	D _{water}	Sc _G	k _G	Sc _L	K _L	K	K _L	K	D _{air}	C _i	E	E	
Acenaphthene	Y	4.48	154	2.15E-03	2.83E-06	7.52E-03	1.80E-04	7.345E-03	8.33E-06	3.0E+00	1.244E-04	1.08E+03	2.7E-07	2.1E-07	2.7E-07	2.1E-07	0.0506	1.6E-01	8.31E-07	7.18E+01	3.99E-04
Acenaphthylene	Y	43.2	152	6.68E-03	8.79E-06	4.66E-03	1.11E-04	4.551E-03	6.98E-06	3.4E+00	1.150E-04	1.29E+03	2.4E-07	1.7E-07	2.4E-07	1.7E-07	0.045	1.7E+00	7.08E-06	6.11E+02	3.40E-03
Ammonia	Y	348	17	-	-	6.58E-04	1.57E-05	6.427E-04	1.10E-05	6.6E-01	3.410E-04	8.18E+02	3.3E-07	1.3E-07	3.3E-07	1.3E-07	0.228	1.0E+01	3.37E-05	2.91E+03	1.62E-02
Aniline	N	0.212	93.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	Y	15.4	178	6.53E-06	8.59E-09	2.27E-03	5.42E-05	2.217E-03	7.85E-06	3.9E+00	1.045E-04	1.15E+03	2.6E-07	1.2E-07	2.6E-07	1.2E-07	0.039	5.6E-01	1.73E-06	1.50E+02	8.33E-04
Arsenic, Inorganic	N	0.024	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	N	2.23	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	N	12.6	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	Y	40.2	78.1	9.48E+01	1.25E-01	2.27E-01	5.42E-03	2.217E-01	1.03E-05	1.7E+00	1.823E-04	8.74E+02	3.2E-07	3.1E-07	3.2E-07	3.1E-07	0.0895	1.2E+00	9.67E-06	8.35E+02	4.64E-03
Benz(a)pyrene	N	9.26	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(b)fluoranthene	N	8.33	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(o,g,h,i)perylene	N	4.22	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzofluoranthene	N	2.93	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	N	0.03	391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	N	0.108	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	N	9.78	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	N	0.057	58.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p	N	436	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	N	182	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	N	0.822	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	Y	10.2	168	2.48E-03	3.26E-06	8.71E-03	2.08E-04	8.507E-03	7.38E-06	3.7E+00	1.080E-04	1.22E+03	2.5E-07	2.0E-07	2.5E-07	2.0E-07	0.041	3.9E-01	1.92E-06	1.66E+02	9.23E-04
Dimethylphenol, 2,4-	N	38	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	Y	3.02	106	9.60E+00	1.26E-02	3.22E-01	7.69E-03	3.145E-01	8.46E-06	2.2E+00	1.524E-04	1.06E+03	2.8E-07	2.8E-07	2.8E-07	2.8E-07	0.0685	1.1E-01	7.25E-07	6.26E+01	3.48E-04
Fluoranthene	N	25.9	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	Y	21.1	166	6.00E-04	7.90E-07	3.93E-03	9.38E-05	3.838E-03	7.89E-06	3.4E+00	1.133E-04	1.14E+03	2.6E-07	1.6E-07	2.6E-07	1.6E-07	0.044	7.7E-01	3.16E-06	2.73E+02	1.52E-03
Indeno(1,2,3-cd)pyrene	N	3.05	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	N	187	55.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	N	0.555	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	N	4.89	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	Y	105	142	5.50E-02	7.24E-05	2.12E-02	5.06E-04	2.071E-02	7.78E-06	2.9E+00	1.273E-04	1.16E+03	2.6E-07	2.4E-07	2.6E-07	2.4E-07	0.0524	3.9E+00	2.30E-05	1.99E+03	1.10E-02
Naphthalene	Y	283	128	8.50E-02	1.12E-04	1.80E-02	4.30E-04	1.758E-02	8.38E-06	2.5E+00	1.402E-04	1.07E+03	2.8E-07	2.5E-07	2.8E-07	2.5E-07	0.0605	9.9E+00	6.14E-05	5.31E+03	2.95E-02
Nickel Soluble Salts	N	0.303	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	Y	74.1	178	1.21E-04	1.59E-07	1.73E-03	4.13E-05	1.690E-03	6.69E-06	4.4E+00	9.623E-05	1.35E+03	2.4E-07	9.6E-08	2.4E-07	9.6E-08	0.0345	3.0E+00	7.23E-06	6.25E+02	3.47E-03
Phenol	N	249	94.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	Y	27.9	202	4.50E-06	5.92E-09	4.87E-04	1.16E-05	4.756E-04	7.25E-06	5.4E+00	8.326E-05	1.24E+03	2.5E-07	3.4E-08	2.5E-07	3.4E-08	0.0278	1.1E+00	9.17E-07	7.92E+01	4.40E-04
Styrene	Y	0.194	104	6.40E+00	8.42E-03	1.12E-01	2.67E-03	1.094E-01	8.78E-06	2.1E+00	1.562E-04	1.03E+03	2.8E-07	2.8E-07	2.8E-07	2.8E-07	0.0711	6.6E-03	4.61E-08	3.98E+00	2.21E-05
Toluene	Y	17.6	92.1	2.84E+01	3.74E-02	2.71E-01	6.47E-03	2.647E-01	9.20E-06	1.9E+00	1.659E-04	9.78E+02	2.9E-07	2.9E-07	2.9E-07	2.9E-07	0.0778	5.8E-01	4.23E-06	3.65E+02	2.03E-03
TPH C06-C09 aliphatic	Y	6.08	103	9.16E+01	1.21E-01	5.05E+01	1.21E+00	4.932E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	1.9E-01	1.47E-06	1.27E+02	7.07E-04
TPH C10-C14 aliphatic	Y	1730	170	1.16E+00	1.53E-03	6.26E+01	1.49E+00	6.114E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	4.19E-04	3.62E+04	2.01E-01
TPH C10-C14 aromatic	Y	1730	136	1.16E+00	1.53E-03	1.41E-01	3.37E-03	1.377E-01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	4.14E-04	3.58E+04	1.99E-01
TPH C15-C28 aliphatic	N	1520	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	N	1520	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	N	332	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	N	332	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	Y	0.92	120	2.10E+00	2.76E-03	2.52E-01	6.02E-03	2.461E-01	7.92E-06	2.5E+00	1.405E-04	1.14E+03	2.7E-07	2.6E-07	2.7E-07	2.6E-07	0.0607	3.3E-02	2.20E-07	1.90E+01	1.06E-04
Vanadium and compounds	N	0.0228	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	Y	6.7	106	7.99E+00	1.05E-02	2.12E-01	5.06E-03	2.071E-01	9.90E-06	1.8E+00	1.756E-04	9.09E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.0847	2.1E-01	1.61E-06	1.39E+02	7.72E-04

Notes:
Assumes viscosity of air at 25 deg C
(*) Adopted density and viscosity of air values are those published in USEPA Air Emissions for Wast and Waste Water Nov 1994. (viscosity = 1.81 x 10⁻⁴, density = 1.2 x 10⁻³)
** where windspeeds are greater than 3.25 m/s, F/D ratios greater than 51.2 and diffusivity of ether is 8.5 x 10⁻⁵
where viscosity of water is assumed to be 9 x

Summary of Derived RBSLs

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	2.22E+04	-	-	2.22E+04	>Sat	5.11E+02	1.87E+03	-	-	1.87E+03	>Sol	4.48E+00
Acenaphthylene	3.58E+04	-	-	3.58E+04	>Sat	1.70E+03	9.08E+02	-	-	9.08E+02	>Sol	4.32E+01
Ammonia	-	-	-	-	-	-	6.82E+03	-	-	6.82E+03	-	3.48E+02
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	1.19E+06	-	-	1.19E+06	>Sat	2.15E+03	4.99E+01	-	-	4.99E+01	>Sol	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1.53E+01	-	2.48E+01	1.53E+01	-	1.51E+03	9.49E+01	-	1.54E+02	9.49E+01	-	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	1.74E+05	-	-	1.74E+05	>Sat	2.77E+02	3.22E+03	-	-	3.22E+03	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.92E+03	-	-	3.92E+03	>Sat	2.61E+02	1.29E+04	-	-	1.29E+04	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	5.14E+04	-	-	5.14E+04	>Sat	2.10E+03	1.42E+02	-	-	1.42E+02	>Sol	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	2.59E+03	-	-	2.59E+03	>Sat	7.65E+03	2.85E+02	-	-	2.85E+02	>Sol	1.05E+02
Naphthalene	4.08E+01	-	-	4.08E+01	-	1.02E+04	2.88E+00	-	-	2.88E+00	-	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	3.19E+05	-	-	3.19E+05	>Sat	5.18E+03	6.35E+01	-	-	6.35E+01	>Sol	7.41E+01
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	1.84E+06	-	-	1.84E+06	>Sat	2.64E+03	2.94E+01	-	-	2.94E+01	>Sol	2.79E+01
Styrene	-	-	-	-	-	-	1.04E+04	-	-	1.04E+04	>Sol	1.94E-01
Toluene	1.00E+04	-	-	1.00E+04	>Sat	2.65E+03	4.95E+04	-	-	4.95E+04	>Sol	1.76E+01
TPH C06-C09 aliphatic	3.36E+03	-	-	3.36E+03	>Sat	5.93E+02	9.03E+04	-	-	9.03E+04	>Sol	6.08E+00
TPH C10-C14 aliphatic	8.73E+03	-	-	8.73E+03	>Sat	6.94E+04	5.70E-01	-	-	5.70E-01	>Sol	1.73E+03
TPH C10-C14 aromatic	4.25E+03	-	-	4.25E+03	>Sat	6.94E+04	1.45E+01	-	-	1.45E+01	-	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.43E+01	-	-	1.43E+01	-	2.20E+02	2.78E+02	-	-	2.78E+02	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	8.56E+02	-	-	8.56E+02	>Sat	2.57E+03	2.18E+03	-	-	2.18E+03	>Sol	6.70E+00
	-	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	C _{sat} (mg/kg)	Volatilisation Factor from Subsurface Soil to Indoor Air (mg/m3)/(mg/kg)	Vapour Concentration in Indoor Air (From Subsurface Soil) (mg/m3)	Threshold Intake and Risk Calculations			
					Inhalation RIC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	511	3.94E+01	8.64E-06	3.40E-04	2.10E-01	1.89E-06	7.46E-05	3.55E-04
Acenaphthylene	1700	1.63E+02	5.36E-06	8.71E-04	2.10E-01	1.17E-06	1.91E-04	9.09E-04
Ammonia	-	-	-	-	-	-	-	-
Aniline	-	-	NV	-	-	-	-	-
Anthracene	2150	1.42E+00	8.02E-07	1.14E-06	1.05E+00	1.76E-07	2.51E-07	2.39E-07
Arsenic, Inorganic	-	-	NV	-	-	-	-	-
Barium	-	-	NV	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-
Benzene	1510	6.59E+02	7.15E-04	4.71E-01	9.60E-03	1.57E-04	1.03E-01	1.08E+01
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	NV	-	-	-	-	-
Cadmium (Water)	-	-	NV	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	NV	-	1.00E-04	-	-	-
Chromium(VI)	2.3	-	NV	-	1.00E-04	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-
Cobalt	-	-	NV	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	NV	-	5.95E-01	-	-	-
Cresol, o-	-	-	NV	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-
Dibenzofuran	277	5.69E+01	5.51E-06	3.13E-04	2.10E-01	1.21E-06	6.87E-05	3.27E-04
Dimethylphenol, 2,4-	-	-	NV	-	-	-	-	-
Ethylbenzene	261	1.67E+02	3.79E-04	6.31E-02	1.30E+00	8.30E-05	1.38E-02	1.06E-02
Fluoranthene	2440	2.89E+01	NV	-	1.40E-01	-	-	-
Fluorene	2100	3.10E+01	2.48E-06	7.71E-05	1.40E-01	5.45E-07	1.69E-05	1.21E-04
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-
Iron	60600	-	NV	-	2.80E+00	-	-	-
Lead and Compounds	13600	-	NV	-	5.00E-04	-	-	-
Manganese	-	-	NV	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.92E-05	6.05E-03	1.40E-01	1.08E-05	1.33E-03	9.47E-03
Naphthalene	10200	9.66E+01	6.70E-05	6.47E-03	3.00E-03	1.47E-05	1.42E-03	4.73E-01
Nickel Soluble Salts	-	-	NV	-	-	-	-	-
Phenanthrene	5180	3.84E+01	6.00E-07	2.31E-05	2.10E-01	1.32E-07	5.06E-06	2.41E-05
Phenol	-	-	NV	-	-	-	-	-
Pyrene	2640	1.47E+01	5.20E-08	7.63E-07	1.05E-01	1.14E-08	1.67E-07	1.59E-06
Styrene	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	5.69E-04	1.65E-01	5.00E+00	1.25E-04	3.63E-02	7.25E-03
TPH C06-C09 aliphatic	593	2.21E+02	3.13E-03	6.91E-01	1.84E+01	6.85E-04	1.52E-01	8.24E-03
TPH C10-C14 aliphatic	69400	1.11E+02	6.53E-05	7.26E-03	1.00E+00	1.43E-05	1.59E-03	1.59E-03
TPH C10-C14 aromatic	69400	1.54E+02	2.68E-05	4.14E-03	2.00E-01	5.88E-06	9.07E-04	4.54E-03
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	7.00E+00	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	1.05E-01	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	7.00E+00	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	1.05E-01	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.23E-03	1.67E-01	7.00E-03	4.90E-04	3.65E-02	5.22E+00
Vanadium and compounds	248	-	NV	-	1.00E-03	-	-	-
Xylenes (total)	2567	8.90E+00	2.93E-04	2.61E-03	2.20E-01	6.42E-05	5.72E-04	2.60E-03

TOTAL	1.65E+01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

2.66E-04

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

2.61E-06

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	3.55E-04	3.55E-04	9.02E-06	9.02E-06	9.02E-06	2.22E+04	3.55E-04	3.55E-04	2.22E+04	0.18%	0.18%
Acenaphthylene	1700	1.63E+02	9.09E-04	9.09E-04	5.59E-06	5.59E-06	5.59E-06	3.58E+04	9.09E-04	9.09E-04	3.58E+04	0.45%	0.45%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	2.39E-07	2.39E-07	1.67E-07	1.67E-07	1.67E-07	1.19E+06	2.39E-07	2.39E-07	1.19E+06	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	1.08E+01	1.08E+01	1.63E-02	1.63E-02	1.63E-02	1.53E+01	2.50E-01	-	1.53E+01	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	3.27E-04	3.27E-04	5.75E-06	5.75E-06	5.75E-06	1.74E+05	3.27E-04	3.27E-04	1.74E+05	0.03%	0.03%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	1.06E-02	1.06E-02	6.38E-05	6.38E-05	6.38E-05	3.92E+03	1.06E-02	1.06E-02	3.92E+03	4.26%	4.26%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	1.21E-04	1.21E-04	3.89E-06	3.89E-06	3.89E-06	5.14E+04	1.21E-04	1.21E-04	5.14E+04	0.06%	0.06%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	9.47E-03	9.47E-03	7.71E-05	7.71E-05	7.71E-05	2.59E+03	9.47E-03	9.47E-03	2.59E+03	4.74%	4.74%
Naphthalene	10200	9.66E+01	4.73E-01	4.73E-01	4.90E-03	4.90E-03	4.90E-03	4.08E+01	2.00E-01	-	4.08E+01	100.00%	100.00%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	2.41E-05	2.41E-05	6.27E-07	6.27E-07	6.27E-07	3.19E+05	2.41E-05	2.41E-05	3.19E+05	0.01%	0.01%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	1.59E-06	1.59E-06	1.09E-07	1.09E-07	1.09E-07	1.84E+06	1.59E-06	1.59E-06	1.84E+06	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	7.25E-03	7.25E-03	2.49E-05	2.49E-05	2.49E-05	1.00E+04	7.25E-03	7.25E-03	1.00E+04	2.90%	2.90%
TPH C06-C09 aliphatic	593	2.21E+02	8.24E-03	8.24E-03	3.73E-05	3.73E-05	3.73E-05	3.36E+03	8.24E-03	8.24E-03	3.36E+03	6.59%	6.59%
TPH C10-C14 aliphatic	69400	1.11E+02	1.59E-03	1.59E-03	1.43E-05	1.43E-05	1.43E-05	8.73E+03	1.59E-03	1.59E-03	8.73E+03	1.27%	1.27%
TPH C10-C14 aromatic	69400	1.54E+02	4.54E-03	4.54E-03	2.94E-05	2.94E-05	2.94E-05	4.25E+03	4.54E-03	4.54E-03	4.25E+03	3.63%	3.63%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	5.22E+00	5.22E+00	6.99E-02	6.99E-02	6.99E-02	1.43E+01	1.00E+00	-	1.43E+01	100.00%	100.00%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2567	8.90E+00	2.60E-03	2.60E-03	2.92E-04	2.92E-04	2.92E-04	8.56E+02	2.60E-03	2.60E-03	8.56E+02	1.04%	1.04%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Non-Threshold Lifetime Health Effects (Adult and Child)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (ILCR)		Risk/Soil Concentration (i.e., exposure and toxicity factor)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL				Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg		mg/kg	%	%
Acenaphthene	511	3.94E+01	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	2.66E-04	2.66E-04	4.03E-07	4.03E-07	4.03E-07	2.48E+01	1.00E-05	2.48E+01	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	-	-	-	-	-	-	-	-	-	-
Naphthalene	10200	9.66E+01	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	3.84E+01	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	1.47E+01	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.93E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	2.91E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	2.21E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	1.11E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	1.54E+02	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	7.02E+01	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	8.04E+01	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	3.16E+00	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	1.66E+00	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2567	7.46E+01	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement - Commercial Workers Present (Risk Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW vapours from flowing water	TOTAL (All Pathways)	GW vapours from flowing water	Total Vapour Pathways	TOTAL (All Pathways)					GW vapours from flowing water	TOTAL
			unitless	unitless	unitless	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	4.16E-04	4.16E-04	1.07E-04	1.07E-04	1.07E-04	1.87E+03	4.16E-04	4.16E-04	1.87E+03	0.2%	0.21%
Acenaphthylene	43.2	1.61E+01	3.55E-03	3.55E-03	2.20E-04	2.20E-04	2.20E-04	9.08E+02	3.55E-03	3.55E-03	9.08E+02	1.8%	1.77%
Ammonia	348	4.82E+05	5.10E-02	5.10E-02	1.47E-04	1.47E-04	1.47E-04	6.82E+03	1.00E+00	-	6.82E+03	100.0%	100.00%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	1.74E-04	1.74E-04	4.00E-03	4.00E-03	4.00E-03	4.99E+01	1.74E-04	1.74E-04	4.99E+01	0.1%	0.09%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.06E-01	1.06E-01	2.64E-03	2.64E-03	2.64E-03	9.49E+01	2.50E-01	-	9.49E+01	100.0%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	9.64E-04	9.64E-04	3.11E-04	3.11E-04	3.11E-04	3.22E+03	9.64E-04	9.64E-04	3.22E+03	0.1%	0.10%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	5.86E-05	5.86E-05	1.94E-05	1.94E-05	1.94E-05	1.29E+04	3.28E-03	3.28E-03	1.29E+04	1.3%	1.31%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	2.37E-03	2.37E-03	1.41E-03	1.41E-03	1.41E-03	1.42E+02	2.37E-03	2.37E-03	1.42E+02	1.2%	1.19%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.73E-02	1.73E-02	7.03E-04	7.03E-04	7.03E-04	2.85E+02	1.73E-02	1.73E-02	2.85E+02	8.6%	8.64%
Naphthalene	283	3.10E+01	2.15E+00	2.15E+00	6.95E-02	6.95E-02	6.95E-02	2.88E+00	2.00E-01	-	2.88E+00	100.0%	100.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	3.62E-03	3.62E-03	3.15E-03	3.15E-03	3.15E-03	6.35E+01	3.62E-03	3.62E-03	6.35E+01	1.8%	1.81%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	9.19E-04	9.19E-04	6.81E-03	6.81E-03	6.81E-03	2.94E+01	9.19E-04	9.19E-04	2.94E+01	0.5%	0.46%
Styrene	0.194	3.10E+02	1.86E-05	1.86E-05	9.61E-05	9.61E-05	9.61E-05	1.04E+04	2.98E-02	2.98E-02	1.04E+04	3.0%	2.98%
Toluene	17.6	5.26E+02	8.89E-05	8.89E-05	5.05E-06	5.05E-06	5.05E-06	4.95E+04	2.66E-03	2.66E-03	4.95E+04	1.1%	1.06%
TPH C06-C09 aliphatic	6.08	1.18E+01	8.42E-06	8.42E-06	1.38E-06	1.38E-06	1.38E-06	9.03E+04	1.63E-05	1.63E-05	9.03E+04	0.0%	0.01%
TPH C10-C14 aliphatic	1730	9.99E-02	2.19E-02	2.19E-02	2.19E-01	2.19E-01	2.19E-01	5.70E-01	2.19E-02	2.19E-02	5.70E-01	17.5%	17.52%
TPH C10-C14 aromatic	1730	2.53E+01	2.18E-01	2.18E-01	8.61E-03	8.61E-03	8.61E-03	1.45E+01	1.25E-01	-	1.45E+01	100.0%	100.00%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.31E-03	3.31E-03	3.59E-03	3.59E-03	3.59E-03	2.78E+02	2.05E-01	2.05E-01	2.78E+02	20.5%	20.48%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	7.69E-04	7.69E-04	1.15E-04	1.15E-04	1.15E-04	2.18E+03	1.22E-03	1.22E-03	2.18E+03	0.5%	0.49%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects
Barangaroo Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement - (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapours from Flowing Water	TOTAL (All Pathways)	GW Vapours from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)				GW Vapours from Flowing Water	TOTAL
	mg/L	mg/L	unitless	unitless	L/mg	L/mg	L/mg	mg/L		mg/L	%	%
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	2.61E-06	2.61E-06	6.50E-08	6.50E-08	6.50E-08	1.54E+02	1.00E-05	1.54E+02	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix E

Risk Scenario 3 Unpaved Rec

1. General Information:

Site: Barangaroo
 Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Client: Lend Lease
 Scenario: Scenario 3 - Unpaved Recreation (Risk Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Recreational User

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐	Incidental Ingestion of Soil
☐	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☒	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐	Inhalation of Groundwater-Derived Vapours in Indoor Air
☒	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☐	Incidental Ingestion of Groundwater (Bathing or Excavation)
☐	Dermal Contact with Groundwater (Bathing or Excavation)
☐	Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐	Soil RBSLs saturation limited?
☐	Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:

	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benzo(a)anthracene		1.00E-05	1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene		1.00E-05	652	9.26
Benzo(b)fluoranthene		1.00E-05	587	8.33
Benzo(g,h,i)perylene		1.00E-05	305	4.22
Benzo(k)fluoranthene		1.00E-05	231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene		1.00E-05	771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene		1.00E-05	71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene		1.00E-05	2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene		1.00E-05	247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

	Units	Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:							
Body weight	kg	70	13			70	13
Exposure duration	yr	30	6	64	6	64	6
Averaging time (carcinogens)	yr	70	70	70	70	70	70
Averaging time (non-carcinogens)	yr	30	6	64	6	64	6
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	25	100			25	100
Exposure frequency for soil ingestion	days/yr	350	350			350	350
Fraction of daily soil intake from site	unitless	0.5	0.5			0.5	0.5
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	3600	2100			3600	2100
Soil to skin adherence factor	mg/cm2	0.5	0.5			0.5	0.5
Exposure frequency for dermal contact with soil	days/yr	350	350			350	350
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	0	0			0	0
Exposure frequency (indoor air)	days/yr	350	350			350	350
Particulate emission factor (indoor air)	m3/kg	NA	NA			NA	NA
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	2	2	2	2	2	2
Exposure frequency (outdoor air)	days/yr	350	350	365	365	365	365
Particulate emission factor (outdoor air)	m3/kg	1.36E+09	#####			1.36E+09	1.36E+09
Potable Water Ingestion							
Potable water intake rate	L/day	0	0			0	0
Exposure frequency for potable water intake	days/yr	350	350			350	350
Incidental Water Ingestion							
Incidental ingestion rate	L/day	NA	NA			NA	NA
Exposure frequency for incidental water ingestion	days/yr	350	350			350	350
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	18150	6880			18150	6880
Exposure time for dermal water contact	hr/day	1	1			1	1
Exposure frequency for dermal water contact	days/yr	350	350			350	350

Vapour Modelling - Soil to Outdoor and Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	50	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100		50	HV	50	It has been assumed that contamination will be present at a minimum depth of 0.5 m as aesthetic factors will ensure that contaminated soils are unlikely to be present in the surficial soil layers.
				Sand (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay, therefore sand has been conservatively assumed in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Biodegradation adjustment	unitless	1		10	BioA	10	Adjustment for biodegradation in unpaved areas; see text.
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)		LB	300	
Enclosed-space foundation or wall thickness	cm	15			Lcrack	15	
Enclosed-space air exchange rate	1/s	0.000138889			ENCAER	1.39E-04	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)		NU	0.0019	
Volumetric air content in found./wall cracks	cc/cc	0.26			VACF	0.26	
Volumetric water content in found./wall cracks	cc/cc	0.12			wvcfnd	0.12	
<u>Convective vapour flow term</u>							
Calculate convective flow term?		Y			Conv	Y	
Convective flow rate (if specified directly)	cm3/sec						
Convective flow through slab (calculated)	cm3/sec	10.88			Qs	10.88	
Slab Area	cm2	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc		
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(c)	378	windsp	378	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(d)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.
<u>Other</u>							
Averaging time for surface emission vapour flux	sec	1.89E+08	(e)		atvapor	1.89E+08	Defaults to receptor exposure duration

(a) Building Code of Australia minimum ceiling height for habitable dwelling.
(b) USEPA (2004) upper limit of range for slab on grade foundation.
(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.
(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.
(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

Vapour Modelling - Soil to Outdoor and Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ³ /g)	(cm ³ /g)	(cc:H ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapopur pressure

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1}	D _{s2}	D _{s3}	D _{stot}	D _{crack}	C _{sat}	Convective
	(cm ² /s)				(cm ² /s)	mg/kg	Factor (unless)
Acenaphthene	8.18E-03	-	-	8.18E-03	3.96E-03	3.94E+01	3.10E+01
Acenaphthylene	7.28E-03	-	-	7.28E-03	3.52E-03	1.63E+02	3.49E+01
Ammonia	3.69E-02	-	-	3.69E-02	1.79E-02	1.87E+04	6.86E+00
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV
Anthracene	6.31E-03	-	-	6.31E-03	3.06E-03	1.42E+00	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	-	-	1.45E-02	6.98E-03	6.59E+02	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	1.44E+04	NV
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	3.20E-03	5.69E+01	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	5.35E-03	1.67E+02	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	-	-	7.11E-03	3.45E-03	3.10E+01	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	4.09E-03	1.23E+02	3.00E+01
Naphthalene	9.78E-03	-	-	9.78E-03	4.72E-03	9.66E+01	2.60E+01
Phenanthrene	5.58E-03	-	-	5.58E-03	2.72E-03	3.84E+01	4.52E+01
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV
Pyrene	4.50E-03	-	-	4.50E-03	2.26E-03	1.47E+01	5.43E+01
Styrene	1.15E-02	-	-	1.15E-02	5.55E-03	2.93E+02	2.21E+01
Toluene	1.26E-02	-	-	1.26E-02	6.07E-03	2.91E+02	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	2.21E+02	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.11E+02	1.57E+01
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.54E+02	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	4.74E-03	7.46E+01	2.59E+01
Xylenes (total)	1.37E-02	-	-	1.37E-02	6.61E-03	8.90E+00	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1}	VF _{as2}	VF _{p (indoor)}	VF _{p (outdoor)}	VF _{samb}	VF _{seep}
	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)
Acenaphthene	1.55E-06	5.22E-05	-	7.35E-10	7.26E-07	2.54E-05
Acenaphthylene	1.15E-06	5.22E-05	-	7.35E-10	4.00E-07	1.56E-05
Ammonia	1.57E-05	5.22E-05	-	7.35E-10	7.43E-05	6.19E-04
Aniline	NV	NV	-	7.35E-10	NV	NV
Anthracene	4.16E-07	5.22E-05	-	7.35E-10	5.19E-08	2.30E-06
Benz(a)anthracene	NV	NV	-	7.35E-10	NV	NV
Benzene	5.94E-06	5.22E-05	-	7.35E-10	1.06E-04	2.18E-03
Benzo(a)pyrene	NV	NV	-	7.35E-10	NV	NV
Benzo(b)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Benzo(g,h,i)perylene	NV	NV	-	7.35E-10	NV	NV
Benzo(k)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Bis(2-ethylhexyl)phalate	NV	NV	-	7.35E-10	NV	NV
Chrysene	NV	NV	-	7.35E-10	NV	NV
Cresol, m-&p-	NV	NV	-	7.35E-10	NV	NV
Cresol, o-	NV	NV	-	7.35E-10	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	7.35E-10	NV	NV
Dibenzofuran	1.12E-06	5.22E-05	-	7.35E-10	3.74E-07	1.58E-05
Dimethylphenol, 2,4-	NV	NV	-	7.35E-10	NV	NV
Ethylbenzene	3.78E-06	5.22E-05	-	7.35E-10	4.30E-05	1.14E-03
Fluoranthene	NV	NV	-	7.35E-10	NV	NV
Fluorene	7.77E-07	5.22E-05	-	7.35E-10	1.81E-07	7.20E-06
Indeno(1,2,3-cd)pyrene	NV	NV	-	7.35E-10	NV	NV
Methylnaphthalene, 2-	3.77E-06	5.22E-05	-	7.35E-10	4.28E-06	1.45E-04
Naphthalene	4.73E-06	5.22E-05	-	7.35E-10	6.73E-06	2.00E-04
Phenanthrene	3.38E-07	5.22E-05	-	7.35E-10	3.44E-08	1.69E-06
Phenol	NV	NV	-	7.35E-10	NV	NV
Pyrene	8.94E-08	5.22E-05	-	7.35E-10	2.40E-09	1.43E-07
Styrene	2.32E-05	5.22E-05	-	7.35E-10	1.62E-04	4.14E-03
Toluene	4.94E-06	5.22E-05	-	7.35E-10	7.34E-05	1.72E-03
TPH C06-C09 aliphatic	1.31E-05	5.22E-05	-	7.35E-10	5.19E-04	9.59E-03
TPH C10-C14 aliphatic	1.90E-06	5.22E-05	-	7.35E-10	1.08E-05	2.00E-04
TPH C10-C14 aromatic	1.22E-06	5.22E-05	-	7.35E-10	4.45E-06	8.23E-05
TPH C15-C28 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C15-C28 aromatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aromatic	NV	NV	-	7.35E-10	NV	NV
Trimethylbenzene, 1,2,4-	2.73E-05	5.22E-05	-	7.35E-10	2.25E-04	6.65E-03
Xylenes (total)	3.70E-06	5.22E-05	-	7.35E-10	4.12E-05	8.91E-04

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	200	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295		183	HV	183	Groundwater assumed to be at a depth of 2 m based on groundwater data for the Site.
SCS Soil Type:				Sand (<12% fines)			The soil type above groundwater across the site consists of fill (mostly sand and gravel), thus sand has conservatively been assumed as the main soil type in this scenario.
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Adjustment for vadose zone biodegradation	unitless	1		10	BioA_GW	10	Adjustment for biodegradation in unpaved areas; see text
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm				Hvtwo		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA			VACS2	NA	
Water-filled porosity (volumetric)	cm3/cm3	NA			wvcvz2	NA	
Total soil porosity	cm3/cm3	NA			TPOR2	NA	
<u>Vadose Zone Layer 3 (lens)</u>							
Thickness	cm				Hvthree		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA			VACS3	NA	
Water-filled porosity (volumetric)	cm3/cm3	NA			Vwvcvz3	NA	
Total soil porosity	cm3/cm3	NA			TPOR3	NA	
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):				Sand (<12% fines)			As above
Thickness of capillary fringe	cm	5		17	hcap	17	
Volumetric air content in capillary fringe soils	cc/cc	0.038		0.122	VAC	0.122	
Volumetric water content in capillary fringe soils	cc/cc	0.342		0.253	wccap	0.253	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(e)	378	windsp	378	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(f)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.

(a) Building Code of Australia minimum ceiling height for habitable dwelling.
(b) USEPA (2004) upper limit of range for slab on grade foundation.
(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)
(d) Assumes trench is 2 m long.
(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.
(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

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B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Consta	MW	Molecular weight
S	Solubility	VP	Vapopur pressure

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C. Chemical-Specific Diffusion Coefficients

Chemical	D _{s1}	D _{s2}	D _{s3}	D _{stot}	D _{crack}	D _{cap}	D _{ws}	Convective
	(cm ² /s)				(cm ² /s)	(cm ² /s)	(cm ² /s)	Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	3.96E-03	4.07E-04	3.12E-03	3.10E+01
Acenaphthylene	7.28E-03	-	-	7.28E-03	3.52E-03	4.00E-04	2.96E-03	3.49E+01
Ammonia	3.69E-02	-	-	3.69E-02	1.79E-02	2.69E-03	1.77E-02	6.86E+00
Aniline	NV	NV	NV	NV	NV	NV	NV	NV
Anthracene	6.31E-03	-	-	6.31E-03	3.06E-03	5.05E-04	3.19E-03	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	1.45E-02	-	-	1.45E-02	6.98E-03	5.81E-04	4.77E-03	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	3.20E-03	3.26E-04	2.51E-03	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	NV	NV	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	5.35E-03	4.44E-04	3.65E-03	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	3.45E-03	4.31E-04	3.07E-03	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	4.09E-03	3.65E-04	2.93E-03	3.00E+01
Naphthalene	9.78E-03	-	-	9.78E-03	4.72E-03	4.24E-04	3.40E-03	2.60E+01
Phenanthrene	5.58E-03	-	-	5.58E-03	2.72E-03	5.05E-04	3.01E-03	4.52E+01
Phenol	NV	NV	NV	NV	NV	NV	NV	NV
Pyrene	4.50E-03	-	-	4.50E-03	2.26E-03	1.27E-03	3.70E-03	5.43E+01
Styrene	1.15E-02	-	-	1.15E-02	5.55E-03	4.64E-04	3.81E-03	2.21E+01
Toluene	1.26E-02	-	-	1.26E-02	6.07E-03	5.04E-04	4.14E-03	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	6.45E-04	5.31E-03	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	6.45E-04	5.31E-03	1.57E+01
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	7.80E-03	6.50E-04	5.34E-03	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	4.74E-03	3.94E-04	3.24E-03	2.59E+01
Xylenes (total)	1.37E-02	-	-	1.37E-02	6.61E-03	5.50E-04	4.52E-03	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{ws}	Effective diffusion coefficient between groundwater and soil surface

Vapour Modelling - Groundwater to Outdoor and Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp}	VF _{wamb}	VF _{trench}
	(mg/m ³ -air / mg/L-H ₂ O)	(mg/m ³ -air / mg/L-H ₂ O)	(mg/m ³ -air / mg/L -water)
Acenaphthene	1.41E-04	6.98E-07	4.41E-06
Acenaphthylene	8.47E-05	4.10E-07	4.41E-06
Ammonia	2.09E-05	3.47E-07	4.41E-06
Aniline	NV	NV	NV
Anthracene	4.29E-05	2.15E-07	4.41E-06
Benz(a)anthracene	NV	NV	NV
Benzene	5.13E-03	3.22E-05	4.41E-06
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m-&p-	NV	NV	NV
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	1.45E-04	6.51E-07	4.41E-06
Dimethylphenol, 2,4-	NV	NV	NV
Ethylbenzene	6.48E-03	3.50E-05	4.41E-06
Fluoranthene	NV	NV	NV
Fluorene	7.28E-05	3.59E-07	4.41E-06
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	3.84E-04	1.85E-06	4.41E-06
Naphthalene	3.51E-04	1.82E-06	4.41E-06
Phenanthrene	3.17E-05	1.55E-07	4.41E-06
Phenol	NV	NV	NV
Pyrene	9.87E-06	5.36E-08	4.41E-06
Styrene	2.30E-03	1.27E-05	4.41E-06
Toluene	5.78E-03	3.34E-05	4.41E-06
TPH C06-C09 aliphatic	1.19E+00	7.98E-03	4.41E-06
TPH C10-C14 aliphatic	1.47E+00	9.89E-03	4.41E-06
TPH C10-C14 aromatic	3.32E-03	2.24E-05	4.41E-06
TPH C15-C28 aliphatic	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	4.79E-03	2.43E-05	4.41E-06
Xylenes (total)	4.68E-03	2.85E-05	4.41E-06

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	6.95E+05	6.95E+05	-	6.95E+05	>Sat	5.11E+02	7.22E+05	7.22E+05	-	7.22E+05	>Sol	4.48E+00
Acenaphthylene	1.26E+06	1.26E+06	-	1.26E+06	>Sat	1.70E+03	1.23E+06	1.23E+06	-	1.23E+06	>Sol	4.32E+01
Ammonia	-	-	-	-	-	-	2.40E+06	2.40E+06	-	2.40E+06	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	4.86E+07	4.86E+07	-	4.86E+07	>Sat	2.15E+03	1.17E+07	1.17E+07	-	1.17E+07	>Sol	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	2.71E+02	2.71E+02	1.88E+02	1.88E+02	-	1.51E+03	8.94E+02	8.94E+02	6.21E+02	6.21E+02	-	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	6.73E+06	6.73E+06	-	6.73E+06	>Sat	2.77E+02	3.87E+06	3.87E+06	-	3.87E+06	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	9.07E+04	9.07E+04	-	9.07E+04	>Sat	2.61E+02	1.12E+05	1.12E+05	-	1.12E+05	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	1.85E+06	1.85E+06	-	1.85E+06	>Sat	2.10E+03	9.36E+05	9.36E+05	-	9.36E+05	>Sol	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7.85E+04	7.85E+04	-	7.85E+04	>Sat	7.65E+03	1.82E+05	1.82E+05	-	1.82E+05	>Sol	1.05E+02
Naphthalene	1.07E+03	1.07E+03	-	1.07E+03	>Sat	1.02E+04	3.95E+03	3.95E+03	-	3.95E+03	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	1.47E+07	1.47E+07	-	1.47E+07	>Sat	5.18E+03	3.25E+06	3.25E+06	-	3.25E+06	>Sol	7.41E+01
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	1.05E+08	1.05E+08	-	1.05E+08	>Sat	2.64E+03	4.70E+06	4.70E+06	-	4.70E+06	>Sol	2.79E+01
Styrene	-	-	-	-	-	-	2.46E+05	2.46E+05	-	2.46E+05	>Sol	1.94E-01
Toluene	2.04E+05	2.04E+05	-	2.04E+05	>Sat	2.65E+03	4.49E+05	4.49E+05	-	4.49E+05	>Sol	1.76E+01
TPH C06-C09 aliphatic	5.32E+04	5.32E+04	-	5.32E+04	>Sat	5.93E+02	3.46E+03	3.46E+03	-	3.46E+03	>Sol	6.08E+00
TPH C10-C14 aliphatic	1.38E+05	1.38E+05	-	1.38E+05	>Sat	6.94E+04	1.52E+02	1.52E+02	-	1.52E+02	>Sol	1.73E+03
TPH C10-C14 aromatic	6.74E+04	6.74E+04	-	6.74E+04	>Sat	6.94E+04	1.34E+04	1.34E+04	-	1.34E+04	>Sol	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	3.74E+02	3.74E+02	-	3.74E+02	>Sat	2.20E+02	3.46E+03	3.46E+03	-	3.46E+03	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	1.60E+04	1.60E+04	-	1.60E+04	>Sat	2.58E+03	2.32E+04	2.32E+04	-	2.32E+04	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater-Derived Vapours in Outdoor Air

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

AppE_Scen3_UnpavedRec_Risk_11Apr2011as.xls Risk-SubSurfSoil VapInhal-Outd

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Outdoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Outdoor Air ((mg/m3)/(mg/L))	Vapour Concentration in Outdoor Air (From Subsurface Groundwater) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (L/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	4.48	3.90E+00	6.98E-07	2.72E-06	2.10E-01	5.82E-08	2.27E-07	1.08E-06	5.82E-08	2.27E-07	1.08E-06
Acenaphthylene	43.2	1.61E+01	4.10E-07	6.60E-06	2.10E-01	3.40E-08	5.50E-07	2.62E-06	3.42E-08	5.50E-07	2.62E-06
Ammonia	348	4.82E+05	3.47E-07	1.21E-04	6.95E-02	2.89E-08	1.01E-05	1.45E-04	2.89E-08	1.01E-05	1.45E-04
Aniline	0.212	3.60E+04	NV	-	1.00E-03	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	2.15E-07	9.35E-09	1.05E+00	1.80E-08	7.79E-10	7.42E-10	1.80E-08	7.79E-10	7.42E-10
Arsenic, Inorganic	0.024	-	NV	-	1.00E-03	-	-	-	-	-	-
Barium	2.23	-	NV	-	5.00E-04	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.22E-05	1.30E-03	9.60E-03	2.69E-06	1.08E-04	1.12E-02	2.69E-06	1.08E-04	1.12E-02
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	NV	-	8.75E-02	-	-	-	-	-	-
Cadmium (Water)	0.108	-	NV	-	3.00E-04	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	NV	-	1.00E-04	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	NV	-	1.00E-04	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-	-	-	-
Cobalt	0.057	-	NV	-	1.00E-04	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	NV	-	6.00E-01	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	NV	-	6.00E-01	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.51E-07	2.02E-06	2.10E-01	5.42E-08	1.68E-07	8.00E-07	5.42E-08	1.68E-07	8.00E-07
Dimethylphenol, 2,4-	38	7.87E+03	-	NV	7.00E-02	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	3.50E-05	1.06E-04	1.30E+00	2.91E-06	8.80E-06	6.77E-06	2.91E-06	8.80E-06	6.77E-06
Fluoranthene	25.9	2.60E-01	NV	-	1.40E-01	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.59E-07	6.06E-07	1.40E-01	2.99E-08	5.05E-08	3.61E-07	2.99E-08	5.05E-08	3.61E-07
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-	-	-	-
Iron	187	-	NV	-	2.45E+00	-	-	-	-	-	-
Lead and Compounds	0.555	-	NV	-	5.00E-04	-	-	-	-	-	-
Manganese	4.89	-	NV	-	1.50E-04	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.85E-06	4.55E-05	1.40E-01	1.54E-07	3.79E-06	2.71E-05	1.54E-07	3.79E-06	2.71E-05
Naphthalene	283	3.10E+01	1.82E-06	5.65E-05	3.00E-03	1.52E-07	4.71E-06	1.57E-03	1.52E-07	4.71E-06	1.57E-03
Nickel Soluble Salts	0.303	-	NV	-	9.00E-05	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.55E-07	1.78E-07	2.10E-01	1.29E-08	1.49E-08	7.07E-08	1.29E-08	1.49E-08	7.07E-08
Phenol	249	8.28E+04	NV	-	2.00E-01	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	5.36E-08	7.24E-09	1.05E-01	4.47E-09	6.03E-10	5.74E-09	4.47E-09	6.03E-10	5.74E-09
Styrene	0.194	3.10E+02	1.27E-05	2.46E-06	2.60E-01	1.06E-06	2.05E-07	7.89E-07	1.06E-06	2.05E-07	7.89E-07
Toluene	17.6	5.26E+02	3.34E-05	5.88E-04	5.00E+00	2.79E-06	4.90E-05	9.80E-06	2.79E-06	4.90E-05	9.80E-06
TPH C06-C09 aliphatic	6.08	1.18E+01	7.98E-03	4.85E-02	1.84E-01	6.65E-04	4.04E-03	2.20E-04	6.65E-04	4.04E-03	2.20E-04
TPH C10-C14 aliphatic	1730	9.99E-02	9.89E-03	9.88E-04	1.00E+00	8.24E-04	8.23E-05	8.23E-05	8.24E-04	8.23E-05	8.23E-05
TPH C10-C14 aromatic	1730	2.53E+01	2.24E-05	5.67E-04	2.00E-01	1.87E-06	4.72E-05	2.36E-04	1.87E-06	4.72E-05	2.36E-04
TPH C15-C28 aliphatic	1520	1.11E-04	NV	-	7.00E+00	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	NV	-	1.05E-01	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	NV	-	7.00E+00	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	NV	-	1.05E-01	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	2.43E-05	2.23E-05	7.00E-03	2.02E-06	1.86E-06	2.66E-04	2.02E-06	1.86E-06	2.66E-04
Vanadium and compounds	0.0228	-	NV	-	1.00E-03	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	2.85E-05	1.91E-04	2.20E-01	2.37E-06	1.59E-05	7.23E-05	2.37E-06	1.59E-05	7.23E-05
TOTAL								1.39E-02			1.39E-02

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	1.13E-05	1.13E-05	2.88E-07	2.88E-07	2.88E-07	6.95E+05	1.13E-05	1.13E-05	6.95E+05	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	2.58E-05	2.58E-05	1.59E-07	1.59E-07	1.59E-07	1.26E+06	2.58E-05	2.58E-05	1.26E+06	0.00%	0.00%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	5.87E-09	5.87E-09	4.12E-09	4.12E-09	4.12E-09	4.86E+07	5.87E-09	5.87E-09	4.86E+07	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	6.08E-01	6.08E-01	9.21E-04	9.21E-04	9.21E-04	2.71E+02	2.50E-01	-	2.71E+02	125.00%	125.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	8.45E-06	8.45E-06	1.49E-07	1.49E-07	1.49E-07	6.73E+06	8.45E-06	8.45E-06	6.73E+06	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.60E-04	4.60E-04	2.76E-06	2.76E-06	2.76E-06	9.07E+04	4.60E-04	4.60E-04	9.07E+04	#DIV/0!	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	3.35E-06	3.35E-06	1.08E-07	1.08E-07	1.08E-07	1.85E+06	3.35E-06	3.35E-06	1.85E+06	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.13E-04	3.13E-04	2.55E-06	2.55E-06	2.55E-06	7.85E+04	3.13E-04	3.13E-04	7.85E+04	#DIV/0!	-
Naphthalene	10200	9.66E+01	1.80E-02	1.80E-02	1.87E-04	1.87E-04	1.87E-04	1.07E+03	1.80E-02	1.80E-02	1.07E+03	1.80%	1.80%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	5.24E-07	5.24E-07	1.36E-08	1.36E-08	1.36E-08	1.47E+07	5.24E-07	5.24E-07	1.47E+07	0.00%	0.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	2.80E-08	2.80E-08	1.91E-09	1.91E-09	1.91E-09	1.05E+08	2.80E-08	2.80E-08	1.05E+08	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	3.56E-04	3.56E-04	1.22E-06	1.22E-06	1.22E-06	2.04E+05	3.56E-04	3.56E-04	2.04E+05	0.18%	0.18%
TPH C06-C09 aliphatic	593	2.21E+02	5.19E-04	5.19E-04	2.35E-06	2.35E-06	2.35E-06	5.32E+04	5.19E-04	5.19E-04	5.32E+04	0.05%	0.05%
TPH C10-C14 aliphatic	69400	1.11E+02	1.00E-04	1.00E-04	9.03E-07	9.03E-07	9.03E-07	1.38E+05	1.00E-04	1.00E-04	1.38E+05	0.05%	0.05%
TPH C10-C14 aromatic	69400	1.54E+02	2.86E-04	2.86E-04	1.85E-06	1.85E-06	1.85E-06	6.74E+04	2.86E-04	2.86E-04	6.74E+04	0.03%	0.03%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.00E-01	2.00E-01	2.68E-03	2.68E-03	2.68E-03	3.74E+02	2.00E-01	2.00E-01	3.74E+02	159.80%	159.80%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	1.39E-04	1.39E-04	1.56E-05	1.56E-05	1.56E-05	1.60E+04	1.39E-04	1.39E-04	1.60E+04	0.11%	0.11%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Child Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL (%)	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg	HI	HI	mg/kg	%	%
Acenaphthene	511	3.94E+01	1.13E-05	1.13E-05	2.88E-07	2.88E-07	2.88E-07	6.95E+05	1.13E-05	1.13E-05	6.95E+05	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	2.58E-05	2.58E-05	1.59E-07	1.59E-07	1.59E-07	1.26E+06	2.58E-05	2.58E-05	1.26E+06	0.01%	0.01%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	5.87E-09	5.87E-09	4.12E-09	4.12E-09	4.12E-09	4.86E+07	5.87E-09	5.87E-09	4.86E+07	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	6.08E-01	6.08E-01	9.21E-04	9.21E-04	9.21E-04	2.71E+02	2.50E-01	-	2.71E+02	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
#REF!	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	8.45E-06	8.45E-06	1.49E-07	1.49E-07	1.49E-07	6.73E+06	8.45E-06	8.45E-06	6.73E+06	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.60E-04	4.60E-04	2.76E-06	2.76E-06	2.76E-06	9.07E+04	4.60E-04	4.60E-04	9.07E+04	0.18%	0.18%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	3.35E-06	3.35E-06	1.08E-07	1.08E-07	1.08E-07	1.85E+06	3.35E-06	3.35E-06	1.85E+06	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.13E-04	3.13E-04	2.55E-06	2.55E-06	2.55E-06	7.85E+04	3.13E-04	3.13E-04	7.85E+04	0.16%	0.16%
Naphthalene	10200	9.66E+01	1.80E-02	1.80E-02	1.87E-04	1.87E-04	1.87E-04	1.07E+03	1.80E-02	1.80E-02	1.07E+03	9.02%	9.02%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	5.24E-07	5.24E-07	1.36E-08	1.36E-08	1.36E-08	1.47E+07	5.24E-07	5.24E-07	1.47E+07	0.00%	0.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	2.80E-08	2.80E-08	1.91E-09	1.91E-09	1.91E-09	1.05E+08	2.80E-08	2.80E-08	1.05E+08	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	3.56E-04	3.56E-04	1.22E-06	1.22E-06	1.22E-06	2.04E+05	3.56E-04	3.56E-04	2.04E+05	0.14%	0.14%
TPH C06-C09 aliphatic	593	2.21E+02	5.19E-04	5.19E-04	2.35E-06	2.35E-06	2.35E-06	5.32E+04	5.19E-04	5.19E-04	5.32E+04	0.42%	0.42%
TPH C10-C14 aliphatic	69400	1.11E+02	1.00E-04	1.00E-04	9.03E-07	9.03E-07	9.03E-07	1.38E+05	1.00E-04	1.00E-04	1.38E+05	0.08%	0.08%
TPH C10-C14 aromatic	69400	1.54E+02	2.86E-04	2.86E-04	1.85E-06	1.85E-06	1.85E-06	6.74E+04	2.86E-04	2.86E-04	6.74E+04	0.23%	0.23%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.00E-01	2.00E-01	2.68E-03	2.68E-03	2.68E-03	3.74E+02	2.00E-01	2.00E-01	3.74E+02	19.98%	19.98%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	1.39E-04	1.39E-04	1.56E-05	1.56E-05	1.56E-05	1.60E+04	1.39E-04	1.39E-04	1.60E+04	0.06%	0.06%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Non-Threshold Lifetime Health Effects (Adult and Child)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (ILCR)		Risk/Soil Concentration (i.e., exposure and toxicity factor)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Outdoors	TOTAL	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL				Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg		mg/kg	%	%
Acenaphthene	511	3.94E+01	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	3.50E-05	3.50E-05	5.31E-08	5.31E-08	5.31E-08	1.88E+02	1.00E-05	1.88E+02	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	-	-	-	-	-	-	-	-	-	-
Naphthalene	10200	9.66E+01	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour unitless	TOTAL (All Pathways) unitless	GW to Outdoor Vapour L/mg	Total Vapour Pathways L/mg	TOTAL (All Pathways) L/mg					GW to Outdoor Vapour %	TOTAL %
Acenaphthene	4.48	3.90E+00	1.08E-06	1.08E-06	2.77E-07	2.77E-07	2.77E-07	7.22E+05	1.08E-06	1.08E-06	7.22E+05	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	2.62E-06	2.62E-06	1.63E-07	1.63E-07	1.63E-07	1.23E+06	2.62E-06	2.62E-06	1.23E+06	0.00%	0.00%
Ammonia	348	4.82E+05	1.45E-04	1.45E-04	4.17E-07	4.17E-07	4.17E-07	2.40E+06	2.01E-01	2.01E-01	2.40E+06	20.08%	20.08%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	7.42E-10	7.42E-10	1.71E-08	1.71E-08	1.71E-08	1.17E+07	7.42E-10	7.42E-10	1.17E+07	0.00%	0.00%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.12E-02	1.12E-02	2.80E-04	2.80E-04	2.80E-04	8.94E+02	2.50E-01	-	8.94E+02	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.00E-07	8.00E-07	2.58E-07	2.58E-07	2.58E-07	3.87E+06	8.00E-07	8.00E-07	3.87E+06	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	6.77E-06	6.77E-06	2.24E-06	2.24E-06	2.24E-06	1.12E+05	3.79E-04	-	1.12E+05	0.15%	0.15%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.61E-07	3.61E-07	2.14E-07	2.14E-07	2.14E-07	9.36E+05	3.61E-07	3.61E-07	9.36E+05	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	2.71E-05	2.71E-05	1.10E-06	1.10E-06	1.10E-06	1.82E+05	2.71E-05	-	1.82E+05	0.01%	0.01%
Naphthalene	283	3.10E+01	1.57E-03	1.57E-03	5.06E-05	5.06E-05	5.06E-05	3.95E+03	1.57E-03	1.57E-03	3.95E+03	0.78%	0.78%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	7.07E-08	7.07E-08	6.15E-08	6.15E-08	6.15E-08	3.25E+06	7.07E-08	7.07E-08	3.25E+06	0.00%	0.00%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	5.74E-09	5.74E-09	4.26E-08	4.26E-08	4.26E-08	4.70E+06	5.74E-09	5.74E-09	4.70E+06	0.00%	0.00%
Styrene	0.194	3.10E+02	7.89E-07	7.89E-07	4.07E-06	4.07E-06	4.07E-06	2.46E+05	1.26E-03	1.26E-03	2.46E+05	0.13%	0.13%
Toluene	17.6	5.26E+02	9.80E-06	9.80E-06	5.57E-07	5.57E-07	5.57E-07	4.49E+05	2.93E-04	2.93E-04	4.49E+05	0.12%	0.12%
TPH C06-C09 aliphatic	6.08	1.18E+01	2.20E-04	2.20E-04	3.61E-05	3.61E-05	3.61E-05	3.46E+03	4.26E-04	4.26E-04	3.46E+03	0.34%	0.34%
TPH C10-C14 aliphatic	1730	9.99E-02	8.23E-05	8.23E-05	8.24E-04	8.24E-04	8.24E-04	1.52E+02	8.23E-05	8.23E-05	1.52E+02	0.07%	0.07%
TPH C10-C14 aromatic	1730	2.53E+01	2.36E-04	2.36E-04	9.33E-06	9.33E-06	9.33E-06	1.34E+04	2.36E-04	2.36E-04	1.34E+04	0.19%	0.19%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	2.66E-04	2.66E-04	2.89E-04	2.89E-04	2.89E-04	3.46E+03	1.65E-02	1.65E-02	3.46E+03	1.65%	1.65%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	7.23E-05	7.23E-05	1.08E-05	1.08E-05	1.08E-05	2.32E+04	1.14E-04	1.14E-04	2.32E+04	0.05%	0.05%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Outdoor Vapour	TOTAL
	mg/L	mg/L	unitless	unitless	L/mg	L/mg	L/mg	mg/L			mg/L	%	%
Acenaphthene	4.48	3.90E+00	1.08E-06	1.08E-06	2.77E-07	2.77E-07	2.77E-07	7.22E+05	1.08E-06	1.08E-06	7.22E+05	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	2.62E-06	2.62E-06	1.63E-07	1.63E-07	1.63E-07	1.23E+06	2.62E-06	2.62E-06	1.23E+06	0.00%	0.00%
Ammonia	348	4.82E+05	1.45E-04	1.45E-04	4.17E-07	4.17E-07	4.17E-07	2.40E+06	2.01E-01	2.01E-01	2.40E+06	20.08%	20.08%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	7.42E-10	7.42E-10	1.71E-08	1.71E-08	1.71E-08	1.17E+07	7.42E-10	7.42E-10	1.17E+07	0.00%	0.00%
Arsenic, inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.12E-02	1.12E-02	2.80E-04	2.80E-04	2.80E-04	8.94E+02	2.50E-01	-	8.94E+02	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.00E-07	8.00E-07	2.58E-07	2.58E-07	2.58E-07	3.87E+06	8.00E-07	8.00E-07	3.87E+06	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	6.77E-06	6.77E-06	2.24E-06	2.24E-06	2.24E-06	1.12E+05	3.79E-04	3.79E-04	1.12E+05	0.15%	0.15%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.61E-07	3.61E-07	2.14E-07	2.14E-07	2.14E-07	9.36E+05	3.61E-07	3.61E-07	9.36E+05	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	2.71E-05	2.71E-05	1.10E-06	1.10E-06	1.10E-06	1.82E+05	2.71E-05	2.71E-05	1.82E+05	0.01%	0.01%
Naphthalene	283	3.10E+01	1.57E-03	1.57E-03	5.06E-05	5.06E-05	5.06E-05	3.95E+03	1.57E-03	1.57E-03	3.95E+03	0.78%	0.78%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	7.07E-08	7.07E-08	6.15E-08	6.15E-08	6.15E-08	3.25E+06	7.07E-08	7.07E-08	3.25E+06	0.00%	0.00%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	5.74E-09	5.74E-09	4.26E-08	4.26E-08	4.26E-08	4.70E+06	5.74E-09	5.74E-09	4.70E+06	0.00%	0.00%
Styrene	0.194	3.10E+02	7.89E-07	7.89E-07	4.07E-06	4.07E-06	4.07E-06	2.46E+05	1.26E-03	1.26E-03	2.46E+05	0.13%	0.13%
Toluene	17.6	5.26E+02	9.80E-06	9.80E-06	5.57E-07	5.57E-07	5.57E-07	4.49E+05	2.93E-04	2.93E-04	4.49E+05	0.12%	0.12%
TPH C06-C09 aliphatic	6.08	1.18E+01	2.20E-04	2.20E-04	3.61E-05	3.61E-05	3.61E-05	3.46E+03	4.26E-04	4.26E-04	3.46E+03	0.34%	0.34%
TPH C10-C14 aliphatic	1730	9.99E+02	8.23E-05	8.23E-05	8.24E-04	8.24E-04	8.24E-04	1.52E+02	8.23E-05	8.23E-05	1.52E+02	0.07%	0.07%
TPH C10-C14 aromatic	1730	2.53E+01	2.36E-04	2.36E-04	9.33E-06	9.33E-06	9.33E-06	1.34E+04	2.36E-04	2.36E-04	1.34E+04	0.19%	0.19%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	2.66E-04	2.66E-04	2.89E-04	2.89E-04	2.89E-04	3.46E+03	1.65E-02	1.65E-02	3.46E+03	1.65%	1.65%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	7.23E-05	7.23E-05	1.08E-05	1.08E-05	1.08E-05	2.32E+04	1.14E-04	1.14E-04	2.32E+04	0.05%	0.05%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreation (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)				GW to Outdoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg				%	%
	mg/L	mg/L						mg/L		mg/L		
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	6.48E-07	6.48E-07	1.61E-08	1.61E-08	1.61E-08	6.21E+02	1.00E-05	6.21E+02	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salt	0.102	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix F

Risk Scenario 4 Paved Rec

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Lend Lease
Scenario: Scenario 4 - Paved Recreation (Risk Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Recreational User

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐ Incidental Ingestion of Soil
☐ Dermal Contact with Soil
☐ Inhalation of Surface Soil-Derived Dust in Indoor Air
☐ Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐ Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐ Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☒ Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐ Inhalation of Groundwater-Derived Vapours in Indoor Air
☒ Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐ Ingestion of Potable Groundwater
☐ Incidental Ingestion of Groundwater (Bathing or Excavation)
☐ Dermal Contact with Groundwater (Bathing or Excavation)
☐ Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐ Y Soil RBSLs saturation limited?
☐ Y Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.20	1.00E-05	511	4.48
Acenaphthylene	0.20	1.00E-05	1700	43.2
Ammonia	1.00	1.00E-05		348
Aniline	1.00	1.00E-05		0.212
Anthracene	0.20	1.00E-05	2150	15.4
Arsenic, Inorganic	1.00	1.00E-05		0.024
Barium	1.00	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1.00	1.00E-05		0.03
Cadmium (Water)	1.00	1.00E-05		0.108
Chromium(III), Insoluble Salts	1.00	1.00E-05	210	0.102
Chromium(VI)	1.00	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1.00	1.00E-05		0.057
Cresol, m-&p-	1.00	1.00E-05	2290	436
Cresol, o-	1.00	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1.00	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1.00	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.20	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1.00	1.00E-05	60600	187
Lead and Compounds	1.00	1.00E-05	13600	0.555
Manganese	1.00	1.00E-05		4.89
Methylnaphthalene, 2-	0.20	1.00E-05	7650	105
Naphthalene	0.20	1.00E-05	10200	283
Nickel Soluble Salts	1.00	1.00E-05		0.303
Phenanthrene	0.20	1.00E-05	5180	74.1
Phenol	1.00	1.00E-05		249
Pyrene	0.20	1.00E-05	2640	27.9
Styrene	1.00	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1.00	1.00E-05	220	0.92
Vanadium and compounds	1.00	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

		Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:		Units					
Body weight	kg	70	13	70	13	70	13
Exposure duration	yr	30	6	64	6	64	6
Averaging time (carcinogens)	yr	70	70	70	70	70	70
Averaging time (non-carcinogens)	yr	30	6	64	6	64	6
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	25	100			25	100
Exposure frequency for soil ingestion	days/yr	350	350			350	350
Fraction of daily soil intake from site	unitless	0.5	0.5			0.5	0.5
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	3600	2100			3600	2100
Soil to skin adherence factor	mg/cm2	0.5	0.5			0.5	0.5
Exposure frequency for dermal contact with soil	days/yr	350	350			350	350
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	0	0			0	0
Exposure frequency (indoor air)	days/yr	350	350			350	350
Particulate emission factor (indoor air)	m3/kg	NA	NA			NA	NA
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	2	2	2	2	2	2
Exposure frequency (outdoor air)	days/yr	350	350	365	365	365	365
Particulate emission factor (outdoor air)	m3/kg	1.36E+09	1.36E+09			1.36E+09	1.36E+09
Potable Water Ingestion							
Potable water intake rate	L/day	0	0			0	0
Exposure frequency for potable water intake	days/yr	350	350			350	350
Incidental Water Ingestion							
Incidental ingestion rate	L/day	NA	NA			NA	NA
Exposure frequency for incidental water ingestion	days/yr	350	350			350	350
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	18150	6880			18150	6880
Exposure time for dermal water contact	hr/day	1	1			1	1
Exposure frequency for dermal water contact	days/yr	350	350			350	350

-Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

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Barangaroo
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Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	200	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295		173	HV	173	Groundwater assumed to be at a depth of 2 m based on groundwater data for the Site.
				Sand (<12% fines)			The soil type above groundwater across the site consists of fill (mostly sand and gravel), thus sand has conservatively been assumed as the main soil type in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm ³ /cm ³	0.38		0.375	TPOR	0.375	
Adjustment for vadose zone biodegradation	unitless	1		10	BioA_GW	10	Adjustment for biodegradation in unpaved areas; see text
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm			10	Hvtwo	10	Assumed thickness of concrete pavings in the public open space area.
				User Specified (Enter values in 'Soil Data' worksheet)			Porosities for concrete have been assumed to be sand (multiplied by 1%).
SCS Soil Type:							
Air-filled porosity (volumetric)	cm ³ /cm ³	NA		0.00321	VACS2	0.00321	
Water-filled porosity (volumetric)	cm ³ /cm ³	NA		0.00054	wvcv2	0.00054	
Total soil porosity	cm ³ /cm ³	NA		0.00375	TPOR2	0.00375	
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):				Sand (<12% fines)			As above
Thickness of capillary fringe	cm	5		17	hcap	17	
Volumetric air content in capillary fringe soils	cc/cc	0.038		0.122	VAC	0.122	
Volumetric water content in capillary fringe soils	cc/cc	0.342		0.253	wccap	0.253	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(e)	378.3	windsp	378.3	Based on the average annual 9am and 3pm windspeeds measured at Observatory Point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(f)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

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B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc (cm ² /g)	Kd (cm ² /g)	H' (cc-H ₂ O / cc-air)	S (mg/L-water)	D ^{air} (cm ² /s)	D ^{soil} (cm ² /s)	MW (g/mol)	VP (mmHg)	Volatile?
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benzo(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

Chemical	D _s (cm ² /s)	D _{crack}	D _{cap}	D _{vs}	D _{crack} (cm ² /s)	D _{cap} (cm ² /s)	D _{vs} (cm ² /s)	Convective Factor (unitless)
Acenaphthene	8.18E-03	1.79E-05	-	3.16E-04	3.96E-03	4.07E-04	3.22E-04	3.10E+01
Acenaphthylene	7.28E-03	1.59E-05	-	2.81E-04	3.52E-03	4.00E-04	2.88E-04	3.49E+01
Ammonia	3.69E-02	8.07E-05	-	1.42E-03	1.79E-02	2.69E-03	1.48E-03	6.86E+00
Aniline	NV	NV	NV	NV	NV	NV	NV	NV
Anthracene	6.31E-03	1.38E-05	-	2.43E-04	3.06E-03	5.05E-04	2.54E-04	4.00E+01
Benzo(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	1.45E-02	3.17E-05	-	5.58E-04	6.98E-03	5.81E-04	5.60E-04	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	6.63E-03	1.45E-05	-	2.56E-04	3.20E-03	3.26E-04	2.60E-04	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	NV	NV	NV
Ethylbenzene	1.11E-02	2.42E-05	-	4.27E-04	5.35E-03	4.44E-04	4.29E-04	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	7.11E-03	1.56E-05	-	2.74E-04	3.45E-03	4.31E-04	2.83E-04	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	1.85E-05	-	3.27E-04	4.09E-03	3.65E-04	3.30E-04	3.00E+01
Naphthalene	9.78E-03	2.14E-05	-	3.77E-04	4.72E-03	4.24E-04	3.81E-04	2.60E+01
Phenanthrene	5.58E-03	1.22E-05	-	2.15E-04	2.72E-03	5.05E-04	2.26E-04	4.52E+01
Phenol	NV	NV	NV	NV	NV	NV	NV	NV
Pyrene	4.50E-03	9.85E-06	-	1.74E-04	2.26E-03	1.27E-03	1.87E-04	5.43E+01
Styrene	1.15E-02	2.51E-05	-	4.43E-04	5.55E-03	4.64E-04	4.45E-04	2.21E+01
Toluene	1.26E-02	2.75E-05	-	4.85E-04	6.07E-03	5.04E-04	4.87E-04	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	3.54E-05	-	6.24E-04	7.80E-03	6.45E-04	6.25E-04	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	3.54E-05	-	6.24E-04	7.80E-03	6.45E-04	6.25E-04	1.57E+01
TPH C10-C14 aromatic	1.62E-02	3.54E-05	-	6.24E-04	7.80E-03	6.50E-04	6.26E-04	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	2.15E-05	-	3.79E-04	4.74E-03	3.94E-04	3.80E-04	2.59E+01
Xylenes (total)	1.37E-02	3.00E-05	-	5.28E-04	6.61E-03	5.50E-04	5.30E-04	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{vs}	Effective diffusion coefficient between groundwater and soil surface

Vapour Modelling - Groundwater to Outdoor and Indoor Air

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Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp}	VF _{wamb}	VF _{trench}
	(mgm ³ air / mg/L H ₂ O)	(mgm ³ air / mg/L H ₂ O)	(mgm ³ air / mg/L water)
Acenaphthene	2.63E-04	7.19E-08	4.41E-06
Acenaphthylene	1.47E-04	3.99E-08	4.41E-06
Ammonia	7.92E-05	2.90E-08	4.41E-06
Aniline	NV	NV	NV
Anthracene	6.41E-05	1.72E-08	4.41E-06
Benz(a)anthracene	NV	NV	NV
Benzene	1.29E-02	3.78E-06	4.41E-06
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m-&p-	NV	NV	NV
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	2.51E-04	6.75E-08	4.41E-06
Dimethylphenol, 2,4-	NV	NV	NV
Ethylbenzene	1.46E-02	4.10E-06	4.41E-06
Fluoranthene	NV	NV	NV
Fluorene	1.22E-04	3.31E-08	4.41E-06
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	7.58E-04	2.08E-07	4.41E-06
Naphthalene	7.33E-04	2.04E-07	4.41E-06
Phenanthrene	4.38E-05	1.16E-08	4.41E-06
Phenol	NV	NV	NV
Pyrene	1.03E-05	2.71E-09	4.41E-06
Styrene	5.23E-03	1.48E-06	4.41E-06
Toluene	1.37E-02	3.92E-06	4.41E-06
TPH C06-C09 aliphatic	3.15E+00	9.39E-04	4.41E-06
TPH C10-C14 aliphatic	3.91E+00	1.16E-03	4.41E-06
TPH C10-C14 aromatic	8.81E-03	2.62E-06	4.41E-06
TPH C15-C28 aliphatic	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	1.02E-02	2.85E-06	4.41E-06
Xylenes (total)	1.15E-02	3.34E-06	4.41E-06

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

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Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	10.01	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100		0.01	HV	0.01	Assumes that contaminated soils are located directly below concrete pavings
				Sand (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay, therefore sand has been conservatively assumed in this scenario
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning: see text.
Biodegradation adjustment	unitless	1		10	BioA	10	Conservatively assumes no soil vapour biodegradation
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm			10	Hvtwo	10	Assumed thickness of concrete pavings in the public open space area
				User Specified (Enter values in 'Soil Data' worksheet)			Porosities for concrete have been assumed to be sand (multiplied by 1%)
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA		0.00321	VACS2	0.00321	
Water-filled porosity (volumetric)	cm3/cm3	NA		0.00054	wvcvz2	0.00054	
Total soil porosity	cm3/cm3	NA		0.00375	TPOR2	0.00375	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(c)	378.3	windsp	378.3	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(d)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.
<u>Other</u>							
Averaging time for surface emission vapour flux	sec	1.89E+08	(e)		atvapor	1.89E+08	Defaults to receptor exposure duration

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O/cc-air)	(mg/L/water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{soil}	D _{soil}	D _{soil}	D _{soil}	D _{crack}	C _{sat}	Convective
	(cm ² /s)				(cm ² /s)	mg/kg	Factor (unitless)
Acenaphthene	8.18E-03	1.79E-05	-	1.79E-05	3.96E-03	3.94E+01	3.10E+01
Acenaphthylene	7.28E-03	1.59E-05	-	1.59E-05	3.52E-03	1.63E+02	3.49E+01
Ammonia	3.69E-02	8.07E-05	-	8.07E-05	1.79E-02	1.87E+04	6.86E+00
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV
Anthracene	6.31E-03	1.38E-05	-	1.38E-05	3.06E-03	1.42E+00	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	3.17E-05	-	3.17E-05	6.98E-03	6.59E+02	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	1.44E+04	NV
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	1.45E-05	-	1.45E-05	3.20E-03	5.69E+01	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV
Ethylbenzene	1.11E-02	2.42E-05	-	2.43E-05	5.35E-03	1.67E+02	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	1.56E-05	-	1.56E-05	3.45E-03	3.10E+01	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	1.85E-05	-	1.86E-05	4.09E-03	1.23E+02	3.00E+01
Naphthalene	9.78E-03	2.14E-05	-	2.14E-05	4.72E-03	9.66E+01	2.60E+01
Phenanthrene	5.58E-03	1.22E-05	-	1.22E-05	2.72E-03	3.84E+01	4.52E+01
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV
Pyrene	4.50E-03	9.85E-06	-	9.86E-06	2.26E-03	1.47E+01	5.43E+01
Styrene	1.15E-02	2.51E-05	-	2.52E-05	5.55E-03	2.93E+02	2.21E+01
Toluene	1.26E-02	2.75E-05	-	2.75E-05	6.07E-03	2.91E+02	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	3.54E-05	-	3.54E-05	7.80E-03	2.21E+02	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	3.54E-05	-	3.54E-05	7.80E-03	1.11E+02	1.57E+01
TPH C10-C14 aromatic	1.62E-02	3.54E-05	-	3.54E-05	7.80E-03	1.54E+02	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	2.15E-05	-	2.15E-05	4.74E-03	7.46E+01	2.59E+01
Xylenes (total)	1.37E-02	3.00E-05	-	3.00E-05	6.61E-03	8.90E+00	1.86E+01

Definition of Parameters

D _{soil}	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1}	VF _{as2}	VF _{p (indoor)}	VF _{p (outdoor)}	VF _{samb}	VF _{seep}
	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)	(m ³ -air / mg/kg)	(mg/m ³ -air / mg/kg-soil)	(mg/m ³ -air / mg/kg-soil)
Acenaphthene	7.26E-08	5.22E-05	-	7.35E-10	7.93E-09	2.87E-06
Acenaphthylene	5.39E-08	5.22E-05	-	7.35E-10	4.37E-09	1.60E-06
Ammonia	7.35E-07	5.22E-05	-	7.35E-10	8.12E-07	2.16E-04
Aniline	NV	NV	-	7.35E-10	NV	NV
Anthracene	1.94E-08	5.22E-05	-	7.35E-10	5.67E-10	2.10E-07
Benz(a)anthracene	NV	NV	-	7.35E-10	NV	NV
Benzene	2.78E-07	5.22E-05	-	7.35E-10	1.16E-06	3.89E-04
Benzo(a)pyrene	NV	NV	-	7.35E-10	NV	NV
Benzo(b)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Benzo(g,h,i)perylene	NV	NV	-	7.35E-10	NV	NV
Benzo(k)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	-	7.35E-10	NV	NV
Chrysene	NV	NV	-	7.35E-10	NV	NV
Cresol, m-&p-	NV	NV	-	7.35E-10	NV	NV
Cresol, o-	NV	NV	-	7.35E-10	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	7.35E-10	NV	NV
Dibenzofuran	5.22E-08	5.22E-05	-	7.35E-10	4.09E-09	1.51E-06
Dimethylphenol, 2,4-	NV	NV	-	7.35E-10	NV	NV
Ethylbenzene	1.77E-07	5.22E-05	-	7.35E-10	4.70E-07	1.64E-04
Fluoranthene	NV	NV	-	7.35E-10	NV	NV
Fluorene	3.63E-08	5.22E-05	-	7.35E-10	1.98E-09	7.27E-07
Indeno(1,2,3-cd)pyrene	NV	NV	-	7.35E-10	NV	NV
Methylnaphthalene, 2-	1.76E-07	5.22E-05	-	7.35E-10	4.68E-08	1.69E-05
Naphthalene	2.21E-07	5.22E-05	-	7.35E-10	7.35E-08	2.61E-05
Phenanthrene	1.58E-08	5.22E-05	-	7.35E-10	3.76E-10	1.41E-07
Phenol	NV	NV	-	7.35E-10	NV	NV
Pyrene	4.18E-09	5.22E-05	-	7.35E-10	2.63E-11	9.96E-09
Styrene	1.09E-06	5.22E-05	-	7.35E-10	1.77E-06	6.15E-04
Toluene	2.31E-07	5.22E-05	-	7.35E-10	8.02E-07	2.75E-04
TPH C06-C09 aliphatic	6.14E-07	5.22E-05	-	7.35E-10	5.67E-06	1.86E-03
TPH C10-C14 aliphatic	8.88E-08	5.22E-05	-	7.35E-10	1.18E-07	3.89E-05
TPH C10-C14 aromatic	5.69E-08	5.22E-05	-	7.35E-10	4.86E-08	1.60E-05
TPH C15-C28 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C15-C28 aromatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aromatic	NV	NV	-	7.35E-10	NV	NV
Trimethylbenzene, 1,2,4-	1.28E-06	5.22E-05	-	7.35E-10	2.46E-06	8.71E-04
Xylenes (total)	1.73E-07	5.22E-05	-	7.35E-10	4.50E-07	1.52E-04

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	6.36E+07	6.36E+07	-	6.36E+07	>Sat	5.11E+02	7.00E+06	7.00E+06	-	7.00E+06	>Sol	4.48E+00
Acenaphthylene	1.15E+08	1.15E+08	-	1.15E+08	>Sat	1.70E+03	1.26E+07	1.26E+07	-	1.26E+07	>Sol	4.32E+01
Ammonia	-	-	-	-	-	-	2.88E+07	2.88E+07	-	2.88E+07	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	4.44E+09	4.44E+09	-	4.44E+09	>Sat	2.15E+03	1.47E+08	1.47E+08	-	1.47E+08	>Sol	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	2.48E+04	2.48E+04	1.72E+04	1.72E+04	>Sat	1.51E+03	7.62E+03	7.62E+03	5.29E+03	5.29E+03	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	6.16E+08	6.16E+08	-	6.16E+08	>Sat	2.77E+02	3.73E+07	3.73E+07	-	3.73E+07	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	8.29E+06	8.29E+06	-	8.29E+06	>Sat	2.61E+02	9.50E+05	9.50E+05	-	9.50E+05	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	1.70E+08	1.70E+08	-	1.70E+08	>Sat	2.10E+03	1.02E+07	1.02E+07	-	1.02E+07	>Sol	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7.18E+06	7.18E+06	-	7.18E+06	>Sat	7.65E+03	1.62E+06	1.62E+06	-	1.62E+06	>Sol	1.05E+02
Naphthalene	9.79E+04	9.79E+04	-	9.79E+04	>Sat	1.02E+04	3.53E+04	3.53E+04	-	3.53E+04	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	1.34E+09	1.34E+09	-	1.34E+09	>Sat	5.18E+03	4.33E+07	4.33E+07	-	4.33E+07	>Sol	7.41E+01
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	9.60E+09	9.60E+09	-	9.60E+09	>Sat	2.64E+03	9.29E+07	9.29E+07	-	9.29E+07	>Sol	2.79E+01
Styrene	-	-	-	-	-	-	2.10E+06	2.10E+06	-	2.10E+06	>Sol	1.94E-01
Toluene	1.87E+07	1.87E+07	-	1.87E+07	>Sat	2.65E+03	3.82E+06	3.82E+06	-	3.82E+06	>Sol	1.76E+01
TPH C06-C09 aliphatic	4.87E+06	4.87E+06	-	4.87E+06	>Sat	5.93E+02	2.94E+04	2.94E+04	-	2.94E+04	>Sol	6.08E+00
TPH C10-C14 aliphatic	1.27E+07	1.27E+07	-	1.27E+07	>Sat	6.94E+04	1.29E+03	1.29E+03	-	1.29E+03	>Sol	1.73E+03
TPH C10-C14 aromatic	6.17E+06	6.17E+06	-	6.17E+06	>Sat	6.94E+04	1.14E+05	1.14E+05	-	1.14E+05	>Sol	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	3.42E+04	3.42E+04	-	3.42E+04	>Sat	2.20E+02	2.95E+04	2.95E+04	-	2.95E+04	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	1.47E+06	1.47E+06	-	1.47E+06	>Sat	2.58E+03	1.98E+05	1.98E+05	-	1.98E+05	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater-Derived Vapours in Outdoor Air

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Outdoor Air [(mg/m3)/(mg/kg)]	Vapour Concentration in Outdoor Air (From Subsurface Soil) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (kg/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	511	3.94E+01	7.93E-09	3.12E-07	2.10E-01	6.61E-10	2.60E-08	1.24E-07	6.61E-10	2.60E-08	1.24E-07
Acenaphthylene	1700	1.63E+02	4.37E-09	7.10E-07	2.10E-01	3.64E-10	5.92E-08	2.82E-07	3.64E-10	5.92E-08	2.82E-07
Ammonia	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	NV	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	5.67E-10	8.08E-10	1.05E+00	4.73E-11	6.74E-11	6.42E-11	4.73E-11	6.74E-11	6.42E-11
Arsenic, inorganic	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	1.16E-06	7.65E-04	9.60E-03	9.67E-08	6.37E-05	6.64E-03	9.67E-08	6.37E-05	6.64E-03
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), insoluble Salts	210	-	-	-	1.00E-04	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	1.00E-04	-	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	NV	-	6.00E-01	-	-	-	-	-	-
Cresol, o-	-	-	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	4.09E-09	2.33E-07	2.10E-01	3.41E-10	1.94E-08	9.24E-08	3.41E-10	1.94E-08	9.24E-08
Dimethylphenol, 2,4-	-	-	NV	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.70E-07	7.84E-05	1.30E+00	3.92E-08	6.53E-06	5.03E-06	3.92E-08	6.53E-06	5.03E-06
Fluoranthene	2440	2.89E+01	NV	-	1.40E-01	-	-	-	-	-	-
Fluorene	2100	3.10E+01	1.98E-09	6.15E-08	1.40E-01	1.65E-10	5.12E-09	3.66E-08	1.65E-10	5.12E-09	3.66E-08
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	2.45E+00	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	5.00E-04	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.68E-08	5.75E-06	1.40E-01	3.90E-09	4.79E-07	3.42E-06	3.90E-09	4.79E-07	3.42E-06
Naphthalene	10200	9.66E+01	7.35E-08	7.10E-06	3.00E-03	6.13E-09	5.92E-07	1.97E-04	6.13E-09	5.92E-07	1.97E-04
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	3.76E-10	1.44E-08	2.10E-01	3.13E-11	1.20E-09	5.73E-09	3.13E-11	1.20E-09	5.73E-09
Phenol	-	-	NV	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	2.63E-11	3.85E-10	1.05E-01	2.19E-12	3.21E-11	3.06E-10	2.19E-12	3.21E-11	3.06E-10
Styrene	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	8.02E-07	2.33E-04	5.00E+00	6.68E-08	1.94E-05	3.89E-06	6.68E-08	1.94E-05	3.89E-06
TPH C06-C09 aliphatic	593	2.21E+02	5.67E-06	1.25E-03	1.84E+01	4.72E-07	1.04E-04	5.68E-06	4.72E-07	1.04E-04	5.68E-06
TPH C10-C14 aliphatic	69400	1.11E+02	1.18E-07	1.32E-05	1.00E+00	9.87E-09	1.10E-06	9.87E-09	1.10E-06	1.10E-06	1.10E-06
TPH C10-C14 aromatic	69400	1.54E+02	4.86E-08	7.50E-06	2.00E-01	4.05E-09	6.25E-07	3.13E-06	4.05E-09	6.25E-07	3.13E-06
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	7.00E+00	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	1.05E-01	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	7.00E+00	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	1.05E-01	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.46E-06	1.83E-04	7.00E-03	2.05E-07	1.53E-05	2.18E-03	2.05E-07	1.53E-05	2.18E-03
Vanadium and compounds	248	-	-	-	1.00E-03	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	4.50E-07	4.00E-06	2.20E-01	3.75E-08	3.34E-07	1.52E-06	3.75E-08	3.34E-07	1.52E-06

TOTAL

9.05E-03

9.05E-03

3.82E-07

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Outdoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Outdoor Air (mg/m3)/(mg/L)	Vapour Concentration in Outdoor Air (From Subsurface Groundwater) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (L/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	4.48	3.90E+00	7.19E-08	2.81E-07	2.10E-01	6.00E-09	2.34E-08	1.11E-07	6.00E-09	2.34E-08	1.11E-07
Acenaphthylene	43.2	1.61E+01	3.99E-08	6.42E-07	2.10E-01	3.33E-09	5.95E-08	2.55E-07	3.33E-09	5.95E-08	2.55E-07
Ammonia	348	4.82E+05	2.90E-08	1.01E-05	6.95E-02	2.42E-09	8.41E-07	1.21E-05	2.42E-09	8.41E-07	1.21E-05
Aniline	0.212	3.60E-04	-	-	1.00E-03	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	1.72E-08	7.46E-10	1.05E+00	1.43E-09	6.21E-11	5.92E-11	1.43E-09	6.21E-11	5.92E-11
Arsenic, inorganic	0.024	-	-	-	1.00E-03	-	-	-	-	-	-
Barium	2.23	-	-	-	5.00E-04	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.78E-06	1.52E-04	9.60E-03	3.15E-07	1.27E-05	1.32E-03	3.15E-07	1.27E-05	1.32E-03
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.53	8.00E-04	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyloxy)phthalate	0.03	2.70E-01	NV	-	8.75E-02	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	3.00E-04	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	1.00E-04	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	1.00E-04	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	1.00E-04	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	NV	-	6.00E-01	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	NV	-	6.00E-01	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.75E-08	2.09E-07	2.10E-01	5.62E-09	1.74E-08	8.30E-08	5.62E-09	1.74E-08	8.30E-08
Dibenzophenone, 2,4-	38	7.87E+03	-	-	7.00E-02	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	4.10E-06	1.24E-05	1.30E+00	3.42E-07	1.03E-06	7.94E-07	3.42E-07	1.03E-06	7.94E-07
Fluoranthene	25.9	2.60E-01	NV	-	1.40E-01	-	-	-	-	-	-
Fluorene	11.91	1.69E+00	3.31E-08	5.59E-08	1.40E-01	2.76E-09	4.66E-09	3.33E-08	2.76E-09	4.66E-09	3.33E-08
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-	-	-	-
Iron	187	-	-	-	2.45E+00	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	5.00E-04	-	-	-	-	-	-
Manganese	4.89	-	-	-	1.50E-04	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	2.08E-07	5.11E-06	1.40E-01	1.73E-08	4.26E-07	3.04E-06	1.73E-08	4.26E-07	3.04E-06
Naphthalene	283	3.10E+01	2.04E-07	6.32E-06	3.00E-03	1.70E-08	5.27E-07	1.76E-04	1.70E-08	5.27E-07	1.76E-04
Nickel Soluble Salts	0.303	-	-	-	9.00E-05	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.16E-08	1.34E-08	2.10E-01	9.70E-10	1.12E-09	5.31E-09	9.70E-10	1.12E-09	5.31E-09
Phenol	249	8.28E+04	NV	-	2.00E-01	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	2.71E-09	3.66E-10	1.05E-01	2.26E-10	3.05E-11	2.26E-10	3.05E-11	2.26E-10	3.05E-11
Styrene	0.194	3.10E+02	1.48E-06	2.88E-07	2.60E-01	1.24E-07	2.40E-08	9.22E-08	1.24E-07	2.40E-08	9.22E-08
Toluene	17.6	5.26E+02	3.92E-06	6.90E-05	5.00E+00	3.27E-07	5.75E-06	1.15E-06	3.27E-07	5.75E-06	1.15E-06
TPH C06-C09 aliphatic	6.08	1.18E+01	9.39E-04	5.71E-03	1.84E+01	7.83E-05	4.76E-04	2.59E-05	7.83E-05	4.76E-04	2.59E-05
TPH C10-C14 aliphatic	1730	9.99E-02	1.16E-03	1.16E-04	1.00E+00	9.70E-05	9.69E-06	9.70E-05	9.69E-06	9.69E-06	9.69E-06
TPH C10-C14 aromatic	1730	2.53E+01	2.62E-06	6.64E-05	2.00E-01	2.19E-07	5.53E-06	2.77E-05	2.19E-07	5.53E-06	2.77E-05
TPH C15-C28 aliphatic	1520	1.11E-04	NV	-	7.00E+00	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	NV	-	1.05E-01	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	NV	-	7.00E+00	-	-	-	-	-	-
TPH C29-C36 aromatic	332	2.60E-03	NV	-	1.05E-01	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E-01	2.85E-06	2.62E-06	7.00E-03	2.37E-07	2.18E-07	3.12E-05	2.37E-07	2.18E-07	3.12E-05
Vanadium and compounds	0.0228	-	-	-	1.00E-03	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	3.34E-06	2.24E-05	2.20E-01	2.78E-07	1.87E-06	8.48E-06	2.78E-07	1.87E-06	8.48E-06

TOTAL

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

7.60E-08

Soil RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	1.24E-07	1.24E-07	3.15E-09	3.15E-09	3.15E-09	6.36E+07	1.24E-07	1.24E-07	6.36E+07	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	2.82E-07	2.82E-07	1.73E-09	1.73E-09	1.73E-09	1.15E+08	2.82E-07	2.82E-07	1.15E+08	0.00%	0.00%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	6.42E-11	6.42E-11	4.50E-11	4.50E-11	4.50E-11	4.44E+09	6.42E-11	6.42E-11	4.44E+09	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	6.64E-03	6.64E-03	1.01E-05	1.01E-05	1.01E-05	2.48E+04	6.64E-03	6.64E-03	2.48E+04	2.66%	2.66%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	9.24E-08	9.24E-08	1.62E-09	1.62E-09	1.62E-09	6.16E+08	9.24E-08	9.24E-08	6.16E+08	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	5.03E-06	5.03E-06	3.01E-08	3.01E-08	3.01E-08	8.29E+06	5.03E-06	5.03E-06	8.29E+06	0.00%	0.00%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	3.66E-08	3.66E-08	1.18E-09	1.18E-09	1.18E-09	1.70E+08	3.66E-08	3.66E-08	1.70E+08	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.42E-06	3.42E-06	2.78E-08	2.78E-08	2.78E-08	7.18E+06	3.42E-06	3.42E-06	7.18E+06	0.00%	0.00%
Naphthalene	10200	9.66E+01	1.97E-04	1.97E-04	2.04E-06	2.04E-06	2.04E-06	9.79E+04	1.97E-04	1.97E-04	9.79E+04	0.10%	0.10%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	5.73E-09	5.73E-09	1.49E-10	1.49E-10	1.49E-10	1.34E+09	5.73E-09	5.73E-09	1.34E+09	0.00%	0.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	3.06E-10	3.06E-10	2.08E-11	2.08E-11	2.08E-11	9.60E+09	3.06E-10	3.06E-10	9.60E+09	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	3.89E-06	3.89E-06	1.34E-08	1.34E-08	1.34E-08	1.87E+07	3.89E-06	3.89E-06	1.87E+07	0.00%	0.00%
TPH C06-C09 aliphatic	593	2.21E+02	5.68E-06	5.68E-06	2.57E-08	2.57E-08	2.57E-08	4.87E+06	5.68E-06	5.68E-06	4.87E+06	0.00%	0.00%
TPH C10-C14 aliphatic	69400	1.11E+02	1.10E-06	1.10E-06	9.87E-09	9.87E-09	9.87E-09	1.27E+07	1.10E-06	1.10E-06	1.27E+07	0.00%	0.00%
TPH C10-C14 aromatic	69400	1.54E+02	3.13E-06	3.13E-06	2.03E-08	2.03E-08	2.03E-08	6.17E+06	3.13E-06	3.13E-06	6.17E+06	0.00%	0.00%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.18E-03	2.18E-03	2.93E-05	2.93E-05	2.93E-05	3.42E+04	2.18E-03	2.18E-03	3.42E+04	0.22%	0.22%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	1.52E-06	1.52E-06	1.70E-07	1.70E-07	1.70E-07	1.47E+06	1.52E-06	1.52E-06	1.47E+06	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Child Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL (%)	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg	HI	HI	mg/kg	%	%
Acenaphthene	511	3.94E+01	1.24E-07	1.24E-07	3.15E-09	3.15E-09	3.15E-09	6.36E+07	1.24E-07	1.24E-07	6.36E+07	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	2.82E-07	2.82E-07	1.73E-09	1.73E-09	1.73E-09	1.15E+08	2.82E-07	2.82E-07	1.15E+08	0.00%	0.00%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	6.42E-11	6.42E-11	4.50E-11	4.50E-11	4.50E-11	4.44E+09	6.42E-11	6.42E-11	4.44E+09	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	6.64E-03	6.64E-03	1.01E-05	1.01E-05	1.01E-05	2.48E+04	6.64E-03	6.64E-03	2.48E+04	2.66%	2.66%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	9.24E-08	9.24E-08	1.62E-09	1.62E-09	1.62E-09	6.16E+08	9.24E-08	9.24E-08	6.16E+08	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	5.03E-06	5.03E-06	3.01E-08	3.01E-08	3.01E-08	8.29E+06	5.03E-06	5.03E-06	8.29E+06	0.00%	0.00%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	3.66E-08	3.66E-08	1.18E-09	1.18E-09	1.18E-09	1.70E+08	3.66E-08	3.66E-08	1.70E+08	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.42E-06	3.42E-06	2.78E-08	2.78E-08	2.78E-08	7.18E+06	3.42E-06	3.42E-06	7.18E+06	0.00%	0.00%
Naphthalene	10200	9.66E+01	1.97E-04	1.97E-04	2.04E-06	2.04E-06	2.04E-06	9.79E+04	1.97E-04	1.97E-04	9.79E+04	0.10%	0.10%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	5.73E-09	5.73E-09	1.49E-10	1.49E-10	1.49E-10	1.34E+09	5.73E-09	5.73E-09	1.34E+09	0.00%	0.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	3.06E-10	3.06E-10	2.08E-11	2.08E-11	2.08E-11	9.60E+09	3.06E-10	3.06E-10	9.60E+09	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	3.89E-06	3.89E-06	1.34E-08	1.34E-08	1.34E-08	1.87E+07	3.89E-06	3.89E-06	1.87E+07	0.00%	0.00%
TPH C06-C09 aliphatic	593	2.21E+02	5.68E-06	5.68E-06	2.57E-08	2.57E-08	2.57E-08	4.87E+06	5.68E-06	5.68E-06	4.87E+06	0.00%	0.00%
TPH C10-C14 aliphatic	69400	1.11E+02	1.10E-06	1.10E-06	9.87E-09	9.87E-09	9.87E-09	1.27E+07	1.10E-06	1.10E-06	1.27E+07	0.00%	0.00%
TPH C10-C14 aromatic	69400	1.54E+02	3.13E-06	3.13E-06	2.03E-08	2.03E-08	2.03E-08	6.17E+06	3.13E-06	3.13E-06	6.17E+06	0.00%	0.00%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.18E-03	2.18E-03	2.93E-05	2.93E-05	2.93E-05	3.42E+04	2.18E-03	2.18E-03	3.42E+04	0.22%	0.22%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	1.52E-06	1.52E-06	1.70E-07	1.70E-07	1.70E-07	1.47E+06	1.52E-06	1.52E-06	1.47E+06	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Non-Threshold Lifetime Health Effects (Adult and Child)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (ILCR)		Risk/Soil Concentration (i.e., exposure and toxicity factor)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Outdoors	TOTAL	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	3.82E-07	3.82E-07	5.80E-10	5.80E-10	5.80E-10	1.72E+04	3.82E-07	3.82E-07	1.72E+04	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	#VALUE!	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	#VALUE!	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	-	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	#VALUE!	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	#VALUE!	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	10200	9.66E+01	-	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	-	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	#VALUE!	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol) mg/L	Vapour Only Risk at Sol (if necessary) mg/L	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour unitless	TOTAL (All Pathways) unitless	GW to Outdoor Vapour L/mg	Total Vapour Pathways L/mg	TOTAL (All Pathways) L/mg					GW to Outdoor Vapour %	TOTAL %
Acenaphthene	4.48	3.90E+00	1.11E-07	1.11E-07	2.86E-08	2.86E-08	2.86E-08	7.00E+06	1.11E-07	1.11E-07	7.00E+06	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	2.55E-07	2.55E-07	1.58E-08	1.58E-08	1.58E-08	1.26E+07	2.55E-07	2.55E-07	1.26E+07	0.00%	0.00%
Ammonia	348	4.82E+05	1.21E-05	1.21E-05	3.48E-08	3.48E-08	3.48E-08	2.88E+07	1.68E-02	1.68E-02	2.88E+07	1.68%	1.68%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	5.92E-11	5.92E-11	1.36E-09	1.36E-09	1.36E-09	1.47E+08	5.92E-11	5.92E-11	1.47E+08	0.00%	0.00%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.32E-03	1.32E-03	3.28E-05	3.28E-05	3.28E-05	7.62E+03	5.87E-02	5.87E-02	7.62E+03	23.49%	23.49%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.30E-08	8.30E-08	2.68E-08	2.68E-08	2.68E-08	3.73E+07	8.30E-08	8.30E-08	3.73E+07	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	7.94E-07	7.94E-07	2.63E-07	2.63E-07	2.63E-07	9.50E+05	4.45E-05	4.45E-05	9.50E+05	0.02%	0.02%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.33E-08	3.33E-08	1.97E-08	1.97E-08	1.97E-08	1.02E+07	3.33E-08	3.33E-08	1.02E+07	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	3.04E-06	3.04E-06	1.24E-07	1.24E-07	1.24E-07	1.62E+06	3.04E-06	3.04E-06	1.62E+06	0.00%	0.00%
Naphthalene	283	3.10E+01	1.76E-04	1.76E-04	5.66E-06	5.66E-06	5.66E-06	3.53E+04	1.76E-04	1.76E-04	3.53E+04	0.09%	0.09%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	5.31E-09	5.31E-09	4.62E-09	4.62E-09	4.62E-09	4.33E+07	5.31E-09	5.31E-09	4.33E+07	0.00%	0.00%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	2.91E-10	2.91E-10	2.15E-09	2.15E-09	2.15E-09	9.29E+07	2.91E-10	2.91E-10	9.29E+07	0.00%	0.00%
Styrene	0.194	3.10E+02	9.22E-08	9.22E-08	4.75E-07	4.75E-07	4.75E-07	2.10E+06	1.47E-04	1.47E-04	2.10E+06	0.01%	0.01%
Toluene	17.6	5.26E+02	1.15E-06	1.15E-06	6.54E-08	6.54E-08	6.54E-08	3.82E+06	3.44E-05	3.44E-05	3.82E+06	0.01%	0.01%
TPH C06-C09 aliphatic	6.08	1.18E+01	2.59E-05	2.59E-05	4.25E-06	4.25E-06	4.25E-06	2.94E+04	5.02E-05	5.02E-05	2.94E+04	0.04%	0.04%
TPH C10-C14 aliphatic	1730	9.99E-02	9.69E-06	9.69E-06	9.70E-05	9.70E-05	9.70E-05	1.29E+03	9.69E-06	9.69E-06	1.29E+03	0.01%	0.01%
TPH C10-C14 aromatic	1730	2.53E+01	2.77E-05	2.77E-05	1.09E-06	1.09E-06	1.09E-06	1.14E+05	2.77E-05	2.77E-05	1.14E+05	0.02%	0.02%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.12E-05	3.12E-05	3.39E-05	3.39E-05	3.39E-05	2.95E+04	1.93E-03	1.93E-03	2.95E+04	0.19%	0.19%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	8.48E-06	8.48E-06	1.27E-06	1.27E-06	1.27E-06	1.98E+05	1.34E-05	1.34E-05	1.98E+05	0.01%	0.01%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Outdoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg					%	%
	mg/L	mg/L						mg/L			mg/L		
Acenaphthene	4.48	3.90E+00	1.11E-07	1.11E-07	2.86E-08	2.86E-08	2.86E-08	7.00E+06	1.11E-07	1.11E-07	7.00E+06	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	2.55E-07	2.55E-07	1.58E-08	1.58E-08	1.58E-08	1.26E+07	2.55E-07	2.55E-07	1.26E+07	0.00%	0.00%
Ammonia	348	4.82E+05	1.21E-05	1.21E-05	3.48E-08	3.48E-08	3.48E-08	2.88E+07	1.68E-02	1.68E-02	2.88E+07	1.68%	1.68%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	5.92E-11	5.92E-11	1.36E-09	1.36E-09	1.36E-09	1.47E+08	5.92E-11	5.92E-11	1.47E+08	0.00%	0.00%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.32E-03	1.32E-03	3.28E-05	3.28E-05	3.28E-05	7.62E+03	5.87E-02	5.87E-02	7.62E+03	23.49%	23.49%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.30E-08	8.30E-08	2.68E-08	2.68E-08	2.68E-08	3.73E+07	8.30E-08	8.30E-08	3.73E+07	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	7.94E-07	7.94E-07	2.63E-07	2.63E-07	2.63E-07	9.50E+05	4.45E-05	4.45E-05	9.50E+05	0.02%	0.02%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.33E-08	3.33E-08	1.97E-08	1.97E-08	1.97E-08	1.02E+07	3.33E-08	3.33E-08	1.02E+07	0.00%	0.00%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	3.04E-06	3.04E-06	1.24E-07	1.24E-07	1.24E-07	1.62E+06	3.04E-06	3.04E-06	1.62E+06	0.00%	0.00%
Naphthalene	283	3.10E+01	1.76E-04	1.76E-04	5.66E-06	5.66E-06	5.66E-06	3.53E+04	1.76E-04	1.76E-04	3.53E+04	0.09%	0.09%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	5.31E-09	5.31E-09	4.62E-09	4.62E-09	4.62E-09	4.33E+07	5.31E-09	5.31E-09	4.33E+07	0.00%	0.00%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	2.91E-10	2.91E-10	2.15E-09	2.15E-09	2.15E-09	9.29E+07	2.91E-10	2.91E-10	9.29E+07	0.00%	0.00%
Styrene	0.194	3.10E+02	9.22E-08	9.22E-08	4.75E-07	4.75E-07	4.75E-07	2.10E+06	1.47E-04	1.47E-04	2.10E+06	0.01%	0.01%
Toluene	17.6	5.26E+02	1.15E-06	1.15E-06	6.54E-08	6.54E-08	6.54E-08	3.82E+06	3.44E-05	3.44E-05	3.82E+06	0.01%	0.01%
TPH C06-C09 aliphatic	6.08	1.18E+01	2.59E-05	2.59E-05	4.25E-06	4.25E-06	4.25E-06	2.94E+04	5.02E-05	5.02E-05	2.94E+04	0.04%	0.04%
TPH C10-C14 aliphatic	1730	9.99E-02	9.69E-06	9.69E-06	9.70E-05	9.70E-05	9.70E-05	1.29E+03	9.69E-06	9.69E-06	1.29E+03	0.01%	0.01%
TPH C10-C14 aromatic	1730	2.53E+01	2.77E-05	2.77E-05	1.09E-06	1.09E-06	1.09E-06	1.14E+05	2.77E-05	2.77E-05	1.14E+05	0.02%	0.02%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.12E-05	3.12E-05	3.39E-05	3.39E-05	3.39E-05	2.95E+04	1.93E-03	1.93E-03	2.95E+04	0.19%	0.19%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	8.48E-06	8.48E-06	1.27E-06	1.27E-06	1.27E-06	1.98E+05	1.34E-05	1.34E-05	1.98E+05	0.01%	0.01%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Outdoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	7.60E-08	7.60E-08	1.89E-09	1.89E-09	1.89E-09	5.29E+03	3.38E-06	3.38E-06	5.29E+03	33.83%	33.83%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix G

Risk Scenario 5 Comm SOG

1. General Information:

Site: Barangaroo
 Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Client: Lend Lease
 Scenario: Scenario 5 - Commercial Slab on Ground (Risk Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Commercial/Industrial

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways	
☐	Incidental Ingestion of Soil
☐	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☒	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways	
☒	Inhalation of Groundwater-Derived Vapours in Indoor Air
☐	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☐	Incidental Ingestion of Groundwater (Bathing or Excavation)
☐	Dermal Contact with Groundwater (Bathing or Excavation)
☐	Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐	Soil RBSLs saturation limited?
☐	Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:

	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Groundwater	
			Soil (mg/kg)	(mg/L)
Acenaphthene	0.20	1.00E-05	511	4.48
Acenaphthylene	0.20	1.00E-05	1700	43.2
Ammonia	1.00	1.00E-05		348
Aniline	1.00	1.00E-05		0.212
Anthracene	0.20	1.00E-05	2150	15.4
Arsenic, Inorganic	1.00	1.00E-05		0.024
Barium	1.00	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1.00	1.00E-05		0.03
Cadmium (Water)	1.00	1.00E-05		0.108
Chromium(III), Insoluble Salts	1.00	1.00E-05	210	0.102
Chromium(VI)	1.00	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1.00	1.00E-05		0.057
Cresol, m-&p-	1.00	1.00E-05	2290	436
Cresol, o-	1.00	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1.00	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1.00	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.20	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1.00	1.00E-05	60600	187
Lead and Compounds	1.00	1.00E-05	13600	0.555
Manganese	1.00	1.00E-05		4.89
Methylnaphthalene, 2-	0.20	1.00E-05	7650	105
Naphthalene	0.20	1.00E-05	10200	283
Nickel Soluble Salts	1.00	1.00E-05		0.303
Phenanthrene	0.20	1.00E-05	5180	74.1
Phenol	1.00	1.00E-05		249
Pyrene	0.20	1.00E-05	2640	27.9
Styrene	1.00	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.13	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.13	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.13	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.13	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.13	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.13	1.00E-05	20600	332
TPH C29-C36 aromatic	0.13	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1.00	1.00E-05	220	0.92
Vanadium and compounds	1.00	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

	Units	Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:							
Body weight	kg	70	N/A	70		70	N/A
Exposure duration	yr	25	N/A	30		30	N/A
Averaging time (carcinogens)	yr	70	N/A	70		70	N/A
Averaging time (non-carcinogens)	yr	25	N/A	30		30	N/A
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	NA	N/A			NA	N/A
Exposure frequency for soil ingestion	days/yr	240	N/A			240	N/A
Fraction of daily soil intake from site	unitless	1	N/A			1	N/A
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	NA	N/A			NA	N/A
Soil to skin adherence factor	mg/cm2	0.5	N/A			0.5	N/A
Exposure frequency for dermal contact with soil	days/yr	240	N/A			240	N/A
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	8	N/A	8		8	N/A
Exposure frequency (indoor air)	days/yr	240	N/A	240		240	N/A
Particulate emission factor (indoor air)	m3/kg	1.81E+09	N/A			1.81E+09	N/A
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	NA	N/A			NA	N/A
Exposure frequency (outdoor air)	days/yr	240	N/A			240	N/A
Particulate emission factor (outdoor air)	m3/kg	1.36E+09	N/A			1.36E+09	N/A
Potable Water Ingestion							
Potable water intake rate	L/day	2	N/A			2	N/A
Exposure frequency for potable water intake	days/yr	240	N/A			240	N/A
Incidental Water Ingestion							
Incidental ingestion rate	L/day	0	N/A			0	N/A
Exposure frequency for incidental water ingestion	days/yr	240	N/A			240	N/A
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	NA	N/A			NA	N/A
Exposure time for dermal water contact	hr/day	NA	N/A			NA	N/A
Exposure frequency for dermal water contact	days/yr	240	N/A			240	N/A

~Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

Vapour Modelling - Groundwater to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	200	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295		183	HV	183	Groundwater assumed to be at a depth of 2 m based on groundwater data for the Site.
				Sand (<12% fines)			The soil type above groundwater across the site consists of fill (mostly sand and gravel), thus sand has conservatively been assumed as the main soil type in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm ³ /cm ³	0.38		0.375	TPOR	0.375	
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):				Sand (<12% fines)			As above
Thickness of capillary fringe	cm	5		17	hcap	17	
Volumetric air content in capillary fringe soils	cc/cc	0.038		0.122	VAC	0.122	
Volumetric water content in capillary fringe soils	cc/cc	0.342		0.253	wccap	0.253	
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)	300	LB	300	ASTM (2002) default
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	Default - considered conservative for Australian bldg
Enclosed-space air exchange rate	1/s	0.000555556		0.000555556	ENCAER	5.56E-04	2 exchanges per hour commercial building
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.00038	NU	0.00038	USEPA (2004) default crack fraction for slab on grade
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	USEPA (2004) Sand values
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	wvcfnd	0.054	USEPA (2004) Sand values
<u>Convective vapour flow term</u>							
Calculate convective flow term? (ENTER Y or N)		Y		N	Conv	N	
Convective flow rate (if specified directly)	cm ³ /sec			0.001			Negligible rate to account for assumption that advective flow is not likely.
Convective flow through slab (calculated)	cm ³ /sec	10.88			Qs	0.00	
Slab Area	cm ²	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc	0.0019	
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	Viscosity of air at 20 deg C.

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc (cm ² /g)	Kd (cm ² /g)	H ¹ (cc-H ₂ O / cc-air)	S (mg/L-water)	D ^{air} (cm ² /s)	D ^{soil} (cm ² /s)	MW (g/mol)	VP (mmHg)	Volatile?
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	7.87E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H ¹	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

C. Chemical-Specific Diffusion Coefficients

Chemical	D _{soil} (cm ² /s)	D _{soil}	D _{soil}	D _{soil}	D _{crack} (cm ² /s)	D _{cap} (cm ² /s)	D _{ws} (cm ² /s)	Convective Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	4.07E-04	3.12E-03	6.89E-03
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	4.00E-04	2.96E-03	7.75E-03
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	2.69E-03	1.77E-02	1.53E-03
Aniline	NV	NV	NV	NV	NV	NV	NV	NV
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	5.05E-04	3.19E-03	8.94E-03
Benzo(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	5.81E-04	4.77E-03	3.90E-03
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	3.26E-04	2.51E-03	8.51E-03
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	NV	NV	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	4.44E-04	3.65E-03	5.09E-03
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	4.31E-04	3.07E-03	7.93E-03
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	3.65E-04	2.93E-03	6.66E-03
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	4.24E-04	3.40E-03	5.77E-03
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	5.05E-04	3.01E-03	1.01E-02
Phenol	NV	NV	NV	NV	NV	NV	NV	NV
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.27E-03	3.70E-03	1.25E-02
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	4.64E-04	3.81E-03	4.91E-03
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	5.04E-04	4.14E-03	4.48E-03
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	6.45E-04	5.31E-03	3.49E-03
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	6.45E-04	5.31E-03	3.49E-03
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	6.50E-04	5.34E-03	3.49E-03
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	3.94E-04	3.24E-03	5.75E-03
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	5.50E-04	4.52E-03	4.12E-03

Definition of Parameters

D _g	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{ws}	Effective diffusion coefficient between groundwater and soil surface

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Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp}	VF _{wamb}	VF _{trench}
	(mgm ³ air / mg/L H ₂ O)	(mgm ³ air / mg/L H ₂ O)	(mgm ³ air / mg/L water)
Acenaphthene	9.26E-06	1.17E-05	7.41E-06
Acenaphthylene	5.11E-06	6.89E-06	7.41E-06
Ammonia	3.65E-06	5.84E-06	7.41E-06
Aniline	NV	NV	NV
Anthracene	2.16E-06	3.62E-06	7.41E-06
Benz(a)anthracene	NV	NV	NV
Benzene	4.93E-04	5.41E-04	7.41E-06
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m-&p-	NV	NV	NV
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	8.70E-06	1.09E-05	7.41E-06
Dimethylphenol, 2,4-	NV	NV	NV
Ethylbenzene	5.35E-04	5.87E-04	7.41E-06
Fluoranthene	NV	NV	NV
Fluorene	4.22E-06	6.03E-06	7.41E-06
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	2.70E-05	3.11E-05	7.41E-06
Naphthalene	2.65E-05	3.06E-05	7.41E-06
Phenanthrene	1.46E-06	2.60E-06	7.41E-06
Phenol	NV	NV	NV
Pyrene	3.33E-07	9.01E-07	7.41E-06
Styrene	1.93E-04	2.13E-04	7.41E-06
Toluene	5.11E-04	5.61E-04	7.41E-06
TPH C06-C09 aliphatic	1.22E-01	1.34E-01	7.41E-06
TPH C10-C14 aliphatic	1.52E-01	1.66E-01	7.41E-06
TPH C10-C14 aromatic	3.42E-04	3.76E-04	7.41E-06
TPH C15-C28 aliphatic	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	3.71E-04	4.08E-04	7.41E-06
Xylenes (total)	4.35E-04	4.79E-04	7.41E-06

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

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Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	0.001	Autocalculates from layer thicknesses
<i>Vadose Zone Layer 1 (soil type where source is)</i>							
Thickness	cm	100		0.001	HV	0.001	Assumes that contaminated soils are located directly below building slab.
				Sand (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay, therefore sand has been conservatively assumed in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning: see text.
Biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<i>Building Characteristics</i>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)	300	LB	300	ASTM (2002) default
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	Default - considered conservative for Australian bldg
Enclosed-space air exchange rate	1/s	0.000555556		0.000555556	ENCAER	5.56E-04	2 exchanges per hour commercial building
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.00038	NU	0.00038	USEPA (2004) default crack fraction for slab on grade
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	USEPA (2004) Sand values
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	wvcfnd	0.054	USEPA (2004) Sand values
<i>Convective vapour flow term</i>							
Calculate convective flow term?		Y		N	Conv	N	
Convective flow rate (if specified directly)	cm3/sec			0.001			Negligible rate to account for assumption that advective flow is not likely.
Convective flow through slab (calculated)	cm3/sec	10.88			Qs	0.00	
Slab Area	cm2	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc		
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{soil}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/kg-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	N
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1}	D _{s2}	D _{s3}	D _{soil}	D _{crack}	C _{sat}	Convective
	(cm ² /s)				(cm ² /s)	mg/kg	Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	3.94E+01	6.89E-03
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	1.63E+02	7.75E-03
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	1.87E+04	1.53E-03
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	1.42E+00	8.94E-03
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	6.59E+02	3.90E-03
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	1.44E+04	NV
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	5.69E+01	8.51E-03
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	1.67E+02	5.09E-03
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	3.10E+01	7.93E-03
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	1.23E+02	6.66E-03
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	9.66E+01	5.77E-03
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	3.84E+01	1.01E-02
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.47E+01	1.25E-02
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	2.93E+02	4.91E-03
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	2.91E+02	4.48E-03
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	2.21E+02	3.49E-03
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.11E+02	3.49E-03
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.54E+02	3.49E-03
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	7.46E+01	5.75E-03
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	8.90E+00	4.12E-03

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1} (mgm ³ -air / mg/kg-soil)	VF _{as2} (mgm ³ -air / mg/kg-soil)	VF _{p1} (indoor) (mgm ³ -air / mg/kg-soil)	VF _p (outdoor) (m ³ -air / mg/kg-soil)	VF _{samb} (mgm ³ -air / mg/kg-soil)	VF _{resp} (mgm ³ -air / mg/kg-soil)
Acenaphthene	1.17E-05	1.75E-05	5.51E-10	7.35E-10	3.35E-01	9.30E-07
Acenaphthylene	8.66E-06	1.75E-05	5.51E-10	7.35E-10	1.94E-01	5.13E-07
Ammonia	1.18E-04	1.75E-05	5.51E-10	7.35E-10	1.33E+01	9.50E-05
Aniline	NV	NV	5.51E-10	7.35E-10	NV	NV
Anthracene	3.12E-06	1.75E-05	5.51E-10	7.35E-10	2.67E-02	6.66E-08
Benz(a)anthracene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzene	4.46E-05	1.75E-05	5.51E-10	7.35E-10	3.64E+01	1.36E-04
Benzo(a)pyrene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzo(b)fluoranthene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzo(g,h,i)perylene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzo(k)fluoranthene	NV	NV	5.51E-10	7.35E-10	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	5.51E-10	7.35E-10	NV	NV
Chrysene	NV	NV	5.51E-10	7.35E-10	NV	NV
Cresol, m-&p-	NV	NV	5.51E-10	7.35E-10	NV	NV
Cresol, o-	NV	NV	5.51E-10	7.35E-10	NV	NV
Dibenz(a,h)anthracene	NV	NV	5.51E-10	7.35E-10	NV	NV
Dibenzofuran	8.38E-06	1.75E-05	5.51E-10	7.35E-10	1.89E-01	4.80E-07
Dimethylphenol, 2,4-	NV	NV	5.51E-10	7.35E-10	NV	NV
Ethylbenzene	2.84E-05	1.75E-05	5.51E-10	7.35E-10	1.71E+01	5.51E-05
Fluoranthene	NV	NV	5.51E-10	7.35E-10	NV	NV
Fluorene	5.84E-06	1.75E-05	5.51E-10	7.35E-10	8.90E-02	2.32E-07
Indeno(1,2,3-cd)pyrene	NV	NV	5.51E-10	7.35E-10	NV	NV
Methylnaphthalene, 2-	2.83E-05	1.75E-05	5.51E-10	7.35E-10	1.95E+00	5.48E-06
Naphthalene	3.55E-05	1.75E-05	5.51E-10	7.35E-10	2.86E+00	8.61E-06
Phenanthrene	2.54E-06	1.75E-05	5.51E-10	7.35E-10	1.85E-02	4.41E-08
Phenol	NV	NV	5.51E-10	7.35E-10	NV	NV
Pyrene	6.72E-07	1.75E-05	5.51E-10	7.35E-10	1.39E-03	3.09E-09
Styrene	1.74E-04	1.75E-05	5.51E-10	7.35E-10	6.33E+01	2.07E-04
Toluene	3.71E-05	1.75E-05	5.51E-10	7.35E-10	2.73E+01	9.39E-05
TPH C06-C09 aliphatic	9.87E-05	1.75E-05	5.51E-10	7.35E-10	1.67E+02	6.63E-04
TPH C10-C14 aliphatic	1.43E-05	1.75E-05	5.51E-10	7.35E-10	3.48E+00	1.39E-05
TPH C10-C14 aromatic	9.14E-06	1.75E-05	5.51E-10	7.35E-10	1.43E+00	5.69E-06
TPH C15-C28 aliphatic	NV	NV	5.51E-10	7.35E-10	NV	NV
TPH C15-C28 aromatic	NV	NV	5.51E-10	7.35E-10	NV	NV
TPH C29-C36 aliphatic	NV	NV	5.51E-10	7.35E-10	NV	NV
TPH C29-C36 aromatic	NV	NV	5.51E-10	7.35E-10	NV	NV
Trimethylbenzene, 1,2,4-	2.05E-04	1.75E-05	5.51E-10	7.35E-10	9.53E+01	2.88E-04
Xylenes (total)	2.78E-05	1.75E-05	5.51E-10	7.35E-10	1.46E+01	5.27E-05

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	2.06E+05	-	-	2.06E+05	>Sat	5.11E+02	2.07E+04	-	-	2.07E+04	>Sol	4.48E+00
Acenaphthylene	3.74E+05	-	-	3.74E+05	>Sat	1.70E+03	3.75E+04	-	-	3.75E+04	>Sol	4.32E+01
Ammonia	-	-	-	-	-	-	8.68E+04	-	-	8.68E+04	-	3.48E+02
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	1.44E+07	-	-	1.44E+07	>Sat	2.15E+03	4.43E+05	-	-	4.43E+05	>Sol	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	8.07E+01	-	1.31E+02	8.07E+01	-	1.51E+03	2.22E+01	-	3.60E+01	2.22E+01	-	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	2.00E+06	-	-	2.00E+06	>Sat	2.77E+02	1.10E+05	-	-	1.10E+05	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	2.69E+04	-	-	2.69E+04	>Sat	2.61E+02	2.77E+03	-	-	2.77E+03	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	5.50E+05	-	-	5.50E+05	>Sat	2.10E+03	3.03E+04	-	-	3.03E+04	>Sol	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	2.33E+04	-	-	2.33E+04	>Sat	7.65E+03	4.73E+03	-	-	4.73E+03	>Sol	1.05E+02
Naphthalene	3.18E+02	-	-	3.18E+02	>Sat	1.02E+04	1.03E+02	-	-	1.03E+02	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	4.35E+06	-	-	4.35E+06	>Sat	5.18E+03	1.31E+05	-	-	1.31E+05	>Sol	7.41E+01
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	3.10E+07	-	-	3.10E+07	>Sat	2.64E+03	2.88E+05	-	-	2.88E+05	>Sol	2.79E+01
Styrene	-	-	-	-	-	-	6.14E+03	-	-	6.14E+03	>Sol	1.94E-01
Toluene	6.07E+04	-	-	6.07E+04	>Sat	2.65E+03	1.12E+04	-	-	1.12E+04	>Sol	1.76E+01
TPH C06-C09 aliphatic	1.58E+04	-	-	1.58E+04	>Sat	5.93E+02	8.57E+01	-	-	8.57E+01	>Sol	6.08E+00
TPH C10-C14 aliphatic	4.12E+04	-	-	4.12E+04	>Sat	6.94E+04	3.76E+00	-	-	3.76E+00	>Sol	1.73E+03
TPH C10-C14 aromatic	2.00E+04	-	-	2.00E+04	>Sat	6.94E+04	3.34E+02	-	-	3.34E+02	>Sol	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.11E+02	-	-	1.11E+02	>Sat	2.20E+02	8.60E+01	-	-	8.60E+01	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	4.76E+03	-	-	4.76E+03	>Sat	2.58E+03	5.76E+02	-	-	5.76E+02	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater-Derived Vapours in Indoor Air

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	C _{sat} (mg/kg)	Volatilisation Factor from Subsurface Soil to Indoor Air (mg/m ³)/(mg/kg)	Vapour Concentration in Indoor Air (From Subsurface Soil) (mg/m ³)	Threshold Intake and Risk Calculations				Non-Threshold Intake and Risk Calculations				
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (kg/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)	Inhalation Unit Risk (ug/m ³)-1	Adult Exposure Factor (non- threshold) (kg/m ³)	Lifetime Exposure Factor (non-threshold) (kg/m ³)	Lifetime Exposure Adjusted Air Concentration (non- threshold) (mg/m ³)	Lifetime Excess Cancer Risk (unitless)
Acenaphthene	511	3.94E+01	9.30E-07	3.66E-05	2.10E-01	2.04E-07	8.02E-06	3.82E-05	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	5.13E-07	8.33E-05	2.10E-01	1.12E-07	1.83E-05	8.69E-05	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	NV	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	6.66E-08	9.49E-08	1.05E+00	1.46E-08	2.08E-08	1.98E-08	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-	8.70E-03	-	-	-	-
Benzene	1510	6.59E+02	1.36E-04	8.95E-02	9.60E-03	2.98E-05	1.96E-02	2.04E+00	6.00E-06	1.28E-05	1.28E-05	8.41E-03	5.05E-05
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-	8.70E-02	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-	8.70E-03	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-	8.70E-04	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-	8.70E-03	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	1.00E-04	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	1.00E-04	-	-	-	4.00E-02	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-	8.70E-04	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	NV	-	6.00E-01	-	-	-	-	-	-	-	-
Cresol, o-	-	-	NV	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-	8.70E-02	-	-	-	-
Dibenzofuran	277	5.69E+01	4.80E-07	2.73E-05	2.10E-01	1.05E-07	5.99E-06	2.85E-05	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	NV	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	5.51E-05	9.18E-03	1.30E+00	1.21E-05	2.01E-03	1.55E-03	-	-	-	-	-
Fluoranthene	2440	2.89E+01	NV	-	1.40E-01	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	2.32E-07	7.21E-06	1.40E-01	5.09E-08	1.58E-06	1.13E-05	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-	8.70E-03	-	-	-	-
Iron	60600	-	-	-	2.45E+00	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	5.00E-04	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	5.48E-06	6.74E-04	1.40E-01	1.20E-06	1.48E-04	1.05E-03	-	-	-	-	-
Naphthalene	10200	9.66E+01	8.61E-06	8.32E-04	3.00E-03	1.89E-06	1.82E-04	6.08E-02	-	-	-	-	-
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	4.41E-08	1.70E-06	2.10E-01	9.67E-09	3.72E-07	1.77E-06	-	-	-	-	-
Phenol	-	-	NV	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	3.09E-09	4.53E-08	1.05E-01	6.76E-10	9.92E-09	9.45E-08	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	9.39E-05	2.73E-02	5.00E+00	2.06E-05	5.99E-03	1.20E-03	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.21E+02	6.63E-04	1.47E-01	1.84E+01	1.45E-04	3.21E-02	1.75E-03	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	1.39E-05	1.54E-03	1.00E+00	3.04E-06	3.37E-04	3.37E-04	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	5.69E-06	8.78E-04	2.00E-01	1.25E-06	1.92E-04	9.62E-04	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	7.00E+00	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	1.05E-01	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	7.00E+00	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	1.05E-01	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.88E-04	2.15E-02	7.00E-03	6.31E-05	4.71E-03	6.73E-01	-	-	-	-	-
Vanadium and compounds	248	-	-	-	1.00E-03	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	5.27E-05	4.69E-04	2.20E-01	1.15E-05	1.03E-04	4.67E-04	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

TOTAL

2.79E+00

5.05E-05

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

	1.12E-05

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
			mg/kg	mg/kg	unitless	unitless	kg/mg					kg/mg	kg/mg
Acenaphthene	511	3.94E+01	3.82E-05	3.82E-05	9.70E-07	9.70E-07	9.70E-07	2.06E+05	3.82E-05	3.82E-05	2.06E+05	0.02%	0.02%
Acenaphthylene	1700	1.63E+02	8.69E-05	8.69E-05	5.35E-07	5.35E-07	5.35E-07	3.74E+05	8.69E-05	8.69E-05	3.74E+05	0.04%	0.04%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	1.98E-08	1.98E-08	1.39E-08	1.39E-08	1.39E-08	1.44E+07	1.98E-08	1.98E-08	1.44E+07	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	2.04E+00	2.04E+00	3.10E-03	3.10E-03	3.10E-03	8.07E+01	2.50E-01	-	8.07E+01	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	2.85E-05	2.85E-05	5.01E-07	5.01E-07	5.01E-07	2.00E+06	2.85E-05	2.85E-05	2.00E+06	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	1.55E-03	1.55E-03	9.28E-06	9.28E-06	9.28E-06	2.69E+04	1.55E-03	1.55E-03	2.69E+04	0.62%	0.62%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	1.13E-05	1.13E-05	3.64E-07	3.64E-07	3.64E-07	5.50E+05	1.13E-05	1.13E-05	5.50E+05	0.01%	0.01%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	1.05E-03	1.05E-03	8.58E-06	8.58E-06	8.58E-06	2.33E+04	1.05E-03	1.05E-03	2.33E+04	0.53%	0.53%
Naphthalene	10200	9.66E+01	6.08E-02	6.08E-02	6.29E-04	6.29E-04	6.29E-04	3.18E+02	6.08E-02	6.08E-02	3.18E+02	30.39%	30.39%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	1.77E-06	1.77E-06	4.60E-08	4.60E-08	4.60E-08	4.35E+06	1.77E-06	1.77E-06	4.35E+06	0.00%	0.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	9.45E-08	9.45E-08	6.44E-09	6.44E-09	6.44E-09	3.10E+07	9.45E-08	9.45E-08	3.10E+07	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	1.20E-03	1.20E-03	4.12E-06	4.12E-06	4.12E-06	6.07E+04	1.20E-03	1.20E-03	6.07E+04	0.48%	0.48%
TPH C06-C09 aliphatic	593	2.21E+02	1.75E-03	1.75E-03	7.90E-06	7.90E-06	7.90E-06	1.58E+04	1.75E-03	1.75E-03	1.58E+04	1.40%	1.40%
TPH C10-C14 aliphatic	69400	1.11E+02	3.37E-04	3.37E-04	3.04E-06	3.04E-06	3.04E-06	4.12E+04	3.37E-04	3.37E-04	4.12E+04	0.27%	0.27%
TPH C10-C14 aromatic	69400	1.54E+02	9.62E-04	9.62E-04	6.24E-06	6.24E-06	6.24E-06	2.00E+04	9.62E-04	9.62E-04	2.00E+04	0.77%	0.77%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	6.73E-01	6.73E-01	9.01E-03	9.01E-03	9.01E-03	1.11E+02	6.73E-01	6.73E-01	1.11E+02	67.27%	67.27%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	4.67E-04	4.67E-04	5.25E-05	5.25E-05	5.25E-05	4.76E+03	4.67E-04	4.67E-04	4.76E+03	0.19%	0.19%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Non-Threshold Lifetime Health Effects (Adult and Child)
Barangaroo
Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (ILCR)		Risk/Soil Concentration (i.e., exposure and toxicity factor)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL				Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg		mg/kg	%	%
Acenaphthene	511	3.94E+01	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.05E-05	5.05E-05	7.65E-08	7.65E-08	7.65E-08	1.31E+02	1.00E-05	1.31E+02	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	-	-	-	-	-	-	-	-	-	-
Naphthalene	10200	9.66E+01	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario



Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Indoor Vapour	TOTAL (All Pathways)	GW to Indoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Indoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	3.77E-05	3.77E-05	9.66E-06	9.66E-06	9.66E-06	2.07E+04	3.77E-05	3.77E-05	2.07E+04	0.02%	0.02%
Acenaphthylene	43.2	1.61E+01	8.59E-05	8.59E-05	5.33E-06	5.33E-06	5.33E-06	3.75E+04	8.59E-05	8.59E-05	3.75E+04	0.04%	0.04%
Ammonia	348	4.82E+05	4.01E-03	4.01E-03	1.15E-05	1.15E-05	1.15E-05	8.68E+04	1.00E+00	-	8.68E+04	100.00%	100.00%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	1.96E-08	1.96E-08	4.52E-07	4.52E-07	4.52E-07	4.43E+05	1.96E-08	1.96E-08	4.43E+05	0.00%	0.00%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	4.52E-01	4.52E-01	1.12E-02	1.12E-02	1.12E-02	2.22E+01	2.50E-01	-	2.22E+01	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	2.81E-05	2.81E-05	9.08E-06	9.08E-06	9.08E-06	1.10E+05	2.81E-05	2.81E-05	1.10E+05	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	2.72E-04	2.72E-04	9.02E-05	9.02E-05	9.02E-05	2.77E+03	1.52E-02	1.52E-02	2.77E+03	6.10%	6.10%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	1.12E-05	1.12E-05	6.60E-06	6.60E-06	6.60E-06	3.03E+04	1.12E-05	1.12E-05	3.03E+04	0.01%	0.01%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.04E-03	1.04E-03	4.23E-05	4.23E-05	4.23E-05	4.73E+03	1.04E-03	1.04E-03	4.73E+03	0.52%	0.52%
Naphthalene	283	3.10E+01	5.99E-02	5.99E-02	1.93E-03	1.93E-03	1.93E-03	1.03E+02	5.99E-02	5.99E-02	1.03E+02	29.95%	29.95%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.75E-06	1.75E-06	1.52E-06	1.52E-06	1.52E-06	1.31E+05	1.75E-06	1.75E-06	1.31E+05	0.00%	0.00%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	9.39E-08	9.39E-08	6.95E-07	6.95E-07	6.95E-07	2.88E+05	9.39E-08	9.39E-08	2.88E+05	0.00%	0.00%
Styrene	0.194	3.10E+02	3.16E-05	3.16E-05	1.63E-04	1.63E-04	1.63E-04	6.14E+03	5.05E-02	5.05E-02	6.14E+03	5.05%	5.05%
Toluene	17.6	5.26E+02	3.95E-04	3.95E-04	2.24E-05	2.24E-05	2.24E-05	1.12E+04	1.18E-02	1.18E-02	1.12E+04	4.72%	4.72%
TPH C06-C09 aliphatic	6.08	1.18E+01	8.87E-03	8.87E-03	1.46E-03	1.46E-03	1.46E-03	8.57E+01	1.72E-02	1.72E-02	8.57E+01	13.77%	13.77%
TPH C10-C14 aliphatic	1730	9.99E-02	3.32E-03	3.32E-03	3.33E-02	3.33E-02	3.33E-02	3.76E+00	3.32E-03	3.32E-03	3.76E+00	2.66%	2.66%
TPH C10-C14 aromatic	1730	2.53E+01	9.48E-03	9.48E-03	3.75E-04	3.75E-04	3.75E-04	3.34E+02	9.48E-03	9.48E-03	3.34E+02	7.58%	7.58%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.07E-02	1.07E-02	1.16E-02	1.16E-02	1.16E-02	8.60E+01	6.63E-01	6.63E-01	8.60E+01	66.25%	66.25%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	2.91E-03	2.91E-03	4.34E-04	4.34E-04	4.34E-04	5.76E+02	4.60E-03	4.60E-03	5.76E+02	1.84%	1.84%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 5 - Commercial Slab on Ground (Risk Based Calculations) Scenario



Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Indoor Vapour	TOTAL (All Pathways)	GW to Indoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)				GW to Indoor Vapour	TOTAL
	mg/L	mg/L	unitless	unitless	L/mg	L/mg	L/mg	mg/L		mg/L	%	%
Acenaphthene	4.48	3.90E+00	-	-	-		-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-		-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-		-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	-	-		-	-	-	-	-	-
Anthracene	15.4	4.34E-02	-	-	-		-	-	-	-	-	-
Arsenic, Inorganic	0.024		-	-	-		-	-	-	-	-	-
Barium	2.23		-	-	-		-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-		-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.12E-05	1.12E-05	2.78E-07	2.78E-07	2.78E-07	3.60E+01	1.00E-05	3.60E+01	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-		-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-		-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-		-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-		-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-		-	-	-	-	-	-
Cadmium (Water)	0.108		-	-	-		-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102		-	-	-		-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-		-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-		-	-	-	-	-	-
Cobalt	0.057		-	-	-		-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-		-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-		-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-		-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	-	-	-		-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-		-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-		-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-		-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-		-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-		-	-	-	-	-	-
Iron	187		-	-	-		-	-	-	-	-	-
Lead and Compounds	0.555		-	-	-		-	-	-	-	-	-
Manganese	4.89		-	-	-		-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-		-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-		-	-	-	-	-	-
Nickel Soluble Salts	0.303		-	-	-		-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-		-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-		-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-		-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-		-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-		-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-		-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-		-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-		-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-		-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-		-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-		-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-		-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-		-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-		-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	-	-	-		-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix H

Risk Scenario 6 IntMaint

1. General Information:

Site: Barangaroo
 Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Client: Lend Lease
 Scenario: Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Construction/Excavation Worker

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☒	Incidental Ingestion of Soil
☒	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☒	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐	Inhalation of Groundwater-Derived Vapours in Indoor Air
☐	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☒	Incidental Ingestion of Groundwater (Bathing or Excavation)
☒	Dermal Contact with Groundwater (Bathing or Excavation)
☒	Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐	Soil RBSLs saturation limited?
☐	Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (If only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁶ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene	1	1.00E-05	652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene	0.2	1.00E-05	2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	1	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

		Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:		Units					
Body weight	kg	70	N/A	70		70	N/A
Exposure duration	yr	1	N/A	1		1	N/A
Averaging time (carcinogens)	yr	70	N/A	70		70	N/A
Averaging time (non-carcinogens)	yr	1	N/A	1		1	N/A
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	200	N/A	330		330	N/A
Exposure frequency for soil ingestion	days/yr	240	N/A	15		15	N/A
Fraction of daily soil intake from site	unitless	1	N/A	1		1	N/A
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	5000	N/A	3600		3600	N/A
Soil to skin adherence factor	mg/cm2	0.5	N/A	1.5		1.5	N/A
Exposure frequency for dermal contact with soil	days/yr	240	N/A	15		15	N/A
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	NA	N/A			NA	N/A
Exposure frequency (indoor air)	days/yr	240	N/A			240	N/A
Particulate emission factor (indoor air)	m3/kg	NA	N/A			NA	N/A
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	8	N/A	8		8	N/A
Exposure frequency (outdoor air)	days/yr	240	N/A	15		15	N/A
Particulate emission factor (outdoor air)	m3/kg	1.00E+05	N/A	3.60E+07		3.60E+07	N/A
Potable Water Ingestion							
Potable water intake rate	L/day	0	N/A			0	N/A
Exposure frequency for potable water intake	days/yr	240	N/A			240	N/A
Incidental Water Ingestion							
Incidental ingestion rate	L/day	0.05	N/A	0.005		0.005	N/A
Exposure frequency for incidental water ingestio	days/yr	240	N/A	15		15	N/A
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	6510	N/A	3870		3870	N/A
Exposure time for dermal water contact	hr/day	8	N/A	1		1	N/A
Exposure frequency for dermal water contact	days/yr	240	N/A	15		15	N/A

* USEPA (2002)

USEPA (1997) (Exposure factors handbook) - based on assumption that head, forearms and hands will be exposed. 50th percentile data

** USEPA (1997) (Exposure factors handbook) - based on assumption that lower legs and feet only would be contacting water. 50th percentile

-Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

Vapour Modelling - Groundwater to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	300	Autocalculates from layer thicknesses
<u>Varose Zone Layer 1</u>							
Thickness	cm	295			HV	295	
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01			OC	0.01	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26			VACS	0.26	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12			vwcvz	0.12	
Total soil porosity	cm ³ /cm ³	0.38			TPOR	0.38	
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):							
Thickness of capillary fringe	cm	5			hcap	5	
Volumetric air content in capillary fringe soils	cc/cc	0.038			VAC	0.038	
Volumetric water content in capillary fringe soils	cc/cc	0.342			vwccap	0.342	
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)		LB	300	
Enclosed-space foundation or wall thickness	cm	15			Lcrack	15	
Enclosed-space air exchange rate	1/s	0.00138889			ENCAER	1.39E-04	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)		NU	0.0019	
Volumetric air content in found./wall cracks	cc/cc	0.26			VACF	0.26	
Volumetric water content in found./wall cracks	cc/cc	0.12			vwctnd	0.12	
<u>Convective vapour flow term</u>							
Calculate convective flow term? (ENTER Y or N)		Y			Conv	Y	
Convective flow rate (if specified directly)	cm ³ /sec						
Convective flow through slab (calculated)	cm ³ /sec	10.88			Qs	10.88	
Slab Area	cm ²	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc	0.0019	
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	Viscosity of air at 20 deg C.
<u>Additional Trench Characteristics (for GW level above base of trench, i.e., assumes groundwater flows into trench)</u>							
Groundwater seepage velocity (into trench)	cm/sec	1.50E-04	(c)	1.50E-04	Vgw	0.00015	default for permeable fill (max expected for
Depth of groundwater in trench	cm	50		50	Dgw	50	assumes gw may be present at 2 mbgl (on average)
Dimension of trench (length or width) perpendicular to GW flow	cm	200	(d)	200	WSAtrench	200	maximum assumed trench dimension
Flow rate of groundwater in trench	cm ³ /sec				Qgw	1.5	Calculated from above three parameters
<u>Outdoor Air Characteristics</u>							
							Based on the average annual 9am and 3pm
							windspeeds measured at observatory point in Sydney
							(note that this is the closest Bureau of Meteorology
							wind recording location to the Site), divided by 10
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	22.5	(e)	37.8	windsp	37.8	2 m deep and 2 m long trench
Width of source area parallel to wind or groundwater flow direction	cm	600	(f)	600	WSA	600	assumes all vapours mixed w/in trench
Ambient air mixing zone height	cm	200		200	AAMZH	200	

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

Vapour Modelling - Groundwater to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D ^{soil}	D ^{water}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	5.03E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	5.03E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	3.10E-02	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	7.02E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	1.64E+02	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	1.77E+03	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	1.46E+00	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	5.87E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	5.99E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(k)fluoranthene	1.95E+06	1.95E+04	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	5.87E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	1.20E+03	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	1.81E+03	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m- & p-	3.00E+02	3.00E+00	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	3.07E+00	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	1.91E+04	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	9.16E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	4.92E+00	3.89E-05	7.87E-03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	4.46E+00	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	5.55E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	9.16E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	1.95E+04	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	2.48E+01	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	1.54E+01	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	1.67E+02	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	1.87E+00	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	5.43E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	4.46E+00	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	2.34E+00	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	4.47E+01	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	5.50E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	3.02E+01	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.38E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	3.16E+06	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	Y
TPH C15-C28 aromatic	3.79E+04	3.79E+02	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	Y
TPH C29-C36 aliphatic	6.31E+08	6.31E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	Y
TPH C29-C36 aromatic	1.26E+05	1.26E+03	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	6.14E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	3.83E+00	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient D ^{soil}	Diffusion coefficient in air
Kd	Soil-water partition coefficient D ^{water}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Const: MW	Molecular weight
S	Solubility VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

Chemical	D _{soil} (cm ² /s)	D _{crack}	D _{cap}	D _{soil}	D _{crack}	D _{cap}	D _{soil}	Convective Factor (unitless)
Acenaphthene	3.96E-03	-	-	3.96E-03	3.96E-03	2.22E-04	3.09E-03	3.10E+01
Acenaphthylene	3.52E-03	-	-	3.52E-03	3.52E-03	2.97E-04	2.98E-03	3.49E+01
Ammonia	1.79E-02	-	-	1.79E-02	1.79E-02	3.28E-03	1.67E-02	6.86E+00
Aniline	NV	NV	NV	NV	NV	NV	NV	NV
Anthracene	3.06E-03	-	-	3.06E-03	3.06E-03	6.77E-04	2.89E-03	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	6.98E-03	-	-	6.98E-03	6.98E-03	2.04E-05	1.04E-03	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m- & p-	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	3.20E-03	-	-	3.20E-03	3.20E-03	1.70E-04	2.47E-03	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	NV	NV	NV
Ethylbenzene	5.35E-03	-	-	5.35E-03	5.35E-03	1.40E-05	7.26E-04	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	3.45E-03	-	-	3.45E-03	3.45E-03	3.96E-04	3.05E-03	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	4.09E-03	-	-	4.09E-03	4.09E-03	7.81E-05	2.20E-03	3.00E+01
Naphthalene	4.72E-03	-	-	4.72E-03	4.72E-03	9.83E-05	2.65E-03	2.60E+01
Phenanthrene	2.72E-03	-	-	2.72E-03	2.72E-03	7.56E-04	2.60E-03	4.52E+01
Phenol	NV	NV	NV	NV	NV	NV	NV	NV
Pyrene	2.26E-03	-	-	2.26E-03	2.26E-03	2.90E-03	2.27E-03	5.43E+01
Styrene	5.55E-03	-	-	5.55E-03	5.55E-03	2.44E-05	1.16E-03	2.21E+01
Toluene	6.07E-03	-	-	6.07E-03	6.07E-03	1.66E-05	8.60E-04	2.02E+01
TPH C06-C09 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.30E-05	7.08E-04	1.57E+01
TPH C10-C14 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.08E-04	1.57E+01
TPH C10-C14 aromatic	7.80E-03	-	-	7.80E-03	7.80E-03	2.67E-05	1.33E-03	1.57E+01
TPH C15-C28 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.07E-04	1.57E+01
TPH C15-C28 aromatic	7.82E-03	-	-	7.82E-03	7.82E-03	4.10E-04	6.01E-03	1.57E+01
TPH C29-C36 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.07E-04	1.57E+01
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	4.74E-03	-	-	4.74E-03	4.74E-03	1.40E-05	7.13E-04	2.59E+01
Xylenes (total)	6.61E-03	-	-	6.61E-03	6.61E-03	2.00E-05	1.02E-03	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{soil}	Effective diffusion coefficient between groundwater and soil surface

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp}	VF _{wamb}	VF _{wtrch}
	(mg/m ³ air / mg/L H ₂ O)	(mg/m ³ air / mg/L H ₂ O)	(mg/m ³ air / mg/L water)
Acenaphthene	1.12E-03	6.15E-06	3.31E-04
Acenaphthylene	6.78E-04	3.68E-06	3.31E-04
Ammonia	1.92E-04	2.90E-06	3.31E-04
Aniline	NV	NV	NV
Anthracene	3.24E-04	1.74E-06	3.31E-04
Benz(a)anthracene	NV	NV	NV
Benzene	1.55E-02	6.27E-05	3.31E-04
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m- & p-	NV	NV	NV
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	1.13E-03	5.69E-06	3.31E-04
Dimethylphenol, 2,4-	NV	NV	NV
Ethylbenzene	1.62E-02	6.18E-05	3.31E-04
Fluoranthene	NV	NV	NV
Fluorene	5.80E-04	3.17E-06	3.31E-04
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	2.54E-03	1.24E-05	3.31E-04
Naphthalene	2.43E-03	1.26E-05	3.31E-04
Phenanthrene	2.31E-04	1.19E-06	3.31E-04
Phenol	NV	NV	NV
Pyrene	5.94E-05	2.92E-07	3.31E-04
Styrene	8.34E-03	3.45E-05	3.31E-04
Toluene	1.57E-02	6.16E-05	3.31E-04
TPH C06-C09 aliphatic	2.48E+00	9.46E-03	3.31E-04
TPH C10-C14 aliphatic	3.08E+00	1.17E-02	3.31E-04
TPH C10-C14 aromatic	1.17E-02	4.97E-05	3.31E-04
TPH C15-C28 aliphatic	4.06E+00	1.55E-02	3.31E-04
TPH C15-C28 aromatic	1.03E-03	7.79E-06	3.31E-04
TPH C29-C36 aliphatic	4.18E+00	1.59E-02	3.31E-04
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	1.25E-02	4.75E-05	3.31E-04
Xylenes (total)	1.42E-02	5.72E-05	3.31E-04

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{wtrch}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100		2000	LDSSZ	2000	Large value to eliminate mass limiting in surface soil
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	100	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100			HV	100	
				Sand and gravel (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	shd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm				Hvtwo		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA			VACS2	NA	
Water-filled porosity (volumetric)	cm3/cm3	NA			wvcvz2	NA	
Total soil porosity	cm3/cm3	NA			TPOR2	NA	
<u>Building Characteristics</u>							
Enclosed-space volumefiltration area (ratio)	cm	300	(a)		LB	300	
Enclosed-space foundation or wall thickness	cm	15			Lcrack	15	
Enclosed-space air exchange rate	1/s	0.000138889			ENCAER	1.39E-04	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)		NU	0.0019	
Volumetric air content in found./wall cracks	cc/cc	0.26			VACF	0.26	
Volumetric water content in found./wall cracks	cc/cc	0.12			wcfnd	0.12	
<u>Convective vapour flow term</u>							
Calculate convective flow term?		Y			Conv	Y	
Convective flow rate (if specified directly)	cm3/sec						
Convective flow through slab (calculated)	cm3/sec	10.88			Qs	10.88	
Slab Area	cm2	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc		
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	22.5	(c)	37.8	windsp	37.8	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site), divided by 10
Width of source area parallel to wind or groundwater flow direction	cm	600	(d)	600	WSA	600	2 m deep and 2 m long trench
Ambient air mixing zone height	cm	200		200	AAMZH	200	assumes all vapours mixed w/in trench
<u>Other</u>							
Averaging time for surface emission vapour flux	sec	3.15E+07	(e)		atvapor	3.15E+07	Defaults to receptor exposure duration

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	K _{oc} (cm ³ /kg)	K _d (cm ³ /kg)	H [*] (m ³ -atm/(mol-cm ³))	S (mg/kg-water)	D ^{so} (cm ² /s)	D ^{wt} (cm ² /s)	MW (g/mol)	VP (mmHg)	Volatile?
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzoturan	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.89E-06	1.79E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.90E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	Y
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	Y
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	Y
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

K _{oc}	Organic carbon partition coefficient	D ^{so}	Diffusion coefficient in air
K _d	Soil-water partition coefficient	D ^{wt}	Diffusion coefficient in water
H [*]	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{so} cm ² /s	D _{cr}	D _{so}	D _{soil}	D _{soil} cm ² /s	C _{sat} mg/kg	Convective Factor (soil/gas)
Acenaphthene	8.18E-03	-	-	8.18E-03	3.96E-03	3.94E+01	3.10E+01
Acenaphthylene	7.28E-03	-	-	7.28E-03	3.52E-03	1.63E+02	3.49E+01
Ammonia	3.69E-02	-	-	3.69E-02	1.79E-02	1.87E+04	6.86E+00
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV
Anthracene	6.31E-03	-	-	6.31E-03	3.06E-03	1.42E+00	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	-	-	1.45E-02	6.98E-03	6.59E+02	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m- & p-	NV	NV	NV	NV	NV	1.44E+04	NV
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	3.20E-03	5.69E+01	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	5.35E-03	1.67E+02	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	-	-	7.11E-03	3.45E-03	3.10E+01	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	4.09E-03	1.23E+02	3.00E+01
Naphthalene	9.78E-03	-	-	9.78E-03	4.72E-03	9.66E+01	2.60E+01
Phenanthrene	5.58E-03	-	-	5.58E-03	2.72E-03	3.84E+01	4.52E+01
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV
Pyrene	4.50E-03	-	-	4.50E-03	2.26E-03	1.47E+01	5.43E+01
Styrene	1.15E-02	-	-	1.15E-02	5.55E-03	2.93E+02	2.21E+01
Toluene	1.26E-02	-	-	1.26E-02	6.07E-03	2.91E+02	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	2.21E+02	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.11E+02	1.57E+01
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.54E+02	1.57E+01
TPH C15-C28 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	7.02E+01	1.57E+01
TPH C15-C28 aromatic	1.62E-02	-	-	1.62E-02	7.82E-03	8.04E+01	1.57E+01
TPH C29-C36 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	3.16E+00	1.57E+01
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	4.74E-03	7.46E+01	2.59E+01
Xylenes (total)	1.37E-02	-	-	1.37E-02	6.61E-03	8.90E+00	1.86E+01

Definition of Parameters

D _e	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{soil} (mgm ³ /air / mg/kg-soil)	VF _{soil} (mgm ³ /air / mg/kg-soil)	VF _{soil/vent} (mgm ³ /air / mg/kg-soil)	VF _{soil/vent} (mgm ³ /air / mg/kg-soil)	VF _{vent} (mgm ³ /air / mg/kg-soil)	VF _{vent} (mgm ³ /air / mg/kg-soil)
Acenaphthene	5.07E-05	8.36E-03	-	2.78E-08	4.84E-06	2.34E-04
Acenaphthylene	3.77E-05	8.36E-03	-	2.78E-08	2.67E-06	1.42E-04
Ammonia	5.13E-04	8.36E-03	-	2.78E-08	4.95E-04	6.07E-03
Aniline	NV	NV	-	2.78E-08	NV	NV
Anthracene	1.36E-05	8.36E-03	-	2.78E-08	3.46E-07	2.07E-05
Benz(a)anthracene	NV	NV	-	2.78E-08	NV	NV
Benzene	1.94E-04	8.36E-03	-	2.78E-08	7.07E-04	2.08E-02
Benzo(a)pyrene	NV	NV	-	2.78E-08	NV	NV
Benzo(b)fluoranthene	NV	NV	-	2.78E-08	NV	NV
Benzo(g,h,i)perylene	NV	NV	-	2.78E-08	NV	NV
Benzo(k)fluoranthene	NV	NV	-	2.78E-08	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	-	2.78E-08	NV	NV
Chrysene	NV	NV	-	2.78E-08	NV	NV
Cresol, m- & p-	NV	NV	-	2.78E-08	NV	NV
Cresol, o-	NV	NV	-	2.78E-08	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	2.78E-08	NV	NV
Dibenzofuran	3.64E-05	8.36E-03	-	2.78E-08	2.50E-06	1.43E-04
Dimethylphenol, 2,4-	NV	NV	-	2.78E-08	NV	NV
Ethylbenzene	1.24E-04	8.36E-03	-	2.78E-08	2.87E-04	1.07E-02
Fluoranthene	NV	NV	-	2.78E-08	NV	NV
Fluorene	2.54E-05	8.36E-03	-	2.78E-08	1.21E-06	6.55E-05
Indeno(1,2,3-cd)pyrene	NV	NV	-	2.78E-08	NV	NV
Methylnaphthalene, 2-	1.23E-04	8.36E-03	-	2.78E-08	2.85E-05	1.34E-03
Naphthalene	1.54E-04	8.36E-03	-	2.78E-08	4.48E-05	1.86E-03
Phenanthrene	1.10E-05	8.36E-03	-	2.78E-08	2.29E-07	1.51E-05
Phenol	NV	NV	-	2.78E-08	NV	NV
Pyrene	2.92E-06	8.36E-03	-	2.78E-08	1.60E-08	1.24E-06
Styrene	7.58E-04	8.36E-03	-	2.78E-08	1.08E-03	3.89E-02
Toluene	1.61E-04	8.36E-03	-	2.78E-08	4.89E-04	1.63E-02
TPH C06-C09 aliphatic	4.29E-04	8.36E-03	-	2.78E-08	3.46E-03	9.17E-02
TPH C10-C14 aliphatic	6.20E-05	8.36E-03	-	2.78E-08	7.22E-05	1.92E-03
TPH C10-C14 aromatic	3.97E-05	8.36E-03	-	2.78E-08	2.97E-05	7.87E-04
TPH C15-C28 aliphatic	2.99E-05	8.36E-03	-	2.78E-08	1.68E-06	4.45E-05
TPH C15-C28 aromatic	2.10E-05	8.36E-03	-	2.78E-08	8.29E-07	2.20E-05
TPH C29-C36 aliphatic	2.14E-05	8.36E-03	-	2.78E-08	8.64E-07	2.29E-05
TPH C29-C36 aromatic	NV	NV	-	2.78E-08	NV	NV
Trimethylbenzene, 1,2,4-	8.93E-04	8.36E-03	-	2.78E-08	1.50E-03	6.20E-02
Xylenes (total)	1.21E-04	8.36E-03	-	2.78E-08	2.74E-04	8.46E-03

Definition of Parameters

VF _{so}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{soil/vent}	Volatilization factor from subsurface soils to ambient air
VF _{soil/vent}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

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Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	1.98E+04	-	-	1.98E+04	-	5.11E+02	6.05E+01	-	-	6.05E+01	-	4.48E+00
Acenaphthylene	1.98E+04	-	-	1.98E+04	-	1.70E+03	5.71E+01	-	-	5.71E+01	-	4.32E+01
Ammonia	-	-	-	-	-	-	1.53E+04	-	-	1.53E+04	-	3.48E+02
Aniline	-	-	-	-	-	-	9.77E+02	-	1.71E+04	9.77E+02	-	2.12E-01
Anthracene	9.90E+04	-	-	9.90E+04	-	2.15E+03	1.84E+02	-	-	1.84E+02	-	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	3.84E+02	-	-	3.84E+02	-	2.40E-02
Barium	-	-	-	-	-	-	5.65E+02	-	-	5.65E+02	-	2.23E+00
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	3.76E+02	-	5.09E+04	3.76E+02	-	1.51E+03	3.38E+00	-	5.32E+02	3.38E+00	-	4.02E+01
Benzo(a)pyrene	-	-	6.72E+01	6.72E+01	-	6.52E+02	-	-	1.00E-02	1.00E-02	-	9.26E+00
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	9.73E+00	-	-	9.73E+00	-	3.00E-02
Cadmium (Water)	-	-	-	-	-	-	1.45E+01	-	-	1.45E+01	-	1.08E-01
Chromium(III), Insoluble Salts	1.80E+05	-	-	1.80E+05	-	2.10E+02	8.44E+03	-	-	8.44E+03	-	1.02E-01
Chromium(VI)	9.54E+02	-	4.60E+04	9.54E+02	-	2.30E+00	7.58E+00	-	-	7.58E+00	-	1.02E-01
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	2.60E+02	-	-	2.60E+02	-	5.70E-02
Cresol, m-&p-	1.96E+05	-	-	1.96E+05	-	2.29E+03	4.86E+03	-	-	4.86E+03	-	4.36E+02
Cresol, o-	-	-	-	-	-	-	4.92E+03	-	-	4.92E+03	-	1.82E+02
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	3.09E+05	-	-	3.09E+05	-	2.77E+02	2.67E+02	-	-	2.67E+02	-	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	7.22E+02	-	-	7.22E+02	-	3.80E+01
Ethylbenzene	1.25E+05	-	-	1.25E+05	-	2.61E+02	2.11E+02	-	-	2.11E+02	-	3.02E+00
Fluoranthene	1.32E+04	-	-	1.32E+04	-	2.44E+03	1.14E+01	-	-	1.14E+01	-	2.59E+01
Fluorene	1.32E+04	-	-	1.32E+04	-	2.10E+03	3.16E+01	-	-	3.16E+01	-	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	1.53E+04	-	-	1.53E+04	-	1.36E+04	1.11E+03	-	-	1.11E+03	-	5.55E-01
Manganese	-	-	-	-	-	-	2.39E+03	-	-	2.39E+03	-	4.89E+00
Methylnaphthalene, 2-	4.10E+04	-	-	4.10E+04	-	7.65E+03	3.77E+01	-	-	3.77E+01	-	1.05E+02
Naphthalene	4.33E+03	-	-	4.33E+03	-	1.02E+04	2.88E+01	-	-	2.88E+01	-	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	3.50E+02	-	-	3.50E+02	-	3.03E-01
Phenanthrene	1.98E+04	-	-	1.98E+04	-	1.00E+00	3.63E+01	-	-	3.63E+01	-	7.41E+01
Phenol	-	-	-	-	-	-	2.34E+04	-	-	2.34E+04	-	2.49E+02
Pyrene	9.90E+03	-	-	9.90E+03	-	2.64E+03	1.31E+01	-	-	1.31E+01	-	2.79E+01
Styrene	-	-	-	-	-	-	8.79E+01	-	-	8.79E+01	-	1.94E-01
Toluene	2.88E+05	-	-	2.88E+05	-	2.65E+03	7.56E+02	-	-	7.56E+02	-	1.76E+01
TPH C06-C09 aliphatic	3.22E+06	-	-	3.22E+06	-	5.93E+02	1.39E+03	-	-	1.39E+03	-	6.08E+00
TPH C10-C14 aliphatic	6.45E+04	-	-	6.45E+04	-	6.94E+04	4.26E+00	-	-	4.26E+00	-	1.73E+03
TPH C10-C14 aromatic	2.57E+04	-	-	2.57E+04	-	6.94E+04	1.70E+01	-	-	1.70E+01	-	1.73E+03
TPH C15-C28 aliphatic	4.89E+05	-	-	4.89E+05	-	9.32E+04	2.17E+02	-	-	2.17E+02	-	1.52E+03
TPH C15-C28 aromatic	7.33E+03	-	-	7.33E+03	-	9.32E+04	4.62E+00	-	-	4.62E+00	-	1.52E+03
TPH C29-C36 aliphatic	4.89E+05	-	-	4.89E+05	-	2.06E+04	2.47E+02	-	-	2.47E+02	-	3.32E+02
TPH C29-C36 aromatic	7.34E+03	-	-	7.34E+03	-	2.06E+04	2.51E+00	-	-	2.51E+00	-	3.32E+02
Trimethylbenzene, 1,2,4-	1.60E+07	-	-	1.60E+07	-	2.20E+02	1.55E+03	-	-	1.55E+03	-	9.20E-01
Vanadium and compounds	2.20E+04	-	-	2.20E+04	-	2.48E+02	9.60E+02	-	-	9.60E+02	-	2.28E-02
Xylenes (total)	2.31E+05	-	-	2.31E+05	-	2.58E+03	4.07E+02	-	-	4.07E+02	-	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Incidental Ingestion of Soil
- x Dermal Contact with Soil
- x Inhalation of Soil-Derived Dust in Outdoor Air
- x Inhalation of Surface Soil-Derived Vapours in Outdoor Air

SSTL for carcinogenic PAH's is included in SSTL for BaP

Pathways included in derivation of Groundwater RBSL:

- x Incidental Ingestion of Groundwater (Bathing or Excavation)
- x Dermal Contact with Groundwater (Bathing or Excavation)
- x Inhalation of Groundwater Vapours (Where GW Enters Trench)

Health Risk Calculations - Incidental Soil Ingestion
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Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Soil Concentration (mg/kg)	Oral Soil Bioavailability Factor (unitless)	Threshold Intake and Risk Calculations			
			Oral RfD (mg/kg/day)	Adult Intake Factor (threshold) (kg/kg/day)	Adult Intake (threshold) (mg/kg/day)	Hazard Index (Adult) (unitless)
Acenaphthene	511	1.00E+00	6.00E-02	1.94E-07	9.90E-05	1.65E-03
Acenaphthylene	1700	1.00E+00	6.00E-02	1.94E-07	3.29E-04	5.49E-03
Ammonia	-	-	-	-	-	-
Aniline	-	-	-	-	-	-
Anthracene	2150	1.00E+00	3.00E-01	1.94E-07	4.17E-04	1.39E-03
Arsenic, Inorganic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Benz(a)anthracene	1470	1.00E+00	-	-	-	-
Benzene	1510	1.00E+00	5.00E-04	1.94E-07	2.93E-04	5.85E-01
Benzo(a)pyrene	652	1.00E+00	-	-	-	-
Benzo(b)fluoranthene	587	1.00E+00	-	-	-	-
Benzo(g,h,i)perylene	305	1.00E+00	-	-	-	-
Benzo(k)fluoranthene	231	1.00E+00	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	1.00E+00	1.50E+00	1.94E-07	4.07E-05	2.71E-05
Chromium(VI)	2.3	1.00E+00	1.40E-03	1.94E-07	4.46E-07	3.18E-04
Chrysene	771	1.00E+00	-	-	-	-
Cobalt	-	-	-	-	-	-
Cresol, m-&p	2290	1.00E+00	1.00E-01	1.94E-07	4.44E-04	4.44E-03
Cresol, o-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	1.00E+00	-	-	-	-
Dibenzofuran	277	1.00E+00	6.00E-02	1.94E-07	5.37E-05	8.94E-04
Dimethylphenol, 2,4-	-	-	-	-	-	-
Ethylbenzene	261	1.00E+00	9.71E-02	1.94E-07	5.06E-05	5.21E-04
Fluoranthene	2440	1.00E+00	4.00E-02	1.94E-07	4.73E-04	1.18E-02
Fluorene	2100	1.00E+00	4.00E-02	1.94E-07	4.07E-04	1.02E-02
Indeno(1,2,3-cd)pyrene	247	1.00E+00	-	-	-	-
Lead and Compounds	13600	1.00E+00	3.50E-03	1.94E-07	2.63E-03	7.53E-01
Manganese	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.00E+00	4.00E-02	1.94E-07	1.48E-03	3.71E-02
Naphthalene	10200	1.00E+00	2.00E-02	1.94E-07	1.98E-03	9.88E-02
Nickel Soluble Salts	-	-	-	-	-	-
Phenanthrene	1	1.00E+00	6.00E-02	1.94E-07	1.94E-07	3.23E-06
Phenol	-	-	-	-	-	-
Pyrene	2640	1.00E+00	3.00E-02	1.94E-07	5.11E-04	1.70E-02
Styrene	-	-	-	-	-	-
Toluene	2650	1.00E+00	2.23E-01	1.94E-07	5.13E-04	2.30E-03
TPH C06-C09 aliphatic	593	1.00E+00	5.00E+00	1.94E-07	1.15E-04	2.30E-05
TPH C10-C14 aliphatic	69400	1.00E+00	1.00E-01	1.94E-07	1.34E-02	1.34E-01
TPH C10-C14 aromatic	69400	1.00E+00	4.00E-02	1.94E-07	1.34E-02	3.36E-01
TPH C15-C28 aliphatic	93200	1.00E+00	2.00E+00	1.94E-07	1.81E-02	9.03E-03
TPH C15-C28 aromatic	93200	1.00E+00	3.00E-02	1.94E-07	1.81E-02	6.02E-01
TPH C29-C36 aliphatic	20600	1.00E+00	2.00E+00	1.94E-07	3.99E-03	2.00E-03
TPH C29-C36 aromatic	20600	1.00E+00	3.00E-02	1.94E-07	3.99E-03	1.33E-01
Trimethylbenzene, 1,2,4-	220	1.00E+00	-	-	-	-
Vanadium and compounds	248	1.00E+00	5.00E-03	1.94E-07	4.80E-05	9.61E-03
Xylenes (total)	2576	1.00E+00	1.79E-01	1.94E-07	4.99E-04	2.79E-03

TOTAL

2.77E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

1.32E-06

Health Risk Calculations - Dermal Contact with Soil
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Soil Concentration (mg/kg)	Dermal Absorption Factor (DAF) (unitless)	Threshold Intake and Risk Calculations			
			Dermal RID (mg/kg/day)	Adult Intake Factor (threshold) (kg/kg/day)	Adult Intake (threshold) (mg/kg/day)	Hazard Index (Adult) (unitless)
Acenaphthene	511	0.13	6.00E-02	4.12E-07	2.11E-04	3.51E-03
Acenaphthylene	1700	0.13	6.00E-02	4.12E-07	7.01E-04	1.17E-02
Ammonia	-	-	-	-	-	-
Aniline	-	-	-	-	-	-
Anthracene	2150	0.13	3.00E-01	4.12E-07	8.86E-04	2.95E-03
Arsenic, Inorganic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Benz(a)anthracene	1470	0.13	-	-	-	-
Benzene	1510	-	5.00E-04	-	-	-
Benzo(a)pyrene	652	0.13	-	-	-	-
Benzo(b)fluoranthene	587	0.13	-	-	-	-
Benzo(g,h,i)perylene	305	0.13	-	-	-	-
Benzo(k)fluoranthene	231	0.13	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-
Chromium(III), Insoluble Salt	210	0.01	1.95E-02	3.17E-08	6.66E-06	3.41E-04
Chromium(VI)	2.3	0.01	3.50E-05	3.17E-08	7.29E-08	2.08E-03
Chrysene	771	0.13	-	-	-	-
Cobalt	-	-	-	-	-	-
Cresol, m-&p-	2290	0.1	1.00E-01	3.17E-07	7.26E-04	7.26E-03
Cresol, o-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	0.13	-	-	-	-
Dibenzofuran	277	-	6.00E-02	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-
Ethylbenzene	261	-	9.71E-02	-	-	-
Fluoranthene	2440	0.13	4.00E-02	4.12E-07	1.01E-03	2.51E-02
Fluorene	2100	0.13	4.00E-02	4.12E-07	8.65E-04	2.16E-02
Indeno(1,2,3-cd)pyrene	247	0.13	-	-	-	-
Lead and Compounds	13600	0.01	3.50E-03	3.17E-08	4.31E-04	1.23E-01
Manganese	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	-	4.00E-02	-	-	-
Naphthalene	10200	0.13	2.00E-02	4.12E-07	4.20E-03	2.10E-01
Nickel Soluble Salts	-	-	-	-	-	-
Phenanthrene	1	0.13	6.00E-02	4.12E-07	4.12E-07	6.87E-06
Phenol	-	-	-	-	-	-
Pyrene	2640	0.13	3.00E-02	4.12E-07	1.09E-03	3.63E-02
Styrene	-	-	-	-	-	-
Toluene	2650	-	2.23E-01	-	-	-
TPH C06-C09 aliphatic	593	-	5.00E+00	-	-	-
TPH C10-C14 aliphatic	69400	-	1.00E-01	-	-	-
TPH C10-C14 aromatic	69400	-	4.00E-02	-	-	-
TPH C15-C28 aliphatic	93200	0.1	2.00E+00	3.17E-07	2.95E-02	1.48E-02
TPH C15-C28 aromatic	93200	0.1	3.00E-02	3.17E-07	2.95E-02	9.85E-01
TPH C29-C36 aliphatic	20600	0.1	2.00E+00	3.17E-07	6.53E-03	3.27E-03
TPH C29-C36 aromatic	20600	0.1	3.00E-02	3.17E-07	6.53E-03	2.18E-01
Trimethylbenzene, 1,2,4-	220	-	-	-	-	-
Vanadium and compounds	248	0.01	5.00E-03	3.17E-08	7.86E-06	1.57E-03
Xylenes (total)	2576	-	1.79E-01	-	-	-

TOTAL	1.67E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

9.68E-05

Health Risk Calculations - Inhalation of Soil-Derived Particulates in Outdoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Soil Conc (mg/kg)	Particulate Concentration in Outdoor Air (From Surface Soil) (m3/kg)	Threshold Intake and Risk Calculations			
			Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	511	2.78E-08	2.10E-01	3.81E-10	1.94E-07	9.26E-07
Acenaphthylene	1700	2.78E-08	2.10E-01	3.81E-10	6.47E-07	3.08E-06
Ammonia	-	-	-	-	-	-
Aniline	-	-	-	-	-	-
Anthracene	2150	2.78E-08	1.05E+00	3.81E-10	8.18E-07	7.79E-07
Arsenic, Inorganic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Benz(a)anthracene	1470	2.78E-08	-	-	-	-
Benzene	1510	2.78E-08	9.60E-03	3.81E-10	5.75E-07	5.99E-05
Benzo(a)pyrene	652	2.78E-08	-	-	-	-
Benzo(b)fluoranthene	587	2.78E-08	-	-	-	-
Benzo(g,h,i)perylene	305	2.78E-08	-	-	-	-
Benzo(k)fluoranthene	231	2.78E-08	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	2.78E-08	1.00E-04	3.81E-10	7.99E-08	7.99E-04
Chromium(VI)	2.3	2.78E-08	1.00E-04	3.81E-10	8.75E-10	8.75E-06
Chrysene	771	2.78E-08	-	-	-	-
Cobalt	-	-	-	-	-	-
Cresol, m-&p-	2290	2.78E-08	6.00E-01	3.81E-10	8.71E-07	1.45E-06
Cresol, o-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	2.78E-08	-	-	-	-
Dibenzofuran	277	2.78E-08	2.10E-01	3.81E-10	1.05E-07	5.02E-07
Dimethylphenol, 2,4-	-	-	-	-	-	-
Ethylbenzene	261	2.78E-08	1.30E+00	3.81E-10	9.93E-08	7.64E-08
Fluoranthene	2440	2.78E-08	1.40E-01	3.81E-10	9.28E-07	6.63E-06
Fluorene	2100	2.78E-08	1.40E-01	3.81E-10	7.99E-07	5.71E-06
Indeno(1,2,3-cd)pyrene	247	2.78E-08	-	-	-	-
Lead and Compounds	13600	2.78E-08	5.00E-04	3.81E-10	5.18E-06	1.04E-02
Manganese	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	2.78E-08	1.40E-01	3.81E-10	2.91E-06	2.08E-05
Naphthalene	10200	2.78E-08	3.00E-03	3.81E-10	3.88E-06	1.29E-03
Nickel Soluble Salts	-	-	-	-	-	-
Phenanthrene	1	2.78E-08	2.10E-01	3.81E-10	3.81E-10	1.81E-09
Phenol	-	-	-	-	-	-
Pyrene	2640	2.78E-08	1.05E-01	3.81E-10	1.00E-06	9.57E-06
Styrene	-	-	-	-	-	-
Toluene	2650	2.78E-08	5.00E+00	3.81E-10	1.01E-06	2.02E-07
TPH C06-C09 aliphatic	593	2.78E-08	1.84E+01	3.81E-10	2.26E-07	1.23E-08
TPH C10-C14 aliphatic	69400	2.78E-08	1.00E+00	3.81E-10	2.64E-05	2.64E-05
TPH C10-C14 aromatic	69400	2.78E-08	2.00E-01	3.81E-10	2.64E-05	1.32E-04
TPH C15-C28 aliphatic	93200	2.78E-08	7.00E+00	3.81E-10	3.55E-05	5.07E-06
TPH C15-C28 aromatic	93200	2.78E-08	1.05E-01	3.81E-10	3.55E-05	3.38E-04
TPH C29-C36 aliphatic	20600	2.78E-08	7.00E+00	3.81E-10	7.84E-06	1.12E-06
TPH C29-C36 aromatic	20600	2.78E-08	1.05E-01	3.81E-10	7.84E-06	7.47E-05
Trimethylbenzene, 1,2,4-	220	2.78E-08	7.00E-03	3.81E-10	8.37E-08	1.20E-05
Vanadium and compounds	248	2.78E-08	1.00E-03	3.81E-10	9.44E-08	9.44E-05
Xylenes (total)	2576	2.78E-08	2.20E-01	3.81E-10	9.80E-07	4.46E-06

TOTAL

1.33E-02

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

4.68E-07

Health Risk Calculations - Inhalation of Surface Soil-Derived Vapours in Outdoor Air

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Outdoor Air [(mg/m3)/(mg/kg)]	Vapour Concentration in Outdoor Air (From Surface Soil) (mg/m3)	Threshold Intake and Risk Calculations			
					Inhalation RIC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
	511	3.94E+01	5.07E-05	2.00E-03	2.10E-01	6.95E-07	2.74E-05	1.30E-04
Acenaphthylene	1700	1.63E+02	3.77E-05	6.12E-03	2.10E-01	5.16E-07	8.38E-05	3.99E-04
Ammonia	-	-	-	-	-	-	-	-
Aniline	-	-	NV	-	-	-	-	-
Anthracene	2150	1.42E+00	1.36E-05	1.93E-05	1.05E+00	1.86E-07	2.65E-07	2.52E-07
Arsenic, Inorganic	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-
Benzene	1510	6.59E+02	1.94E-04	1.28E-01	9.60E-03	2.66E-06	1.75E-03	1.83E-01
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	NV	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Sal	210	#VALUE!	-	-	1.00E-04	-	-	-
Chromium(VI)	2.3	#VALUE!	-	-	1.00E-04	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	NV	-	6.00E-01	-	-	-
Cresol, o-	-	-	NV	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-
Dibenzofuran	277	5.69E+01	3.64E-05	2.07E-03	2.10E-01	4.99E-07	2.84E-05	1.35E-04
Dimethylphenol, 2,4-	-	-	NV	-	-	-	-	-
Ethylbenzene	261	1.67E+02	1.24E-04	2.06E-02	1.30E+00	1.69E-06	2.82E-04	2.17E-04
Fluoranthene	2440	2.89E+01	NV	-	1.40E-01	-	-	-
Fluorene	2100	3.10E+01	2.54E-05	7.87E-04	1.40E-01	3.47E-07	1.08E-05	7.70E-05
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-
Lead and Compounds	13600	#VALUE!	-	-	5.00E-04	-	-	-
Manganese	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	1.23E-04	1.51E-02	1.40E-01	1.69E-06	2.07E-04	1.48E-03
Naphthalene	10200	9.66E+01	1.54E-04	1.49E-02	3.00E-03	2.12E-06	2.04E-04	6.81E-02
Nickel Soluble Salts	-	-	-	-	-	-	-	-
Phenanthrene	1	3.84E+01	1.10E-05	1.10E-05	2.10E-01	1.51E-07	1.51E-07	7.20E-07
Phenol	-	-	NV	-	-	-	-	-
Pyrene	2640	1.47E+01	2.92E-06	4.28E-05	1.05E-01	4.00E-08	5.86E-07	5.59E-06
Styrene	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	1.61E-04	4.69E-02	5.00E+00	2.21E-06	6.43E-04	1.29E-04
TPH C06-C09 aliphatic	593	2.21E+02	4.29E-04	9.48E-02	1.84E+01	5.88E-06	1.30E-03	7.06E-05
TPH C10-C14 aliphatic	69400	1.11E+02	6.20E-05	6.89E-03	1.00E+00	8.49E-07	9.44E-05	9.44E-05
TPH C10-C14 aromatic	69400	1.54E+02	3.97E-05	6.13E-03	2.00E-01	5.44E-07	8.40E-05	4.20E-04
TPH C15-C28 aliphatic	93200	7.02E+01	2.99E-05	2.10E-03	7.00E+00	4.09E-07	2.87E-05	4.10E-06
TPH C15-C28 aromatic	93200	8.04E+01	2.10E-05	1.69E-03	1.05E-01	2.88E-07	2.31E-05	2.20E-04
TPH C29-C36 aliphatic	20600	3.16E+00	2.14E-05	6.77E-05	7.00E+00	2.94E-07	9.27E-07	1.32E-07
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	1.05E-01	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	8.93E-04	6.67E-02	7.00E-03	1.22E-05	9.13E-04	1.30E-01
Vanadium and compounds	248	#VALUE!	-	-	1.00E-03	-	-	-
Xylenes (total)	2576	8.90E+00	1.21E-04	1.08E-03	2.20E-01	1.66E-06	1.47E-05	6.70E-05
TOTAL								
3.85E-01								

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Trench Air (where groundwater enters trench)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Trench Air (where GW enters trench) [(mg/m3)/(mg/L)]	Vapour Concentration in Trench Air (from GW within trench) (mg/m3)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	4.48	3.90E+00	3.31E-04	1.29E-03	2.10E-01	4.53E-06	1.77E-05	8.41E-05
Acenaphthylene	43.2	1.61E+01	3.31E-04	5.32E-03	2.10E-01	4.53E-06	7.29E-05	3.47E-04
Ammonia	348	4.82E+05	3.31E-04	1.15E-01	6.95E-02	4.53E-06	1.58E-03	2.27E-02
Aniline	0.212	3.60E+04	NV	-	1.00E-03	-	-	-
Anthracene	15.4	4.34E-02	3.31E-04	1.44E-05	1.05E+00	4.53E-06	1.97E-07	1.87E-07
Arsenic, Inorganic	0.024	-	NV	-	1.00E-03	-	-	-
Barium	2.23	-	NV	-	5.00E-04	-	-	-
Benz(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-
Benzene	40.2	1.79E+03	3.31E-04	1.33E-02	9.60E-03	4.53E-06	1.82E-04	1.90E-02
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	NV	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	NV	-	-	-	-	-
Cadmium (Water)	0.108	-	NV	-	8.75E-02	-	-	-
Chromium(III), Insoluble Salts	0.102	-	NV	-	3.00E-04	-	-	-
Chromium(VI)	0.102	1.69E+06	NV	-	1.00E-04	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-
Cobalt	0.057	-	NV	-	1.00E-04	-	-	-
Cresol, m-&p-	436	2.27E+04	NV	-	6.00E-01	-	-	-
Cresol, o-	182	2.59E+04	NV	-	6.00E-01	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	3.31E-04	1.03E-03	2.10E-01	4.53E-06	1.40E-05	6.69E-05
Dimethylphenol, 2,4-	38	7.87E+03	NV	-	7.00E-02	-	-	-
Ethylbenzene	3.02	1.69E+02	3.31E-04	9.99E-04	1.30E+00	4.53E-06	1.37E-05	1.05E-05
Fluoranthene	25.9	2.60E-01	NV	-	1.40E-01	-	-	-
Fluorene	21.1	1.69E+00	3.31E-04	5.59E-04	1.40E-01	4.53E-06	7.66E-06	5.47E-05
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-
Lead and Compounds	0.555	-	NV	-	5.00E-04	-	-	-
Manganese	4.89	-	NV	-	1.50E-04	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	3.31E-04	8.13E-03	1.40E-01	4.53E-06	1.11E-04	7.96E-04
Naphthalene	283	3.10E+01	3.31E-04	1.03E-02	3.00E-03	4.53E-06	1.40E-04	4.68E-02
Nickel Soluble Salts	0.303	-	NV	-	9.00E-05	-	-	-
Phenanthrene	74.1	1.15E+00	3.31E-04	3.80E-04	2.10E-01	4.53E-06	5.21E-06	2.48E-05
Phenol	249	8.28E+04	NV	-	2.00E-01	-	-	-
Pyrene	27.9	1.35E-01	3.31E-04	4.46E-05	1.05E-01	4.53E-06	6.12E-07	5.82E-06
Styrene	0.194	3.10E+02	3.31E-04	6.42E-05	2.60E-01	4.53E-06	8.79E-07	3.38E-06
Toluene	17.6	5.26E+02	3.31E-04	5.82E-03	5.00E+00	4.53E-06	7.97E-05	1.59E-05
TPH C06-C09 aliphatic	6.08	1.18E+01	3.31E-04	2.01E-03	1.84E+01	4.53E-06	2.75E-05	1.50E-06
TPH C10-C14 aliphatic	1730	9.99E-02	3.31E-04	3.30E-05	1.00E+00	4.53E-06	4.53E-07	4.53E-07
TPH C10-C14 aromatic	1730	2.53E+01	3.31E-04	8.37E-03	2.00E-01	4.53E-06	1.15E-04	5.73E-04
TPH C15-C28 aliphatic	1520	1.11E-04	3.31E-04	3.67E-08	7.00E+00	4.53E-06	5.03E-10	7.18E-11
TPH C15-C28 aromatic	1520	1.06E+00	3.31E-04	3.51E-04	1.05E-01	4.53E-06	4.80E-06	4.57E-05
TPH C29-C36 aliphatic	332	2.50E-06	3.31E-04	8.27E-10	7.00E+00	4.53E-06	1.13E-11	1.62E-12
TPH C29-C36 aromatic	332	6.60E-03	NV	-	1.05E-01	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.31E-04	3.04E-04	7.00E-03	4.53E-06	4.17E-06	5.95E-04
Vanadium and compounds	0.0228	-	NV	-	1.00E-03	-	-	-
Xylenes (total)	6.7	1.06E+01	3.31E-04	2.22E-03	2.20E-01	4.53E-06	3.04E-05	1.38E-04

TOTAL

9.12E-02

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

1.56E-08

TOTAL	6.89E-01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

2.92E-07

TOTAL	1.28E+02

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

9.25E-03

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (on Hazard Index)					Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)							RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Revised RBSL (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL				
			Soil Ingestion	Dermal Contact	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	TOTAL (All Pathways)	Soil Ingestion	Dermal Contact	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	Total Non-Vapour Pathways	Total Vapour Pathways	TOTAL (All Pathways)						Soil Ingestion	Dermal Contact	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	TOTAL
Acenaphthene	511	3.94E+01	1.65E-03	3.51E-03	9.26E-07	1.30E-04	5.29E-03	3.23E-06	6.87E-06	1.81E-09	3.31E-06	1.01E-05	3.31E-06	1.34E-05	1.49E+04	1.51E-01	1.30E-04	1.98E+04	1.98E+04	31.95%	67.97%	0.02%	0.07%	100.00%
Acenaphthylene	1700	1.63E+02	5.49E-03	1.17E-02	3.08E-06	3.99E-04	1.76E-02	3.23E-06	6.87E-06	1.81E-09	2.46E-06	1.01E-05	2.46E-06	1.26E-05	1.59E+04	1.61E-01	3.99E-04	1.98E+04	1.98E+04	31.91%	67.88%	0.02%	0.20%	100.00%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	1.39E-03	2.95E-03	7.79E-07	2.52E-07	4.34E-03	6.46E-07	1.37E-06	3.62E-10	1.77E-07	2.02E-06	1.77E-07	2.20E-06	9.10E+04	1.84E-01	2.52E-07	9.90E+04	9.90E+04	31.97%	68.01%	0.02%	0.00%	100.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.85E-01	-	5.99E-05	1.83E-01	7.68E-01	3.87E-04	-	3.96E-08	2.77E-04	3.88E-04	2.77E-04	6.64E-04	3.76E+02	2.50E-01	-	-	3.76E+02	58.32%	-	0.01%	41.67%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a,h)pyrene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salt	210	-	2.71E-05	3.41E-04	7.99E-04	-	1.17E-03	1.29E-07	1.63E-06	3.81E-06	-	5.56E-06	-	5.56E-06	1.80E+05	-	-	-	1.80E+05	2.32%	29.24%	68.44%	-	100.00%
Chromium(VI)	2.3	-	3.18E-04	2.08E-03	8.75E-06	-	2.41E-03	1.38E-04	9.06E-04	3.81E-06	-	1.05E-03	-	1.05E-03	9.54E+02	-	-	-	9.54E+02	13.20%	86.43%	0.36%	-	100.00%
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m- & p-	2290	1.44E+04	4.44E-03	7.26E-03	1.45E-06	-	1.17E-02	1.94E-06	3.17E-06	6.34E-10	-	5.11E-06	-	5.11E-06	1.96E+05	1.00E+00	-	-	1.96E+05	37.93%	62.06%	0.01%	-	100.00%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	8.94E-04	-	5.02E-07	1.35E-04	1.03E-03	3.23E-06	-	1.81E-09	2.38E-06	3.23E-06	2.38E-06	5.61E-06	1.78E+05	5.76E-01	1.35E-04	3.09E+05	3.09E+05	99.93%	-	0.06%	0.01%	100.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	5.21E-04	-	7.64E-08	2.17E-04	7.38E-04	2.00E-06	-	2.93E-10	1.30E-06	2.00E-06	1.30E-06	3.30E-06	7.58E+04	1.52E-01	2.17E-04	1.25E+05	1.25E+05	99.90%	-	0.01%	0.09%	100.00%
Fluoranthene	2440	2.89E+01	1.18E-02	2.51E-02	6.63E-06	-	3.70E-02	4.84E-06	1.03E-05	2.72E-09	1.30E-06	1.51E-05	-	1.51E-05	1.32E+04	2.00E-01	-	-	1.32E+04	31.97%	68.01%	0.02%	-	100.00%
Fluorene	2100	3.10E+01	1.02E-02	2.16E-02	5.71E-06	7.70E-05	3.19E-02	4.84E-06	1.03E-05	2.72E-09	2.48E-06	1.51E-05	2.48E-06	1.76E-05	1.13E+04	1.72E-01	7.70E-05	1.32E+04	1.32E+04	31.96%	67.98%	0.02%	0.04%	100.00%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	7.53E-01	1.23E-01	1.04E-02	-	8.86E-01	5.54E-05	9.06E-06	7.61E-07	-	6.52E-05	-	6.52E-05	1.53E+04	-	-	-	1.53E+04	84.93%	13.90%	1.17%	-	100.00%
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.71E-02	-	2.08E-05	1.48E-03	3.86E-02	4.84E-06	-	2.72E-09	1.21E-05	4.85E-06	1.21E-05	1.69E-05	1.18E+04	5.88E-02	1.48E-03	4.10E+04	4.10E+04	99.20%	-	0.06%	0.74%	100.00%
Naphthalene	10200	9.66E+01	9.88E-02	2.10E-01	1.29E-03	6.81E-02	3.78E-01	9.69E-06	2.06E-05	1.27E-07	7.05E-04	3.04E-05	7.05E-04	7.36E-04	2.72E+02	7.64E-02	6.81E-02	4.33E+03	4.33E+03	20.99%	44.66%	0.27%	34.07%	100.00%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	1	3.84E+01	3.23E-06	6.87E-06	1.81E-09	7.20E-07	1.08E-05	3.23E-06	6.87E-06	1.81E-09	7.20E-07	1.01E-05	7.20E-07	1.08E-05	1.85E+04	1.87E-01	2.77E-05	1.98E+04	1.98E+04	31.97%	68.00%	0.02%	0.01%	100.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	1.70E-02	3.63E-02	9.57E-06	5.59E-06	5.33E-02	6.46E-06	1.37E-05	3.62E-09	3.81E-07	2.02E-05	3.81E-07	2.06E-05	9.72E+03	1.96E-01	5.59E-06	9.90E+03	9.90E+03	31.97%	68.01%	0.02%	0.00%	100.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	2.30E-03	-	2.02E-07	1.29E-04	2.43E-03	8.69E-07	-	7.61E-11	4.42E-07	8.69E-07	4.42E-07	1.31E-06	1.91E+05	1.66E-01	1.29E-04	2.88E+05	2.88E+05	99.94%	-	0.01%	0.05%	100.00%
TPH C06-C09 aliphatic	593	2.21E+02	2.30E-05	-	1.23E-08	7.06E-05	9.36E-05	3.87E-08	-	2.07E-11	3.19E-07	3.88E-08	3.19E-07	3.58E-07	3.49E+05	1.36E-02	7.06E-05	3.22E+06	3.22E+06	99.89%	-	0.05%	0.06%	100.00%
TPH C10-C14 aliphatic	69400	1.11E+02	1.34E-01	-	2.64E-05	9.44E-05	1.35E-01	1.94E-06	-	3.81E-10	8.49E-07	1.94E-06	8.49E-07	2.79E-06	4.49E+04	8.70E-02	9.44E-05	6.45E+04	6.45E+04	99.90%	-	0.02%	0.08%	100.00%
TPH C10-C14 aromatic	69400	1.54E+02	3.38E-01	-	1.32E-04	4.20E-04	3.37E-01	4.84E-06	-	1.90E-09	2.72E-06	4.85E-06	2.72E-06	7.57E-06	1.65E+04	8.05E-02	4.20E-04	2.57E+04	2.57E+04	99.62%	-	0.04%	0.34%	100.00%
TPH C15-C28 aliphatic	93200	7.02E+01	9.03E-03	1.48E-02	5.07E-06	4.10E-06	2.38E-02	9.69E-08	1.59E-07	5.44E-11	5.85E-08	2.55E-07	5.85E-08	3.14E-07	3.98E+05	1.02E-01	4.10E-06	4.89E+05	4.89E+05	37.92%	62.05%	0.02%	0.00%	100.00%
TPH C15-C28 aromatic	93200	8.04E+01	6.02E-01	9.85E-01	3.38E-04	2.20E-04	1.59E+00	6.46E-06	1.06E-05	3.62E-09	2.74E-06	1.70E-05	2.74E-06	1.98E-05	6.32E+03	1.08E-01	2.20E-04	7.33E+03	7.33E+03	37.86%	61.95%	0.02%	0.18%	100.00%
TPH C29-C36 aliphatic	20600	3.16E+00	2.00E-03	3.27E-03	1.12E-06	1.32E-07	5.26E-03	9.69E-08	1.59E-07	5.44E-11	4.20E-08	2.55E-07	4.20E-08	2.97E-07	4.20E+05	1.07E-01	1.32E-07	4.89E+05	4.89E+05	37.92%	62.06%	0.02%	0.00%	100.00%
TPH C29-C36 aromatic	20600	1.66E+00	1.33E-01	2.18E-01	7.47E-05	-	3.51E-01	6.46E-06	1.06E-05	3.62E-09	-	1.70E-05	-	1.70E-05	7.34E+03	1.25E-01	-	-	7.34E+03	37.92%	62.06%	0.02%	-	100.00%
Trimethylbenzene, 1,2,4-	220	7.46E+01	-	-	1.20E-05	1.30E-01	1.30E-01	-	-	5.44E-08	1.75E-03	5.44E-08	1.75E-03	1.75E-03	5.72E+02	1.30E-01	1.30E-01	1.60E+07	1.60E+07	-	-	86.96%	13.04%	100.00%
Vanadium and compounds	248	-	9.61E-03	1.57E-03	9.44E-05	-	1.13E-02	3.87E-05	6.34E-06	3.81E-07	-	4.55E-05	-	4.55E-05	2.20E+04	-	-	-	2.20E+04	85.22%	13.94%	0.84%	-	100.00%
Xylenes (total)	2576	8.90E+00	2.79E-03	-	4.46E-06	6.70E-05	2.86E-03	1.08E-06	-	1.73E-09	7.52E-06	1.08E-06	7.52E-06	8.61E-06	2.90E+04	3.15E-02	6.70E-05	2.31E+05	2.31E+05	99.81%	-	0.16%	0.03%	100.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Non-Threshold Lifetime Health Effects (Adult and Child)
 Barangaroo
 Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (ILCR)					Risk/Soil Concentration (i.e., exposure and toxicity factor)							RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL					
			Soil Ingestion	Dermal Contact	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	TOTAL	Soil Ingestion	Dermal Contact	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	Total Non- Vapour Pathways	Total Vapour Pathways	TOTAL				Soil Ingestion	Dermal Contact	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	TOTAL	
			mg/kg	mg/kg	unitless	unitless	unitless	unitless	unitless	kg/mg	kg/mg	kg/mg	kg/mg	kg/mg				kg/mg	kg/mg	mg/kg		mg/kg	%
Acenaphthene	511	3.94E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	1.75E-07	3.72E-07	6.95E-08	-	6.17E-07	1.19E-10	2.53E-10	4.73E-11	-	4.19E-10	-	4.19E-10	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	1.46E-07	-	4.92E-11	1.50E-07	2.97E-07	9.69E-11	-	3.26E-14	9.95E-11	9.69E-11	9.95E-11	1.96E-10	5.09E+04	1.00E-05	5.09E+04	49.32%	-	0.02%	50.66%	100.00%	
Benzo(a)pyrene	652	1.90E+00	7.76E-07	9.60E-05	3.08E-07	-	9.71E-05	1.19E-09	1.47E-07	4.73E-10	-	1.49E-07	1.49E-07	6.72E+01	1.00E-05	6.72E+01	0.80%	98.88%	0.32%	-	100.00%		
Benzo(b)fluoranthene	587	1.80E+00	6.99E-08	1.49E-07	2.78E-08	-	2.46E-07	1.19E-10	2.53E-10	4.73E-11	-	4.19E-10	4.19E-10	4.19E-10	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	3.63E-09	7.72E-09	1.44E-09	-	1.28E-08	1.19E-11	2.53E-11	4.73E-12	-	4.19E-11	4.19E-11	4.19E-11	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	2.75E-08	5.85E-08	1.09E-08	-	9.69E-08	1.19E-10	2.53E-10	4.73E-11	-	4.19E-10	4.19E-10	4.19E-10	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	5.00E-10	-	5.00E-10	-	-	2.17E-10	-	2.17E-10	2.17E-10	4.60E+04	1.00E-05	4.60E+04	-	-	100.00%	-	100.00%		
Chrysene	771	7.24E-01	9.18E-09	1.95E-08	3.65E-09	-	3.23E-08	1.19E-11	2.53E-11	4.73E-12	-	4.19E-11	4.19E-11	4.19E-11	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	8.50E-08	1.81E-07	3.38E-08	-	3.00E-07	1.19E-09	2.53E-09	4.73E-10	-	4.19E-09	4.19E-09	4.19E-09	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	2.94E-08	6.25E-08	1.17E-08	-	1.04E-07	1.19E-10	2.53E-10	4.73E-11	-	4.19E-10	4.19E-10	4.19E-10	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	10200	9.66E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	1	3.84E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Risk at Input Groundwater Concentration (Hazard Index)					Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)							RBSL (assumes no soil limit)	Risk at RBSL (with soil)	Vapour Only Risk at Sol (if necessary)	Revised RBSL (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL				
	Cgw mg/L	Solubility mg/L	GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL (All Pathways)	GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	Total Non- Vapour Pathways	Total Vapour Pathways	TOTAL (All Pathways)										
			unitless	unitless	unitless	unitless	L/mg	L/mg	L/mg	L/mg	L/mg	L/mg						L/mg				
Acenaphthene	4.48	3.90E+00	8.41E-05	2.19E-04	1.46E-02	1.49E-02	2.16E-05	4.89E-05	3.26E-03	3.31E-03	2.16E-05	3.33E-03	6.01E+01	1.99E-01	8.41E-05	6.05E+01	6.05E+01	0.04%	1.48%	98.48%	100.00%	
Acenaphthylene	43.2	1.61E+01	3.47E-04	2.11E-03	1.49E-01	1.51E-01	2.16E-05	4.89E-05	3.45E-03	3.50E-03	2.16E-05	3.52E-03	5.68E+01	1.99E-01	3.47E-04	5.71E+01	5.71E+01	0.17%	1.40%	98.43%	100.00%	
Ammonia	348	4.82E+05	2.27E-02	-	-	2.27E-02	6.52E-05	-	-	-	6.52E-05	6.52E-05	1.53E+04	1.00E+00	-	-	1.53E+04	100.00%	-	-	100.00%	
Aniline	0.212	3.60E+04	-	-	8.89E-05	1.28E-04	2.17E-04	-	4.19E-04	6.04E-04	1.02E-03	1.02E-03	9.77E+02	1.00E+00	-	-	9.77E+02	-	40.99%	59.01%	100.00%	
Anthracene	15.4	4.34E-02	1.87E-07	1.51E-04	1.66E-02	1.67E-02	4.31E-06	9.78E-06	1.08E-03	1.09E-03	4.31E-06	1.09E-03	1.84E+02	1.99E-01	1.87E-07	1.84E+02	1.84E+02	0.00%	0.90%	99.10%	100.00%	
Arsenic, Inorganic	0.024	-	-	-	3.52E-05	2.73E-05	6.25E-05	-	1.47E-03	1.14E-03	2.60E-03	2.60E-03	3.84E+02	1.00E+00	-	-	3.84E+02	-	56.37%	43.63%	100.00%	
Barium	2.23	-	-	-	3.27E-04	3.62E-03	3.95E-03	-	1.47E-04	1.62E-03	1.77E-03	1.77E-03	5.65E+02	1.00E+00	-	-	5.65E+02	-	8.29%	91.71%	100.00%	
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Benzene	40.2	1.79E+03	1.90E-02	2.36E-01	2.72E+00	2.98E+00	4.72E-04	5.87E-03	6.77E-02	7.36E-02	4.72E-04	7.40E-02	3.38E+00	2.50E-01	-	-	3.38E+00	0.64%	7.93%	91.43%	100.00%	
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	3.52E-06	3.08E-03	3.08E-03	-	1.17E-04	1.03E-01	1.03E-01	1.03E-01	9.73E+00	1.00E+00	-	-	9.73E+00	-	0.11%	99.89%	100.00%	
Cadmium (Water)	0.108	-	-	-	4.53E-04	7.01E-03	7.46E-03	-	4.19E-03	6.49E-02	6.91E-02	6.91E-02	1.45E+01	1.00E+00	-	-	1.45E+01	-	6.07%	93.93%	100.00%	
Chromium(III), Insoluble Salts	0.102	-	-	-	2.00E-07	1.19E-05	1.21E-05	-	1.96E-06	1.17E-04	1.18E-04	1.18E-04	8.44E+03	1.00E+00	-	-	8.44E+03	-	1.65%	98.35%	100.00%	
Chromium(VI)	0.102	1.69E+06	-	-	2.14E-04	1.32E-02	1.35E-02	-	2.10E-03	1.30E-01	1.32E-01	1.32E-01	7.58E+00	1.00E+00	-	-	7.58E+00	-	1.59%	98.41%	100.00%	
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cobalt	0.057	-	-	-	1.67E-04	5.18E-05	2.19E-04	-	2.94E-03	9.09E-04	3.84E-03	3.84E-03	2.60E+02	1.00E+00	-	-	2.60E+02	-	76.36%	23.64%	100.00%	
Cresol, m-&p-	436	2.27E+04	-	-	1.28E-02	7.70E-02	8.98E-02	-	2.94E-05	1.77E-04	2.06E-04	2.06E-04	4.86E+03	1.00E+00	-	-	4.86E+03	-	14.26%	85.74%	100.00%	
Cresol, o-	182	2.59E+04	-	-	5.34E-03	3.17E-02	3.70E-02	-	2.94E-05	1.74E-04	2.03E-04	2.03E-04	4.92E+03	1.00E+00	-	-	4.92E+03	-	14.43%	85.57%	100.00%	
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Dibenzofuran	10.2	3.10E+00	6.69E-05	4.99E-04	3.77E-02	3.82E-02	2.16E-05	4.89E-05	3.69E-03	3.74E-03	2.16E-05	3.76E-03	2.66E+02	9.94E-01	6.69E-05	2.67E+02	2.67E+02	0.01%	1.31%	98.69%	100.00%	
Dimethylphenol, 2,4-	38	7.87E+03	-	-	5.58E-03	4.71E-02	5.26E-02	-	1.47E-04	1.24E-03	1.39E-03	1.39E-03	7.22E+02	1.00E+00	-	-	7.22E+02	-	10.60%	89.40%	100.00%	
Ethylbenzene	3.02	1.69E+02	1.05E-05	9.13E-05	3.48E-03	3.59E-03	3.48E-06	3.02E-05	1.15E-03	1.18E-03	3.48E-06	1.19E-03	2.11E+02	2.50E-01	5.89E-04	2.11E+02	2.11E+02	0.24%	2.55%	97.22%	100.00%	
Fluoranthene	25.9	2.60E-01	-	-	1.90E-03	4.53E-01	4.55E-01	-	7.34E-05	1.75E-02	1.76E-02	1.76E-02	1.14E+01	2.00E-01	-	-	1.14E+01	-	0.42%	99.58%	100.00%	
Fluorene	21.1	1.69E+00	5.47E-05	1.55E-03	1.32E-01	1.33E-01	3.24E-05	7.34E-05	6.25E-03	6.32E-03	3.24E-05	6.35E-03	3.15E+01	1.99E-01	5.47E-05	3.16E+01	3.16E+01	0.03%	1.16%	98.81%	100.00%	
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Lead and Compounds	0.555	-	-	-	4.65E-04	3.60E-05	5.02E-04	-	8.39E-04	6.49E-05	9.04E-04	9.04E-04	1.11E+03	1.00E+00	-	-	1.11E+03	-	92.82%	7.18%	100.00%	
Manganese	4.89	-	-	-	1.00E-04	1.94E-03	2.04E-03	-	2.05E-05	3.97E-04	4.18E-04	4.18E-04	2.39E+03	1.00E+00	-	-	2.39E+03	-	4.91%	95.09%	100.00%	
Methylnaphthalene, 2-	105	2.46E+01	7.96E-04	7.71E-03	5.47E-01	5.55E-01	3.24E-05	7.34E-05	5.21E-03	5.28E-03	3.24E-05	5.31E-03	3.76E+01	2.00E-01	7.96E-04	3.77E+01	3.77E+01	0.40%	1.38%	98.22%	100.00%	
Naphthalene	283	3.10E+01	4.68E-02	4.15E-02	1.50E+00	1.59E+00	1.51E-03	1.47E-04	5.29E-03	5.44E-03	1.51E-03	6.95E-03	2.88E+01	2.00E-01	-	-	2.88E+01	21.72%	2.11%	76.16%	100.00%	
Nickel Soluble Salts	0.303	-	-	-	1.78E-04	6.88E-04	8.66E-04	-	5.87E-04	2.27E-03	2.86E-03	2.86E-03	3.50E+02	1.00E+00	-	-	3.50E+02	-	20.53%	79.47%	100.00%	
Phenanthrene	74.1	1.15E+00	2.48E-05	3.63E-03	4.04E-01	4.08E-01	2.16E-05	4.89E-05	5.45E-03	5.50E-03	2.16E-05	5.52E-03	3.62E+01	1.99E-01	2.48E-05	3.63E+01	3.63E+01	0.01%	0.89%	99.10%	100.00%	
Phenol	249	8.28E+04	-	-	2.44E-03	8.18E-03	1.06E-02	-	9.78E-06	3.29E-05	4.27E-05	4.27E-05	2.34E+04	1.00E+00	-	-	2.34E+04	-	22.94%	77.06%	100.00%	
Pyrene	27.9	1.35E-01	5.82E-06	2.73E-03	4.25E-01	4.27E-01	4.31E-05	9.78E-05	1.52E-02	1.53E-02	4.31E-05	1.54E-02	1.30E+01	1.99E-01	5.82E-06	1.31E+01	1.31E+01	0.00%	0.64%	99.36%	100.00%	
Styrene	0.194	3.10E+02	3.38E-06	7.40E-05	2.13E-03	2.21E-03	1.74E-05	3.81E-04	1.10E-02	1.14E-02	1.74E-05	1.14E-02	8.79E+01	1.00E+00	-	-	8.79E+01	0.15%	3.35%	96.50%	100.00%	
Toluene	17.6	5.26E+02	1.59E-05	3.22E-04	5.58E-03	5.82E-03	9.06E-07	1.32E-05	3.17E-04	3.30E-04	9.06E-07	3.31E-04	7.55E+02	2.50E-01	4.77E-04	7.56E+02	7.56E+02	0.19%	3.98%	96.83%	100.00%	
TPH C06-C09 aliphatic	6.08	1.18E+01	1.50E-06	3.57E-06	5.42E-04	5.47E-04	2.46E-07	5.87E-07	8.91E-05	8.97E-05	2.46E-07	8.99E-05	1.39E+03	1.25E-01	2.91E-06	1.39E+03	1.39E+03	0.00%	0.65%	99.34%	100.00%	
TPH C10-C14 aliphatic	1730	9.99E-02	4.53E-07	5.08E-02	5.07E+01	5.08E+01	4.53E-06	2.94E-05	2.93E-02	2.93E-02	4.53E-06	2.93E-02	4.26E+00	1.25E-01	4.53E-07	4.26E+00	4.26E+00	0.00%	0.10%	99.90%	100.00%	
TPH C15-C18 aromatic	1730	2.53E+01	5.73E-04	1.27E-01	1.26E+01	1.27E+01	2.26E-05	7.34E-05	7.27E-03	7.34E-03	2.26E-05	7.37E-03	1.70E+01	1.25E-01	-	-	1.70E+01	0.31%	1.00%	98.70%	100.00%	
TPH C19-C28 aromatic	1520	1.11E-04	7.18E-11	2.23E-03	8.74E-01	8.76E-01	6.47E-07	1.47E-06	5.75E-04	5.76E-04	6.47E-07	5.77E-04	2.17E+02	1.25E-01	7.18E-11	2.17E+02	2.17E+02	0.00%	0.25%	99.75%	100.00%	
TPH C19-C28 aromatic	1520	1.06E+00	4.57E-05	1.49E-01	4.10E+01	4.11E+01	4.31E-05	9.78E-05	2.70E-02	2.71E-02	4.31E-05	2.71E-02	4.61E+00	1.25E-01	4.57E-05	4.62E+00	4.62E+00	0.04%	0.36%	99.60%	100.00%	
TPH C29-C36 aliphatic	332	2.50E-06	1.62E-12	4.87E-04	1.67E-01	1.68E-01	6.47E-07	1.47E-06	5.04E-04	5.06E-04	6.47E-07	5.07E-04	2.47E+02	1.25E-01	1.62E-12	2.47E+02	2.47E+02	0.00%	0.29%	99.71%	100.00%	
TPH C29-C36 aromatic	6.08	1.18E+01	1.50E-06	3.57E-06	5.42E-04	5.47E-04	2.46E-07	5.87E-07	8.91E-05	8.97E-05	2.46E-07	8.99E-05	1.39E+03	1.25E-01	2.91E-06	1.39E+03	1.39E+03	0.00%	0.65%	99.34%	100.00%	
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	5.95E-04	-	1.34E-05	1.04E-05	5.87E-04	5.95E-04	6.47E-04	6.47E-04	5.87E-04	6.47E-04	1.55E+03	3.69E-02	3.69E-02	#DIV/0!	1.55E+03	3.69%	-	-	3.69%	
Vanadium and compounds	0.0228	-	-	-	1.34E-05	1.04E-05	2.37E-05	-	5.87E-04	4.54E-04	1.04E-03	1.04E-03	9.60E+02	1.00E+00	-	-	9.60E+02	-	56.37%	43.63%	100.00%	
Xylenes (total)	6.7	1.06E+01	1.38E-04	1.10E-04	4.01E-03	4.25E-03	2.06E-05	1.84E-05	5.98E-04	6.14E-04	2.06E-05	6.35E-04	3.94E+02	2.42E-01	2.18E-04	4.07E+02	4.07E+02	0.09%	2.67%	97.25%	100.00%	

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)				Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)					RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Revised RBSL (If necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL			
			GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL (All Pathways)	GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	Total Non-Vapour Pathways	Total Vapour Pathways					GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL
	mg/L	mg/L	unitless	unitless	unitless	unitless	L/mg	L/mg	L/mg	L/mg	L/mg	mg/L	mg/L	mg/L	mg/L	%	%	%	%
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	349	4.82E+05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	5.07E-11	7.30E-11	1.24E-10	-	2.39E-10	3.44E-10	5.83E-10	-	5.83E-10	1.71E+04	1.00E-05	-	1.71E+04	-	40.99%	59.01%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	2.27E-08	9.71E-06	9.73E-06	-	1.80E-09	7.70E-07	7.72E-07	-	7.72E-07	-	1.29E+01	1.29E+01	-	0.23%	99.77%	100.00%
Benzene	40.2	1.79E+03	1.56E-08	5.90E-08	6.80E-07	7.55E-07	3.88E-10	1.47E-09	1.69E-08	1.84E-08	3.88E-10	1.88E-08	5.32E+02	1.00E-05	-	5.32E+02	2.07%	7.81%	90.12%
Benzo(a)pyrene	9.26	1.62E-03	-	1.67E-07	9.21E-03	9.21E-03	-	1.80E-08	9.95E-04	9.95E-04	-	9.95E-04	1.00E-02	1.00E-05	-	1.00E-02	-	0.00%	100.00%
Benzo(b)fluoranthene	8.33	1.50E-03	-	1.50E-08	4.85E-06	4.86E-06	-	1.80E-09	5.82E-07	5.84E-07	-	5.84E-07	-	-	-	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Benzo(g,h,i)perylene	4.22	2.60E-04	-	7.61E-10	6.60E-07	6.60E-07	-	1.80E-10	1.56E-07	1.56E-07	-	1.56E-07	-	6.39E+01	6.39E+01	-	0.12%	99.88%	100.00%
Benzo(k)fluoranthene	2.93	8.00E-04	-	5.28E-09	2.83E-06	2.83E-06	-	1.80E-09	9.64E-07	9.66E-07	-	9.66E-07	-	1.03E+01	1.03E+01	-	0.19%	99.81%	100.00%
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	1.76E-09	8.14E-07	8.15E-07	-	1.80E-10	8.32E-08	8.34E-08	-	8.34E-08	-	1.20E+02	1.20E+02	-	0.22%	99.78%	100.00%
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	1.48E-08	1.09E-05	1.09E-05	-	1.80E-08	1.33E-05	1.33E-05	-	1.33E-05	-	7.51E-01	7.51E-01	-	0.14%	99.86%	100.00%
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	5.50E-09	5.28E-06	5.28E-06	-	1.80E-09	1.73E-06	1.73E-06	-	1.73E-06	-	5.77E+00	5.77E+00	-	0.10%	99.90%	100.00%
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix I

Risk Scenario 7 HDRes

1. General Information:

Site:

Barangaroo

Address:

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Client:

Lend Lease

Scenario:

Scenario 7 - High Density Residential (Risk Based Calculations)

Header Colour (Defaults = Blue):

Blue

2. Select Receptor:

Residential (High Density/Minimal Soil Access)

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐

Incidental Ingestion of Soil

☐

Dermal Contact with Soil

☐

Inhalation of Surface Soil-Derived Dust in Indoor Air

☐

Inhalation of Surface Soil-Derived Dust in Outdoor Air

☐

Inhalation of Surface Soil-Derived Vapours in Outdoor Air

☐

Inhalation of Soil-Derived Vapours From Excavation (USEPA 2002 method)

☒

Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

☐

Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐

Inhalation of Groundwater-Derived Vapours in Indoor Air

☐

Inhalation of Groundwater-Derived Vapours in Outdoor Air

☐

Ingestion of Potable Groundwater

☐

Incidental Ingestion of Groundwater (Bathing or Excavation)

☐

Dermal Contact with Groundwater (Bathing or Excavation)

☐

Inhalation of Groundwater Vapours during Irrigation/ Showering

☐

Ingestion of Vegetables Irrigated with Groundwater

☐

Inhalation of Groundwater Vapours (Where GW Enters Trench)

☒

Inhalation of vapour emissions from flowing water (groundwater in basement)

☐

Inhalation of Soil Vapour-Derived Vapours in Indoor Air

☐

Inhalation of Soil Vapour-Derived Vapours in Outdoor Air

Y

Soil RBSLs saturation limited?

Y

Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1 for media for which you want RBSLs):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child

General receptor parameters:

Units

Body weight

kg

70

13

70

13

Exposure duration

yr

64

6

64

6

Averaging time (carcinogens)

yr

70

70

70

70

Averaging time (non-carcinogens)

yr

64

6

64

6

Incidental Soil Ingestion

Daily soil ingestion rate

mg/day

Exposure frequency for soil ingestion

days/yr

Fraction of daily soil intake from site

unitless

Dermal Absorption of Soil

Exposed skin surface area for soil contact

cm2

Soil to skin adherence factor

mg/cm2

Exposure frequency for dermal contact with soil

days/yr

Indoor Inhalation

Exposure time (indoor air)

hrs/day

24

24

24

24

Exposure frequency (indoor air)

days/yr

350

350

350

350

Particulate emission factor (indoor air)

m3/kg

Outdoor Inhalation

Exposure time (outdoor air)

hrs/day

Exposure frequency (outdoor air)

days/yr

Particulate emission factor (outdoor air)

m3/kg

Potable Water Ingestion

Potable water intake rate

L/day

Exposure frequency for potable water intake

days/yr

Incidental Water Ingestion

Incidental ingestion rate

L/day

Exposure frequency for incidental water ingestion

days/yr

Dermal Contact with Water

Exposed skin surface for water contact

cm2

Exposure time for dermal water contact

hr/day

Exposure frequency for dermal water contact

days/yr

Vapour Inhalation Shower/ Sprinkler

Exposure frequency

days/yr

Exposure time

min/ day

Inhalation rate

m3/hr

Inhalation Absorption Adjustment Factor

mg/mg

Lung retention factor

unitless

Ingestion of Home Grown Produce

Proportion of homegrown produce ingested

Exposure frequency

days/year

Inhalation of Vapours from Flowing Water

Exposure time

hrs/day

24

24

24

24

Exposure frequency

days/year

350

350

350

350

Vapour Modelling - Soil to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	0.001	Autocalculates from layer thicknesses
<i>Vadose Zone Layer 1 (soil type where source is)</i>							
Thickness	cm	100		0.001	HV	0.001	Negligible distance - assumes soil is adjacent building foundation
				Sand and gravel (<12% fines)			Conservative assumption for mixed fill.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Vadose zone biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<i>Building Characteristics</i>							
Enclosed-space volume/infiltration area (ratio)	cm	240	(a)	1875	LB	1875	Assumes vapours are mixed through 25 m by 25 m by 3 m high basement section separately. Soil vapour infiltration through upper 2 m of 2 of 4 basement walls only, ie volume = 25*25*(3)=1875 m3 and infiltration area = 100 m2. See text.
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	Conservative Default, ASTM 2002
Enclosed-space air exchange rate	1/s	0.000138889		0.001111111	ENCAER	1.11E-03	4 per hour, considered likely average ventilation rate between carpark and overlying level.
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.0002	NU	0.0002	USEPA (2004) default for basement foundation.
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	Assumes cracks in concrete are filled with sand
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	wvchd	0.054	Assumes cracks in concrete are filled with sand
Basement to First Floor Attenuation Factor	unitless	10		10	FFAs	10	Dilution effect between basement and first floor
Convective vapour flow term							
Calculate convective flow term?		Y		83	Conv	Y	Default USEPA 2004 5L/ min
Convective flow rate (if specified directly)	cm3/sec						
Convective flow through slab (calculated)	cm3/sec	10.88		166.7335948	Qs	166.73	
Slab Area	cm2	700000		7250000	Ab	7250000	Area through which vapours may enter (conservatively includes
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019		0.0002	Nuc		
Soil vapour permeability	cm ²	1.00E-08		1.00E-07	kv	1.00E-07	Conservative default for coarse sand/gravel
Indoor-outdoor pressure differential	g/cm-s ²	40		40	dP	40	USEPA (2004b) default
Slab perimeter	cm	3400		10000	Xcrack	10000	Perimeter of basement footprint.
Depth below ground to bottom of slab	cm	15		300	Zcrack	300	Advection occurring to max depth of 3 m.
Viscosity of air	g/cm-s	1.81E-04		1.81E-04	uair	1.81E-04	Viscosity of air at 20 C

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

(f) USEPA (2002) default (0.5 acre).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{soil}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O/cc-air)	(mg/L-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Arsenic, Inorganic	-	-	-	-	-	-	7.80E+01	-	N
Barium	-	-	-	-	-	-	1.37E+02	-	N
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Cadmium (Water)	-	-	-	-	-	-	1.12E+02	-	N
Chromium(III), Insoluble Salts	-	-	-	-	-	-	5.20E+01	-	N
Chromium(VI)	-	-	-	1.69E+06	-	-	5.20E+01	-	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cobalt	-	-	-	-	-	-	5.89E+01	-	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Blank	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Iron	-	-	-	-	-	-	5.59E+01	-	N
Lead and Compounds	-	-	-	-	-	-	2.07E+02	-	N
Manganese	-	-	-	-	-	-	5.49E+01	-	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Nickel Soluble Salts	-	-	-	-	-	-	5.87E+01	-	N
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Vanadium and compounds	-	-	-	-	-	-	5.09E+01	-	N
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+02	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{soil} (cm ² /s)	D _{soil} (cm ² /s)	D _{soil} (cm ² /s)	D _{soil} (cm ² /s)	D _{crack} (cm ² /s)	C _{soil} (mg/kg)	Convective Factor (unitless)	D _e (cm ² /s)	M _{excav} (g)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	3.94E+01	2.11E+02	3.66E-06	7.25E+04
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	1.63E+02	2.37E+02	2.02E-06	5.38E+04
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	1.87E+04	4.68E+01	3.75E-04	7.34E+05
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV	NV	NV
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	1.42E+00	2.74E+02	2.62E-07	1.94E+04
Arsenic, Inorganic	NV	NV	NV	NV	NV		NV	NV	NV
Barium	NV	NV	NV	NV	NV		NV	NV	NV
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV	NV	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	6.59E+02	1.19E+02	5.35E-03	2.77E+06
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Cadmium (Water)	NV	NV	NV	NV	NV		NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV	NV	NV	NV		NV	NV	NV
Chromium(VI)	NV	NV	NV	NV	NV		NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV	NV	NV
Cobalt	NV	NV	NV	NV	NV		NV	NV	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	1.44E+04	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV	NV	NV
Blank	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	5.69E+01	2.60E+02	1.89E-06	5.21E+04
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV	NV	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	1.67E+02	1.56E+02	2.17E-03	1.77E+06
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	3.10E+01	2.42E+02	9.14E-07	3.62E+04
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV	NV	NV
Iron	NV	NV	NV	NV	NV		NV	NV	NV
Lead and Compounds	NV	NV	NV	NV	NV		NV	NV	NV
Manganese	NV	NV	NV	NV	NV		NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	1.23E+02	2.04E+02	2.16E-05	1.76E+05
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	9.66E+01	1.76E+02	3.39E-05	2.21E+05
Nickel Soluble Salts	NV	NV	NV	NV	NV		NV	NV	NV
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	3.84E+01	3.09E+02	1.73E-07	1.58E+04
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV	NV	NV
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.47E+01	3.83E+02	1.21E-08	4.17E+03
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	2.93E+02	1.50E+02	8.17E-04	1.08E+06
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	2.91E+02	1.37E+02	3.70E-03	2.31E+06
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	2.21E+02	1.07E+02	2.61E-02	6.13E+06
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.11E+02	1.07E+02	5.46E-04	8.86E+05
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.54E+02	1.07E+02	2.24E-04	5.68E+05
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	7.46E+01	1.76E+02	1.13E-03	1.28E+06
Vanadium and compounds	NV	NV	NV	NV	NV		NV	NV	NV
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	8.90E+01	1.26E+02	2.08E-03	1.73E+06

Definition of Parameters

D_e Effective diffusion coefficient in soil based on vapor-phase concentration

D_{crack} Effective diffusion coefficient through foundation cracks

C_{soil} Soil concentration at which dissolved pore-water and vapor phases become saturated

D_a = Apparent diffusivity (for construction scenario Volatilisation Factor)

M_{excav} = Cumulative unit mass emitted from excavation (Eq E-13 in USEPA, 2002).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as} (mg/m ³ -air / mg/kg-soil)	VF _{sp} (mg/m ³ -air / mg/kg-soil)	VF _{p (indoor)} (mg/m ³ -air / mg/kg-soil)	VF _{p (outdoor)} mg ³ -air / mg/kg	VF _{samb} (mg/m ³ -air / mg/kg-soil)	VF _{seep} (mg/m ³ -air / mg/kg-soil)	VF _{excav} (mg/m ³ -air / mg/kg-soil)
Acenaphthene	2.61E-06	8.77E-05			3.35E-02	8.22E-07	-3.12E+08
Acenaphthylene	1.94E-06	8.77E-05			1.94E-02	5.10E-07	-2.32E+08
Ammonia	2.64E-05	8.77E-05			1.33E+00	1.87E-05	-3.16E+09
Aniline	NV	NV			NV	NV	NV
Anthracene	6.98E-07	8.77E-05			2.67E-03	7.63E-08	-8.35E+07
Arsenic, Inorganic	NV	NV			NV	NV	NV
Barium	NV	NV			NV	NV	NV
Benz(a)anthracene	NV	NV			NV	NV	NV
Benzene	9.98E-06	8.77E-05			3.64E+00	6.80E-05	-1.19E+10
Benzo(a)pyrene	NV	NV			NV	NV	NV
Benzo(b)fluoranthene	NV	NV			NV	NV	NV
Benzo(g,h,i)perylene	NV	NV			NV	NV	NV
Benzo(k)fluoranthene	NV	NV			NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV			NV	NV	NV
Cadmium (Water)	NV	NV			NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV			NV	NV	NV
Chromium(VI)	NV	NV			NV	NV	NV
Chrysene	NV	NV			NV	NV	NV
Cobalt	NV	NV			NV	NV	NV
Cresol, m-&p-	NV	NV			NV	NV	NV
Cresol, o-	NV	NV			NV	NV	NV
Blank	NV	NV			NV	NV	NV
Dibenz(a,h)anthracene	NV	NV			NV	NV	NV
Dibenzofuran	1.87E-06	8.77E-05			1.89E-02	5.24E-07	-2.24E+08
Dimethylphenol, 2,4-	NV	NV			NV	NV	NV
Ethylbenzene	6.35E-06	8.77E-05			1.71E+00	3.60E-05	-7.61E+09
Fluoranthene	NV	NV			NV	NV	NV
Fluorene	1.30E-06	8.77E-05			8.90E-03	2.36E-07	-1.56E+08
Indeno(1,2,3-cd)pyrene	NV	NV			NV	NV	NV
Iron	NV	NV			NV	NV	NV
Lead and Compounds	NV	NV			NV	NV	NV
Manganese	NV	NV			NV	NV	NV
Methylnaphthalene, 2-	6.34E-06	8.77E-05			1.95E-01	4.68E-06	-7.59E+08
Naphthalene	7.95E-06	8.77E-05			2.86E-01	6.38E-06	-9.51E+08
Nickel Soluble Salts	NV	NV			NV	NV	NV
Phenanthrene	5.68E-07	8.77E-05			1.85E-03	5.71E-08	-6.80E+07
Phenol	NV	NV			NV	NV	NV
Pyrene	1.50E-07	8.77E-05			1.39E-04	4.95E-09	-1.80E+07
Styrene	3.90E-05	8.77E-05			6.33E+00	1.31E-04	-4.67E+09
Toluene	8.30E-06	8.77E-05			2.73E+00	5.41E-05	-9.93E+09
TPH C06-C09 aliphatic	2.21E-05	8.77E-05			1.67E+01	2.98E-04	-2.64E+10
TPH C10-C14 aliphatic	3.19E-06	8.77E-05			3.48E-01	6.21E-06	-3.82E+09
TPH C10-C14 aromatic	2.04E-06	8.77E-05			1.43E-01	2.55E-06	-2.45E+09
TPH C15-C28 aliphatic	NV	NV			NV	NV	NV
TPH C15-C28 aromatic	NV	NV			NV	NV	NV
TPH C29-C36 aliphatic	NV	NV			NV	NV	NV
TPH C29-C36 aromatic	NV	NV			NV	NV	NV
Trimethylbenzene, 1,2,4-	4.59E-05	8.77E-05			9.53E+00	2.12E-04	-5.50E+09
Vanadium and compounds	NV	NV			NV	NV	NV
Xylenes (total)	6.22E-06	8.77E-05			1.46E+00	2.79E-05	-7.44E+09

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep}	Volatilization factor from soil to enclosed-space vapors
VF _{excav}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Calculation of Vapour Emissions from Water with Flow
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

PARAMETERS

Concrete permeability	(select from drop down list)	High permeability
Permeability Rate (m/day)		8.6.E-02
Water Temperature (deg. C)		18.0
Dimensions of Basement / Impoundment		
Height (m)		3.0
Width (m)		25.0
Depth (m)		25.0
Volume total basement/ impoundment (m3)		1875

Dimensions of Wet Section of Basement/ Impoundment

Height (m)	5.0
Width (m)	5.0
Depth of Water (m)	0.01
Fetch/ Depth (m) ratio of Wet Basement Section	500
Volume of wet basement/ impoundment (m3)	0.2500
Area covered in water (m2)	25
Effective diameter of impoundment/ basement (m)	5.6
Volume of water entering basement (m³/sec)	2.50E-07

Air exchange rate (exchanges/day)

Windspeed (m/s)	if < 3.5 m/sec	9.60E+01
	if = or > 3.5 m/sec	3.00E-02
Basement to first floor attenuation factor		10

Parameter Definition	Volatile	Chemical Concentration in Water (mg/L)	Molecular weight (g/mol)	Vapour Pressure (mmHg)	Vapour Pressure (atm)	Henry's Law Coefficient (unitless)	Henry's Law Coefficient (calculated)	Equilibrium Coefficient (at 25 deg C)	Diffusivity in Water (cm²/sec)	Schmidt Number on Gas Side (*)	Gas Phase Mass Transfer Coefficient (m/sec)	Schmidt Number on Liquid Side #	Liquid Phase Mass Transfer Coefficient (m/s) <3.5 m/s	Overall Mass Transfer Coefficient (m/s) (windspeed <3.5 m/s)	Adopted Liquid Mass Transfer Coefficient (m/s)	Overall Mass Transfer Coefficient (m/s)	Diffusivity in Air (cm²/sec)	Equilibrium Concentration of water in Basement/ Impoundment (g/m³)	Air Emission Rate from Liquid Surface (g/sec)	Air Emission Rate from Liquid Surface (mg/day)	Adjusted Concentration in Basement Air (includes air exchange) (mg/m3)
		C	MW	Vap	Vap	unitless	atm.m3/g mol	K _{ow}	D _{water}	Sc _G	k _G	Sc _L	K _L	K	K _L	K	D _{air}	C _L	E	E	
Acenaphthene	Y	4.48	154	2.15E-03	2.83E-06	7.52E-03	1.80E-04	7.345E-03	8.33E-06	3.0E+00	1.244E-04	1.08E+03	2.7E-07	2.1E-07	2.7E-07	2.1E-07	0.0506	1.6E-01	8.31E-07	7.18E+01	3.99E-05
Acenaphthylene	Y	43.2	152	6.68E-03	8.79E-06	4.66E-03	1.11E-04	4.551E-03	6.98E-06	3.4E+00	1.150E-04	1.29E+03	2.4E-07	1.7E-07	2.4E-07	1.7E-07	0.045	1.7E+00	7.08E-06	6.11E+02	3.40E-04
Ammonia	Y	348	17	-	-	6.58E-04	1.57E-05	6.427E-04	1.10E-05	6.6E-01	3.410E-04	8.18E+02	3.3E-07	1.3E-07	3.3E-07	1.3E-07	0.228	1.0E+01	3.37E-05	2.91E+03	1.62E-03
Aniline	N	0.212	93.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	Y	15.4	178	6.53E-06	8.59E-09	2.27E-03	5.42E-05	2.217E-03	7.85E-06	3.9E+00	1.045E-04	1.15E+03	2.6E-07	1.2E-07	2.6E-07	1.2E-07	0.039	5.6E-01	1.73E-06	1.50E+02	8.33E-05
Arsenic, Inorganic	N	0.024	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	N	2.23	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	N	12.6	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	Y	40.2	78.1	9.48E+01	1.25E-01	2.27E-01	5.42E-03	2.217E-01	1.03E-05	1.7E+00	1.823E-04	8.74E+02	3.2E-07	3.1E-07	3.2E-07	3.1E-07	0.0895	1.2E+00	9.67E-06	8.35E+02	4.64E-04
Benzo(a)pyrene	N	9.26	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	N	8.33	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	N	4.22	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	N	2.93	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	N	0.03	391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	N	0.108	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	N	9.78	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	N	0.057	58.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m- & p-	N	436	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	N	182	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	N	0.822	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	Y	10.2	168	2.48E-03	3.26E-06	8.71E-03	2.08E-04	8.507E-03	7.38E-06	3.7E+00	1.080E-04	1.22E+03	2.5E-07	2.0E-07	2.5E-07	2.0E-07	0.041	3.9E-01	1.92E-06	1.66E+02	9.23E-05
Dimethylphenol, 2,4-	N	38	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	Y	3.02	106	9.60E+00	1.26E-02	3.22E-01	7.69E-03	3.145E-01	8.46E-06	2.2E+00	1.524E-04	1.06E+03	2.8E-07	2.8E-07	2.8E-07	2.8E-07	0.0685	1.1E-01	7.25E-07	6.26E+01	3.48E-05
Fluoranthene	N	25.9	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	Y	21.1	166	6.00E-04	7.90E-07	3.93E-03	9.38E-05	3.838E-03	7.89E-06	3.4E+00	1.133E-04	1.14E+03	2.6E-07	1.6E-07	2.6E-07	1.6E-07	0.044	7.7E-01	3.16E-06	2.73E+02	1.52E-04
Indeno(1,2,3-cd)pyrene	N	3.05	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	N	187	55.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	N	0.555	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	N	4.89	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	Y	105	142	5.50E-02	7.24E-05	2.12E-02	5.06E-04	2.071E-02	7.78E-06	2.9E+00	1.273E-04	1.16E+03	2.6E-07	2.4E-07	2.6E-07	2.4E-07	0.0524	3.9E+00	2.30E-05	1.99E+03	1.10E-03
Naphthalene	Y	283	128	8.50E-02	1.12E-04	1.80E-02	4.30E-04	1.758E-02	8.38E-06	2.5E+00	1.402E-04	1.07E+03	2.8E-07	2.5E-07	2.8E-07	2.5E-07	0.0605	9.9E+00	6.14E-05	5.31E+03	2.95E-03
Nickel Soluble Salts	N	0.303	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	Y	74.1	178	1.21E-04	1.59E-07	1.73E-03	4.13E-05	1.690E-03	6.69E-06	4.4E+00	9.623E-05	1.35E+03	2.4E-07	9.6E-08	2.4E-07	9.6E-08	0.0345	3.0E+00	7.23E-06	6.25E+02	3.47E-04
Phenol	N	249	94.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	Y	27.9	202	4.50E-06	5.92E-09	4.87E-04	1.16E-05	4.756E-04	7.25E-06	5.4E+00	8.326E-05	1.24E+03	2.5E-07	3.4E-08	2.5E-07	3.4E-08	0.0278	1.1E+00	9.17E-07	7.92E+01	4.40E-05
Styrene	Y	0.194	104	6.40E+00	8.42E-03	1.12E-01	1.094E-01	1.994E-01	1.094E-01	2.1E+00	1.562E-04	1.03E+03	2.9E-07	2.9E-07	2.9E-07	2.9E-07	0.0711	6.6E-03	4.61E-08	3.98E+00	2.21E-06
Toluene	Y	17.6	92.1	2.84E+01	3.74E-02	2.71E-01	6.47E-03	2.647E-01	9.20E-06	1.9E+00	1.659E-04	9.78E+02	2.9E-07	2.9E-07	2.9E-07	2.9E-07	0.0778	5.8E-01	4.23E-06	3.65E+02	2.03E-04
TPH C06-C09 aliphatic	Y	6.08	103	9.18E+01	1.21E-01	5.05E+01	1.21E+00	4.932E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	1.9E-01	1.47E-06	1.27E+02	7.07E-05
TPH C10-C14 aliphatic	Y	1730	170	1.16E+00	1.53E-03	6.26E+01	1.49E+00	6.114E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	4.19E-04	3.62E+04	2.01E-02
TPH C10-C14 aromatic	Y	1730	136	1.16E+00	1.53E-03	1.41E-01	3.37E-03	1.377E-01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	4.14E-04	3.58E+04	1.99E-02
TPH C15-C28 aliphatic	n	1520	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	n	1520	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	n	332	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	n	332	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	Y	0.92	120	2.10E+00	2.76E-03	2.52E-01	6.02E-03	2.461E-01	7.92E-06	2.5E+00	1.405E-04	1.14E+03	2.7E-07	2.6E-07	2.7E-07	2.6E-07	0.0607	3.3E-02	2.20E-07	1.90E+01	1.06E-05
Vanadium and compounds	N	0.0228	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	Y	6.7	106	7.99E+00	1.05E-02	2.12E-01	5.06E-03	2.071E-01	9.90E-06	1.8E+00	1.756E-04	9.09E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.0847	2.1E-01	1.61E-06	1.39E+02	7.72E-05

Notes:

Assumes viscosity of air at 25 deg C

(*) Adopted density and viscosity of air values are those published in USEPA Air Emissions for Wast and Waste Water Nov 1994. (viscosity = 1.81 x 10⁻⁴, density = 1.2 x 10⁻³)

** where windspeeds are greater than 3.25 m/s, F/D ratios greater than 51.2 and diffusivity of ether is 8.5 x 10⁻⁵

where viscosity of water is assumed to be 9 x 10⁻³ g/cm per sec and density of water 1g/cm³.

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Summary of Derived RBSLs

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	5.33E+04	2.66E+05	-	5.33E+04	>Sat	5.11E+02	4.28E+03	4.28E+03	-	4.28E+03	>Sol	4.48E+00
Acenaphthylene	8.59E+04	4.30E+05	-	8.59E+04	>Sat	1.70E+03	2.08E+03	2.08E+03	-	2.08E+03	>Sol	4.32E+01
Ammonia	-	-	-	-	-	-	1.56E+04	1.56E+04	-	1.56E+04	-	3.48E+02
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2.87E+06	1.43E+07	-	2.87E+06	>Sat	2.15E+03	1.14E+02	1.14E+02	-	1.14E+02	>Sol	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	3.68E+01	1.47E+02	2.56E+01	2.56E+01	-	1.51E+03	2.17E+02	2.17E+02	1.51E+02	1.51E+02	-	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	4.18E+05	4.18E+05	-	4.18E+05	>Sat	2.77E+02	7.35E+03	7.35E+03	-	7.35E+03	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	9.41E+03	3.76E+04	-	9.41E+03	>Sat	2.61E+02	2.94E+04	2.94E+04	-	2.94E+04	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	1.24E+05	6.18E+05	-	1.24E+05	>Sat	2.10E+03	3.25E+02	3.25E+02	-	3.25E+02	>Sol	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	6.23E+03	3.12E+04	-	6.23E+03	>Sat	7.65E+03	6.51E+02	6.51E+02	-	6.51E+02	>Sol	1.05E+02
Naphthalene	9.81E+01	4.91E+02	-	9.81E+01	>Sat	1.02E+04	6.58E+00	6.58E+00	-	6.58E+00	-	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	7.67E+05	3.83E+06	-	7.67E+05	>Sat	5.18E+03	1.45E+02	1.45E+02	-	1.45E+02	>Sol	7.41E+01
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	4.43E+06	2.21E+07	-	4.43E+06	>Sat	2.64E+03	6.72E+01	6.72E+01	-	6.72E+01	>Sol	2.79E+01
Styrene	-	-	-	-	-	-	2.38E+04	2.38E+04	-	2.38E+04	>Sol	1.94E-01
Toluene	2.41E+04	9.64E+04	-	2.41E+04	>Sat	2.65E+03	1.13E+05	1.13E+05	-	1.13E+05	>Sol	1.76E+01
TPH C06-C09 aliphatic	8.06E+03	6.45E+04	-	8.06E+03	>Sat	5.93E+02	2.06E+05	2.06E+05	-	2.06E+05	>Sol	6.08E+00
TPH C10-C14 aliphatic	2.10E+04	1.68E+05	-	2.10E+04	>Sat	6.94E+04	6.48E-01	6.48E-01	-	6.48E-01	>Sol	1.73E+03
TPH C10-C14 aromatic	1.02E+04	8.17E+04	-	1.02E+04	>Sat	6.94E+04	3.32E+01	3.32E+01	-	3.32E+01	>Sol	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	3.44E+01	3.44E+01	-	3.44E+01	-	2.20E+02	6.36E+02	6.36E+02	-	6.36E+02	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2.06E+03	-	-	2.06E+03	>Sat	2.58E+03	4.98E+03	4.98E+03	-	4.98E+03	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

Pathways included in derivation of Soil Vapour RBSL:

Pathways included in derivation of Groundwater RBSL:

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Indoor Air (mg/m3)/(mg/kg)	Vapour Concentration in Indoor Air (From Subsurface Soil) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RIC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (kg/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	511	3.94E+01	8.22E-07	3.24E-05	2.10E-01	7.89E-07	3.10E-05	1.48E-04	7.89E-07	3.10E-05	1.48E-04
Acenaphthylene	1700	1.63E+02	5.10E-07	8.28E-05	2.10E-01	4.89E-07	7.94E-05	3.78E-04	4.89E-07	7.94E-05	3.78E-04
Ammonia	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	NV	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	7.63E-08	1.09E-07	1.05E+00	7.32E-08	1.04E-07	9.93E-08	7.32E-08	1.04E-07	9.93E-08
Arsenic, inorganic	-	-	NV	-	-	-	-	-	-	-	-
Barium	-	-	NV	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	6.80E-05	4.49E-02	9.60E-03	6.52E-05	4.30E-02	4.48E+00	6.52E-05	4.30E-02	4.48E+00
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	NV	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	NV	-	1.00E-04	-	-	-	-	-	-
Chromium(VI)	2.3	-	NV	-	1.00E-04	-	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-	-	-	-
Cobalt	-	-	NV	-	-	-	-	-	-	-	-
Cresol, m-&p	2290	1.44E+04	NV	-	5.95E-01	-	-	-	-	-	-
Cresol, o-	-	-	NV	-	-	-	-	-	-	-	-
-	-	-	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	5.24E-07	2.98E-05	2.10E-01	5.02E-07	2.86E-05	1.36E-04	5.02E-07	2.86E-05	1.36E-04
Dimethylphenol, 2,4-	-	-	NV	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	3.60E-05	6.01E-03	1.30E+00	3.45E-05	5.76E-03	4.43E-03	3.45E-05	5.76E-03	4.43E-03
Fluoranthene	2440	2.89E+01	NV	-	1.40E-01	-	-	-	-	-	-
Fluorene	2100	3.10E+01	2.36E-07	7.33E-06	1.40E-01	2.27E-07	7.03E-06	5.02E-05	2.27E-07	7.03E-06	5.02E-05
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-	-	-	-
Iron	60600	-	NV	-	2.80E+00	-	-	-	-	-	-
Lead and Compounds	13600	-	NV	-	5.00E-04	-	-	-	-	-	-
Manganese	-	-	NV	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.68E-06	5.76E-04	1.40E-01	4.49E-06	5.52E-04	3.94E-03	4.49E-06	5.52E-04	3.94E-03
Naphthalene	10200	9.66E+01	6.38E-06	6.16E-04	3.00E-03	6.11E-06	5.91E-04	1.97E-01	6.11E-06	5.91E-04	1.97E-01
Nickel Soluble Salts	-	-	NV	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	5.71E-08	2.20E-06	2.10E-01	5.48E-08	2.11E-06	1.00E-05	5.48E-08	2.11E-06	1.00E-05
Phenol	-	-	NV	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	4.95E-09	7.26E-08	1.05E-01	4.75E-09	6.96E-08	6.63E-07	4.75E-09	6.96E-08	6.63E-07
Styrene	-	-	NV	-	-	-	-	-	-	-	-

TOTAL

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

2.58E-04

Health Risk Calculations - Vapours from Flowing Water
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Vapour Concentration in Basement/ Impoundment	Aqueous Solubility	Threshold Intake and Risk Calculations						
			Inhalation RIC	Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)	Child Exposure Factor (threshold)	Child Exposure Adjusted Air Concentration (threshold)	Hazard Index (Child)
	mg/m³	(mg/L)	(mg/m3)	(L/m3)	(mg/m3)	(unitless)	(L/m3)	(mg/m3)	(unitless)
Acenaphthene	3.99E-05	3.90E+00	2.10E-01	9.59E-01	3.83E-05	1.82E-04	9.59E-01	3.83E-05	1.82E-04
Acenaphthylene	3.40E-04	1.61E+01	2.10E-01	9.59E-01	3.26E-04	1.55E-03	9.59E-01	3.26E-04	1.55E-03
Ammonia	1.62E-03	4.82E+05	6.95E-02	9.59E-01	1.55E-03	2.23E-02	9.59E-01	1.55E-03	2.23E-02
Aniline	-	3.60E+04	-	-	-	-	-	-	-
Anthracene	8.33E-05	4.34E-02	1.05E+00	9.59E-01	7.98E-05	7.60E-05	9.59E-01	7.98E-05	7.60E-05
Arsenic, Inorganic	-	0.00E+00	-	-	-	-	-	-	-
Barium	-	0.00E+00	-	-	-	-	-	-	-
Benz(a)anthracene	-	9.40E-03	-	-	-	-	-	-	-
Benzene	4.64E-04	1.79E+03	9.60E-03	9.59E-01	4.45E-04	4.63E-02	9.59E-01	4.45E-04	4.63E-02
Benzo(a)pyrene	-	1.62E-03	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	1.50E-03	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	2.60E-04	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	8.00E-04	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	2.70E-01	-	-	-	-	-	-	-
Cadmium (Water)	-	0.00E+00	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Chromium(VI)	-	1.69E+06	-	-	-	-	-	-	-
Chrysene	-	2.00E-03	-	-	-	-	-	-	-
Cobalt	-	0.00E+00	-	-	-	-	-	-	-
Cresol, m-&p-	-	2.27E+04	-	-	-	-	-	-	-
Cresol, o-	-	2.59E+04	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	2.49E-03	-	-	-	-	-	-	-
Dibenzofuran	9.23E-05	3.10E+00	2.10E-01	9.59E-01	8.85E-05	4.22E-04	9.59E-01	8.85E-05	4.22E-04
Dimethylphenol, 2,4-	-	7.87E+03	-	-	-	-	-	-	-
Ethylbenzene	3.48E-05	1.69E+02	1.30E+00	9.59E-01	3.33E-05	2.57E-05	9.59E-01	3.33E-05	2.57E-05
Fluoranthene	-	2.60E-01	-	-	-	-	-	-	-
Fluorene	1.52E-04	1.69E+00	1.40E-01	9.59E-01	1.45E-04	1.04E-03	9.59E-01	1.45E-04	1.04E-03
Indeno(1,2,3-cd)pyrene	-	1.90E-04	-	-	-	-	-	-	-
Iron	-	0.00E+00	-	-	-	-	-	-	-
Lead and Compounds	-	0.00E+00	-	-	-	-	-	-	-
Manganese	-	0.00E+00	-	-	-	-	-	-	-
Methylnaphthalene, 2-	1.10E-03	2.46E+01	1.40E-01	9.59E-01	1.06E-03	7.56E-03	9.59E-01	1.06E-03	7.56E-03
Naphthalene	2.95E-03	3.10E+01	3.00E-03	9.59E-01	2.83E-03	9.42E-01	9.59E-01	2.83E-03	9.42E-01
Nickel Soluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Phenanthrene	3.47E-04	1.15E+00	2.10E-01	9.59E-01	3.33E-04	1.59E-03	9.59E-01	3.33E-04	1.59E-03
Phenol	-	8.28E+04	-	-	-	-	-	-	-
Pyrene	4.40E-05	1.35E-01	1.05E-01	9.59E-01	4.22E-05	4.02E-04	9.59E-01	4.22E-05	4.02E-04
Styrene	2.21E-06	3.10E+02	2.60E-01	9.59E-01	2.12E-06	8.16E-06	9.59E-01	2.12E-06	8.16E-06
Toluene	2.03E-04	5.26E+02	5.00E+00	9.59E-01	1.95E-04	3.89E-05	9.59E-01	1.95E-04	3.89E-05
TPH C06-C09 aliphatic	7.07E-05	1.18E+01	1.84E+01	9.59E-01	6.78E-05	3.68E-06	9.59E-01	6.78E-05	3.68E-06
TPH C10-C14 aliphatic	2.01E-02	9.99E-02	1.00E+00	9.59E-01	1.93E-02	1.93E-02	9.59E-01	1.93E-02	1.93E-02
TPH C10-C14 aromatic	1.99E-02	2.53E+01	2.00E-01	9.59E-01	1.91E-02	9.53E-02	9.59E-01	1.91E-02	9.53E-02
TPH C15-C28 aliphatic	-	1.11E-04	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	1.06E+00	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	2.50E-06	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	6.60E-03	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.06E-05	5.70E+01	7.00E-03	9.59E-01	1.01E-05	1.45E-03	9.59E-01	1.01E-05	1.45E-03
Vanadium and compounds	-	-	-	-	-	-	-	-	-
Xylenes (total)	7.72E-05	1.06E+02	2.20E-01	9.59E-01	7.40E-05	3.37E-04	9.59E-01	7.40E-05	3.37E-04

TOTAL

1.14E+00

1.14E+00

2.67E-06

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

[illegible]

2.67E-06

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	1.48E-04	1.48E-04	3.76E-06	3.76E-06	3.76E-06	5.33E+04	1.48E-04	1.48E-04	5.33E+04	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	3.78E-04	3.78E-04	2.33E-06	2.33E-06	2.33E-06	8.59E+04	3.78E-04	3.78E-04	8.59E+04	0.04%	0.04%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	9.93E-08	9.93E-08	6.97E-08	6.97E-08	6.97E-08	2.87E+06	9.93E-08	9.93E-08	2.87E+06	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	4.48E+00	4.48E+00	6.79E-03	6.79E-03	6.79E-03	3.68E+01	2.50E-01	4.48E+00	3.68E+01	25.00%	25.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salt	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blank	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.36E-04	1.36E-04	2.39E-06	2.39E-06	2.39E-06	4.18E+05	1.36E-04	1.36E-04	4.18E+05	0.01%	0.01%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.43E-03	4.43E-03	2.66E-05	2.66E-05	2.66E-05	9.41E+03	4.43E-03	4.43E-03	9.41E+03	0.44%	0.44%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	5.02E-05	5.02E-05	1.62E-06	1.62E-06	1.62E-06	1.24E+05	5.02E-05	5.02E-05	1.24E+05	0.01%	0.01%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.94E-03	3.94E-03	3.21E-05	3.21E-05	3.21E-05	6.23E+03	3.94E-03	3.94E-03	6.23E+03	0.39%	0.39%
Naphthalene	10200	9.66E+01	1.97E-01	1.97E-01	2.04E-03	2.04E-03	2.04E-03	9.81E+01	1.97E-01	1.97E-01	9.81E+01	19.69%	19.69%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	1.00E-05	1.00E-05	2.61E-07	2.61E-07	2.61E-07	7.67E+05	1.00E-05	1.00E-05	7.67E+05	0.00%	0.00%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	6.63E-07	6.63E-07	4.52E-08	4.52E-08	4.52E-08	4.43E+06	6.63E-07	6.63E-07	4.43E+06	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	3.02E-03	3.02E-03	1.04E-05	1.04E-05	1.04E-05	2.41E+04	3.02E-03	3.02E-03	2.41E+04	0.30%	0.30%
TPH C06-C09 aliphatic	593	2.21E+02	3.43E-03	3.43E-03	1.55E-05	1.55E-05	1.55E-05	8.06E+03	3.43E-03	3.43E-03	8.06E+03	0.34%	0.34%
TPH C10-C14 aliphatic	69400	1.11E+02	6.62E-04	6.62E-04	5.96E-06	5.96E-06	5.96E-06	2.10E+04	6.62E-04	6.62E-04	2.10E+04	0.07%	0.07%
TPH C10-C14 aromatic	69400	1.54E+02	1.89E-03	1.89E-03	1.22E-05	1.22E-05	1.22E-05	1.02E+04	1.89E-03	1.89E-03	1.02E+04	0.19%	0.19%
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.17E+00	2.17E+00	2.91E-02	2.91E-02	2.91E-02	3.44E+01	1.00E+00	-	3.44E+01	100.00%	100.00%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+01	1.08E-02	1.08E-02	1.22E-04	1.22E-04	1.22E-04	2.06E+03	1.08E-02	1.08E-02	2.06E+03	1.08%	1.08%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Child Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL (%)	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg	HI	HI	mg/kg	%	%
Acenaphthene	511	3.94E+01	1.48E-04	1.48E-04	3.76E-06	3.76E-06	3.76E-06	2.66E+05	1.48E-04	1.48E-04	2.66E+05	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	3.78E-04	3.78E-04	2.33E-06	2.33E-06	2.33E-06	4.30E+05	3.78E-04	3.78E-04	4.30E+05	0.04%	0.04%
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	9.93E-08	9.93E-08	6.97E-08	6.97E-08	6.97E-08	1.43E+07	9.93E-08	9.93E-08	1.43E+07	0.00%	0.00%
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	4.48E+00	4.48E+00	6.79E-03	6.79E-03	6.79E-03	1.47E+02	1.00E+00	-	1.47E+02	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.36E-04	1.36E-04	2.39E-06	2.39E-06	2.39E-06	4.18E+05	1.36E-04	1.36E-04	4.18E+05	0.01%	0.01%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.43E-03	4.43E-03	2.66E-05	2.66E-05	2.66E-05	3.76E+04	4.43E-03	4.43E-03	3.76E+04	0.44%	0.44%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	5.02E-05	5.02E-05	1.62E-06	1.62E-06	1.62E-06	6.18E+05	5.02E-05	5.02E-05	6.18E+05	0.01%	0.01%
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	3.94E-03	3.94E-03	3.21E-05	3.21E-05	3.21E-05	3.12E+04	3.94E-03	3.94E-03	3.12E+04	0.39%	0.39%
Naphthalene	10200	9.66E+01	1.97E-01	1.97E-01	2.04E-03	2.04E-03	2.04E-03	4.91E+02	1.97E-01	1.97E-01	4.91E+02	19.69%	19.69%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	3.84E+01	1.00E-05	1.00E-05	2.61E-07	2.61E-07	2.61E-07	3.83E+06	1.00E-05	1.00E-05	3.83E+06	0.00%	0.00%
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	1.47E+01	6.63E-07	6.63E-07	4.52E-08	4.52E-08	4.52E-08	2.21E+07	6.63E-07	6.63E-07	2.21E+07	0.00%	0.00%
TPH C06-C09 aliphatic	593	2.93E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	2.91E+02	3.02E-03	3.02E-03	1.04E-05	1.04E-05	1.04E-05	9.64E+04	3.02E-03	3.02E-03	9.64E+04	0.30%	0.30%
TPH C10-C14 aromatic	69400	2.21E+02	3.43E-03	3.43E-03	1.55E-05	1.55E-05	1.55E-05	6.45E+04	3.43E-03	3.43E-03	6.45E+04	0.34%	0.34%
TPH C15-C28 aliphatic	93200	1.11E+02	6.62E-04	6.62E-04	5.96E-06	5.96E-06	5.96E-06	1.68E+05	6.62E-04	6.62E-04	1.68E+05	0.07%	0.07%
TPH C15-C28 aromatic	93200	1.54E+02	1.89E-03	1.89E-03	1.22E-05	1.22E-05	1.22E-05	8.17E+04	1.89E-03	1.89E-03	8.17E+04	0.19%	0.19%
TPH C29-C36 aliphatic	20600	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	7.46E+01	2.17E+00	2.17E+00	2.91E-02	2.91E-02	2.91E-02	3.44E+01	1.00E+00	-	3.44E+01	100.00%	100.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Non-Threshold Lifetime Health Effects (Adult and Child)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (ILCR)		Risk/Soil Concentration (i.e., exposure and toxicity factor)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL				Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg		mg/kg	%	%
Acenaphthene	511	3.94E+01	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	2.58E-04	2.58E-04	3.91E-07	3.91E-07	3.91E-07	2.56E+01	1.00E-05	2.56E+01	100.00%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	-	-	-	-	-	-	-	-	-	-
Naphthalene	10200	9.66E+01	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	3.84E+01	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	1.47E+01	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.93E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	2.91E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	2.21E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	1.11E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	1.54E+02	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	7.02E+01	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	8.04E+01	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	3.16E+00	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	1.66E+00	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	7.46E+01	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW vapours from flowing water	TOTAL (All Pathways)	GW vapours from flowing water	Total Vapour Pathways	TOTAL (All Pathways)					GW vapours from flowing water	TOTAL
			unitless	unitless	unitless	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	1.82E-04	1.82E-04	4.67E-05	4.67E-05	4.67E-05	4.28E+03	1.82E-04	1.82E-04	4.28E+03	0.1%	0.09%
Acenaphthylene	43.2	1.61E+01	1.55E-03	1.55E-03	9.63E-05	9.63E-05	9.63E-05	2.08E+03	1.55E-03	1.55E-03	2.08E+03	0.8%	0.78%
Ammonia	348	4.82E+05	2.23E-02	2.23E-02	6.41E-05	6.41E-05	6.41E-05	1.56E+04	1.00E+00	-	1.56E+04	100.0%	100.00%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	7.60E-05	7.60E-05	1.75E-03	1.75E-03	1.75E-03	1.14E+02	7.60E-05	7.60E-05	1.14E+02	0.0%	0.04%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	4.63E-02	4.63E-02	1.15E-03	1.15E-03	1.15E-03	2.17E+02	2.50E-01	-	2.17E+02	100.0%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	4.22E-04	4.22E-04	1.36E-04	1.36E-04	1.36E-04	7.35E+03	4.22E-04	4.22E-04	7.35E+03	0.0%	0.04%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	2.57E-05	2.57E-05	8.49E-06	8.49E-06	8.49E-06	2.94E+04	1.44E-03	1.44E-03	2.94E+04	0.6%	0.57%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	1.04E-03	1.04E-03	6.15E-04	6.15E-04	6.15E-04	3.25E+02	1.04E-03	1.04E-03	3.25E+02	0.5%	0.52%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	7.56E-03	7.56E-03	3.07E-04	3.07E-04	3.07E-04	6.51E+02	7.56E-03	7.56E-03	6.51E+02	3.8%	3.78%
Naphthalene	283	3.10E+01	9.42E-01	9.42E-01	3.04E-02	3.04E-02	3.04E-02	6.58E+00	2.00E-01	-	6.58E+00	100.0%	100.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.59E-03	1.59E-03	1.38E-03	1.38E-03	1.38E-03	1.45E+02	1.59E-03	1.59E-03	1.45E+02	0.8%	0.79%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	4.02E-04	4.02E-04	2.98E-03	2.98E-03	2.98E-03	6.72E+01	4.02E-04	4.02E-04	6.72E+01	0.2%	0.20%
Styrene	0.194	3.10E+02	8.16E-06	8.16E-06	4.21E-05	4.21E-05	4.21E-05	2.38E+04	1.30E-02	1.30E-02	2.38E+04	1.3%	1.30%
Toluene	17.6	5.26E+02	3.89E-05	3.89E-05	2.21E-06	2.21E-06	2.21E-06	1.13E+05	1.16E-03	1.16E-03	1.13E+05	0.5%	0.47%
TPH C06-C09 aliphatic	6.08	1.18E+01	3.68E-06	3.68E-06	6.06E-07	6.06E-07	6.06E-07	2.06E+05	7.15E-06	7.15E-06	2.06E+05	0.0%	0.01%
TPH C10-C14 aliphatic	1730	9.99E-02	1.93E-02	1.93E-02	1.93E-01	1.93E-01	1.93E-01	6.48E-01	1.93E-02	1.93E-02	6.48E-01	15.4%	15.43%
TPH C10-C14 aromatic	1730	2.53E+01	9.53E-02	9.53E-02	3.77E-03	3.77E-03	3.77E-03	3.32E+01	9.53E-02	9.53E-02	3.32E+01	76.3%	76.26%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.45E-03	1.45E-03	1.57E-03	1.57E-03	1.57E-03	6.36E+02	8.96E-02	8.96E-02	6.36E+02	9.0%	8.96%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	3.37E-04	3.37E-04	5.02E-05	5.02E-05	5.02E-05	4.98E+03	5.32E-03	5.32E-03	4.98E+03	2.1%	2.13%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapours from Flowing Water	TOTAL (All Pathways)	GW Vapour from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)					GW Vapours from Flowing Water	TOTAL
			unitless	unitless	unitless	L/mg	L/mg				mg/L	%	%
Acenaphthene	4.48	3.90E+00	1.82E-04	1.82E-04	4.67E-05	4.67E-05	4.67E-05	4.28E+03	1.82E-04	1.82E-04	4.28E+03	0.1%	0.09%
Acenaphthylene	43.2	1.61E+01	1.55E-03	1.55E-03	9.63E-05	9.63E-05	9.63E-05	2.08E+03	1.55E-03	1.55E-03	2.08E+03	0.8%	0.78%
Ammonia	348	4.82E+05	2.23E-02	2.23E-02	6.41E-05	6.41E-05	6.41E-05	1.56E+04	1.00E+00	-	1.56E+04	100.0%	100.00%
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	7.60E-05	7.60E-05	1.75E-03	1.75E-03	1.75E-03	1.14E+02	7.60E-05	7.60E-05	1.14E+02	0.0%	0.04%
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	4.63E-02	4.63E-02	1.15E-03	1.15E-03	1.15E-03	2.17E+02	2.50E-01	-	2.17E+02	100.0%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	4.22E-04	4.22E-04	1.36E-04	1.36E-04	1.36E-04	7.35E+03	4.22E-04	4.22E-04	7.35E+03	0.0%	0.04%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	2.57E-05	2.57E-05	8.49E-06	8.49E-06	8.49E-06	2.94E+04	1.44E-03	1.44E-03	2.94E+04	0.6%	0.57%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	1.04E-03	1.04E-03	6.15E-04	6.15E-04	6.15E-04	3.25E+02	1.04E-03	1.04E-03	3.25E+02	0.5%	0.52%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	7.56E-03	7.56E-03	3.07E-04	3.07E-04	3.07E-04	6.51E+02	7.56E-03	7.56E-03	6.51E+02	3.8%	3.78%
Naphthalene	283	3.10E+01	9.42E-01	9.42E-01	3.04E-02	3.04E-02	3.04E-02	6.58E+00	2.00E-01	-	6.58E+00	100.0%	100.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.59E-03	1.59E-03	1.38E-03	1.38E-03	1.38E-03	1.45E+02	1.59E-03	1.59E-03	1.45E+02	0.8%	0.79%
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	4.02E-04	4.02E-04	2.98E-03	2.98E-03	2.98E-03	6.72E+01	4.02E-04	4.02E-04	6.72E+01	0.2%	0.20%
Styrene	0.194	3.10E+02	8.16E-06	8.16E-06	4.21E-05	4.21E-05	4.21E-05	2.38E+04	1.30E-02	1.30E-02	2.38E+04	1.3%	1.30%
Toluene	17.6	5.26E+02	3.89E-05	3.89E-05	2.21E-06	2.21E-06	2.21E-06	1.13E+05	1.16E-03	1.16E-03	1.13E+05	0.5%	0.47%
TPH C06-C09 aliphatic	6.08	1.18E+01	3.68E-06	3.68E-06	6.06E-07	6.06E-07	6.06E-07	2.06E+05	7.15E-06	7.15E-06	2.06E+05	0.0%	0.01%
TPH C10-C14 aliphatic	1730	9.99E-02	1.93E-02	1.93E-02	1.93E-01	1.93E-01	1.93E-01	6.48E-01	1.93E-02	1.93E-02	6.48E-01	15.4%	15.43%
TPH C10-C14 aromatic	1730	2.53E+01	9.53E-02	9.53E-02	3.77E-03	3.77E-03	3.77E-03	3.32E+01	9.53E-02	9.53E-02	3.32E+01	76.3%	76.26%
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.45E-03	1.45E-03	1.57E-03	1.57E-03	1.57E-03	6.36E+02	8.96E-02	8.96E-02	6.36E+02	9.0%	8.96%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	3.37E-04	3.37E-04	5.02E-05	5.02E-05	5.02E-05	4.98E+03	5.32E-03	5.32E-03	4.98E+03	2.1%	2.13%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Non-Threshold Health Effects
Barangaroo Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7- High Density Residential (Risk Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapours from Flowing Water	TOTAL (All Pathways)	GW Vapours from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)				GW Vapours from Flowing Water	TOTAL
	mg/L	mg/L	unitless	unitless	L/mg	L/mg	L/mg	mg/L		mg/L	%	%
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	-	-	-	-	-	-	-	-	-
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	2.67E-06	2.67E-06	6.64E-08	6.64E-08	6.64E-08	1.51E+02	1.00E-05	1.51E+02	100.00%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.26E+02	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix J

CoPC Toxicity Profiles

Ammonia – Toxicological profile

The following information has been taken from ATSDR (2004):

General

Ammonia occurs naturally as a product of decomposing organic material and volcanic eruptions and has a number of commercial applications including the manufacture of fertilizers, plastics, synthetic fibers and resins and explosives.

In the atmosphere, ammonia can react with acidic substances in the air to produce ammonium aerosols, which can be subject to dry or wet deposition. The best estimate of the half-life of atmospheric ammonia is a few days. In water, ammonia can volatilize to the atmosphere, be removed by microbial processes, or adsorb to sediment and suspended organic material. In soil, ammonia can volatilize to the atmosphere, adsorb to soil particles, undergo microbial transformation to nitrate or nitrite anions, or be taken up by plants.

For the general population, the most likely source of exposure to elevated levels of ammonia is from the use of household cleaners containing ammonia or ammonium salts. People who live near farms, who visit farms during the application of fertilizer, or who live near cattle feedlots, poultry confinement buildings, or other areas where animal populations are concentrated can also be exposed to ammonia. There is also the possibility for exposure to ammonia via water and food ingestion. If untreated surface water is ingested, the average uptake would be 0.36 mg/day (assuming an ammonia concentration in untreated water of 0.18 mg/L and a consumption rate of 2 L/day). For most sources of drinking water, however, adsorption, nitrification, and the conversion of ammonia to chloramines upon chlorination will result in negligible levels of ammonia in most drinking water supplies. Food ingestion can also lead to an exposure to ammonia, primarily due to the use of various ammonium salts as food stabilizers; the estimated exposure from these food additives is 18 mg/day.

Populations that live or work near a hazardous waste site that contains ammonia or ammonium salts could be exposed to above-average levels of ammonia in soil, water, or air in similar concentrations as those in agricultural settings. While these exposures may occur, the half-life of ammonia in nature is probably very short..

Non-carcinogenic Health Effects

No health effects have been found in humans exposed to typical environmental concentrations of ammonia. Exposure to high levels of ammonia in air may be irritating to your skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high concentrations of ammonia. Some people with asthma may be more sensitive to breathing ammonia than others.

Swallowing concentrated solutions of ammonia can cause burns in your mouth, throat, and stomach. Splashing ammonia into your eyes can cause burns and even blindness.

Carcinogenicity and Genotoxicity

There is no evidence that ammonia causes cancer. The Department of Health and Human Services (DHHS), the USEPA, and the International Agency for Research on Cancer (IARC), have not classified ammonia for carcinogenicity.

The available animal and human data indicate that ammonia and ammonium ions may have clastogenic and mutagenic properties, however the majority of studies that indicated positive genotoxicity results were associated with ammonium compounds and were tested on animals. Human studies are inconclusive.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Ammonia

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Inhalation	Minimal Risk Level (MRL)	Threshold	6.95×10^{-2} mg/m ³	ATSDR (2004)	Chronic duration
Inhalation	Reference Concentration (RfC)	Threshold	0.1 mg/m ³	USEPA (2010)	

Adopted Threshold Dose-Response Values

Dose-response values for ammonia have not been published by Australian regulatory bodies or by the World Health Organization (WHO), and AECOM has therefore adopted the Minimal Risk Level (MRL) of 6.95×10^{-2} published by ATSDR (2004) for assessment of threshold inhalation exposure to ammonia.

No dose-response values have been published or adopted to assess oral exposure to ammonia. According to ATSDR (2004), the amount of excess ammonia that can be safely ingested is considered to be substantial.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

Ammonia has not been classified for carcinogenic effects, and no relationship has been reported between oral or inhalation exposure to ammonia and cancer or carcinogenicity in humans (ATSDR, 2004).

References

ATSDR, 2004. *Toxicological Profile for Ammonia*. Agency for Toxic Substances and Disease Registry. September, 2004.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

Aniline – Toxicological profile

Synonyms: Aminobenzene; aniline oil; phenylamine

The following information has been taken from USEPA (2010), ATSDR (2002) and ATSDR (2010):

General

Aniline is a manufactured chemical used by a number of industries to make a wide variety of products such as polyurethane foam, agricultural chemicals, synthetic dyes, antioxidants, stabilizers for the rubber industry, herbicides, varnishes and explosives. Significant exposure may occur only if you work with aniline.

Non-carcinogenic Health Effects

Aniline is a blood toxin which causes hemoglobin to convert to methemoglobin, resulting in cyanosis. Lengthy or repeated exposures may result in decreased appetite, anemia, weight loss, nervous system affects, and kidney, liver and bone marrow damage. Any exposure may cause an allergic skin reaction.

Inhalation of aniline is toxic and affects the ability of blood to oxygenate; symptoms include bluish discoloration of lips and tongue, severe headache, nausea, confusion, dizziness, shock, respiratory paralysis, death. Ingestion of aniline is lethal with early symptoms of ingestion parallel those of inhalation exposure. Aniline can be absorbed through the skin which causes local irritation and dermatitis followed by the typical symptoms of ingestion or inhalation. Aniline vapour is an eye irritant and causes tearing and blurred vision with direct eye contact leading to cornela damage.

Carcinogenicity and Genotoxicity

The IARC have listed aniline in Category 3 (cannot be classified as to its carcinogenicity in humans). ATSDR (2010) report that bladder cancers have been reported in aniline-exposed workers, but have been attributed to concurrent exposure to chemicals other than aniline. USEPA (2010) has classified aniline as a probable human carcinogen (B2), based on induction of tumours in the spleen and body cavity of rats. Some evidence of genotoxicity has been reported based on *in vivo* and *in vitro* tests (USEPA, 2010).

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Aniline

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.007 mg/kg/day	PPRTV	Adopted by USEPA (2009) for derivation of Regional Screening Levels (RSLs)
Oral	Slope Factor	Non threshold	0.0057 (mg/kg/day) ⁻¹	USEPA (2010)	
Inhalation	Reference Concentration (RfC)	Threshold	0.001 mg/m ³	USEPA (2010)	

PPRTV = Provisional Peer Reviewed Toxicity Value

Adopted Threshold Dose-Response Values

In the absence of other published values for assessment of potential threshold effects associated with oral exposure to aniline, AECOM has adopted the Provisional Peer-Reviewed Toxicity Value (PPRTV) of 0.007 mg/kg/day. This value was adopted by USEPA (2009) for the derivation of Regional Screening Levels (RSLs).

For assessment of potential threshold effects associated with inhalation exposure to aniline, AECOM has adopted the Reference Concentration (RfC) of 0.001 mg/m³ published by USEPA (2010).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

For assessment of potential non-threshold effects associated with oral exposure to aniline, AECOM has adopted the oral slope factor of $0.0057 \text{ (}\mu\text{g/m}^3\text{)}^{-1}$ published by USEPA (2010).

To AECOM's knowledge, non-threshold dose-response criteria for inhalation exposure to aniline have not been published by Australian or other regulatory bodies. Potential health effects associated with inhalation exposure to aniline have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2002. *ToxFAQsTM for Aniline*. Agency for Toxic Substances and Disease Registry. April, 2002.

ATSDR, 2010. *Medical Management Guidelines for Aniline*. Agency for Toxic Substances and Disease Registry. On-line resource: <http://www.atsdr.cdc.gov/MHMI/mmq171.html>. Accessed 2 June 2010.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

National Health and Medical Research Council (2004), *Australian Drinking Water Guidelines (ADWG)*.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2009. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. Available on-line at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Tables accessed last updated March 2010.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

Arsenic (inorganic) – Toxicological profile

The following information has been taken from ATSDR (2007):

General

Inorganic arsenic occurs naturally in soil and rocks especially in minerals and ores containing copper or lead. Presently, about 90% of all arsenic produced is used as a preservative (copper chromate arsenate) for wood to protect it from rotting and decay. In the past, inorganic arsenic compounds have been used as pesticides, primarily on cotton fields and in orchards however this is now prohibited.

Naturally occurring arsenic may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching. Arsenic may enter the environment during the mining and smelting and small amounts may be released into the atmosphere from coal-fired power plants and incinerators.

Arsenic readily dissolves in water and is detected in lakes, rivers, or underground water as well as in rain or snow and industrial waste discharges. Arsenic cannot be destroyed in the environment and ultimately ends up in soil or sediments.

Non-carcinogenic Health Effects

Inorganic arsenic is responsible for most cases of arsenic induced toxicity in humans. Although there may be some differences in the potency of different chemical forms (e.g., arsenites tend to be somewhat more toxic than arsenates), these differences are usually minor. An exception would be arsine, which is highly toxic. However, because arsine and its methyl derivatives are gases or volatile liquids and are unlikely to be present at levels of concern at hazardous waste sites, health effect data for these compounds are not discussed in this document.

It is generally accepted that the arsenic-carbon bond is quite strong and most mammalian species do not have the capacity to break this bond; thus, inorganic arsenic is not formed during the metabolism of organic arsenicals. Inorganic As(V) is readily reduced to inorganic forms which are taken up by the cell, usually hepatocytes.

Studies have identified effects on virtually every organ or tissue evaluated, although some end points appear to be more sensitive than others. Available data from humans identify the skin as the most sensitive noncancer target following long-term oral arsenic exposure. Typical dermal effects include hyperkeratinization of the skin (especially on the palms and soles), formation of multiple hyperkeratinized corns or warts, and hyperpigmentation of the skin with interspersed spots of hypopigmentation. Oral exposure data from studies in humans indicate that these lesions typically begin to manifest at exposure levels of about 0.002–0.02 mg As/kg/day. At these exposure levels, peripheral vascular effects are also commonly noted, including cyanosis, gangrene, "Blackfoot Disease." Other reported cardiovascular effects include increased incidences of high blood pressure and circulatory problems.

Nausea, vomiting, and diarrhea are very common symptoms in humans following oral exposure to inorganic arsenicals, both after acute high-dose exposure and after repeated exposure to lower doses; these effects are likely due to a direct irritation of the gastrointestinal mucosa. Acute, high-dose exposure can lead to encephalopathy, with clinical signs such as confusion, hallucinations, impaired memory, and emotional lability, while long-term exposure to lower levels can lead to the development of peripheral neuropathy characterized by a numbness in the hands and feet that may progress to a painful "pins and needles" sensation. Recent studies also have reported neurobehavioral alterations in arsenic-exposed children.

Chronic exposure in drinking water has been associated with excess incidence of miscarriages, stillbirths, preterm births, and infants with low birth weights. Animal data suggest that arsenic may cause changes to reproductive organs of both sexes, including decreased organ weight and increased inflammation of reproductive tissues, although these changes may be secondary effects. However, these changes do not result in a significant impact on reproductive ability.

A large number of studies in humans have reported cardiovascular effects after acute and long term oral exposure to inorganic arsenic compounds. Studies of workers exposed by inhalation report irritation of the mucous membranes of the nose and throat, which may lead to laryngitis, bronchitis, or rhinitis. Increased mortality due to respiratory disease has been reported in some studies of arsenic-exposed workers, but results were inconclusive. It is not known whether respiratory effects following inhaled

inorganic arsenic compounds are due to a direct effect of arsenic on respiratory tissues, general effects of foreign material in the lungs, or an effect of arsenic on the pulmonary vasculature.

Respiratory effects have also been reported following oral exposure to inorganic arsenic and include respiratory distress, hemorrhagic bronchitis, and pulmonary edema; however, it is not clear whether these are primary effects or are the result of damage to the pulmonary vascular system. In general, respiratory effects have not been widely associated with long-term oral exposure to low arsenic doses. However, some studies have reported minor respiratory symptoms, such as cough, sputum, rhinorrhea, and sore throat, in people with repeated oral exposure to 0.03–0.05 mg As/kg/day. More serious respiratory effects, such as bronchitis and sequelae have been observed in patients chronically exposed to arsenic.

Both short-term and chronic oral exposures to inorganic arsenicals have been reported to result in irritant effects on gastrointestinal tissues resulting in nausea, vomiting, diarrhea, and abdominal pain, effects diminishing with cessation of exposure. Similar gastrointestinal effects have been reported after occupational exposures to inorganic arsenicals, although it is not known if these effects were due to absorption of arsenic from the respiratory tract or from mucociliary clearance resulting in eventual oral exposure.

A common effect following both oral and inhalation exposure to inorganic arsenic is the development of peripheral neuropathy. Workers exposed at pesticide plants or smelters, have shown increased incidence of neurological changes including sensory and motor polyneuropathy.

Following high-dose (>2 mg As/kg/day) acute oral exposures to inorganic arsenicals in humans, reported effects include headache, lethargy, mental confusion, hallucination, seizures, and coma. Following longer-term exposure to 0.03–0.1 mg As/kg/day, peripheral neuropathy, characterized initially by numbness of the hands and feet and a “pins and needles” sensation and progressing to muscle weakness, wrist-drop and/or ankle-drop, diminished sensitivity, and altered reflex action. Histological features of the neuropathy include a dying-back axonopathy and demyelination. Following removal from exposure, the neuropathy is only partially reversible and what recovery does occur is generally slow. The mechanism(s) of arsenic-induced neurological changes has not been determined.

Carcinogenicity and Genotoxicity

Arsenic toxicity and carcinogenicity have been known for a long time however the mode of action has not been defined and is still the subject of ongoing research and debate. In contrast to many other chemicals for which carcinogenic assessments have been undertaken, the research available on arsenic carcinogenicity is dominated by epidemiological studies (which have limitations) rather than animal studies. This is principally because arsenic has not been shown to cause cancer in rodents (most common species used in animal tests) due to interspecies differences between rodents and humans.

The WHO revision of the Environmental Health Criteria (WHO, 2001) concluded that arsenic is genotoxic in humans on the basis of clastogenicity in exposed individuals and findings *in vitro*. Revision to the drinking water guideline (WHO, 2008) adopted a practical value based on the analytical limit of reporting rather than based on a dose-response approach. The oral slope factor derived by the USEPA (2010) has not been used by the WHO to derive a guideline as the slope factor was noted to be likely to be an overestimate.

USEPA reviews have retained the approach that there is sufficient supporting evidence for the use of an oral slope factor based on increased rates of bladder and lung cancer. The approach adopted follows a review by the NRC (2001) which concluded that “... *internal cancers are more appropriate as endpoints for risk assessment than non-melanoma skin cancers*”. Slope factors relevant for the assessment of these end points range from 0.4 to 23 (mg/kg/day)⁻¹ (all values as scientifically plausible as the others). The use of the slope factor, however, is more by default by strictly following the USEPA Carcinogenic guidelines (2005) as there remains uncertainty on the carcinogenic mode of action for arsenic (Sams II et al, 2007). Further research is required to define the mode of action and reviewed prior to the US revising the dose-response approach currently adopted. Inherent in the current US approach (where a non-threshold slope factor is derived) are some key uncertainties that likely result in an overestimate of risk (Boyce 2008), which include (SAB 2005, Brown 2007, Lamm and Kruse 2005 and Chu et al 2006):

- The choice of the cancer endpoint;
- The choice of the mathematical model used estimate risk (shape of the dose-response curve at low doses) as there is no clear biological basis for extrapolation; and

- The assumptions used to estimate exposure from studies (primarily epidemiological studies).

Review of recent studies presented by Boyce (2008) has indicated that for carcinogenic effects associated with arsenic exposure a linear (non-threshold) dose-response is not supported (also note discussion by Clewell et al (2007). This is based on the following:

- Epidemiological studies (worldwide) that have repeatedly demonstrated that cancers associated with inorganic arsenic ingestion are observed only in populations exposed to arsenic concentrations in drinking water that are greater than 150 µg/L. In the US, exposures to concentrations in drinking water have only been associated with carcinogenic effects where concentrations are greater than 190 µg/L.
- Mechanistic information on how arsenic affects the cellular processes associated with carcinogenicity. In particular the following is noted (also see ATSDR 2007):
 - Arsenic and its metabolites do not react directly with DNA.
 - Arsenic may modify DNA function through more indirect mechanisms such as inhibition of DNA repair, induction of dysfunctional cell division, perturbation of DNA methylation patterns, modulation of signal transduction pathways (leading to changes in transcriptional controls and the over-stimulation of growth factors), and generation of oxidative stress.
 - Evidence for the indirect mechanisms for genotoxicity identified in *in vitro* studies have nearly all been at concentrations that are cytotoxic. Hence interpretation of the outcomes is difficult as the causation for the observed effects cannot be distinguished between those associated with cytotoxicity (and consequent regenerative cell proliferation) and genotoxicity. A study and review undertaken by Klein et al (2007) concluded that clastogenesis occurs primarily at highly cytotoxic arsenic concentrations suggesting that a non-threshold genotoxic mode may not be supported.
 - The SAB review of *in vivo* and *in vitro* studies identified low level arsenic exposures (approximately an order of magnitude lower than doses identified that result in carcinogenic effects) induce a protective or adaptive cellular response which is not carcinogenic.

On the basis of the above the use of a threshold dose-response approach for the assessment of carcinogenic effects associated with arsenic exposure is considered reasonable.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Arsenic

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	ADI	Threshold	0.002 mg/kg/day	NHMRC (2004)	Maximum tolerable intake for arsenic
Oral	Minimal Risk Level (MRL)	Threshold	0.003	ATSDR (2007)	Chronic duration
Oral	Reference Dose (RfD)	Threshold	0.0003	USEPA (2010)	
Oral	Slope Factor	Non threshold	1.5 (mg/kg/day) ⁻¹	USEPA (2010)	
Inhalation	Reference Concentration (RfC)	Threshold	0.001 mg/m ³	RIVM (2001)	
Inhalation	Unit Risk	Non threshold	0.0015 (ug/m ³) ⁻¹	WHO (2000)	
Inhalation	Unit Risk	Non threshold	0.0043 (ug/m ³) ⁻¹	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to inorganic arsenic, AECOM has adopted an ADI of 0.002 mg/kg/day. This value was used by NHMRC (2004) for derivation of the drinking water guideline value.

For assessment of potential threshold effects associated with inhalation exposure to inorganic arsenic, AECOM has adopted the threshold health based concentration of 0.001 mg/m³ published by RIVM (2001).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

As noted above, a linear (non-threshold) dose-response is not supported for carcinogenic effects associated with arsenic exposure. The use of a threshold dose-response approach for the assessment of carcinogenic effects associated with arsenic exposure is therefore considered reasonable.

References

ATSDR, 2007. *Toxicological Profile for Arsenic*. Agency for Toxic Substances and Disease Registry. August, 2007.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

National Health and Medical Research Council (2004), *Australian Drinking Water Guidelines (ADWG)*.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

RIVM, 2001. *Re-evaluation of human toxicological maximum permissible risk levels, report 711701 025*. National Institute for Public Health and Environment (RIVM). Retrieved April 2010 .

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO) Geneva, 2000.

Barium – Toxicological profile

The following information has been taken from ATSDR (2007):

General

Barium and barium compounds are used by the oil and gas industries to make drilling mud, paints, bricks, tiles, glass, rubber, and other barium compounds. Barium sulfate has medical applications and is used to in x-ray contrasting of the stomach and intestines.

The length of time that barium will last in the environment is dependent on its chemical form. Insoluble barium compounds can persist for a long time in the environment while soluble forms dissolve readily and combine with sulfate or carbonate to become insoluble forms which are commonly found in water and soil.

Non-carcinogenic Health Effects

Soluble barium compounds are generally expected to be of greater health concern than insoluble barium compounds because of their greater potential for absorption.

There are a number of reports of serious health effects in individuals intentionally or accidentally exposed to barium carbonate or chloride. The predominant effect is hypokalemia, which can result in ventricular tachycardia, hypertension and/or hypotension, muscle weakness, and paralysis. At lower doses barium is associated with vomiting, abdominal cramps and diarrhea. Barium is a competitive potassium channel antagonist that blocks the passive efflux of intracellular potassium, resulting in a shift of potassium from extracellular to intracellular compartments. The net result of this shift is a significant decrease in the potassium concentration in the blood plasma.

There are some reports of renal effects in individuals ingesting high doses of barium with animal data providing strong evidence that the most sensitive adverse effect of barium is renal toxicity.

Carcinogenicity and Genotoxicity

Several studies have examined the carcinogenic potential of barium following oral exposure and did not find significant increases in the tumor incidence. No studies have adequately assessed the carcinogenicity of barium following inhalation exposure. The International Agency for Research on Cancer (IARC) has classified barium as a Group D agent (not classifiable as to human carcinogenicity).

Data examining the genotoxicity of barium are inadequate to make a thorough assessment.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Barium

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.02 mg/kg/day	NHMRC (2004)	Converted from drinking water guideline of 0.7 mg/L, assuming 2 L/day ingestion and 70 kg body weight.
Oral	Acceptable Daily Intake (ADI)	Threshold	0.02 mg/kg/day	WHO (2008)	As above.
Oral	Minimal Risk Level (MRL)	Threshold	0.2 mg/kg/day	ATSDR (2007)	Chronic duration
Oral	Reference Dose (RfD)	Threshold	0.2 mg/kg/day	USEPA (2010)	

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Inhalation	Reference Concentration (RfC)	Threshold	0.0005 mg/m ³	HEAST	Value adopted by USEPA (2009) for derivation of Regional Screening Levels

Adopted Threshold Dose-Response Values

An oral ADI of 0.02 mg/kg/day has been adopted for barium. This value was converted from the NHMRC (2004) health-based drinking water guideline assuming daily drinking water intake of 2 L/day and a body weight of 70 kg.

Dose-response values for threshold effects associated with inhalation exposure to benzene have not been published by Australian regulatory bodies or by the World Health Organization (WHO), nor are values published by ATSDR or IRIS. In the absence of other published values, AECOM has adopted the reference concentration of 0.0005 mg/m³ used by USEPA (2009) for the derivation of Regional Screening Levels (RSLs). This value was based on the inhalation reference dose published by HEAST (Health Effects Assessment Summary Tables).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to barium have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to barium have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2007. *Toxicological Profile for Barium*. Agency for Toxic Substances and Disease Registry. August 2007.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

National Health and Medical Research Council (2004), *Australian Drinking Water Guidelines (ADWG)*.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2009. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Tables accessed last updated March 2010.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Benzene – Toxicological profile

The following information has been taken from ATSDR (2007):

General

Although benzene occurs naturally and is emitted by volcanoes and forest fires, the greatest sources are associated with the manufacture of plastics, resins, and nylon and other synthetic fibres. Benzene is used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides and is a natural part of crude oil, gasoline, and cigarette smoke.

Non-carcinogenic Health Effects

Damage to both the humoral and cellular components of the immune system has been known to occur in humans following inhalation exposure. This is manifested by decreased levels of antibodies and decreased levels of leukocytes in workers. Animal data support these findings.

The most characteristic systemic effect resulting from intermediate and chronic benzene exposure is arrested development of blood cells. Early biomarkers of exposure to relatively low levels of benzene include depressed numbers of one or more of the circulating blood cell types. A common clinical finding in benzene hematotoxicity is cytopenia, which is a decrease in various cellular elements of the circulating blood manifested as anemia, leukopenia, or thrombocytopenia in humans and in animals. Benzene associated cytopenias vary and may involve a reduction in one (unicellular cytopenias) to all three (pancytopenia) cellular elements of the blood.

Benzene causes a life-threatening disorder called aplastic anemia in humans and animals. This disorder is characterized by reduction of all cellular elements in the peripheral blood and in bone marrow, leading to fibrosis, an irreversible replacement of bone marrow. Benzene has also been associated with acute non-lymphocytic leukemia in humans, and aplastic anemia may be an early indicator of developing acute non-lymphocytic leukemia in some cases.

Limited information is available on other systemic effects reported in humans and is associated with high-level benzene exposure. Respiratory effects have been noted after acute exposure of humans to benzene vapors. Cardiovascular effects, particularly ventricular fibrillation, have been suggested as the cause of death in fatal exposures to benzene vapor. Gastrointestinal effects have been noted in humans after fatal inhalation exposure (congestive gastritis), and ingestion (toxic gastritis and pyloric stenosis), of benzene.

Myelofibrosis (a form of aplastic anemia) was reported by a gasoline station attendant who had been exposed to benzene by inhalation, and probably also through dermal contact. Myalgia was also reported in steel plant workers exposed to benzene vapors. Reports of renal effects in humans after benzene exposure consist of kidney congestion after fatal inhalation exposure. Dermal and ocular effects including skin irritation and burns, and eye irritation have been reported after exposure to benzene vapors. Swelling and edema have been reported to occur in a human who swallowed benzene. Studies in animals show systemic effects after inhalation exposure, including cardiovascular effects. Oral administration of benzene to animals has yielded information concerning hepatic effects. A study conducted in rabbits lends support to the finding that benzene is irritating and damaging to the skin and also shows that it is irritating and damaging to the eyes following dermal or ocular application.

Carcinogenicity and Genotoxicity

The carcinogenicity of benzene is well documented in exposed workers. Epidemiological studies and case reports provide clear evidence of a causal relationship between occupational exposure to benzene and benzene-containing solvents and the occurrence of acute myelogenous leukemia (AML). The epidemiological studies are generally limited by confounding chemical exposures and methodological problems, including inadequate or lack of exposure monitoring and low statistical power, but a consistent excess risk of leukemia across studies indicates that benzene is the causal factor. The IARC have classified benzene as a Group 1 agent (carcinogenic).

In vivo and *in vitro* data from both humans and animals indicate that benzene and/or its metabolites are genotoxic. Chromosomal aberrations (hypo- and hyperdiploidy, deletions, breaks, and gaps) in peripheral lymphocytes and bone marrow cells are the predominant effects seen in humans.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Benzene

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Minimal Risk Level (MRL)	Threshold	0.0005 mg/kg/day	ATSDR (2007)	
Oral	Reference Dose (RfD)	Threshold	0.004 mg/kg/day	USEPA (2010)	
Oral	Slope Factor	Non Threshold	$0.035 \text{ (mg/kg/day)}^{-1}$	NHMRC (2004)	Converted from unit risk of 1×10^{-6} per 0.001 mg/L, assuming 2 L/day water ingestion rate and 70 kg body weight.
Oral	Slope Factor	Non Threshold	$0.035 \text{ (mg/kg/day)}^{-1}$	WHO (2008)	As above.
Inhalation	Minimal Risk Level (MRL)	Threshold	0.0096 mg/m ³	ATSDR (2007)	Chronic exposure.
Inhalation	Reference Concentration (RfC)	Threshold	0.03 mg/m ³	USEPA (2010)	
Inhalation	Unit Risk	Non-Threshold	$5.88 \times 10^{-6} \text{ (}\mu\text{g/m}^3\text{)}^{-1}$	USEPA (2009)	
Inhalation	Unit Risk	Non-Threshold	$6 \times 10^{-6} \text{ (}\mu\text{g/m}^3\text{)}^{-1}$	WHO (2000)	

Adopted Threshold Dose-Response Values

Dose-response values for threshold effects associated with oral exposure to benzene have not been published by Australian regulatory bodies or by the World Health Organization (WHO). AECOM has therefore adopted the oral reference dose of 0.0005 mg/kg/day published by the ATSDR (2007).

Dose-response values for threshold effects associated with inhalation exposure to benzene have not been published by Australian regulatory bodies or by the World Health Organization (WHO). AECOM has therefore adopted the inhalation reference concentration of 0.0096 mg/m³ published by ATSDR (2007).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

For assessment of potential non-threshold effects associated with oral exposure to benzene, AECOM has adopted the NHMRC (2004) value of $0.035 \text{ (mg/kg/day)}^{-1}$.

For assessment of potential non-threshold effects associated with inhalation exposure to benzene, AECOM has adopted the inhalation unit risk value of $6 \times 10^{-6} \text{ (}\mu\text{g/m}^3\text{)}^{-1}$ published by the WHO (2000).

References

ATSDR, 2007. *Toxicological Profile for Benzene*. Agency for Toxic Substances and Disease Registry. August, 2007.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

NHMRC, 2004. *Australian Drinking Water Guidelines*. National Health and Medical Research Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Centre for Environmental Assessment, Office of Research and Development. Accessed April 2010.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO), Regional Office for Europe. WHO Regional Publications, European Series, No. 91. 2000.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Cadmium – Toxicological profile

The following information has been taken from ATSDR (2008):

General

Cadmium is used in the manufacture of batteries, pigments, coatings/ platings and plastics stabilisers and is extracted as a byproduct during the production of other metals such as zinc, lead, or copper and recycling of batteries.

Cadmium exists as the hydrated ion or as ionic complexes with other inorganic or organic substances. Soluble forms migrate in water while insoluble forms are immobile and will deposit and absorb to sediments. Cadmium which has entered the atmosphere can be transported long distances and is eventually deposited onto soil and water surfaces. Cadmium and cadmium compounds readily migrate through soil and can adhere tightly to organic matter where it can be taken up by plant life and eventually enter the food chain.

Non-carcinogenic Health Effects

Toxicological properties of cadmium are similar for the several different salts and oxides of cadmium that have been investigated, although differences in absorption and distribution lead to different effect levels.

For inhalation exposure, particle size and solubility in biological fluids (in contrast to solubility in water) appear to be the more important determinants of the toxicokinetics. For oral exposure, most experimental studies have used soluble cadmium, which exists as the Cd^{+2} ion regardless of the initial salt. Absorption appears to be similar for cadmium ion and cadmium complexed with proteins in food, except for a few specific types of foods such as Bluff oysters and seal meat. Also, poorly soluble cadmium pigments may be absorbed to a lesser extent than soluble cadmium ion.

There is an extensive database on the toxicity of cadmium in environmentally exposed populations and in cadmium workers; however, most of these studies were focused on the presumed sensitive targets (lung after inhalation exposure and kidney after oral ingestion). Other effects that have been observed in humans and/or animals include reproductive toxicity, hepatic effects, hematological effects, and immunological effects.

The earliest indication of kidney damage in humans is an increased excretion of low molecular weight proteins, particularly β 2-microglobulin, human complex forming glycoprotein (pHC) (also referred to as α 1-microglobulin), and retinol binding protein; increased urinary levels of intracellular enzymes such as N-acetyl- β -glucosaminidase (NAG); and increased excretion of calcium and metallothionein. Numerous studies of cadmium workers and populations living in areas with low, moderate, or high cadmium pollution have found significant associations between urinary cadmium levels and biomarker levels or significant increases in the prevalence of abnormal biomarker levels. At higher exposure levels, decreases in glomerular filtration rate, increased risk of renal failure, and significant increases in the risk of deaths from renal disease have been observed. The sensitivity of the kidney to cadmium is related to its distribution in the body and *de novo* synthesis of metallothionein in the kidney. In the blood, cadmium is bound to metallothionein and is readily filtered at the glomerulus and reabsorbed in the proximal tubule. Within the tubular cells, the metallothionein is degraded in lysosomes and free cadmium is released; the synthesis of endogenous metallothionein by the tubular cells is then stimulated. However, when the total cadmium content in the renal cortex reaches between 50 and 300 $\mu\text{g/g}$ wet weight, the amount of cadmium not bound to metallothionein becomes sufficiently high to cause tubular damage. Free cadmium ions may inactivate metal-dependent enzymes, activate calmodulin, and/or damage cell membranes through activation of oxygen species. Because the toxicity of cadmium is dependent on its concentration in the kidney, adverse effects in humans are typically not observed after shorter durations.

Acute inhalation exposure may cause destruction of lung epithelial cells, resulting in pulmonary edema, tracheobronchitis, and pneumonitis. A single, high-level cadmium exposure can result in long-term impairment of lung function. At the cellular level, catalase, superoxide dismutase, non-protein sulfhydryl, glucose-6-phosphate dehydrogenase, and glutathione peroxidase are decreased in response to cadmium lung insults. The response is cell hyperplasia and after long term inhalation exposure at lower levels decreased lung function has been observed.

Prolonged inhalation or ingestion in humans has led to debilitating bone disease in at risk individuals (poor nutrition, high cadmium exposure). Decreases in bone mineral density, increases in the risk of

fractures, and increases in the risk of osteoporosis have also been observed in populations exposed to high levels of cadmium.

Limited developmental human data is available however in animals cadmium exposure by inhalation, oral or parenteral routes has been shown to be toxic to physiological and neurological development.

Carcinogenicity and Genotoxicity

The International Agency for Research on Cancer (IARC) has classified cadmium as a Group 1 carcinogen (probable human carcinogen) based on its assessment of sufficient evidence of an increase in lung cancer in humans and sufficient evidence of lung cancer in rats.

In-vivo and in-vitro studies suggest cadmium is not genotoxic.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Cadmium

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0007 mg/kg/day	NHMRC (2004)	Concentration that will ensure that critical renal cortex concentrations will not be reached in a 70 year lifetime
Oral	Acceptable Daily Intake (ADI)	Threshold	0.001 mg/kg/day	WHO (2008)	Based on a provisional tolerable weekly intake
Oral	Minimal Risk Level (MRL)	Threshold	0.001 mg/kg/day	ATSDR (2008)	
Oral	Reference Dose (RfD)	Threshold	0.001 mg/kg/day	USEPA (2010)	Based on chronic exposure
Oral	Reference Dose (RfD)	Threshold	0.0005 mg/kg/day	USEPA (2010)	Lower RfD of cadmium (diet) and cadmium (water)
Inhalation	Reference Concentration (RfC)	Threshold	0.0003 mg/m ³	WHO (2000)	Concentration recommended for a lifetime exposure (considers lung cancer in derivation). WHO (2000) concluded that available data are not sufficient to derive unit risk due to concomitant exposure to arsenic studies.
Inhalation	Minimal Risk Level (MRL)	Threshold	0.00001 mg/m ³	ATSDR (2008)	Chronic duration inhalation MRL
Inhalation	Reference Concentration (RfC)	Threshold	0.00001 mg/m ³	USEPA (2010)	
Inhalation	Inhalation Unit Risk (IUR)	Non threshold	0.0018 (ug/m3) ⁻¹	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to cadmium, AECOM has adopted the acceptable daily intake (ADI) of 0.0007 mg/kg/day adopted by the NHMRC (2004) for derivation of the drinking water guideline value.

For assessment of potential threshold effects associated with inhalation exposure to cadmium, AECOM has adopted the Reference Concentration (RfC) of 0.0003 mg/m³ adopted by WHO (2008).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral exposure to cadmium have not been published by Australian or other regulatory bodies. Potential health effects associated with oral exposure to cadmium have therefore been assessed on the basis of threshold dose response criteria.

AECOM has not evaluated potential non-threshold inhalation effects of cadmium based on the following:

- WHO (2000) concluded that the available data are not sufficient to derive an inhalation unit risk due to concomitant exposure to arsenic studies; and
- the health-based air guideline published by WHO (2000) (and adopted for assessment of threshold effects via the inhalation pathway) considered lung cancer risk in its derivation.

References

ATSDR, 2008. *Toxicological Profile for Cadmium*. Draft. Agency for Toxic Substances and Disease Registry. September 2008.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NHMRC, 2004. *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

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WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Chromium – Toxicological profile

The following information has been taken from ATSDR (2008):

General

Chromium is a naturally-occurring element found widely in the environment in the form of chromium (0), chromium (III), and chromium (VI). It is widely used in manufacturing processes and found in many products such as wood treated with copper dichromate, leather tanned with chromic sulfate and stainless steel cookware.

Chromium can be found in air, soil, and water after release from manufacture, use and disposal of chromium-based products, and during the manufacturing process. Chromium does not usually remain in the atmosphere, but is deposited into the soil and water. It can change from one form to another in water and soil depending on the conditions present and does is eventually deposited in soil and water.

Non-carcinogenic Health Effects

In general, chromium (VI) compounds are more toxic than chromium (III) compounds.

Chromium (III) and chromium(VI) can penetrate human skin to some extent, especially if the skin is damaged. Absorbed chromium distributes to nearly all tissues, with the highest concentrations found in kidney and liver. Bone is also a major depot and may contribute to long-term retention kinetics or chromium. Chromium (VI) is reduced to chromium (III) via the intermediate forms of chromium (V), chromium (IV).

Chromium (VI) in blood is taken up into red blood cells, where it undergoes reduction and forms stable complexes with hemoglobin and other intracellular proteins, which are retained for a substantial fraction of the red blood cell lifetime. Absorbed chromium can be transferred to fetuses through the placenta and to infants via breast milk.

Most quantitative studies of the gastrointestinal absorption of chromium in humans have estimated the absorption fraction to be <10% of the ingested dose with more soluble forms being more rapidly absorbed than insoluble compounds. Absorption is also affected by nutritional status; the absorption fraction is higher when dietary intakes are lower.

Chromium (VI)

The primary effects associated with exposure to chromium(VI) compounds are respiratory, gastrointestinal, immunological, hematological, reproductive, and developmental. In addition, dermal and ocular irritation may occur from direct contact. Based on available dose-response data in humans and animals, the most sensitive noncancer effects of chromium(VI) compounds are respiratory (nasal and lung irritation, altered pulmonary function), gastrointestinal (irritation, ulceration and nonneoplastic lesions of the stomach and small intestine), hematological (microcytic, hypochromic anemia), and reproductive (effects on male reproductive organs, including decreased sperm count and histopathological change to the epididymis). Respiratory and gastrointestinal effects appear to be portal-of-entry effects for inhalation and oral exposure, respectively. Similarly, chromium sensitization, the major immunological effect of chromium(VI), typically presents as allergic contact dermatitis resulting from dermal exposures in sensitized individuals, although respiratory effects of sensitization (asthma) may also occur. Accidental or intentional ingestion of extremely high doses of chromium(VI) compounds by humans has resulted in severe respiratory, cardiovascular, gastrointestinal, hematological, hepatic, renal, and neurological effects as part of the sequelae leading to death or in patients who survived because of medical treatment.

Chromium (III)

Although much less information is available on the health effects of chromium (III) and chromium (III) compounds, they appear to be much less toxic than chromium (VI) compounds and are vital for normal metabolic activity. Health effects associated with exposure to chromium (III) compounds have been reported in studies of occupationally exposed populations and individuals; however, interpretation of study results is complicated by concomitant exposures to chromium (VI) or other compounds that can induce adverse health effects. Similarly, interpretation of findings in case reports of exposures to dietary supplements containing high-dose chromium(III) are also complicated, since most supplements contain numerous chemicals; thus, the most reliable information on adverse health effects of chromium(III) is obtained from studies in animals.

The primary effects of chromium (III) compounds are on the respiratory and immunological systems. Respiratory effects appear to be portal-of-entry effects for inhalation exposure. Similarly, chromium allergic dermatitis, the major immunological effect of chromium (III), is typically elicited by dermal contact in sensitized individuals; however, initial sensitization may result from inhalation, oral, or dermal exposure or from a combination of these exposure routes. Conflicting results of studies in animals have been reported in developmental and reproductive studies of chromium (III) compounds; however, results provide evidence of adverse effects on the developing and adult reproductive system. Evidence of developmental or reproductive effects of chromium (III) in humans has not been identified. Based on results of chronic-duration oral studies in animals, chromium (III) compounds (chromium acetate, chromium chloride, chromium nicotinate, chromium oxide, chromium picolinate) do not appear to produce gastrointestinal, hematological, hepatic, renal, cardiovascular, endocrine, or musculoskeletal effects. This is in contrast to chromium (VI) compounds which produce effects in the gastrointestinal, hematological, hepatic and renal systems.

Carcinogenicity and Genotoxicity

Occupational exposure (via inhalation) to chromium (VI) compounds (calcium chromate, chromium trioxide, lead chromate, strontium chromate, and zinc chromate) in various industries has been associated with increased risk of respiratory system cancers, primarily bronchogenic and nasal. Environmental exposure of humans to chromium (VI) in drinking water resulted in statistically significant increases in stomach cancer.

No studies evaluating the carcinogenic activity of chromium (III) compounds in humans were identified and animal studies were inconclusive.

The International Agency for Research on Cancer (IARC) classified chromium (VI) as *carcinogenic to humans (Group 1)* and metallic chromium and chromium (III) compounds as *not classifiable as to their carcinogenicity to humans (Group 3)*.

In-vivo and in-vitro studies indicate chromium (VI) has genotoxic properties however there is no indication that chromium (III) exhibits genotoxic potential.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Chromium (VI) and Chromium (III)

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Chromium (VI)					
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0014 mg/kg/day	NHMRC (2004)	
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0014 mg/kg/day	WHO (2008)	
Oral	Minimal Risk Level (MRL)	Threshold	0.001 mg/kg/day	ATSDR (2008)	
Oral	Reference Dose (RfD)	Threshold	0.003 mg/kg/day	USEPA (2010)	

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Inhalation	Minimal Risk Level (MRL)	Threshold	0.000005 mg/m ³	ATSDR (2008)	For chromium (VI) as chromium trioxide mist and other hexavalent chromium aerosols and mists. Not considered relevant to assessment of exposure to chromium (VI) particulates derived from contaminated soil.
Inhalation	Reference Concentration (RfC)	Threshold	0.0001 mg/m ³	USEPA (2010)	Chromium (VI) particulates
Inhalation	Unit Risk	Non threshold	0.04 (ug/m ³) ⁻¹	WHO (2000a)	
Inhalation	Unit Risk	Non threshold	0.011-0.13 (ug/m ³) ⁻¹	WHO (2000b)	
Inhalation	Unit Risk	Non threshold	0.012 (ug/m ³) ⁻¹	USEPA (IRIS)	
Chromium (III)					
Oral	Reference Dose (RfD)	Threshold	1.5 mg/kg/day	USEPA (2010)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.0001 mg/m ³	ATSDR (2008)	Intermediate duration inhalation exposure to soluble trivalent chromium particulate compounds

Adopted Threshold Dose-Response Values

Chromium (VI)

For assessment of potential threshold effects associated with oral exposure to chromium (VI), AECOM has adopted the minimal risk level (MRL) of 0.001 mg/kg/day adopted by ATSDR (2008).

For assessment of potential threshold effects associated with inhalation exposure to chromium (VI), AECOM has adopted the RfC of 0.0001 mg/m³ published by USEPA (2010) for chromium (VI) particulates. Note that the ATSDR MRL of 0.000005 mg/m³ for hexavalent chromium aerosols and mists was not considered relevant to assessment of exposure to chromium (VI) particulates derived from contaminated soil.

Chromium (III)

For assessment of potential threshold effects associated with oral exposure to chromium (III), AECOM has adopted the USEPA (2010) reference dose (RfD) of 1.5 mg/kg/day.

For assessment of potential threshold effects associated with inhalation exposure to chromium (III), AECOM has adopted the ATSDR (2008) intermediate duration MRL of 0.0001 mg/m³. While this value was derived for intermediate exposure duration, it is considered likely to be suitably protective for assessment of chromium (III) given that:

- The ATSDR MRL is identical to the USEPA (2010) RfC for chromium (VI); and
- chromium (III) compounds appear to be much less toxic than chromium (VI) compounds.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

Chromium (VI)

To AECOM's knowledge, non-threshold dose-response criteria for oral exposure to chromium (VI) have not been published by Australian or other regulatory bodies. Potential health effects associated with oral exposure to chromium (VI) have therefore been assessed on the basis of threshold dose response criteria.

For assessment of potential non-threshold effects associated with inhalation exposure to chromium (IV), AECOM has adopted the unit risk of $0.04 \text{ (ug/m}^3\text{)}^{-1}$ published by WHO (2000a).

Chromium (III)

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to chromium (III) have not been published by Australian or other regulatory bodies. Potential health effects associated with oral or inhalation exposure to chromium (III) have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2010. *Toxicological Profile for Cadmium*. Agency for Toxic Substances and Disease Registry. September 2008.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

National Health and Medical Research Council (2004), *Australian Drinking Water Guidelines (ADWG)*.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2009. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. Available online at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Tables accessed last updated March 2010.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

WHO 2000a. *Air Water Guidelines for Europe*. World Health Organisation, 2000.

WHO 2000b. *Air Water Guidelines Global*. World Health Organisation, 2000.

Cobalt – Toxicological profile

The following information has been taken from ATSDR (2004):

General

Cobalt and its alloys are used in a number of military and industrial applications such as the manufacture of aircraft engines, magnets, and grinding and cutting tools as well as artificial hip and knee joints.

Soils near ore deposits, phosphate rocks, or ore smelting facilities, and soils contaminated by airport traffic, highway traffic, or other industrial pollution may contain high concentrations of cobalt. Small amounts of cobalt may be released into the atmosphere from coal-fired power plants and incinerators, vehicular exhaust, industrial activities relating to the mining and processing of cobalt-containing ores, and the production and use of cobalt alloys and chemicals.

Cobalt released into water may stick to particles in the water column or to the sediment at the bottom of the body of water into which it was released, or remain in the water column in ionic form. The specific fate of cobalt will depend on many factors such as the chemistry of the water and sediment at a site as well as the cobalt concentration and water flow. Cobalt deposited on soil is often strongly attached to soil particles and therefore would not travel very far into the ground. However, the form of the cobalt and the nature of the soil at a particular site will affect how far cobalt will penetrate into the soil. Both in soil and sediment, the amount of cobalt that is mobile will increase under more acidic conditions. Ultimately, most cobalt ends up in the soil or sediment.

Non-carcinogenic Health Effects

Following inhalation exposure to cobalt-containing particles, the primary target of exposure is the respiratory tract. Occupational exposure of humans to cobalt metal or cobalt-containing hard metal have reported primarily respiratory effects, including decreased pulmonary function, asthma, interstitial lung disease, wheezing, and dyspnea. Many of the respiratory tract effects are believed to be the result of the generation of oxidants and free radicals by the cobalt ion. In particular, hard metal (a tungsten carbide/cobalt alloy) is a potent generator of free electrons, resulting in the generation of active oxygen species. However, some of the respiratory effects, such as cobalt-induced asthma, are likely the result of immunosensitization to cobalt. Other sensitive targets of cobalt inhalation in humans include effects on the thyroid and allergic dermatitis, manifesting as eczema and erythema; it is believed that the allergic dermatitis is due, at least in part, to concurrent dermal exposure and the development of immunosensitization to cobalt.

Adequate chronic studies of the oral toxicity of cobalt or cobalt compounds in humans and animals are not presently available. The most sensitive endpoint following oral exposure to cobalt in humans appears to be an increase in erythrocyte numbers (polycythemia).

Following dermal exposure, the most commonly observed effect is dermatitis which is likely caused by an allergic reaction to cobalt with the cobalt ion functioning as a hapten.

Carcinogenicity and Genotoxicity

Studies in animals have indicated a lifetime inhalation of cobalt sulfate resulted in increased tumor incidences in animals however human data were not available. Oral data on the carcinogenic effects of cobalt and cobalt compounds are not available. IARC has classified cobalt and cobalt compounds as possibly carcinogenic to humans (Group 2B).

In-vivo and in-vitro studies indicate cobalt has genotoxic properties.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Cobalt

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Minimal Risk Level (MRL)	Threshold	0.01 mg/kg/day	ATSDR (2004)	Intermediate duration
Inhalation	Minimal Risk Level (MRL)	Threshold	0.0001 mg/m ³	ATSDR (2004)	Chronic duration

Adopted Threshold Dose-Response Values

In the absence of other published dose-response values for assessment of potential non-threshold effects associated with oral exposure to cobalt, AECOM has adopted the minimal risk level (MRL) value for intermediate duration exposure published by ATSDR (2004) and applied an additional uncertainty factor of 10 to convert from intermediate to chronic exposure.

For assessment of potential non-threshold effects associated with inhalation exposure to cobalt, AECOM has adopted the minimal risk level (MRL) value for chronic duration exposure of 0.0001 mg/m³ published by ATSDR (2004)

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to cobalt have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to cobalt have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2004. *Toxicological Profile for Cobalt*. Agency for Toxic Substances and Disease Registry. April 2004.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

Cresols (*m*, *o* and *p*) – Toxicological profile

Synonyms: methylphenols (2, 3 and 4), tricresol

The following information has been taken from ATSDR (2008):

General

Cresols are organic compounds that are widely occurring both in nature and in manufacturing. There are three forms of cresols that are only slightly different in their chemical structure: **ortho-cresol** (*o*-cresol), **meta-cresol** (*m*-cresol), and **para-cresol** (*p*-cresol). These forms occur separately or as a mixture.

Cresols are used to dissolve other chemicals, as disinfectants and deodorizers, and to make specific chemicals that kill insect pests. Cresol solutions are used as household cleaners and disinfectants, perhaps most famously under the trade name Lysol. Cresol solutions can also be found in photographic developers. In the past, cresol solutions have been used as antiseptics in surgery, but they have been largely displaced in this role by less toxic compounds.

Cresols are found in many foods and in wood and tobacco smoke, crude oil, coal tar, and in brown mixtures such as creosote, cresolene and cresylic acids, which are wood preservatives. Small organisms in soil and water produce cresols when they break down materials in the environment.

Non-carcinogenic Health Effects

Information about the effects of cresols in humans is derived mainly from case reports of accidental or intentional ingestion of cresol solutions or from accidental contact of cresol with the skin. Cresols produce corrosive damage at sites of contact; therefore, the skin and mucosal membranes are targets for cresols toxicity. In a single study of controlled exposures in volunteers, brief exposures to 6 mg/m³ *o*-cresol caused 8 out of 10 subjects to complain of respiratory irritation. Fatalities due to ingestion and dermal exposure to cresols have been described. Other effects reported in these acute high oral and/or dermal exposure scenarios include respiratory failure, tachycardia and ventricular fibrillation, abdominal pain, vomiting, and corrosive lesions of the gastrointestinal tract, methemoglobinemia, leukocytosis and hemolysis, hepatocellular injury, renal alterations, skin damage, metabolic acidosis, and unconsciousness. Many of these effects may not have been caused directly by cresols, but may be a result of secondary reactions to shock caused by external and internal burns.

Inhalation or dermal exposure of animals to cresols has produced irritation and corrosion at the site of contact. Animals exposed acutely to cresol vapors and aerosols showed signs of respiratory irritation, although the levels associated with irritation have not been reliably documented. Inflammation and irritation of the upper respiratory tract, pulmonary edema, and hemorrhage and perivascular sclerosis in the lungs were seen in a variety of animal species exposed intermittently to 9–50 mg/m³ of *o*-cresol for ≥1 month; other isomers were not tested. White mice exposed acutely to commercial mixtures of cresol isomers exhibited irritation and inflammation of the eyes and nose. Also noticed in these inhalation studies were effects on the nervous system (excitation, fatigue, convulsions). Animals that died had fatty degeneration and necrosis of the liver, degeneration of the tubular epithelium in the kidneys, bronchitis, pulmonary hemorrhage, and dystrophic changes in the heart and in nerve cells and glia in the brain. All

three cresol isomers, either alone or in combination, severely irritated the skin of rabbits, producing visible and irreversible tissue destruction.

From a limited number of intermediate oral studies, nasal epithelial lesions appear to be a particularly sensitive target for cresols' toxicity. Dietary exposure of rats and mice to *p*-cresol or to a mixture of *m/p*-cresol (58.5% *m*-cresol, 40.9% *p*-cresol) for 28 days or 13 weeks induced dose-related alterations in the nasal respiratory epithelium at doses of 95 mg/kg/day and higher. The severity of the lesions also was dose-related. The lesions were located at the most anterior portions of the nasal septum, dorsal arch, and medial aspect of the nasal turbinates. No such lesions were seen with *o*-or *m*-cresol in the 28-day study or with *o*-cresol in the 13-week study (neither *m*-cresol nor *p*-cresol alone were tested in the 13-week study). Nasal lesions were also observed in male rats and female mice exposed to a mixture of *m/p*-cresol in the feed for 2 years; the results suggested that the lesions already had developed by week 13 and did not increase in severity during the remainder of the dosing period. Intermediate-duration oral gavage studies and two multi-generation reproductive dietary studies in mice did not examine the nasal respiratory epithelium of the animals. It is also relevant to note that in the inhalation studies discussed above, there is no specific mention of evaluation of the nasal cavity. Additional studies may be

necessary to rule out the possibility that the nasal lesions are due to direct contact of cresol with the nasal epithelium.

The nervous system also appears to be a sensitive target of cresols toxicity in oral studies, although this seems to be limited to oral gavage studies. Rodents administered cresols by oral gavage for acute or intermediate durations showed neurological signs such as hypoactivity, excessive salivation, labored respiration, and tremors, in addition to decreased body weight gain. Some neurological signs were observed in rats dosed by gavage with as low as 50 mg/kg/day of cresol isomers. None of these effects have been seen in dietary studies, or if seen, they have occurred at much higher dose levels than in oral gavage studies. The reason for this difference is unknown, but it probably is related to toxicokinetic differences between the two modes of oral dosing.

Dietary exposure to higher doses of cresols, generally >240 mg/kg/day, caused increases in liver weight; thresholds for these changes in liver weight were comparable among cresol isomers. Kidney weight was only increased in rats dosed with ≥861 mg/kg/day *o*-cresol for 28 days. Clinical chemistry tests gave no indication of altered function in these organs and no gross and microscopic alterations were seen, even at the highest doses administered (>1,000 mg/kg/day). Other systemic effects observed in rats and mice treated with relatively high doses of cresols (>1,000 mg/kg/day) in the diet for 13 weeks included decreased weight gain (all isomers). A 2-year study also provided evidence of kidney toxicity in rats (720 mg/kg/day *m/p*-cresol) and thyroid gland toxicity in mice (≥100 mg/kg/day *m/p*-cresol).

Reproductive effects of cresols isomers administered to rats and mice in the diet were limited to mild to moderate uterine atrophy and lengthening of the estrous cycle, generally at the highest dose levels tested (>2,000 mg/kg/day). Dietary multi-generation studies in mice with *o*-cresol and *m/p*-cresol found no significant effects with *o*-cresol; *m/p*-cresol at the highest level tested (1,682 mg/kg/day) caused minor maternal toxicity (reduced body weight gain), decreased number of pups/litter, and increased cumulative days to litter (delay in producing additional F1 offspring). Developmental studies that treated rats and rabbits by oral gavage during gestation observed fetal effects (skeletal variations and delayed ossification) at dose levels that also caused maternal toxicity.

The database in animals is insufficient to propose a toxicity ranking for cresol isomers, even though *p*-cresol seemed to be the most potent for induction of the critical effect, nasal respiratory lesions, in rats and mice in the National Toxicology Program (NTP) study. The human database is inadequate to propose a toxicity ranking for cresol isomers.

Carcinogenicity and Genotoxicity

A 2-year bioassay found equivocal evidence of carcinogenetic activity of *m/p*-cresol (60%/40%) in male Fischer-344 rats based on a nonsignificant increase in the incidence of renal tubule adenoma. The same study found some evidence of carcinogenetic activity in female B6C3F1 mice based on an increased incidence of forestomach squamous cell papilloma. Cresols gave indications of promotion potential in a dermal skin promotion assay; *p*-cresol was the least potent isomer, *o*-cresol was approximately 3 times more potent than *p*-cresol, and *m*-cresol was in between. The EPA has determined that cresols are possible human carcinogens (Group C) based on inadequate data in humans and limited data in animals (the assessment is dated 10/89). According to EPA's updated criteria for classifying chemicals, cresols fall in the category of chemicals for which there is "inadequate information to assess carcinogenic potential." The International Agency for Research on Cancer (IARC) has not classified any of the cresols.

Although *o*-, *p*-, and *m*-cresol and a 1:1:1 mixture of the three cresol isomers gave some indication of genotoxic activity in *in vitro* assays with mammalian cells, most *in vivo* assays were negative, with one exception. Overall, cresols are not considered to pose a genotoxic threat to humans under normal environmental exposure conditions (ATSDR, 2008).

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Cresol (m,o,p)

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Minimal Risk Level (MRL)	Threshold	0.1 mg/kg/day	ATSDR (2008)	Chronic duration oral MRL for cresols (mixture)
Oral	Reference Dose (RfD)	Threshold	0.05 mg/kg/day	USEPA (2010)	For m- and p- cresol. Value for o-cresol has been withdrawn.
Inhalation	Tolerable Concentration (TC)	Threshold	0.6 mg/m ³	WHO (2000)	Converted from ADI of 0.17 mg/kg/day assuming 70 kg body weight and 20 m ³ /day inhalation rate.

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to cresols, AECOM has adopted the minimal risk level (MRL) value 0.1 mg/kg/day published by ATSDR (2008).

For assessment of potential threshold effects associated with inhalation exposure to cresols, AECOM has adopted the tolerable concentration (TC) of 0.6 mg/m³ published by WHO (2000).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to cresols have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposures have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2008. *Toxicological Profile for Cresols*. Agency for Toxic Substances and Disease Registry. September 2008.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

WHO, 2000. *Guidelines for Air Quality*. World Health Organisation, Geneva. 2000.

Cyanide – Toxicological profile

The following information has been taken from ATSDR (2005):

General

Cyanides are both naturally occurring and man-made and many are powerful and rapid-acting poisons. Hydrogen cyanide, sodium cyanide, and potassium cyanide are the forms of cyanide and are most likely to be in the environment as a result of industrial activities. Certain bacteria, fungi, and algae can also produce cyanide, and it is also found in a number of foods and plants.

Many of the cyanides in soil and water come from industrial processes such as metal mining, organic chemical industries, iron and steel plants or manufacturers, and publicly owned wastewater treatment facilities. Automotive exhausts are a source of cyanides, as are fumes from the incineration of municipal waste and cyanide containing pesticides.

Cyanide enters air, water, and soil from both natural processes and industrial activities. Airborne cyanide is present mainly as gaseous hydrogen cyanide and is generally far below levels that would cause concern. A small amount of cyanide in air is present as fine dust particles. This dust eventually settles over land and water and is removed from air by rain and snow. Most cyanide in surface water will form hydrogen cyanide and evaporate. Some cyanide in water will be transformed into less harmful chemicals by microorganisms or will form a complex with metals, such as iron. Cyanide in water does not build up in the bodies of fish.

Cyanides are fairly mobile in soil and can be converted to hydrogen cyanide gas or other chemical forms by microorganisms present in the soil. Cyanides usually do not seep into underground water however cyanide has been detected in underground waters of landfills and industrial waste disposal sites. At the high concentrations found in some landfill leachates and in the wastes stored in some disposal sites, cyanide becomes toxic to soil microorganisms. Because these microorganisms can no longer change cyanide to other chemical forms, cyanide is able to pass through soil into underground water.

Non-carcinogenic Health Effects

The toxicity of individual cyanide compounds is dependent on the ease with which they release cyanide anion (CN^-). For example, cyanide radicals have a low affinity for alkali metals and a high affinity for ferric iron (Fe^{3+}) and other metals; therefore, simple cyanide salts (for example, sodium cyanide or potassium cyanide) are toxic, whereas certain iron-containing cyanide compounds do not release CN^- readily and are nearly nontoxic. Cyanide exerts its primary toxicological effects by binding to the metallic cofactor in metalloenzymes, thereby impairing enzyme and cell function. Cytochrome c oxidase is the most significant target of cyanide exposure since its inhibition prevents tissues from using oxygen causing histotoxic hypoxia. The most vulnerable tissues are those with the highest oxygen demand and/or a deficiency in detoxifying enzymes such as rhodanese. The inhibition of oxygen use by cells causes oxygen tensions to rise in peripheral tissues; this results in a decrease in the unloading gradient for oxyhemoglobin. Thus, oxyhemoglobin is carried in the venous blood, which is one biomarker of cyanide exposure. In addition to binding to cytochrome c oxidase, cyanide inhibits enzymatic activity of a wide variety of enzymes which contribute to the signs of cyanide toxicity.

Although the entire body is affected by cyanide exposure, adverse effects on the central nervous system are of the most consequence to the organism because of the high metabolic demand for oxygen in neurons and its control of respiratory function. Initial stimulation of carotid and aortic bodies and effects on the central nervous system adversely affect the function of the respiratory system, which contributes to the global histotoxic hypoxia leading to death. High inhalation, oral, or dermal exposure levels result in convulsions, unconsciousness, and death due to inactivation of the centers controlling respiration. Lower exposures may result in headache or dizziness.

The signs of cyanide toxicity at concentrations leading to death in humans are well described: intoxication, followed by a brief sensation of dryness and burning in the throat, suffusing warmth, and a hunger for air. Within 1 minute apnea develops and symptoms worsen with loss of consciousness and convulsions. Cardiovascular failure may also occur, although the heart may continue to beat for 3–4 minutes after the last breath. Reported signs sometimes include a bitter almond-like odor on the breath and (in light-toned individuals) a rose-colored hue of the skin. Dermal exposure to cyanide results in comparable effects, but at higher doses.

Nonlethal exposures to hydrogen cyanide gas produces upper respiratory irritation, cough, altered sense of smell, nasal congestion, epistaxis, hemoptysis, and dyspnea in exposed workers. Workers

acutely exposed to cyanogen, which dissociates into hydrogen cyanide and hydrocyanic acid, experienced nasal irritation. Other effects observed at nonlethal exposure levels include hypotension, heart palpitations, precordial pains, nausea and vomiting resulting from central nervous system stimulation or direct contact with cyanide, and albinuria. Animal studies also report bradycardia, arrhythmia, and T-wave abnormalities, vomiting, increased blood urea nitrogen, and histopathology of the renal proximal tubular epithelium and glomeruli. Hepatic effects have not been reported in humans, but have been observed in some animal studies.

Thyroid effects following cyanide exposure result from the interference of thiocyanate, a metabolite of cyanide, with iodine uptake and utilization in the thyroid gland. Enlargement of the thyroid gland and increased levels of thyroid stimulating hormone were observed in workers exposed by inhalation. No data were available for cyanide-induced neurotoxicity in humans following intermediate-duration exposures by any route, but a number of animal studies are available, none of which, systematically evaluated neurotoxicity using a neurobehavioral test battery. Following repeated inhalation exposure to cyanide, transitory neurobehavioral effects (increased response rates without encephalopathy) were observed in monkeys and more serious effects (tremors, rigidity, ataxia, atrophy of Purkinje cells, and vasodilation and hemorrhage in the brain) were observed in dogs, the most sensitive species tested. Oral exposure studies administered cyanide salts by oral gavage, in drinking water, or diet. In oral gavage studies in pigs or rats, behavioral changes (reduced activity) were observed at doses between 0.14 and 0.8 mg cyanide/kg/day and more serious effects (tremors, convulsions) were observed at 7.8 mg CN-/kg/day, a lethal dose. No encephalopathy or overt signs of neurotoxicity were observed following repeated exposure via drinking water to doses as high as 12.5 mg CN-/kg/day in rats or 28.8 mg CN-/kg/day in mice. Myelin degeneration of spinal cord tracts was observed in rats receiving 30 mg CN-/kg/day via dietary exposure.

Chronic exposure to lower cyanide concentrations in occupational settings causes a variety of symptoms from fatigue, dizziness, and headaches to ringing in the ears, paresthesias of extremities, and syncope, or even hemiparesis and hemianopia. In addition, behavioral changes were reported following prolonged cyanide exposure with loss of memory and decreases in visual acuity, psychomotor ability, and visual learning reported in workers. It is possible, however, that during occupational exposure, such as electroplating operations, chemicals other than cyanide may have contributed to the effects observed.

Chronic neurological effects are exacerbated by nutritional deficiencies or other disorders that provide inadequate levels of thiosulfate needed to detoxify cyanide. Among those observed were hyperreflexia or spastic paraparesis of the extremities, spastic dysarthria, visual and hearing difficulties, and cerebellar signs.

Carcinogenicity and Genotoxicity

There is no evidence that cyanide exposure is correlated with carcinogenicity in humans or animals.

Cyanide has only an indirect genotoxic effect in vivo and in vitro, in that dying cells release endonucleases into the cytosol, ultimately resulting in DNA fragmentation.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Cyanide

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.012 mg/kg/day	NHMRC (2004)	
Oral	Acceptable Daily Intake (ADI)	Threshold	0.012 mg/kg/day	WHO (2008)	Protective for acute and long term exposure

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.02 mg/kg/day	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to cyanide, AECOM has adopted the acceptable daily intake (ADI) of 0.012 mg/kg/day adopted by the NHMRC (2004) for the derivation of drinking water guideline values.

To AECOM's knowledge, threshold dose-response criteria for inhalation exposure to cyanide have not been published by Australian or other regulatory bodies. AECOM has therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation effects of cyanide. The oral ADI of 0.012 mg/kg/day was converted to a Tolerable Concentration in air of 0.042 mg/m³ assuming an adult body weight of 70 kg and a daily inhalation volume of 20 m³/day. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to cyanide have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to cyanide have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2005. *Toxicological Profile for Cyanide*. Agency for Toxic Substances and Disease Registry. August, 2005.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council , 2004.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Bis(2-ethylhexyl)phthalate – Toxicological profile

Synonym: DEHP, di-2-ethylhexylphthalate

The following information has been taken from ATSDR (2002):

General

Bis(2-ethylhexyl)phthalate (DEHP) is the most important "phthalate," being the diester of phthalic acid and the branched-chain 2-ethylhexanol. Due to its suitable properties and the low cost, DEHP is widely used as a plasticizer in manufacturing of articles made of PVC. Plastics may contain 1% to 40% of DEHP. It is also used as a hydraulic fluid and as a dielectric fluid in capacitors.

DEHP has a low vapor pressure, but the temperatures for processing PVC articles are often high, leading to release of elevated levels, raising concerns about health risks (see outgassing). It can be absorbed from food and water. Higher levels have been found in milk and cheese. It can also leach into a liquid that comes in contact with the plastic; it extracts faster into nonpolar solvents (eg. oils and fats in foods packed in PVC). Food and Drug Administration (FDA) therefore permits use of DEHP-containing packaging only for foods that primarily contain water. In soil, DEHP contamination moves very slowly because of its low solubility in water.

Non-carcinogenic Health Effects

Reports have suggested an associated between male sexual development and female rates of miscarriage after exposure to DEHP. DEHP is a pseudo-estrogen and a hormone modifier found in most plastic products such as PVC, polycarbonate, nearly all cosmetic chemical products, and many others), and as a cause of dramatically lower sperm counts in men.

A clinically relevant dose and duration of exposure to bis-2-ethylhexylphthalate has been shown to have a significant impact on the behavior of cardiac cells in culture. This includes an uncoupling effect that leads to irregular rhythms in vitro. This is observed in conjunction with a significant decrease in the amount of gap junctional connexin proteins in cardiomyocytes treated with DEHP.

Carcinogenicity and Genotoxicity

IARC classify DEHP as a Group 3 agent (not classifiable) as to its human carcinogenicity.

The genotoxicity of DEHP and its primary metabolites, MEHP and 2-ethylhexanol, has been extensively evaluated in most standard short-term tests of genetic toxicity. The data are consistent and indicate that DEHP, MEHP, and 2-ethylhexanol are not genotoxic.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for DEHP

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.025 mg/kg/day	NHMRC (2004)	
Oral	Acceptable Daily Intake (ADI)	Threshold	0.025 mg/kg/day	WHO (2008)	
Oral	Minimal Risk Level (MRL)	Threshold	0.06 mg/kg/day	ATSDR (2002)	Chronic duration
Oral	Reference Dose (RfD)	Threshold	0.02 mg/kg/day	USEPA (2010)	

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Oral Slope Factor	Non threshold	0.014 (mg/kg/day) ⁻¹	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to DEHP, AECOM has adopted the NHMRC (2004) acceptable daily intake (ADI) of 0.025 mg/kg/day used for the derivation of drinking water guidelines.

To AECOM's knowledge, threshold dose-response criteria for inhalation exposure to DEHP have not been published by Australian or other regulatory bodies. AECOM has therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation effects of DEHP. The oral ADI was converted to a Tolerable/Reference Concentration assuming an adult body weight of 70 kg and a daily inhalation volume of 20 m³/day. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to DEHP have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to DEHP have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2002. *Toxicological Profile for di(2-ethylhexyl)phthalate*. Agency for Toxic Substances and Disease Registry. September, 2002.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

National Health and Medical Research Council (2004), *Australian Drinking Water Guidelines (ADWG)*.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council, 2004.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Dibenzofuran – Toxicological profile

Synonyms: 2,2-Biphenylene oxide, dibenzo(b,d)furan, diphenylene oxide

The following information has been taken from NTP (2001):

General

Dibenzofuran is a component of coal tar and creosotes; a complex mixture of 85% PAHs and 2-17% phenolics typically used to preserve wood. It may be released from the incomplete combustion of coal biomass, refuse, diesel fuel and residual oil, as well as from tobacco smoke. Due to its high heat resistance, dibenzofuran, together with biphenyl, is a component of heat-transfer oils. When combined with methylnaphthalenes, it is suitable as a carrier for dyeing and printing textiles.

Dibenzofuran is a common component of environmental pollutants, and has been identified in air, ground water, fuel gas, fly ash from municipal incinerators, diesel exhaust, gas particulates, and cigarette smoke.

Occupational exposure to dibenzofuran may occur through dermal contact and inhalation, particularly at sites where coal tar and coal tar derivatives, especially creosote, are used

The general population may be exposed to dibenzofuran through inhalation of air which has been contaminated by a variety of combustion sources or by contact with creosote treated wood or fly ash particulates emitted from municipal waste incinerators. Since dibenzofuran is a contaminant often found in waste dumps and in water supplies, exposure through ingestion of contaminated food products, e.g., fish, may occur. Dibenzofuran has been qualitatively identified in drinking water and a variety of foods.

Non-carcinogenic Health Effects

Very little information on the toxicity of dibenzofuran is published in the available literature. The majority of studies which are available involve exposure to mixtures of polycyclic aromatic hydrocarbons (PAHs; the structural class into which dibenzofuran falls), such that reported study effects could not be attributed specifically to dibenzofuran.

Carcinogenicity and Genotoxicity

No epidemiological studies or case reports investigating the association of exposure to dibenzofuran and cancer risks in humans or animals were identified in the available literature. The International Agency for Research on Cancer (IARC) has not reviewed the carcinogenicity of dibenzofuran, however IARC has classified creosotes derived from coal tars (which may contain dibenzofuran) as probably carcinogenic to humans (Group 2A).

Dibenzofuran has been evaluated for mutagenic activity in salmonella by a variety of researchers and was not shown to induce genotoxicity.

Published Dose-Response Values

To AECOM's knowledge, chronic dose-response values for dibenzofuran have not been published by sources recognised and endorsed by NEPC (1999) and enHealth (2004).

Adopted Threshold Dose-Response Values

In the absence of other published values, a surrogate approach has been applied to the adoption of threshold dose-response values for dibenzofuran; it has been assumed that the toxicity of dibenzofuran is similar to that of non-carcinogenic PAHs, based on the following:

- Dibenzofuran falls into the structural class of polycyclic aromatic hydrocarbons.
- Available evidence does not suggest that dibenzofuran is mutagenic or carcinogenic (NTP, 2001).

The geometric mean of oral RfDs and inhalation RfCs adopted for non-carcinogenic PAHs (0.06 mg/kg/day and 0.21 mg/m³, respectively) have therefore been adopted for dibenzofuran (see toxicity profile for PAHs within this document).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral or inhalation exposure to dibenzofuran have not been published by Australian or other regulatory bodies. In light of the lack of evidence for carcinogenicity or genotoxicity, potential health effects associated with oral exposure to dibenzofuran have been assessed on the basis of threshold dose response criteria.

References

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

NTP, 2001. *Summary of Data for Chemical Selection, Dibenzofuran, 132-64-9* (background sheet for nomination to NTP Testing Program). National Toxicology Program, Department of Health and Human Services. http://ntp.niehs.nih.gov/ntp/htdocs/Chem_Background/ExSumPdf/Dibenzofuran.pdf. Nomination Date: 7 March 2001.

2,4- Dimethylphenol – Toxicological profile

The following information has been taken from USEPA (2010):

General

2,4-Dimethylphenol is obtained from coal tar or petroleum as by-products in the fractional distillation and in coal gasification. It is corrosive and is a more powerful disinfectant and antiseptic than phenol and is used in the production of sterilizers, pesticides, wood preservation, antiseptics, resins, dyes and solvents, adhesives and lubricants

Non-carcinogenic Health Effects

Symptoms of exposure to 2,4-dimethylphenol include severe irritation of the skin and eyes, dizziness, stomach pain, exhaustion and damage to the liver and kidneys, headache, nausea and vomiting. It may cause severe burns of the eyes and skin, irritation of the respiratory tract and coma. It may also cause corrosion of tissue of the mucous membranes and upper respiratory tract, eyes and skin.

Inhalation may result in burning sensation, coughing, wheezing, laryngitis and shortness of breath. Inhalation may be fatal as a result of spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema.

This compound is highly toxic by ingestion, inhalation or skin absorption. It is a severe irritant of the skin and eyes. It is corrosive to the skin, eyes, mucous membranes and upper respiratory tract. When heated to decomposition it emits acrid smoke, irritating fumes and toxic fumes of carbon monoxide and carbon dioxide.

Carcinogenicity and Genotoxicity

The International Agency for Research on Cancer (IARC) has classified 2,4-dimethylphenol as a Group 2B agent (probably carcinogenic to humans).

In-vivo and in-vitro studies are not suggestive of genotoxic properties.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for 2,4-dimethylphenol

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.02 mg/kg/day	USEPA (2010)	

Adopted Threshold Dose-Response Values

In the absence of other published values for assessment of potential threshold effects associated with oral exposure to 2,4-dimethylphenol, AECOM has adopted the reference dose (RfD) value of 0.02 mg/kg/day published by USEPA (2010).

To AECOM's knowledge, threshold dose-response criteria for oral exposure to 2,4-dimethylphenol have not been published by Australian or other regulatory bodies. AECOM has therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation health effects. The oral RfD of 0.02 mg/kg/day was converted to a Tolerable/Reference Concentration of 0.07 mg/m³ assuming an adult body weight of 70 kg and a daily inhalation volume of 20 m³/day. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to 2,4-dimethylphenol have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposures have therefore been assessed on the basis of threshold dose response criteria (where available).

References

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

Ethylbenzene – Toxicological profile

The following information has been taken from ATSDR (2007):

General

Ethylbenzene is widely distributed in the environment and is used to manufacture styrene, and is used as a solvent in the manufacture of several organic compounds. Routine human activities, such as driving automobiles, boats, or aircraft, or using gasoline powered tools and equipment, release ethylbenzene to the environment. Environmental and background levels of ethylbenzene are generally small and therefore, have minimal impact on public health. Trace levels of ethylbenzene are found in internal combustion engine exhaust, food, soil, water, and tobacco smoke, but usually at levels well below those that have been shown to exhibit toxic effects in laboratory animals or human exposure studies.

Ethylbenzene is not considered highly persistent in the environment. It partitions primarily to air and removal via photochemically generated hydroxyl radicals is an important degradation mechanism. The half-life for this reaction in the atmosphere is approximately 1–2 days. Biodegradation under aerobic conditions and indirect photolysis are important degradation mechanisms for ethylbenzene in soil and water. Based on a vapor pressure of 9.53 mm Hg and Henry's law constant of 7.9×10^{-3} atm-m³/mol, volatilization from water and soil surfaces is expected to be an important environmental fate process for ethylbenzene.

The general population is primarily exposed to ethylbenzene from the inhalation of ambient air. This is due to the direct release of ethylbenzene into the air by the burning of fossil fuels or industrial processes, and partitioning into the air from other media (e.g., soil, surface water). This partitioning of ethylbenzene into the air or water would play a role in exposure to populations living near hazardous waste sites. In addition to inhalation exposure, ingestion of ethylbenzene may also occur because trace amounts have been found in water supplies and various food items.

Non-carcinogenic Health Effects

Ethylbenzene has been associated with eye irritation, hearing loss (ototoxicity), respiratory irritation/ chest constriction liver problems, with symptoms worsening as the exposure dose increased. Acute- and intermediate-duration studies provide strong evidence that ototoxicity is a sensitive effect following inhalation exposure to ethylbenzene. Initial symptoms included dizziness and vertigo however if exposure is not prolonged, complete recovery occurs. Chronic exposure has been associated with an increase in the mean number of lymphocytes and a decrease in hemoglobin levels.

Carcinogenicity and Genotoxicity

No association has been found between the occurrence of cancer in humans and occupational exposure to ethylbenzene. No cases of malignancy were observed in workers exposed to ethylbenzene monitored for 20 years. No information on ethylbenzene concentrations was reported, although an estimated concentration of 6.4 mg/m³ was derived as described above under hematological effects. However, no clear conclusions can be drawn from this study due to the lack of measured ethylbenzene concentrations. Furthermore, the low exposure concentration limited the power of this study to detect any effect. No other studies were found regarding cancer effects in humans exposed to ethylbenzene by inhalation.

Ethylbenzene showed evidence of carcinogenic activity in male rats based on increased incidences of renal tubule neoplasms, some evidence of carcinogenic activity in female rats based on increased incidences of renal tubule adenomas, some evidence of carcinogenic activity in male mice based on increased incidences of alveolar/bronchiolar neoplasms, and some evidence of carcinogenic activity in female mice based on increased incidences of hepatocellular neoplasms. However, the results of these studies suggest that an increase in the severity of nephropathy in female rats is the most sensitive end point of ethylbenzene exposure, and further assessment of inhalation carcinogenicity is therefore not considered to be required (ATSDR, 2007).

IARC (2006) has classified ethylbenzene as a Group 2B carcinogen (possibly carcinogenic to humans).

Genotoxicity studies on ethylbenzene have provided negative results in a variety of *in vitro* assays using numerous prokaryotic organisms, *S. cerevisiae*, and Chinese hamster ovary cells and rat liver epithelial cells, and in an *in vivo* assay using mouse bone marrow cells. Ethylbenzene has, however, caused a

mutagenic effect in mouse lymphoma cells and has been shown to induce a marginal, yet statistically significant, increase in sister chromatid exchanges in human lymphocytes. In addition, ethylbenzene metabolites have been shown to produce DNA damage. Thus, although the majority of the data suggest that ethylbenzene is not mutagenic in most systems, the two studies that showed positive results suggest that ethylbenzene might cause an increased potential for genotoxicity in humans.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Ethylbenzene

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	ADI	Threshold	0.097 mg/kg/day	NHMRC (2004)	
Oral	ADI	Threshold	0.097 mg/kg/day	WHO (2008)	
Oral	Minimal Risk Level (MRL)	Threshold	0.5 mg/kg/day	ATSDR (2007)	Intermediate duration exposure
Oral	Reference Dose (RfD)	Threshold	0.1 mg/kg/day	USEPA (2010)	
Inhalation	Tolerable Concentration (TC)	Threshold	22 mg/m ³	WHO (2000)	Evaluation undertaken in 1996 (Environmental Health Criteria 186).
Inhalation	Minimal Risk Level (MRL)	Threshold	1.3 mg/m ³	ATSDR (2007)	Chronic duration
Inhalation	Reference Concentration (RfC)	Threshold	1.0 mg/m ³	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential non-threshold effects associated with oral exposure to ethylbenzene, AECOM has adopted the NHMRC (2004) ADI of 0.097 mg/kg/day used to derive drinking water criteria.

For assessment of potential non-threshold effects associated with inhalation exposure to ethylbenzene, AECOM has adopted the MRL of 1.3 mg/m³ published by ATSDR (2007). While WHO (2000) recommended a health based guideline value of 22 mg/m³, the recommendation is based on an old (1996) evaluation of ethylbenzene toxicity, which has not considered more recent pivotal chronic duration inhalation studies, in particular the 2-year mouse and rat chronic inhalation study undertaken by NTP (1999) upon which the ATSDR chronic inhalation MRL is based.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to ethylbenzene have not been published by Australian or other regulatory bodies. As noted above, while there is some evidence of ethylbenzene carcinogenicity in animal studies, a non-carcinogenic endpoint (increase in the severity of nephropathy) is considered to be the most sensitive endpoint of ethylbenzene exposure (ATSDR, 2007). Potential health effects associated with oral and inhalation exposure to ethylbenzene have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2007. *Toxicological Profile for Ethylbenzene*. Draft for Public Comment. Agency for Toxic Substances and Disease Registry. August, 2007.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

NTP, 1999. *NTP technical report on the toxicology and carcinogenesis studies of ethylbenzene in F344/N rats and B6C3F1 mice (inhalation studies)*. National Toxicology Program, U.S. Department of Health and Human Services. NTP TR 466.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council , 2004.

WHO, 2000. *Guidelines for Air Quality*. World Health Organization, Geneva. 2000.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Iron – Toxicological profile

The following information has been taken from WHO (2008) and NHMRC (2004):

General

Iron is one of the most abundant metals in the Earth's crust existing as oxide, sulfide and carbonate minerals in rocks and soils and in the oxidized ferric Fe (III) or ferrous Fe (II) forms in water.

Iron has many domestic and industrial applications, ranging from iron and steel products, pigments in paints, food colours and preparations for preventing iron deficiency in humans. Iron sulfate (hydroxylated ferrous sulfate) is used as a flocculant in water treatment. Iron concentrations in uncontaminated surface waters are usually less than 1 mg/L; however, water supplied through rusting iron pipes can have concentrations of 5 mg/L or higher. In oxygen-depleted ground water, iron concentrations of up to 100 mg/L have been recorded.

Iron has a taste threshold of about 0.3 mg/L in water, and becomes objectionable above 3 mg/L. High iron concentrations give water an undesirable rust-brown appearance and can cause staining of laundry and plumbing fittings, fouling of ion-exchange softeners, and blockages in irrigation systems. Food is the major source of iron intake, and iron is a natural constituent in plants and animals.

Non-carcinogenic Health Effects

Iron is an essential element in human nutrition with minimum daily requirements varying between 10 to 50mg/day depending on age, sex, physiological status and iron bioavailability.

Gastrointestinal absorption of iron varies from 1% to 20%, according to individual requirements and the source of iron. It is used in the production of haemoglobin, myoglobin and a number of enzymes, and is stored in the spleen, liver, bone marrow and muscle.

Numerous cases of iron poisoning have been reported, mainly among young children who ingest medicinal iron supplements formulated for adults with typical symptoms including vomiting, diarrhea, and abdominal pain. Liver failure can develop days later. Physiological regulation of iron absorption confers a high degree of protection against iron toxicity and there are a number of reports of people, particularly adults, taking high doses of iron with no adverse effects. Despite this, iron deficiency remains a common condition throughout the world.

Carcinogenicity and Genotoxicity

There is no evidence that iron induces cancer in humans or laboratory animals. Mutagenicity tests involving iron salts did not induce chromosome aberrations in human cells. Iron and iron compounds are not considered to be genotoxic (NHMRC, 2004).

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Iron

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.8 mg/kg/day	WHO (2008)	Provisional maximum daily tolerable intake
Oral	Reference Dose (RfD)	Threshold	0.7 mg/kg/day	PPRTV	Adopted by USEPA (2009) for derivation of Regional Screening Levels (RSLs)

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to iron, AECOM has adopted an acceptable daily intake (ADI) of 0.8 mg/kg/day established by JECFA (1983).

To AECOM's knowledge, threshold reference concentrations for inhalation exposure to iron have not been published by Australian or other regulatory bodies. AECOM has therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation effects of DEHP. The oral ADI of 0.8 mg/kg/day was converted to a Tolerable/Reference Concentration of 2.8 mg/m³ assuming an adult body weight of 70 kg and a daily inhalation volume of 20 m³/day. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to iron have not been published by Australian or other regulatory bodies. Potential health effects associated with oral exposure to iron have therefore been assessed on the basis of threshold dose response criteria.

References

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council, 2004.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Lead – Toxicological profile

The following information has been taken from ATSDR (2007) and WHO (2000):

General

Lead is used principally in the production of lead-acid batteries, solder and alloys. The organo lead compounds tetraethyl and tetramethyl lead have also been used extensively as antiknock and lubricating agents in petrol, although their use for these purposes in many countries is being phased out. Owing to the decreasing use of lead containing additives in petrol and of lead-containing solder in the food processing industry, concentrations in air and food are declining, and intake from drinking-water constitutes a greater proportion of total intake. Lead is rarely present in tap water as a result of its dissolution from natural sources; rather, its presence is primarily from household plumbing systems containing lead in pipes, solder, fittings or the service connections to homes. The amount of lead dissolved from the plumbing system depends on several factors, including pH, temperature, water hardness and standing time of the water, with soft, acidic water being the most plumbosolvent.

Non-carcinogenic Health Effects

Most of the information gathered about lead toxicity comes from studies of workers from a variety of industries and from studies of adults and children in the general population. The most sensitive targets for lead toxicity are the developing nervous system, the hematological and cardiovascular systems, and the kidney. However, lead's multi-mode action in biological systems has the potential to affect any system or organ in the body.

Studies of lead workers suggest that long-term exposure to lead may be associated with increased mortality due to cerebrovascular disease. Population studies suggest that there is a significant association between bone-lead levels and elevated blood pressure and blood lead levels also have been associated with small elevations in blood pressure. At low levels lead negatively affects kidney function by reducing glomerular filtration rates. Lead inhibits haem synthesis, shortens erythrocyte lifespan and can induce inappropriate production of the hormone erythropoietin leading to inadequate maturation of red cell progenitors, which can contribute to the anemia.

A recent study in children 8–10 years of age suggested that lead accelerates skeletal maturation, which might be a predisposing factor to the development of osteoporosis in later life. Lead also has been associated with increased occurrence of dental caries in children and periodontal bone loss.

Hormonal changes in thyroid levels and reproductive hormones have been observed, as have decreased levels of circulating vitamin D, required for maintenance of calcium homeostasis.

Altered immune parameters have been described in lead workers with changes in some T-cell subpopulations, response to T-cell mitogens, and reduced chemotaxis of polymorphonuclear leukocytes being observed. Some studies have indicated that increased lead exposure in children may be associated with increases in serum IgE, a primary mediator for type-1 hypersensitivity involved in allergic diseases such as asthma.

Prolonged exposure to high amounts of lead induces symptoms of encephalopathy; dullness, irritability, poor attention span, epigastric pain, constipation, vomiting, convulsions, coma, and death.

Lead poisoning in children can leave residual cognitive deficits that can be still detected in adulthood such as malaise, forgetfulness, irritability, lethargy, headache, fatigue, impotence, decreased libido, dizziness, weakness, and paresthesia. Studies of older populations reported associations between lead and/or bone lead and poorer performance in neurobehavioral tests. Lead also has been shown to affect nerve conduction velocity and postural balance in workers.

Carcinogenicity and Genotoxicity

The International Agency for Research on Cancer (IARC) has determined that inorganic lead and lead compounds are probably carcinogenic (class 2B agent) based on sufficient evidence from studies in animals and limited evidence in humans.

Renal tumours have been induced in experimental animals exposed to high concentrations of lead compounds in the diet, and IARC has classified lead and inorganic lead compounds in Group 2B (possible human carcinogen). However, there is evidence from studies in humans that adverse neurotoxic effects other than cancer may occur at very low concentrations of lead and that a guideline value derived on this basis would also be protective for carcinogenic effects.

Lead is a clastogenic agent, as shown by the induction of chromosomal aberrations, micronuclei, and sister chromatid exchanges in peripheral blood cells from lead workers. *In vitro* mutagenicity studies in microorganisms have yielded mostly negative results for lead. Tests using mammalian cells have been inconclusive, with some studies reporting negative results and some reporting chromosome damage.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Lead

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0035 mg/kg/day	NHMRC (2004)	
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0035 mg/kg/day	WHO (2008)	
Inhalation	Reference Concentration (RfC)	Threshold	0.0005 mg/m ³	WHO (2000)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to lead, AECOM has adopted the acceptable daily intake (ADI) of 0.0035 mg/kg/day adopted by NHMRC (2004) for the derivation of drinking water guideline values.

For assessment of potential threshold effects associated with inhalation exposure to lead, AECOM has adopted the reference concentration (RfC) of 0.0005 mg/m³ adopted by WHO (2000) for derivation of air guideline values.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to lead have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to lead have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2007. *Toxicological Profile for Lead*. Agency for Toxic Substances and Disease Registry. August, 2007.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2009. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. Available on-line at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Tables accessed last updated March 2010.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council, 2004.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO) Geneva, 2000.



WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations.* World Health Organization.

Manganese – Toxicological profile

The following information has been taken from ATSDR (2008):

General

Manganese is a normal constituent of air, soil, water, and food and may also be released into the environment as a result of manufacturing activities. As with other elements, manganese cannot break down in the environment. It can only change its form or become attached or separated from particles. The chemical state of manganese and the type of soil determine how fast it moves through the soil and how much is retained in the soil. In water, most of the manganese tends to attach to particles in the water or settle into the sediment. The manganese-containing gasoline additive may degrade in the environment quickly when exposed to sunlight, releasing manganese.

The primary exposure to manganese occurs by ingestion of foods or nutritional supplements containing manganese. Vegetarians consuming foods rich in manganese such as grains, beans, nuts as well as heavy tea drinkers may have a higher intake of manganese than average.

Certain occupations like welding and steel factory work may increase your chances of exposure to high levels of manganese. Because manganese is a natural component of the environment, you are always exposed to low levels of it in water, air, soil and food. Drinking or swimming in water containing manganese may expose you to low levels of this chemical. Air contains low levels of manganese from industry and car exhaust.

Non-carcinogenic Health Effects

While low levels of manganese are required for human health, exposure to high manganese levels is toxic and reports indicate the primary sources of human exposure are in occupational settings.

Inhaled manganese is transported to the brain before it is metabolized by the liver. The symptoms of manganese toxicity may appear slowly over months and years and include the development of manganism, a permanent neurological disorder with symptoms that include tremors, difficulty walking, and facial muscle spasms. These symptoms are often preceded by other lesser symptoms, including irritability, aggressiveness, and hallucinations.

Acute or intermediate exposure to excess manganese also affects the respiratory system. Inhalation exposure to high concentrations of manganese dusts can cause an inflammatory response in the lung, which can result in impaired lung function. Lung toxicity is manifested as an increased susceptibility to infections such as bronchitis and can result in manganic pneumonia.

Many reports indicate that oral exposure to manganese, especially from contaminated water sources, can produce significant health effects. These effects are most prominent in children and are similar to those observed from inhalation exposure. Children are also potentially more sensitive to manganese toxicity than adults.

There is indirect evidence that reproductive outcomes might be affected. Developmental data in humans exposed to manganese by inhalation are limited and consist mostly of reports of adverse pulmonary effects from inhaling airborne manganese dust and adverse neurological effects in offspring following ingestion exposure. Some studies in children suggest that routine exposures to high levels of manganese from contaminated drinking water may ultimately impair intellectual performance and behavior.

The few available inhalation and oral studies in humans and animals indicate that inorganic manganese exposure does not cause significant injury to the heart, stomach, blood, muscle, bone, liver, kidney, skin, or eyes. However, if manganese is in the (VII) oxidation state (as in potassium permanganate), then ingestion may lead to severe corrosion at the point of contact.

Carcinogenicity and Genotoxicity

There is no evidence that manganese causes cancer in humans. Although no firm conclusions can be drawn from the mixed results in animal studies, there are little data to suggest that inorganic manganese is carcinogenic. Manganese has been classified by the USEPA as a group D agent (not classifiable as to human carcinogenicity).

In-vivo and in-vitro studies have not reported genotoxic properties associate with manganese exposure.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Manganese

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.143 mg/kg/day	NHMRC (2004)	Safe consumption level of 10 mg/day was converted to an ADI assuming a 70 kg bodyweight
Oral	Tolerable Daily Intake (TDI)	Threshold	0.06 mg/kg/day	WHO (2008)	
Oral	Reference Dose (RfD)	Threshold	0.14 mg/kg/day	USEPA (2010)	
Inhalation	Health based Guideline Value	Threshold	0.00015 mg/m ³	WHO (2000)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.0003 mg/m ³	ATSDR (2008)	Chronic duration MRL for manganese in inspirable dust
Inhalation	Reference Concentration (RfC)	Threshold	0.00005 mg/m ³	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential non-threshold effects associated with oral exposure to manganese, AECOM has adopted an ADI of 0.143 mg/kg/day based on the safe consumption level adopted by NHMRC (2004) for derivation the drinking water guideline.

For assessment of potential non-threshold effects associated with inhalation exposure to manganese, AECOM has adopted the WHO (2000) guideline value of 0.00015 mg/m³.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to manganese have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to manganese have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2008. *Toxicological Profile for Manganese*. Agency for Toxic Substances and Disease Registry. September 2008.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council , 2004.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO), Regional Office for Europe. WHO Regional Publications, European Series, No. 91. 2000.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

1- and 2- Methylanthalene – Toxicological profile

The following information has been taken from ATSDR (2005):

General

1-Methylanthalene and 2-methylanthalene naturally occurring in fossil fuels and petroleum and is used in the manufacture of dyes and resins. Very little is known the fate of methylanthalenes in the environment.

Non-carcinogenic Health Effects

Epidemiology studies, case reports, or controlled-exposure studies examining the potential health effects of human exposure to 1-methylanthalene or 2-methylanthalene by any route of exposure are not available.

An increased incidence of pulmonary alveolar proteinosis have been observed in mice of both sexes exposed to 1-methyl naphthalene in the diet for 81 weeks at approximate dose levels of 72–75 and 140–144 mg/kg/day and 2-methylanthalene in the diet at doses of 50–54 and 108–114 mg/kg/day

Histologic examination of major tissues and organs in these studies showed no other exposure-related nonneoplastic or neoplastic lesions at other sites (including the bronchiolar regions of the lung). Mice dermally exposed to 30 or 119 mg/kg of methylanthalene (a mixture of 1- and 2- ethylanthalene) for 30–61 weeks also showed increased incidence of pulmonary alveolar proteinosis.

Pulmonary alveolar proteinosis is characterized by an accumulation in the alveolar lumen of foamy cells, cholesterol crystals, and proteinaceous materials rich in lipids. The condition is rare in humans and has not been associated with human exposure to 2-methylanthalene or 1-methylanthalene. Human subjects with this condition can display pulmonary function deficits. The absence of pulmonary alveolar proteinosis in a 13-week range-finding study that exposed B6C3F1 mice to dietary doses as high as 2,500 mg/kg/day suggests that the development of this lesion requires chronic-duration exposure.

The mechanisms by which 1- or 2-methylanthalene may cause pulmonary alveolar proteinosis are poorly understood, but light and electron microscopic observations of lung tissues from mice repeatedly exposed to dermal doses of methylanthalene indicate that type II pneumocytes are a specific cellular target. It has been hypothesized that, in response to 1- or 2-methylanthalene, type II pneumocytes produce increased amounts of lamellar bodies due to hyperplasia and hypertrophy, and eventually transform into balloon cells. The rupture of balloon cells is hypothesized to lead to the accumulation of proteinaceous materials rich in lipids in the alveolar lumen. It is unknown whether the methylanthalenes themselves or their metabolites are responsible for the development of pulmonary alveolar proteinosis.

Carcinogenicity and Genotoxicity

No studies were located that documented carcinogenic effects in humans or animals after inhalation exposure to 1-methylanthalene or 2-methylanthalene.

Limited evidence of carcinogenicity of 1- and 2-methylanthalene in mice has been shown in chronic dietary studies. However the tumorigenic response was predominantly benign and was only consistently seen in male mice exposed to 1-methylanthalene.

IARC has not assessed the carcinogenicity potential of the methylanthalenes. The EPA concluded that the available data for 2-methylanthalene are *inadequate to assess human carcinogenic potential*, noting that there are no human data and the available evidence of 2-methylanthalene in animals is limited and insufficient to determine that 2-methylanthalene is carcinogenic to humans.

Studies into the genotoxicity of methylanthalenes are limited to a single study that reported no effects on human chromosomes in tests evaluating the effects of 1-methylanthalene or 2-methylanthalene on human peripheral lymphocytes *in vitro*. 1-Methylanthalene and 2-methylanthalene were also determined to be nonmutagenic in four strains of *S. typhimurium*.

Additional mutagenicity studies using an *in vivo* approach would be useful to better assess the genotoxicity potentials of 1-methylanthalene and 2-methylanthalene.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for 1-methylnaphthalene and 2- methylnaphthalene

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
1-Methylnaphthalene					
Oral	Minimal Risk Level (MRL)	Threshold	0.07 mg/kg/day	ATSDR (2005)	Chronic duration
2-Methylnaphthalene					
Oral	Minimal Risk Level (MRL)	Threshold	0.04 mg/kg/day	ATSDR (2005)	Chronic duration
Oral	Reference Concentration (RfC)	Threshold	0.004 mg/kg/day	USEPA (2010)	

Adopted Threshold Dose-Response Values

1-methylnaphthalene

For assessment of potential threshold effects associated with oral exposure to 1-methylnaphthalene, AECOM has adopted the minimal risk level (MRL) of 0.07 mg/kg/day published by ATSDR (2005).

To AECOM's knowledge, threshold dose-response criteria for inhalation exposure to 1- methylnaphthalene have not been published by Australian or other regulatory bodies. AECOM has therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation effects of DEHP. The chronic oral MRL of 0.07 mg/kg/day was converted to a Tolerable Concentration of 0.25 mg/m³ assuming an adult body weight of 70 kg and a daily inhalation volume of 20 m³/day. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

2-methylnaphthalene

For assessment of potential threshold effects associated with inhalation exposure to 2-methylnaphthalene, AECOM has adopted the minimal risk level (MRL) of 0.04 mg/m³ published by ATSDR (2005).

To AECOM's knowledge, threshold dose-response criteria for inhalation exposure to 1- methylnaphthalene have not been published by Australian or other regulatory bodies. AECOM has therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation effects of DEHP. The chronic oral MRL of 0.04 mg/kg/day was converted to a Tolerable Concentration of 0.14 mg/m³ assuming an adult body weight of 70 kg and a daily inhalation volume of 20 m³/day. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to methylnaphthalenes have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to methylnaphthalenes have therefore been assessed on the basis of threshold dose response criteria (where available).

References

ATSDR, 2005. *Toxicological Profile for Naphthalene, 1- methylnaphthalene, and 2- methylnaphthalene*. Agency for Toxic Substances and Disease Registry. August 2005.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

Naphthalene – Toxicological profile

The following information has been taken from ATSDR (2005):

General

Naphthalene occurs naturally in fossil fuels such as petroleum and coal, and is produced when organic materials (e.g., fossil fuels, wood, tobacco) are burned. Naphthalene is also produced commercially from either coal tar or petroleum. Commercially-produced naphthalene is predominately used in the production of phthalic anhydride, which is used as an intermediate for polyvinyl chloride plasticizers such as di(2-ethylhexyl) phthalate. Other uses of naphthalene include production of naphthalene sulfonates (used in concrete additives and synthetic tanning agents), pesticides (e.g., carbaryl insecticides and moth repellents), and dye intermediates.

Naphthalene is frequently present in industrial and automobile emissions and effluents and in various media in the general environment due to its natural occurrence in coal and petroleum products and emissions, its use as an intermediate in the production of plasticizers, resins, and insecticides, and its use in a variety of consumer products such as moth repellants.

Non-carcinogenic Health Effects

Reports that establish associations between naphthalene exposure and health effects in humans are restricted to numerous reports of hemolytic anemia or cataracts following acute exposure or occupational exposure to naphthalene, either by ingestion or by inhalation of naphthalene vapors, but these reports have not identified exposure levels associated with these effects. A relationship appears to exist between an inherited deficiency in the enzyme, glucose 6-phosphate dehydrogenase (G6PD), and susceptibility to naphthalene-induced hemolysis. Newborn infants also appear to be susceptible to naphthalene-induced hemolysis presumably due to a decreased ability to conjugate and excrete naphthalene metabolites.

Results from animal studies exposed to naphthalene by oral administration, by inhalation exposure, or by parenteral administration identify several health effects of potential concern for humans, including maternal toxicity during pregnancy with acute oral exposure, decreased body weight (without lesions developing in any tissues or organs) with intermediate oral exposure, and increased incidence of nonneoplastic and neoplastic lesions in the nose (in rats and mice) and the lung (in mice only) with chronic inhalation exposure.

Carcinogenicity and Genotoxicity

The only studies of cancer in humans exposed to naphthalene are two case series reports of cancer; one report of four laryngeal cancer cases (all of whom were smokers) among workers in a naphthalene purification plant in East Germany, and another report of 23 cases of colorectal carcinoma admitted to a hospital in Nigeria. NTP, USEPA, and IARC concur that these studies provide inadequate evidence of naphthalene carcinogenicity in humans. No cohort mortality or morbidity studies or case-control studies examining possible associations between naphthalene exposure and increased risk of cancer (or other health effects) are available.

In animals, chronic inhalation studies have found increased incidences of nonneoplastic and neoplastic lesions in the nose of rats, nonneoplastic lesions in the nose of mice, and neoplastic and nonneoplastic lesions in the lungs of mice. In mice of both sexes, chronic inhalation of 10 or 30 ppm naphthalene induced inflammation of the nose and lung, metaplasia of the olfactory epithelium, and hyperplasia of the nasal respiratory epithelium. In female mice (but not male mice), exposure to 30 ppm (but not 10 ppm) increased the incidence of benign lung tumors (alveolar/bronchiolar adenomas) compared with controls. One other female mouse exposed to 30 ppm showed a malignant lung tumor (alveolar/bronchiolar carcinoma). In rats of both sexes, inhalation of 10, 30, or 60 ppm naphthalene induced nonneoplastic and neoplastic lesions only in the nasal cavity. Nonneoplastic nasal lesions included (1) hyperplasia, atrophy, chronic inflammation, and hyaline degeneration of the olfactory epithelium and (2) hyperplasia, metaplasia or degeneration of the respiratory epithelium or glands. Neoplastic lesions associated with naphthalene exposure in rats were olfactory epithelial neuroblastoma (a rare malignant tumor) and respiratory epithelial adenoma.

The mechanisms by which naphthalene causes nonneoplastic or neoplastic lesions in the respiratory tract of rodents are incompletely understood, but are thought to involve reactive metabolites of naphthalene, including 1,2-naphthalene oxide, 1,2-naphthoquinone, 1,4-naphthoquinone, and possibly 1,2-dihydroxy-3,4-epoxy-1,2,3,4-tetrahydronaphthalene.

Comparison of species susceptibility to naphthalene-induced nonneoplastic lung damage suggests that mice are much more sensitive than rats (e.g., nonneoplastic or neoplastic lung lesions were not found in chronically exposed rats in an NTP study) and that differences in rates and stereoselectivity of naphthalene metabolism to epoxide intermediates may be involved in this species difference. Acute (4-hour) inhalation exposure of mice to naphthalene concentrations as low as 2–10 ppm induced lung injury, whereas rats exposed to naphthalene concentrations as high as 110 ppm showed no signs of lung injury. Some evidence has been reported that rates and stereoselectivity of naphthalene metabolism in primate lung tissue may be more like rats than mice. In *in vitro* studies with microsomes from lymphoblastoid cells, which expressed recombinant human CYP2F1, metabolism of naphthalene to epoxide intermediates was demonstrated, but the predominant enantiomeric form produced (1S,2R-oxide) was different from the form (1R,2S-oxide) produced by mouse CYP2F2. Although these observations on epoxide formation may suggest that mice may be more sensitive than humans to acute naphthalene lung toxicity from epoxide intermediates, the possible role of other potentially reactive metabolites of naphthalene (e.g., the naphthoquinone metabolites) is unknown with chronic exposure scenarios. To date, mechanistic understanding of species differences in naphthalene bioactivation in the lung is too incomplete to definitively rule out the possible human relevance of naphthalene-induced lung lesions in mice.

In contrast, the olfactory epithelium and respiratory epithelium of the nose of rats and mice do not appear to differ in sensitivity to naphthalene nonneoplastic toxicity from chronic inhalation exposure.

Nonneoplastic nasal lesions were found in nearly all exposed animals of both species at the lowest exposure level, 10 ppm, in both chronic studies. CYP monooxygenases, which might be involved in naphthalene metabolism and bioactivation, have been demonstrated to exist in nasal respiratory epithelial and olfactory epithelial tissue from rodents and humans. Studies designed to specifically characterize metabolism of naphthalene in nasal tissue, however, have not been conducted, with the exception of a single study, which examined *in vitro* rates of metabolism of naphthalene to naphthalene oxides in postmitochondrial supernatants from mouse, rat, and hamster olfactory tissue. Metabolic rates (units of nmol/min/mg protein) showed the following order: mouse (87.1) > rat (43.5) > hamster (3.9). This order did not correspond with species differences in sensitivity to single intraperitoneal injections of naphthalene in a companion study. The lowest dose levels producing substantial necrosis and exfoliation in olfactory epithelium were 200 mg/kg in rats and 400 mg/kg in mice and hamsters. To date, mechanistic understanding of species differences in naphthalene bioactivation in the respiratory tissues is too incomplete to definitively rule out the possible human relevance of naphthalene-induced nasal lesions in rodents (nonneoplastic lesions in rats and mice and neoplastic lesions in rats).

It is unknown whether the naphthalene-induced neoplastic lesions found in mice (lung adenomas) and rats (nose respiratory epithelial adenomas and olfactory epithelial neuroblastomas) are produced via a genotoxic mode of action or a nongenotoxic mode requiring tissue damage and regenerative responses as precursor events. Results from genotoxicity tests for naphthalene have been predominately (but not completely) negative, and the general sites of neoplastic lesions, the nose in rats and the lungs in mice, show some correspondence (but not complete) with the general sites of nonneoplastic lesions. However, mechanistic understanding of naphthalene's carcinogenic mode of action is too incomplete to rule out the possibility of a genotoxic mode of action. Key issues that remain unexplained or unstudied include:

The possible significance of the few positive genotoxicity results that have been obtained, including: reverse mutations in *Salmonella typhimurium* by 1,2-naphthoquinone; *in vitro* formation of N-7 guanine adducts of DNA by 1,2-naphthoquinone; reverse mutations for luminescence in the marine bacteria, *Vibrio fischeri*, by naphthalene; induction of sister chromatid exchanges in Chinese hamster ovary cells by naphthalene and in human mononuclear leukocytes by 1,2- or 1,4-naphthoquinone; induction of chromosomal aberrations in Chinese hamster ovaries and preimplantation mouse embryos by naphthalene; induction of somatic mutations and recombination in *Drosophila melanogaster* by naphthalene; and weak (about 2-fold) induction of micronuclei in red blood cells from *Pleurodeles waltl* larvae by naphthalene.

The lack of a mechanistic explanation of why nearly all rats and mice develop nasal nonneoplastic lesions following chronic exposure to naphthalene at concentrations ≥ 10 ppm, but only some rats develop nasal tumors;

The lack of a mechanistic explanation of why both male and female mice exposed to naphthalene show similar incidences of chronic lung inflammation following chronic exposure to 10 or 30 ppm, but only female mice showed statistically significant increased incidence of lung tumors;

The lack of in vivo genotoxicity assays involving target tissues of naphthalene carcinogenicity (nose and lung); and

The lack of information on the possible threshold exposure levels for nonneoplastic nasal lesions in rats and mice at air concentrations <10 ppm.

The National Toxicology Program 11th Report on Carcinogens includes naphthalene in its list of chemicals reasonably anticipated to be human carcinogen.

International Agency for Research on Cancer concluded that naphthalene is possibly carcinogenic to humans (Group 2B) based on specific evaluations that there is inadequate evidence in humans and sufficient evidence in animals for the carcinogenicity of naphthalene. IARC considered the findings for nasal tumors in male and female rats and lung tumors in female mice in the NTP bioassays as sufficient evidence, noting that both nasal tumor types (olfactory epithelial neuroblastomas and respiratory epithelial adenomas) are rare in untreated rats.

The USEPA last assessed the carcinogenicity of naphthalene before the availability of the results from the chronic rat bioassay. In the EPA (1998) Toxicological Review on Naphthalene, it was concluded that there was inadequate evidence in humans and limited evidence in animals of naphthalene carcinogenicity (increased incidence of lung tumors in female mice). Under the EPA 1986 cancer guidelines, naphthalene was assigned to Group C—possible human carcinogen. Under the EPA 1996 proposed cancer guidelines, it was judged that the human carcinogenic potential of naphthalene via the oral or inhalation routes “cannot be determined”, but it was noted that there was suggestive evidence of potential human carcinogenicity based on increased lung tumors in female mice. Currently, the EPA Integrated Risk Information System (IRIS) Office is reassessing the inhalation carcinogenicity of naphthalene.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Naphthalene

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.02 mg/kg/day	USEPA (2010)	Last revised 17 September 1998. Currently under review.
Inhalation	Reference Concentration (RfC)	Threshold	0.003 mg/m ³	USEPA (2010)	Last revised 17 September 1998. Currently under review.
Inhalation	Minimal Risk Level (MRL)	Threshold	0.003 mg/m ³	ATSDR (2005)	Converted from published value of 0.0007 ppm assuming standard temperature and pressure

Adopted Threshold Dose-Response Values

Dose-response values for naphthalene have not been published by Australian regulatory bodies or by the World Health Organization (WHO), and AECOM has therefore adopted the MRL of 0.0007 ppm (0.003 mg/m³) derived by ATSDR (2005) for assessment of chronic inhalation exposure to naphthalene. This value is similar to that published by USEPA (2010). The oral reference dose of 0.02 mg/kg/day published by USEPA (2009) has been adopted for assessment of threshold oral exposure to naphthalene.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

While there is some evidence of naphthalene carcinogenicity based on observations of benign respiratory tumours and one carcinoma in female mice only exposed to naphthalene by inhalation (see above), non-threshold dose-response values for naphthalene based on potential carcinogenicity have not been published. It should also be noted a recent health effects review undertaken by the USEPA Office of Prevention, Pesticides and Toxic Substances (USEPA, 2008) explicitly recognises that humans are less susceptible to the respiratory effects of naphthalene than rodents. It is therefore considered likely that the inhalation reference concentration published by IRIS, which was derived from a mouse inhalation study with an applied 3000-fold uncertainty factor assuming humans are *more* sensitive than rodents, is likely to be protective of both non-carcinogenic and carcinogenic effects of naphthalene.

References

ATSDR, 2005. Toxicological Profile for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene. Agency for Toxic Substances and Disease Registry. August, 2005.

enHealth, 2004. Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards. June 2004.

NEPC, 1999. Schedule B(4) Guideline on Health Risk Assessment Methodology. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. Integrated Risk Information System (IRIS). Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

Nickel – Toxicological profile

The following information has been taken from ATSDR (2005):

General

Nickel is found naturally in the environment and can also be released into the environment from industrial furnaces, power plants or rubbish incinerators.

In the environment, it is primarily found combined with oxygen or sulfur as oxides or sulfides. Nickel is released into the atmosphere during nickel mining and by industries that make or use nickel, nickel alloys, or nickel compounds. These industries also might discharge nickel in waste water. Nickel is also released into the atmosphere by oil-burning power plants, coal-burning power plants, and trash incinerators.

Food is the major source of exposure to nickel. You may also be exposed to nickel by breathing air, drinking water, or smoking tobacco containing nickel. Skin contact with soil, bath or shower water, or metals containing nickel, as well as, metals plated with nickel can also result in exposure. Stainless steel and coins contain nickel. Some jewelry is plated with nickel or made from nickel alloys. Patients may be exposed to nickel in artificial body parts made from nickel-containing alloys and it can be transferred from mother to infant during breastfeeding.

The concentration of nickel in air, rivers and lakes is generally very low and is barely detectable however you may be exposed to higher-than-average levels of nickel if you live near industries that process or use nickel.

Non-carcinogenic Health Effects

The general population can be exposed to nickel via inhalation, oral, and dermal routes of exposure. Based on occupational exposure studies, reports of allergic contact dermatitis, and animal exposure studies, the primary targets of toxicity appear to be the respiratory tract following inhalation exposure, the immune system following inhalation, oral, or dermal exposure, and possibly the reproductive system and the developing organism following oral exposure.

Contact dermatitis is the result of an allergic reaction to nickel that has been reported in the general population and workers exposed via dermal contact with airborne nickel, liquid nickel solution, or prolonged contact with metal items such as jewelry and prosthetic devices that contain nickel. Once an individual becomes sensitized to nickel, dermal contact with only a small amount of nickel can result in dermatitis. Approximately 10–20% of the general population is sensitized to nickel.

Both noncancerous and cancerous respiratory effects have been observed in humans and animals exposed to airborne nickel compounds. Chronic bronchitis, emphysema, pulmonary fibrosis, and impaired lung function have been observed in nickel welders and foundry workers. These effects were not consistently seen across studies, and co-exposure to other toxic metals such as uranium, iron, lead, and chromium confounds the interpretation of the results. Studies examining the risk of death from nonmalignant respiratory disease among nickel workers have not found significant increases; however, many studies found that the number of observed deaths was significantly lower than expected, suggesting a healthy worker effect.

Adverse respiratory effects have been reported in humans and animals exposed to nickel compounds at concentrations much higher than typically found in the environment. The available data on noncancerous respiratory effects in humans are limited. In nickel workers, exposure to nickel did not result in increases in the risk of death from nonmalignant respiratory system disease. Studies examining potential nonlethal respiratory effects have not found consistent results. Animal data provide strong evidence that nickel is a respiratory toxicant; lung inflammation is the predominant effect. Evidence of lung inflammation has been observed following acute-, intermediate-, and chronic-duration exposure of rats to nickel sulfate, nickel subsulfide, or nickel oxide. Human and animal data provide strong evidence that inhalation exposure to some nickel compounds can induce lung cancer.

The potential for nickel compounds to induce reproductive effects has not been firmly established in either humans or animals. A significant increase in human leukocyte antigen (HLA)-DRw6 antigens were found among individuals with nickel contact dermatitis compared to individuals with no history of atopy or contact dermatitis. Nickel sensitization typically involves initial prolonged contact with nickel or exposure to a very large nickel dose. In the general population, the initial nickel contact often comes from body piercing with jewelry that releases large amount of nickel ions. The resulting dermatitis, which

is an inflammatory reaction mediated by type IV hypersensitivity, typically occurs beneath the metal object.

Carcinogenicity and Genotoxicity

The carcinogenicity of nickel via the inhalation pathway has been well documented in occupationally-exposed individuals. Significant increases in the risk of mortality from lung or nasal cancers were observed in several cohorts of nickel refinery workers. Studies of workers in other nickel industries, including nickel mining and smelting, nickel alloy production, stainless steel production, or stainless steel welding, which typically involve exposure to lower concentrations of nickel, have not found significant increases in cancer risks.

No studies were located regarding cancer in humans after oral exposure to nickel, and nickel acetate was found to be noncarcinogenic in lifetime drinking water studies in rats and mice.

The Department of Health and Human Services has determined that metallic nickel may reasonably be anticipated to be a human carcinogen and nickel compounds are known to be human carcinogens. IARC classified metallic nickel in group 2B (possibly carcinogenic to humans) and nickel compounds in group 1 (carcinogenic to humans). USEPA has classified nickel refinery dust and nickel sulfide in Group A (human carcinogen). Other nickel compounds have not been classified by the EPA. These classifications are based on evidence of carcinogenicity via the inhalation, rather than oral, pathway.

Both *in vitro* and *in vivo* studies in mammals indicate that nickel is genotoxic

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Nickel

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.005 mg/kg/day	NHMRC (2004)	Safety factor does not include that for carcinogenicity as effects have only been observed upon inhalation
Oral	Tolerable Daily Intake (TDI)	Threshold	0.012 mg/kg/day	WHO (2008)	
Oral	Reference Dose (RfD)	Threshold	0.02 mg/kg/day	USEPA (2010)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.00009 mg/m ³	ATSDR (2005)	Chronic duration
Inhalation	Unit Risk	Non - threshold	0.0004 (ug/m ³) ⁻¹	WHO (2000)	

Adopted Threshold Dose-Response Values

For assessment of potential non-threshold effects associated with oral exposure to nickel, AECOM has adopted the ADI used by NHMRC (2004) for derivation of the drinking water guideline.

For assessment of potential non-threshold effects associated with inhalation exposure to nickel, AECOM has adopted the ATSDR (2005) chronic inhalation MRL of 0.00009 mg/m³.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

Non-threshold dose-response criteria for oral exposure to nickel have not been published, and nickel is not considered to be carcinogenic via the oral exposure route.

For assessment of potential non-threshold effects associated with inhalation exposure to nickel, AECOM has adopted the WHO (2000) unit risk of 0.0004 (ug/m³)⁻¹.

References

ATSDR, 2005. *Toxicological Profile for Nickel*. Agency for Toxic Substances and Disease Registry. August, 2005.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

NHMRC, 2004. *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council , 2004.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO) Geneva, 2000.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Polycyclic Aromatic Hydrocarbons (PAHs) – Toxicological Profile

The following health effects information has been extracted and modified from ATSDR (1995):

General

PAHs occur ubiquitously in the environment from both synthetic and natural sources. PAHs occur in the atmosphere most commonly in the products of incomplete combustion. These products include fossil fuels; cigarette smoke; industrial processes (such as coke production and refinement of crude oil); and exhaust emissions from gasoline engines, oil-fired heating, and burnt coals. PAHs are present in groundwater, surface water, drinking water, waste water, and sludge. They are found in foods, particularly charbroiled, broiled, or pickled food items, and refined fats and oils. Individuals living in the vicinity of hazardous waste sites where PAHs have been detected at levels above background may experience exposure to these chemicals via inhalation of contaminated air or ingestion of contaminated food, soil, or water.

Within Australia, the following 16 PAHs are typically analysed for and considered as a group in contaminated site assessment work:

- acenaphthene
- acenaphthylene
- anthracene
- benz[a]anthracene
- benzo[a]pyrene
- benzo[b]fluoranthene
- benzo[g,h,i]perylene
- benzo[k]fluoranthene
- chrysene
- dibenz[a,h]anthracene
- fluoranthene
- fluorene
- naphthalene
- indeno[1,2,3-c,d]pyrene
- phenanthrene
- pyrene

These PAHs are the most commonly assessed based on the following considerations:

- More information is available on them than other PAHs.
- They are suspected to be more harmful than other PAHs, and they exhibit harmful effects that are representative of the PAHs.
- There is considered to be a greater chance of exposure to these PAHs than to the others.

The above PAHs with the exception of naphthalene are considered in this toxicity profile. The toxicity of naphthalene (if considered in this risk assessment) is discussed separately.

Non-carcinogenic Health Effects

Noncancer adverse health effects associated with PAH exposure have been observed in animals but generally not in humans (with the exception of adverse hematological and dermal effects). Animal studies demonstrate that PAHs tend to affect proliferating tissues such as bone marrow, lymphoid organs, gonads, and intestinal epithelium.

Carcinogenicity

Evidence exists to indicate that mixtures of PAHs are carcinogenic in humans. The evidence in humans comes primarily from occupational studies of workers exposed to mixtures containing PAHs as a result

of their involvement in such processes as coke production, roofing, oil refining, or coal gasification (e.g., coal tar, roofing tar, soot, coke oven emissions, soot, crude oil) (Hammond et al. 1976; Lloyd 1971; Maclure and MacMahon 1980; Mazumdar et al. 1975; Redmond et al. 1976; Wynder and Hoffmann 1967). PAHs, however, have not been clearly identified as the causative agent. Cancer associated with exposure to PAH-containing mixtures in humans occurs predominantly in the lung and skin following inhalation and dermal exposure, respectively. Some ingestion of PAHs is likely because of swallowing of particles containing PAHs subsequent to mucocilliary clearance of these particulates from the lung.

Certain PAHs are carcinogenic to animals by the oral route (e.g., benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene). The results of dermal studies indicate that benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-c,d]pyrene are tumorigenic in mice following dermal exposure. The sensitivity of mouse skin to PAH tumorigenesis forms the basis for the extensive studies performed using dermal administration. This tumorigenicity can be enhanced or modified with concomitant exposure to more than one PAH, long straight-chain hydrocarbons (i.e., dodecane), or similar organic compounds commonly found at hazardous waste sites. Thus, humans exposed to PAHs in combination with these substances could be at risk for developing skin cancer.

For many of the carcinogenic PAHs, it appears that the site of tumor induction is influenced by the route of administration and site of absorption, i.e., forestomach tumors are observed following ingestion, lung tumors following inhalation, and skin tumors following dermal exposure. However, the observations that (1) mammary tumors are induced following intravenous injection in Sprague-Dawley rats, (2) the susceptibility to tumor development on the skin after dermal application is not similar in rats and mice, and (3) oral cavity tumors are not observed when benzo[a]pyrene is administered in the diet, suggest that the point of first contact may not always be the site of PAH-induced tumors.

Genotoxicity

Benzo[a]pyrene has been thoroughly studied in genetic toxicology test systems, and has been found to induce genetic damage in prokaryotes, eukaryotes, and mammalian cells in vitro, and to produce a wide range of genotoxic effects (gene mutations in somatic cells, chromosome damage in germinal and somatic cells, DNA adduct formation, UDS, sister chromatid exchange, and neoplastic cell transformation). In cultured human cells, benzo[a]pyrene binds to DNA and causes gene mutations, chromosome aberrations, sister chromatid exchange, and UDS.

The results of in vivo studies indicate that many of the same types of adverse effects observed in vitro were seen in mice, rats, and hamsters exposed to benzo[a]pyrene via the oral, dermal, or intraperitoneal routes. The available data also indicate that benzo[a]pyrene is genotoxic in both somatic and germinal cells of intact animals. The only study that was found regarding genotoxic effects in humans following exposure to benzo[a]pyrene reported no correlation between aluminium plant workers' exposure to PAHs, including benzo[a]pyrene, and sister chromatid exchange frequency. The findings from assays using human cells as the target, in conjunction with the data from whole animal experiments, suggest that benzo[a]pyrene would probably have similar deleterious effects on human genetic material.

Because the genotoxic activity of benzo[a]pyrene is well established, it is frequently used as a positive control to demonstrate the sensitivity of various test systems to detect the genotoxic action of unknown compounds. It also serves as the model compound for PAHs, and the available information on the formation of metabolites and structure of benzo[a]pyrene can theoretically be used to predict potential genotoxicity/carcinogenicity of other PAHs that have not been as extensively studied.

Epoxidation is thought to be the major pathway for benzo[a]pyrene metabolism pertinent to macromolecular interaction. The metabolic attack consists of the cytochrome P-450/P-448-dependent MFO system converting the benzo[a]pyrene molecule into an epoxide; the epoxide is acted upon by epoxide hydrolase to form a dihydrodiol, and a second cytochrome MFO reaction gives rise to the ultimate mutagenic/carcinogenic form, benzo[a]pyrene 7,8-diol-9,10-epoxide. One of the unique structural features of the diol epoxide is that it appears to form in the area of the PAH molecule referred to as the bay region (i.e., a deep-pocketed area formed when a single benzo ring is joined to the remainder of the multiple ring system to form a phenanthrene nucleus).

Analysis of the bay region diol epoxides and their contribution to the DNA binding, genotoxicity, and carcinogenicity of various PAHs has provided the basis for the bay region hypothesis. For example, DNA adducts formed with non-bay region diol epoxides of benzo[a]pyrene have low mutagenic potential. The hypothesis further predicts that structures with more reactive bay regions would probably be more genotoxic and more carcinogenic. The body of evidence on the mutagenic and tumorigenic activity of

the PAHs that form bay region diol epoxides (benzo[a]pyrene, benz[a]anthracene, chrysene, dibenz[a,h]anthracene; benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, and indeno[1,2,3-c,d]pyrene) supports this hypothesis.

In summary, several general conclusions can be reached for the unsubstituted PAHs evaluated in this profile. The formation of diol epoxides that covalently bind to DNA appears to be the primary mechanism of action for both genotoxicity and carcinogenicity of several of the unsubstituted PAHs that are genotoxins (benzo[a]pyrene, benz[a]anthracene, dibenz[a,h]anthracene, chrysene, benzo[b]fluoranthene, benzo[j]fluoranthene). There was insufficient evidence to draw meaningful conclusions regarding the genotoxic potential of benzo[g,h,i]perylene, although some evidence does exist.

With regard to the unsubstituted PAHs that either lack a bay region configuration (acenaphthene, acenaphthylene, anthracene, fluorene, and pyrene) or appear to have a weakly reactive bay region (phenanthrene), there is no compelling evidence to suggest that they interact with or damage DNA.

The five PAHs that appear to be exceptions to the bay region diol epoxide hypothesis are fluoranthene, benzo[k]fluoranthene, benzo[j]fluoranthene, and indeno[1,2,3-cd]pyrene (no bay region), and benzo[e]pyrene (two bay regions). The evidence does suggest, however, that fluoranthene possesses genotoxic properties while benzo[e]pyrene is either weakly mutagenic or nonmutagenic.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for PAHs

PAH	Route of Exposure	Criteria Type	Value	Source
Non-threshold Dose-Response Values				
Benzo(a)pyrene	Oral	Slope Factor	0.43 (mg/kg/day) ⁻¹	NHMRC (2004)*
	Oral	Slope Factor	7.3 (mg/kg/day) ⁻¹	USEPA (2010)**
	Inhalation	Unit Risk	0.087 (µg/m ³) ⁻¹	WHO (2000a,b)
Threshold Dose-Response Values				
Acenaphthene	Oral	RfD	0.06 mg/kg/day	USEPA (2010)
Anthracene	Oral	RfD	0.3 mg/kg/day	USEPA (2010)
Fluoranthene	Oral	RfD	0.04 mg/kg/day	USEPA (2010)
Fluorene	Oral	RfD	0.04 mg/kg/day	USEPA (2010)
Pyrene	Oral	RfD	0.03 mg/kg/day	USEPA (2010)

NOTES:

RfD = Reference Dose

* Derived from drinking water unit risk of 1×10^{-6} per 0.00007 mg/L reported by NHMRC (2004), assuming 70 kg body weight and 2L/day water ingestion rate.

** Last updated November 1994.

+ Values are the maxima of reported ranges, where relevant.

Adopted Threshold Dose-Response Values

Oral

Dose-response values for assessment of threshold health effects associated with PAHs have not been published by Australian regulatory agencies or by the World Health Organization (WHO). AECOM has therefore adopted Reference Doses published by USEPA (2010) for acenaphthene, anthracene, fluoranthene, fluorene and pyrene to assess potential threshold health effects associated with oral exposure to these compounds.

In the absence of published oral dose-response criteria for acenaphthylene and phenanthrene, a surrogate approach has been adopted; it has been assumed that the oral toxicity of these compounds is

comparable to the toxicity of the other unsubstituted PAHs with either no or weakly reactive bay region (acenaphthene, anthracene, fluoranthene, fluorene pyrene). The geometric mean of oral RfDs reported for these compounds (0.06 mg/kg/day) has been adopted for both acenaphthylene and phenanthrene.

Other PAHs have been assessed based on non-threshold dose-response values (see below).

Inhalation

USEPA (2010) and other agencies have not published dose-response values for assessment of threshold health effects associated with inhalation exposure to PAHs. AECOM have therefore adopted a route-to-route (oral to inhalation) extrapolation approach for assessment of inhalation effects of non-carcinogenic PAHs. Oral RfDs were converted to Tolerable Concentrations/Reference Concentrations assuming an adult body weight of 70 kg, and a daily inhalation volume of 20 m³. It is noted that there is substantial uncertainty associated with the use of route-to-route extrapolation, due to differences in e.g., absorption, distribution and metabolism of chemicals via the oral versus inhalation exposure routes. However, this approach has been adopted as a conservative measure in the absence of other data.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

Oral

For assessment of potential non-threshold effects associated with oral exposure to benzo(a)pyrene, AECOM has adopted the drinking water unit risk value of 1×10^{-6} per 0.00007 mg/L published by NHMRC (2004). This value was converted to an oral slope factor of 0.043 (mg/kg/day)⁻¹ assuming a body weight of 70 kg and drinking water intake of 2 L/day.

In order to assess potential oral health effects associated with exposure to potentially carcinogenic PAHs other than benzo(a)pyrene, toxic equivalency factors (TEFs) recommended by CCME (2008) have been adopted. These TEFs were adapted from the relative potency scheme recommended by the WHO (1998) based on a detailed critical review by CCME of more than a dozen sets of TEF numbers published over the last twenty years (CCME, 2008). These TEFs represent one of the most recent reviews of relative PAH potency undertaken by an international regulatory agency. TEFs were adopted, where available, for carcinogenic PAHs considered to be genotoxic carcinogens (benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene; see genotoxicity discussion above). The adopted TEFs are shown in **Table 2** below.

Table 2: Toxic Equivalency Factors Used to Derive Oral Dose-Response Criteria for Carcinogenic PAHs Relative to Benzo(a)pyrene (CCME, 2008)

Chemical	Toxic Equivalency Factor (TEF)
Benzo(a)pyrene (index compound)	1.0
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(g,h,i)perylene	0.01
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Dibenzo(a,h)anthracene	1
Indeno(1,2,3-c,d)pyrene	0.1

Inhalation

For assessment of potential non-threshold effects associated with inhalation exposure to benzo(a)pyrene, AECOM has adopted the inhalation unit risk value of 8.7×10^{-2} per $\mu\text{g}/\text{m}^3$ published by WHO (2000a).

In order to assess potential inhalation health effects associated with exposure to potentially carcinogenic PAHs other than benzo(a)pyrene, toxic equivalency factors (TEFs) derived by Ministry of Environment and Energy (MOEE, 1997) have been applied to the adopted dose-response criteria for benzo(a)pyrene.

These TEFs have also been reviewed and applied by WHO (1998; EHC 202). TEFs were adopted, where available, only for carcinogenic PAHs considered to be genotoxic carcinogens (benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene; see discussion of genotoxicity above). The adopted TEFs are shown in **Table 2** above.

References

- ATSDR, 1995. *Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs)*. Agency for Toxic Substances and Disease Registry. September, 1996.
- enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.
- CCME (2008). *Canadian Soil Quality Guidelines. Carcinogenic and other Polycyclic Aromatic Hydrocarbons (PAHs) (Environmental and Human Health Effects) Scientific Supporting Document*. Canadian Council of Ministers of the Environment. PN 1401.
- NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.
- NHMRC, 2004. *Australian Drinking Water Guidelines*. National Health and Medical Research Council.
- USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2009.
- WHO, 1998. *Environmental Health Criteria 202. Selected Non-Heterocyclic Polycyclic Aromatic Hydrocarbons*. International Programme on Chemical Safety (IPCS). Geneva. 1998.
- WHO, 2000a. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization, Regional Office for Europe. WHO Regional Publications, European Series, No. 91. 2000.
- WHO, 2000b. *Guidelines for Air Quality*. World Health Organization. Geneva. 2000.

Phenol– Toxicological profile

The following information has been taken from ATSDR (2008):

General

Phenol is used widely in the petroleum industry, for the manufacture of nylon, epoxy resins, herbicides, hydraulic fluids and plasticisers. Phenol may be released to the environment as a result of manufacturing processes, disposal of phenol containing waste or from automotive exhaust, cigarette smoke or burning wood.

In air phenol is degraded within 1-2 days however in water it may persist for a number of weeks. It has been detected in surface waters, rainwater, sediments, drinking water and groundwater as well as in industrial and urban runoff and at hazardous waste sites. Phenol in soil will be degraded by microorganisms or leached into groundwater.

Exposure to phenol can occur rapidly via inhalation, dermal contact or ingestion and once absorbed will be metabolised and excreted with a few days.

Non-carcinogenic Health Effects

Long-term occupational exposure to phenol has been associated with cardiovascular disease, although workers were also exposed to other chemicals and results are therefore not necessarily attributable to phenol exposure.

Ingestion of liquid products containing concentrated phenol can cause mouth sores, nausea, diarrhea and serious gastrointestinal damage and vomiting. It is associated with cardiac anomalies and upon ingestion can cause increases in respiration rate followed by breathing irregularities and death.

Dermal exposure to phenol can cause severe skin damage (burns) and can cause death. Absorption through the skin is rapid and lead to similar symptoms as phenol ingestion: respiratory depression, nausea, vomiting and possibly death.

In humans, exposure to phenol during pregnancy did not provide evidence of birth defects. Birth defects were observed in animals born to females exposed to phenol during pregnancy however this generally occurred at exposure levels that were also toxic to the mothers. There is no information on levels of phenol in human breast milk.

Laboratory animal studies have indicated that short term exposure to high levels of phenol via inhalation causes respiratory tract irritation and twitching. Longer-term exposure by animal to high levels of phenols caused damage to the heart, kidneys, liver and lungs.

Oral exposure to extremely high concentrations of phenol by animals has resulted in muscle tremors, difficulty walking and death. Short term application of phenol to the skin of laboratory animals has produced blisters and burns.

Carcinogenicity and Genotoxicity

There is no evidence that phenol causes cancer in humans. The International Agency for Research on Cancer (IARC) classification for phenol is Group 3, not classifiable with regard to its carcinogenicity to humans.

Phenol has been tested extensively for genotoxicity in a variety of *in vivo* and *in vitro* tests. The results of these assays have been equivocal. Phenol appears to be potentially genotoxic, although this may be more a result of the action of its metabolites than the parent compound. Additional genotoxicity studies of phenol do not seem to be necessary.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Phenol

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.3 mg/kg/day	USEPA (2010)	
Inhalation	Reference Concentration (RfC)	Threshold	0.2 mg/m ³	Cal EPA (2009)	Adopted by USEPA (2009) for derivation of Regional Screening Levels (RSLs)

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to phenol, AECOM has adopted the reference dose (RfD) of 0.3 mg/kg/day published by USEPA (2010).

In the absence of other published values for assessment of potential threshold effects associated with inhalation exposure to phenol, AECOM has adopted the Cal EPA reference concentration (RfC) of 0.2 mg/m³ day. This value was used by USEPA (2009) for the derivation of Regional Screening Levels (RSLs).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to phenol have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to phenol have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2008. *Toxicological Profile for Phenol*. Agency for Toxic Substances and Disease Registry. September, 2008.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2009. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. Available on-line at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Tables accessed last updated March 2010.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

Styrene – Toxicological profile

Synonyms: vinyl benzene

The following information has been taken from ATSDR (2007):

General

Styrene is widely used in the manufacture of polystyrene plastics, resins and for insulation or in the fabrication of fiberglass boats. Copolymers derived from styrene (styrene-acrylonitrile and acrylonitrile-butadiene-styrene) are used in the manufacture of piping, automotive components, and plastic drinking glasses. Styrene copolymers are also frequently used in liquid toner for photocopiers and printers.

Small amounts of styrene are naturally present in foods such as legumes, beef, clams, eggs, nectarines, and spices and can migrate to food from styrene packaging containers.

Styrene is a combustion product of cigarette smoke and automobile exhausts and is rarely found in drinking water or soil.

Non-carcinogenic Health Effects

Styrene-induced neurotoxicity has been reported in workers since the 1970s with studies over the last 15 years firmly establishing the central nervous system as the critical target of toxicity. Both short and long-term exposures to styrene can result in neurological effects including decreased color discrimination, vestibular effects, hearing impairment, symptoms of neurotoxicity, particularly "feeling drunk" and tiredness, delays in reaction time, impaired performance on tests measuring attention and memory, impaired nerve conduction velocity, and EEG alterations. It is unclear whether chronic exposure is associated with permanent toxicological affects in humans.

Occupational exposure studies have not found significant increases in the occurrence of stillbirth, infant death, malformations, or low birth weight. The National Toxicology Program (NTP) Expert Panel examining the developmental potential of styrene concluded that the human data are not sufficient to evaluate the potential developmental toxicity of styrene in humans and that there was no convincing evidence of developmental toxicity in animals.

Carcinogenicity and Genotoxicity

Overall, human and animal studies suggest that styrene may be a weak human carcinogen. The International Agency for Research on Cancer (IARC) has assigned styrene to Group 2B, possibly carcinogenic to humans.

A variety of in vivo studies involving styrene have been undertaken. Chromosomal damage, DNA strand breaks, and mutagenic effects have frequently been studied in workers exposed to styrene in occupational settings. Although these studies generally did not account for co-exposure to other toxic chemicals, or for confounding factors such as smoking, sex and age.

Mixed results for chromosomal aberrations and sister chromatid studies were obtained in studies of workers chronically exposed to styrene and any effects observed appear to be concentration related.

Styrene has been tested for genotoxic potential in a variety of *in vitro* systems. In the absence of metabolic activation, styrene has not produced gene mutations in *Salmonella* or *E. coli* and mixed results have been found in the presence of metabolic activation. Increases in chromosomal aberrations and sister chromatid exchange have been found in human lymphocytes in the absence of metabolic activation.

Although genotoxic effects in humans have been observed at relatively low concentrations, they were not considered as critical endpoints for development of a guideline, in view of the equivocal evidence for the carcinogenicity of styrene (WHO, 2000).

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Styrene

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0077 mg/kg/day	NHMRC (2004)	Safety factor included for carcinogenic and genotoxic effects
Oral	Acceptable Daily Intake (ADI)	Threshold	0.0077 mg/kg/day	WHO (2008)	As above.
Oral	Minimal Risk Level (MRL)	Threshold	0.1 mg/kg/day	ATSDR (2007)	
Oral	Reference Dose (RfD)	Threshold	0.2 mg/kg/day	USEPA (2010)	
Inhalation	Reference Concentration (RfC)	Threshold	0.26 mg/m ³	WHO (2000)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.85 mg/m ³	ATSDR (2007)	chronic exposure
Inhalation	Reference Concentration (RfC)	Threshold	1 mg/m ³	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to styrene, AECOM has adopted the acceptable daily intake (ADI) of 0.0077 mg/kg/day adopted by the NHMRC (2004) for derivation of drinking water guideline values which incorporates a safety factor for potential carcinogenic/ genotoxic effects.

For assessment of potential threshold effects associated with inhalation exposure to styrene, AECOM has adopted the WHO (2000) health based air guideline value of 0.26 mg/m³.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to styrene have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to styrene have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2007. *Toxicological Profile for Styrene*. Agency for Toxic Substances and Disease Registry. September, 2007.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

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NHMRC 2004, *Australian Drinking Water Guidelines (ADWG)*. National Health and Medical Research Council , 2004.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition.* World Health Organization (WHO) Geneva, 2000.

WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations.* World Health Organization.

Toluene – Toxicological profile

The following information has been taken from ATSDR (2000):

General

Toluene is used in the manufacture of paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes. It enters the environment largely as a result of solvent and petroleum spills at petrol stations and in manufacturing environments. It readily volatilizes into air and readily dissolves into groundwater and surface water bodies. Toluene is broken down by soil microorganisms and evaporates from soil and water surfaces if exposed to oxygen.

Non-carcinogenic Health Effects

Adverse effects on the nervous system are the critical effects of concern from acute, intermediate, or chronic exposure to toluene. Acute exposure is associated with reversible neurological symptoms progressing from fatigue, headaches, and decreased manual dexterity to narcosis with increasing exposure levels. Reversible neurological impairment from acute exposure likely involves the direct interaction of toluene with nervous system membranes. Degenerative changes in white matter regions of the brain have been correlated with the severity of persistent neurological impairment in individuals who abused solvents and have repeatedly inhaled toluene at high exposure levels (4,000–12,000 ppm). Results from studies of groups of occupationally exposed workers suggest that chronic exposure to toluene at lower exposure levels (from about 50 to 200 ppm) can produce subtle changes in neurological functions including cognitive and neuromuscular performance, hearing, and color discrimination. Supporting data come from studies of toluene-exposed animals showing changes in behaviour, hearing loss, and subtle changes in brain structure, electrophysiology, and levels of neurotransmitters. Case reports of birth defects in children of mothers who abused toluene during pregnancy suggest that exposure to high levels of toluene may be toxic to the developing fetus. However, results from animal studies indicate that toluene is not a teratogenic agent, but can retard fetal growth and skeletal development and adversely influence behavior of offspring at exposure levels that overwhelm maternal mechanisms protecting the developing fetus from exposure. Other adverse health effects, including cancer or effects on reproductive performance, do not appear to be of concern for persons who may experience low exposures to toluene by living or working near hazardous waste sites containing toluene.

Carcinogenicity and Genotoxicity

Human and animal studies generally do not support a concern for the carcinogenicity of toluene. The only available human epidemiological studies were negative but inconclusive due to limitations in design. The validated animal inhalation bioassays were negative; however, one available oral study showed a nondose-related increase in a variety of tumors. Thus, the data do not support a firm conclusion regarding the carcinogenicity of toluene. The IARC have not classified toluene for carcinogenic effects.

Results of *in vivo* studies of exposed humans and *in vitro* microbial assays and other *in vitro* systems generally indicate that toluene is nonmutagenic and nongenotoxic.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Chronic Dose-Response Values for Toluene

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Tolerable Daily Intake (TDI)	Threshold	0.223 mg/kg/day	NHMRC (2004)	
Oral	Tolerable Daily Intake (TDI)	Threshold	0.22 mg/kg/day	WHO (2008)	
Oral	Minimal Risk Level (MRL)	Threshold	0.02	ATSDR (2000)	Intermediate duration

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.08 mg/kg/day	USEPA (2010)	
Inhalation	Reference Concentration (RfC)	Threshold	0.26 mg/m ³	WHO (2000)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.3 mg/m ³	ATSDR (2000)	Chronic duration
Inhalation	Reference Concentration (RfC)	Threshold	5 mg/m ³	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to toluene, AECOM has adopted the tolerable daily intake (TDI) value of 0.223 mg/kg/day used by NHMRC (2004) and WHO (2008) for the derivation of drinking water guideline values. It should be noted that USEPA (2010; based on an assessment undertaken in 2005) derived a slightly lower RfD of 0.08 mg/kg/day based on data from the same principle study as that used by WHO and NHMRC (NTP, 1990). The difference in the derived values results primarily from the application of an additional three-fold safety factor by USEPA (2010) to account for deficiencies in the toluene database. While the USEPA evaluation is therefore slightly more conservative than the WHO (2008) and NHMRC (2004) evaluations, the difference between recommended RfDs/TDIs is not significant, and AECOM has adopted the NHMRC (2004) and WHO (2008) value in accordance with the hierarchy of toxicological information sources recommended by NEPC (1999) and enHealth (2004).

For assessment of potential threshold effects associated with inhalation exposure to toluene, AECOM has adopted the RfC of 5 mg/m³ published by USEPA (2010). This value was derived in 2005 based on a more comprehensive and recent review of available published toxicity studies than those undertaken by WHO (2000) and ATSDR (2000), and is therefore considered to be more suitable for quantitative dose-response assessment than the older WHO and ATSDR values.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to toluene have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to toluene have therefore been assessed on the basis of threshold dose response criteria.

References

- ATSDR, 2000. *Toxicological Profile for Toluene*. Agency for Toxic Substances and Disease Registry. September 2000.
- enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.
- NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.
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- WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO) Geneva, 2000.
- WHO, 2008. *Guidelines for Drinking-water Quality. First and Second Addenda to the Third-Edition. Volume 1. Recommendations*. World Health Organization.

Total Petroleum Hydrocarbons – Toxicological profile

The following text has been extracted from ATSDR (1999), WHO (2005) and TPHCWG (1997):

General

Total petroleum hydrocarbon (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site.

Hydrocarbons are organic compounds composed of carbon and hydrogen atoms arranged in varying structural configurations. They may be divided into two families: aliphatics and aromatics. The aliphatics may be further subdivided into four groups: alkanes (straight and branched chain), alkenes, alkynes and cyclic alkanes. Alkynes are not generally found in petroleum products.

There are significant compositional differences between different petroleum products such as gasoline, diesel oil, aviation fuel and heating oil. Crude oil is distilled, and a variety of petroleum product fractions result, with distinct boiling point ranges. The chemical composition of all these products depends on the sources of crude oil or refinery streams from which they are produced. Petroleum products are not the only source of potential contamination of environmental media with hydrocarbons. Other sources include petrochemical products such as solvents and coal-derived products.

Aliphatic and aromatic fractions of TPH are commonly referred to on the basis of their boiling point normalized to the boiling point of the *n*-alkanes or retention time on a boiling point gas chromatographic column. This is characterized by the equivalent carbon (EC) number. For example, the boiling point of hexane, which consists of six carbon atoms, is 69 °C, and its EC number is 6. Benzene also consists of six carbon atoms, but its boiling point is 80 °C, and its EC number is 6.5. The fractions for the aromatic compounds are presented on the basis of their EC numbers; since many of these relate to fractions of whole values, similar to the situation with benzene, they are usually represented as greater than the lower value. Fractions for aliphatic compounds are also presented on the basis of EC numbers; the EC numbers for aliphatic compounds are the same as the carbon (C) numbers for straight-chain alkanes, but differ for branched and cyclic alkanes. Where a carbon number is referred to in this document, it refers to the EC number.

Although the term TPH is widely used, it is rarely well defined. In practice, TPH is defined by the analytical method such that estimates of TPH concentration often vary depending on the analytical method used to measure it. No single method measures the entire range of petroleum-derived hydrocarbons, since petroleum products can include hundreds to thousands of individual compounds with a wide range of molecular weights, many of which may be present in very small proportions. The analytical methods will usually result in some overlap in the measurement of the fractions between different laboratories.

Health Effects

The fact that petroleum products are complex mixtures of hundreds of individual hydrocarbons is a complicating factor in determining their toxicity, such that the traditional approach of evaluating individual components is largely inappropriate. In order to overcome this difficulty, TPH has traditionally been considered as a series of hydrocarbon fractions and appropriate tolerable concentrations determined for those fractions. A number of groups have examined such an approach, but the most widely accepted is that developed by the Total Petroleum Hydrocarbon Working Group (TPHCWG, 1997).

The hazard assessment approach developed by the TPHCWG (1997) is an indicator/surrogate approach. The *indicators* refer to individual compounds within petroleum products which are associated with non-threshold carcinogenic health effects via a genotoxic mechanism. These compounds, primarily benzene and carcinogenic PAHs, must be assessed on an individual basis and are considered separately within the hazard and risk assessment (see below). The *surrogates* (for which tolerable intakes and concentrations are developed) are noncarcinogenic fractions which represent the mass of petroleum product remaining after evaluation of the carcinogenic indicators. In this risk assessment, indicator compounds within TPH (benzene and carcinogenic PAHs) have been assessed separately if reported to present above screening levels. The remainder of this toxicological summary therefore addresses non-carcinogenic (threshold) health effects reported for TPH compounds and/or mixtures.

The following information relating to threshold health effects associated with different TPH fractions has been summarised from TPHCWG (1997) and ATSDR (1999):

Aromatic C₆-C₉

This fraction primarily consists of benzene, toluene, ethylbenzene and xylenes (BTEX) which have been assessed separately in the risk assessment, and for which separate toxicity profiles are available (if BTEX is present above screening levels). Styrene also falls within this fraction, but is not considered to be a significant constituent of petroleum products (ATSDR, 1999; TPHCWG, 1997).

Aromatic C₁₀-C₁₄

This fraction primarily consists of naphthalenes and alkyl-monoaromatics.

Health effects associated with inhalation exposure to the above chemicals include renal, hepatic, neurological, developmental, body weight and endocrine. C₉ aromatic mixtures have also been studied and reported to cause reduced weight gain and increased liver and kidney weights in rats (TPHCWG, 1997). The TPHCWG (1997) developed an inhalation reference concentration (RfC) of 0.2 mg/m³ for the aromatic C₉-C₁₆ fraction, based on available data for C₉ mixtures. These data were considered more appropriate to use than that for individual compounds because they were considered more representative of TPH, which is also a mixture. This RfC has been adopted for assessment of the TPH C₁₀-C₁₄ fraction (which falls within the C₉-C₁₆ range).

Health effects associated with oral exposure to the above chemicals include renal, haematological, respiratory, ocular, hepatic, systemic, anemic and neurological effects. Naphthalene/methylnaphthalene mixtures have also been studied and reported to cause reduced body weight and food consumption, hepatic and thyroid effects in rats (TPHCWG, 1997). TPHCWG (1997) developed an oral reference dose (RfD) of 0.04 mg/kg/day for the aromatic C₉-C₁₆ fraction, based on the fact that the majority of the available RfDs for individual compounds in this fraction are approximately 0.04 mg/kg/day. This RfD has been adopted for assessment of the TPH C₁₀-C₁₄ fraction (which falls within the C₉-C₁₆ range).

Aromatic C₁₅-C₂₈ and C₂₉-C₃₆

These fractions consist entirely of PAHs, for which separately toxicity profiles are available, and which have been considered separately in the risk assessment.

TPHCWG (1997) derived an oral RfD of 0.03 mg/kg/day for the aromatic C₁₇-C₃₅ fraction, based on pyrene as a surrogate. RfDs for other PAHs within this range were not available. This value has been adopted to evaluate the oral toxicity of TPH C₁₅-C₂₈ and C₂₉-C₃₆ where the reported concentrations at a site are not accounted for by reported PAH concentrations (which are considered separately).

TPHCWG (1997) have not derived an inhalation RfC for these fractions, as it was considered to be inappropriate because the compounds are not volatile and inhalation was not considered to be a relevant exposure pathway. In the case of exposure scenarios where inhalation exposure may occur via the particulate phase, the oral RfD of 0.03 mg/kg/day for these fractions (see above) may be converted to an RfC assuming a daily inhalation rate of 20 m³/day and a body weight of 70 kg. The resulting RfC is 0.1 mg/m³.

Aliphatic C₆-C₉

Compounds in this fraction include n-hexane, n-heptane, n-octane, dimethylbutanes, methylpentanes, some branched alkanes including trimethylpentanes, cycloalkanes including cyclopentane, cyclohexane, methylcyclopentane and methylcyclohexane and some alkenes.

Health effects associated with inhalation exposure to the above chemicals include respiratory, neurological, developmental, body weight, haematological, hepatic and renal. TPHCWG (1997) developed an inhalation RfC of 18.4 mg/m³ for the aliphatic TPH C₅-C₈ fraction, based on rat and mice chronic bioassays using commercial hexane mixtures. This RfC has been adopted for assessment of the aliphatic TPH C₆-C₉ fraction.

Health effects associated with oral exposure to the above chemicals include reproductive, developmental, neurological, weight loss. TPHCWG (1997) developed an oral RfD of 5 mg/kg/day for the aliphatic TPH C₅-C₈ fraction, based on the oral RfD derived for commercial hexane (which was similar to that derived for n-heptane). This RfD was stated by TPHCWG (1997) to be appropriate for most situations, with the exception of the rare release of high-purity n-hexane. This RfD has been adopted for assessment of the aliphatic TPH C₆-C₉ fraction.

Aliphatic C₁₀-C₁₄

Compounds in this fraction include n-alkanes, branched alkanes, cycloalkanes and some alkenes.

Few of the individual compounds in this range have been the subject of single compound toxicity studies. However, some petroleum products are mixtures of primarily aliphatic hydrocarbons in the C₉-C₁₆ range, in which this range falls. For example, JP-8 jet fuel is reported to be a mixture containing aliphatic petroleum hydrocarbons ranging from C₉-C₁₆ and the toxicity of this mixture has been studied (ATSDR, 1998). JP-5, JP-7 and kerosene

are also composed primarily of C₉-C₁₆ aliphatics. The data used by TPHCWG (1997) to develop toxicity criteria for this fraction were studies on JP-8 and on dearomatised petroleum streams.

Health effects associated with inhalation exposure to JP-8 and dearomatised petroleum streams include renal and hepatic. TPHCWG (1997) recommended an inhalation RfC of 1 mg/m³ for aliphatic TPH C₉-C₁₆ based on inhalation studies for dearomatised petroleum streams. This RfC has been adopted for assessment of the aliphatic TPH C₁₀-C₁₄ fraction (which falls within the C₉-C₁₆ range).

Health effects associated with oral exposure to JP-8 and dearomatised petroleum streams include body weight, haematological, renal, hepatic, gastrointestinal reproductive and developmental. TPHCWG (1997) recommended an oral RfD of 0.1 mg/kg/day for aliphatic TPH C₉-C₁₆ based on values derived from subchronic oral gavage data for dearomatised aliphatics (C₉-C₁₂ and C₁₀-C₁₃). This RfD was lower than that derived for JP-8 based on oral gavage data. inhalation studies for dearomatised petroleum streams. The RfD was considered to be protective of systemic toxicity as well as developmental and reproductive endpoints. This RfD has been adopted for assessment of the aliphatic TPH C₁₀-C₁₄ fraction (which falls within the C₉-C₁₆ range).

Aliphatic C₁₅-C₂₈ and C₂₉-C₃₆

Compounds in these fractions which are likely to be present in petroleum and petroleum based fuels include primarily straight-chain alkanes. However, mineral-based crankcase oil, mineral-based hydraulic fluids and food-grade and medicinal grade mineral oils contain branched and cyclic alkanes within these ranges.

Health effects reported to be associated with oral exposure to mineral oils include hepatic and lymphatic (based on subchronic toxicity studies of selected mixtures of mineral oil hydrocarbons). TPHCWG (1997) derived a chronic oral RfD of 2 mg/kg/day for aliphatic TPH C₁₇-C₃₄ based on the NOAEL for hepatic effects (liver granulomas) reported in these studies. Lymph node effects occurred at lower exposure levels than hepatic effects, but were considered to be a non-adverse adaptive response to the ingestion of foreign material. This RfD has been adopted to evaluate the oral toxicity of aliphatic TPH C₁₅-C₂₈ and C₂₉-C₃₆.

Information on health effects associated with inhalation exposure to the above compounds or mixtures of petroleum hydrocarbons that fall within this fraction is not available. The majority of these compounds are not likely to be sufficiently volatile to pose a significantly inhalation risk in the vapour phase. In the case of exposure scenarios where inhalation exposure may occur via the particulate phase, the oral RfD of 2 mg/kg/day for these fractions (see above) may be converted to an RfC assuming a daily inhalation rate of 20 m³/day and a body weight of 70 kg. The resulting RfC is 7 mg/m³.

Carcinogenicity and Genotoxicity

In the application of TPH assessment approaches developed by TPHCWG (1997), the presence of individual compounds that are associated with non-threshold carcinogenic health risks must be assessed separately on an individual basis. As noted above, these compounds (benzene and carcinogenic PAHs) are assessed on an individual basis and have been considered separately within the hazard and risk assessment.

Adopted Threshold Dose-Response Values

Chronic threshold dose-response values adopted based on the TPHCWG (1997) approach are summarised in the following table.

Table 1: Adopted Dose-Response Values for Threshold Effects of TPH Fractions (adopted from TPHCWG, 1997)

TPH Fraction	Oral RfD (mg/kg/day)	Inhalation RfC (mg/m ³)	Notes
Aliphatic:			
C ₆ -C ₉	5	18.4	
C ₁₀ -C ₁₄	0.1	1	
C ₁₅ -C ₂₈	2	7	Converted from oral RfD in absence of other information.
C ₂₉ -C ₃₆	2	7	
Aromatic:			
C ₆ -C ₉	0.2	0.4	
C ₁₀ -C ₁₄	0.04	0.2	
C ₁₅ -C ₂₈	0.03	0.1	Converted from oral RfD in absence of other information.
C ₂₉ -C ₃₆	0.03	0.1	

References

ATSDR, 1999. *Toxicological Profile for Total Petroleum Hydrocarbons*. Agency for Toxic Substances and Disease Registry. September 1999.

TPHCWG, 1997. *Total Petroleum Hydrocarbon Working Group Series, Volume 4, Development of Fraction-Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbon (TPH)*. Total Petroleum Hydrocarbon Working Group.

WHO, 2008. *Petroleum Products in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality*. World Health Organization.

1, 2, 4- Trimethylbenzene – Toxicological profile

Synonyms: pseudocumene, pseudocumol, asymmetrical trimethylbenzene

The following information has been taken from USEPA (1994):

General

1,2,4-Trimethylbenzene occurs as a byproduct of petroleum refining and typically constitutes around forty percent of the C₉ fraction with other trimethyl-benzenes and ethyltoluenes making up the remainder of this fraction.

In the environment 1,2,4-trimethylbenzene volatilizes rapidly from surface waters and soils although some adsorptive capacity to soils and sediments has been observed. It is degraded rapidly by reaction with hydroxyl radicals and at a slower rate by ozone. It is highly volatile and biodegradable and considered unlikely to bioaccumulate.

Non-carcinogenic Health Effects

The most common routes of exposure to 1,2,4-trimethylbenzene are inhalation and dermal, although systemic intoxication from dermal absorption is not likely due to the dermal irritation cause by contact with the chemical which prompts quick removal. Inhalation of 1,2,4-trimethylbenzene causes respiratory irritation and pneumonitis and at increasing concentrations induces headache, fatigue and drowsiness. Long-term inhalation exposure to solvents containing 1,2,4-trimethylbenzene may cause nervousness, tension, and bronchitis.

1,2,4-Trimethylbenzene is lipophilic and may accumulate in fat and fatty tissues. Metabolism occurs by side-chain oxidation to form alcohols and carboxylic acids which are then conjugated with glucuronic acid, glycine, or sulfates for urinary excretion. The major routes of excretion of 1,2,4-trimethylbenzene are exhalation of parent compound and elimination of urinary metabolites.

Carcinogenicity and Genotoxicity

No information was found on the carcinogenicity or genotoxicity of 1,2,4 trimethylbenzene in humans or animals.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Trimethylbenzene 1, 2, 4

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Inhalation	Reference Concentration (RfC)	Threshold	0.007 mg/m ³	PPRTV	Adopted by USEPA (2009) for derivation of Regional Screening Levels (RSLs).

Adopted Threshold Dose-Response Values

Dose-response values for assessment of potential threshold effects associated with oral exposure to 1,2,4-trimethylbenzene have been published.

In the absence of other values for assessment of potential threshold effects associated with inhalation exposure to 1,2,4-trimethylbenzene, the Provisional Peer Reviewed Toxicity Value (PPRTV) of 0.007 mg/m³ has been adopted. This value was adopted by USEPA (2009) for derivation of Regional Screening Levels (RSLs).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to 1,2,4-trimethylbenzene have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposures have therefore been assessed on the basis of threshold dose response criteria (where available).

References

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2004. *Chemicals in the Environment: 1,2,4-Trimethylbenzene*. United States Environmental Protection Agency. Office of Pollution Prevention and Toxics. http://www.epa.gov/chemfact/f_trimet.txt. Accessed April 2010.

USEPA, 2009. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. Available on-line at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm. Tables accessed last updated March 2010.

Vanadium – Toxicological profile

The following information has been taken from ATSDR (2009):

General

Vanadium occurs naturally in soil, water and air and is found in continental dust, marine aerosols, and volcanic emissions. Releases of vanadium to the environment are mainly associated with industrial sources, especially oil refineries and power plants using vanadium rich fuel oil and coal. Global human made release of vanadium to the environment has been estimated to be greater than releases due to natural sources. Vanadium is used in the production of rust-resistant springs and high-speed tool steels and vanadium compounds are used in the production of magnets and dietary supplements.

Vanadium particles in the air settle to the ground or are washed out of the air by rain. Smaller particles, such as those emitted from oil-fueled power plants, may stay in the air for longer and are more likely to be transported farther away from the site of release. The transport and partitioning of vanadium in water and soil is influenced by many factors including acidity of the water or soil and the presence of particulates. Vanadium can either be dissolved in water as dissolved ions or adsorbed to particulate matter. As most foods have naturally occurring low concentrations of vanadium the consumption of vanadium-containing supplements may result in intakes of vanadium that would exceed intakes from food and water.

Populations in areas with high levels of residual fuel oil consumption may also be exposed to above-background levels of vanadium, both from increased particulate deposition upon food crops and soil in the vicinity of power plants. Most people take in very little vanadium from breathing. Individuals exposed to cigarette smoke may also be exposed to higher than background levels of vanadium

Non-carcinogenic Health Effects

The general population can be exposed to vanadium primarily through oral and inhalation routes of exposure.

Adverse respiratory effects have been reported in humans and animals exposed to vanadium compounds at concentrations much higher than those typically found in the environment. Although the available data in humans are limited, signs of airway irritation (e.g., coughing, wheezing, sore throat) have been reported in subjects acutely exposed to vanadium and in workers exposed to vanadium pentoxide dust. These effects have persisted for days to weeks after exposure termination and are not always associated with decreased lung function. Studies in laboratory animals provide strong support that the respiratory tract is the most sensitive target following inhalation exposure to vanadium causing alveolar/bronchiolar hyperplasia, inflammation, and fibrosis in rats and mice exposed to vanadium pentoxide (chronic and acute exposure). Longer duration exposures also result in inflammation and hyperplasia in the larynx and hyperplasia in nasal goblet cells.

Other sensitive targets of vanadium toxicity include the gastrointestinal system following oral exposure and hematological system following inhalation or oral exposure. Symptoms of gastrointestinal irritation (diarrhea, cramps, nausea) have been observed in humans following bolus administration of sodium metavanadate or vanadyl sulfate.

In animals vanadium exposure is associated with microcytic erythrocytosis (decreases in hematocrit, hemoglobin, and mean cell volume and increases in reticulocytes and nucleated erythrocytes) which has been observed in rats exposed to vanadium and vanadium pentoxide.

Information on the potential of vanadium to induce developmental effects in humans is limited, but developmental effects have been observed in laboratory animals and include decreases in pup growth, decreases in pup survival and skeletal malformations.

Carcinogenicity and Genotoxicity

No studies have examined the carcinogenic potential of vanadium in humans. An increase in lung carcinoma incidence has been observed in mice chronically exposed to vanadium pentoxide; there is also marginal evidence for lung cancer in male rats (incidence of carcinoma was higher than historical controls but not concurrent controls). Carcinogenicity has not been adequately assessed in laboratory animals following oral exposure. The International Agency for Research on Cancer (IARC) has determined that vanadium pentoxide is possibly carcinogenic (Group 2B) to humans, but other forms of vanadium have not been classified by IARC or the USEPA.

In-vivo and In-vitro studies suggest vanadium compounds are genotoxic and cause clastogenic effects and DNA damage.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Vanadium

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Reference Dose (RfD)	Threshold	0.009 mg/kg/day	USEPA (2010)	For vanadium pentoxide
Oral	Reference Dose (RfD)	Threshold	0.005 mg/kg/day	USEPA (2010)	For vanadium and compounds
Inhalation	Reference Concentration (RfC)	Threshold	0.001 mg/m ³	WHO (2000)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.0001 mg/m ³	ATSDR (2009)	Chronic duration

Adopted Threshold Dose-Response Values

In the absence of other published values, AECOM has adopted the Reference Dose (RfD) of 0.005 mg/kg/day published by USEPA (2010).

For assessment of potential threshold effects associated with inhalation exposure to vanadium compounds, AECOM has adopted the health based guideline value of 0.001 mg/m³ derived by WHO (2000).

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to vanadium compounds have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to vanadium compounds have therefore been assessed on the basis of threshold dose response criteria.

References

ATSDR, 2009. *Toxicological Profile for Vanadium*. Agency for Toxic Substances and Disease Registry. September, 2009.

enHealth, 2004. *Environmental Health Risk Assessment, Guidelines for Assessing Human Health Risks from Environmental Hazards*. June 2004.

NEPC, 1999. *Schedule B(4) Guideline on Health Risk Assessment Methodology*. In: National Environment Protection (Assessment of Site Contamination) Measure. National Environment Protection Council.

USEPA, 2010. *Integrated Risk Information System (IRIS)*. Electronic database maintained by the United States Environmental Protection Agency National Center for Environmental Assessment, Office of Research and Development. Accessed February 2010.

WHO, 2000. *Air Quality Guidelines for Europe. Second Edition*. World Health Organization (WHO), Regional Office for Europe. WHO Regional Publications, European Series, No. 91. 2000.

Xylenes – Toxicological profile

The following information has been taken from ATSDR (2007):

General

Xylene is primarily a synthetic chemical composed of three isomers; *meta* (*m*), *ortho* (*o*) and *para* (*p*). It is primarily used as a solvent (a liquid that can dissolve other substances) in the printing, rubber, and leather industries. Along with other solvents, xylene is also widely used as a cleaning agent, a thinner for paint, and in varnishes. Xylene is found in small amounts in airplane fuel and gasoline.

Non-carcinogenic Health Effects

Xylenes are lipophilic and are rapidly absorbed into the body by all routes of exposure. In humans, absorption has been estimated as >50% through the lungs following inhalation exposure and <50% through the gastrointestinal system and around 2% of the absorbed dose may be absorbed through the skin (via the air).

The major pathway for metabolism involves mixed function oxidases in the liver, resulting in the formation of isomers of methylhippuric acid that are eliminated in the urine. Xylenes tend not to accumulate in the body, but they may be sequestered briefly in fat tissues due to their lipophilicity; elimination of xylene is slower in individuals with a greater percentage of body fat. The primary effects of xylene exposure involve the nervous system by all routes of exposure, the respiratory tract by inhalation exposure, and, at higher oral exposure levels, hepatic, renal, and body weight effects. No adverse health effects have been associated with the background levels of xylene to which the general population is typically exposed. Isomers of xylene have similar toxicokinetic properties and elicit similar toxicological effects, with no single isomer consistently exhibiting the greatest potency, depending on the end point.

At acute-duration inhalation concentrations as low as 50 ppm, xylenes produce irritant effects on the eyes, skin, and mucous membranes; impaired respiratory function; and mild central nervous system effects, including headache and dizziness. Increases in subjective reports of eye irritation, sore throat, and neurological effects (anxiety, forgetfulness, inability to concentrate, and a sensation of intoxication) were noted following chronic-duration occupational exposure at 14 ppm. Irritation of the eye may occur from contact with xylene vapour or from direct contact with xylene liquid, in which case photophobia, redness of the conjunctiva, and partial loss of the conjunctival and corneal epithelia have been reported. Acute exposure to an estimated 10,000 ppm xylenes elicited tremors, mental confusion, and depressant effects (narcosis) on the central nervous system that caused at least one fatality due to respiratory failure. All of these effects are related to the lipophilic properties of xylenes, which interfere with the integrity of cell membranes and alter neuronal function. In addition to neurological and respiratory effects, an increase in the reporting of nausea was noted following controlled exposure to *m*-xylene at 50 ppm. Symptoms of nausea and vomiting have also been noted in workers exposed to xylene vapors.

Other effects of xylene exposure involve the liver and kidney in humans and animals and body weight effects in laboratory animals. Hepatic effects (elevated serum transaminases and hepatocellular vacuolation) were observed in a limited number of case reports describing effects of acute exposure to an estimated 700–10,000 ppm mixed xylene, but were not observed in workers with chronic occupational exposure at 14 ppm. Hepatic effects in laboratory animals exposed orally at ≥750 mg/kg/day or by inhalation at ≥300 ppm include increases in liver weight, serum enzyme levels, and cytochrome P-450 levels, but no histopathology. However, a number of authors characterized the hepatic effects in animals as adaptive rather than adverse. Information on renal effects (distal renal tubular acidemia and abnormal clinical chemistry values) of xylene in acutely exposed humans is confounded by exposure to other compounds or uncertainties as to the duration of exposure. No alterations in renal serum biochemistry values were observed in workers exposed to 14 ppm mixed xylene for several years. Renal effects in repeatedly exposed laboratory animals include increases in renal enzyme activity, cytochrome P-450 content, and increased kidney-to-body-weight ratios following inhalation exposure at 50–2,000 ppm or oral exposure and increased chronic nephropathy in rats exposed at ≥750 mg/kg/day. However, no renal effects were observed in rats exposed via inhalation to 810 ppm mixed xylenes for 13 weeks, gavage doses of 1,000 mg/kg/day 5 days/week for 13 weeks, or gavage doses of 800 mg/kg/day to *m*- or *p*-xylene for 90 consecutive days. It is not known whether the variability in induction of renal effects from mixed xylene is related to variations in the relative amounts of *o*-xylene or ethylbenzene or variations in the strains of rats tested. Decreased body weight gain has been observed in laboratory animals repeatedly exposed by inhalation at ≥700 ppm or by oral dosing or

at ≥ 700 mg/kg/day; a 5–8% reduction in body weight gain observed in male rats exposed at 500 mg/kg during the last year of a 2-year study is not considered biologically significant. Dermal exposure of humans to xylene causes skin irritation, dryness and scaling of the skin, and vasodilation. In addition, one case report demonstrated the possibility that contact urticaria can develop after several months of occupational exposure to 100 ppm xylene vapors. Dermal effects of *m*-xylene, *o*-xylene, or mixed xylenes in laboratory animal studies included skin irritation (erythema and edema) at topical doses as low as 2.3 mg/kg and more serious effects (eschar formation in some animals and epidermal thickening) at topical doses of ≥ 114 mg/kg. Rat skin that developed moderate erythema after treatment with *m*- or *o*-xylene exhibited increases in transepidermal water loss and increases in pro-inflammatory cytokines (interleukin 1- α and tumor necrosis factor- α).

Available studies of developmental or reproductive toxicity from occupational exposure to xylenes are not definitive because of the small number of subjects and/or concurrent exposure to other chemicals. In general, developmental studies in animals reported adverse fetal effects only at concentrations that caused maternal toxicity. Developmental effects in laboratory animals exposed to ≥ 350 ppm xylenes by inhalation include delayed ossification of the skeleton at maternally toxic concentrations and reduced fetal body weight, which is also influenced by maternal body weight effects. Postnatal neurobehavioral deficits (decreased rotarod performance) have been observed in rats gestationally exposed to *m*-xylene at 500 ppm. Oral exposure to 2,060 mg/kg/day of mixed xylene has been associated with cleft plate and decreased foetal weight. Dermal exposure of rats to xylene has been associated with biochemical changes in foetal and maternal brain tissue. No reproductive effects were found in rats following inhalation of 500 ppm xylene before mating and during gestation and lactation. Histopathological examination following intermediate and chronic oral bioassays revealed no adverse effects on the reproductive organs of rats and mice dosed with mixed xylene 5 days/week at 800 and 1,000 mg/kg/day, respectively.

Carcinogenicity and Genotoxicity

There is no definitive evidence for carcinogenic effects of xylene in humans. Epidemiological studies looking for associations with xylene exposure and specific cancers either reported no cases or a limited number of cases exposed to xylene and/or reported concurrent exposure to multiple solvents. Two-year cancer bioassays in rats and mice exposed by oral gavage provided no evidence for carcinogenicity of mixed xylene. Both the IARC and USEPA have determined that xylene is not classifiable as to its carcinogenicity in humans, due to inadequate evidence for the carcinogenicity of xylenes in humans and animals.

The preponderance of data from testing *in vivo* and *in vitro* indicates that xylenes are not mutagenic and do not induce chromosomal anomalies.

Published Dose-Response Values

Available chronic dose-response values published by sources recognised and endorsed by NEPC (1999) and enHealth (2004) are summarised in the following table.

Table 1: Published Dose-Response Values for Xylenes

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Oral	Tolerable Daily Intake	Threshold	0.179 mg/kg/day	NHMRC (2004)	
Oral	Acceptable Daily Intake	Threshold	0.179 mg/kg/day	WHO (2008)	
Oral	Minimal Risk Level (MRL)	Threshold	0.2 mg/kg/day	ATSDR (2007)	Chronic exposure
Oral	Reference Dose (RfD)	Threshold	0.2 mg/kg/day	USEPA (2010)	
Inhalation	Monitoring Investigation Level	Threshold	0.87mg/m ³	NEPC (2004)	Chronic exposure

Route of Exposure	Type	Threshold or Non-Threshold	Value	Source	Notes
Inhalation	Health Based Guideline	Threshold	0.87 mg/m ³	WHO (2000)	
Inhalation	Minimal Risk Level (MRL)	Threshold	0.22 mg/m ³	ATSDR (2007)	Converted from 2 ppm.
Inhalation	Reference Concentration (RfC)	Threshold	0.1 mg/m ³	USEPA (2010)	

Adopted Threshold Dose-Response Values

For assessment of potential threshold effects associated with oral exposure to xylenes, AECOM has adopted the acceptable daily intake (ADI) of 0.179 mg/kg/day adopted by NHMRC (2004) for derivation of drinking water guideline values.

For assessment of potential threshold effects associated with inhalation exposure to xylenes, AECOM has adopted the Minimal Risk Level (MRL) of 0.22 mg/m³ published by ATSDR.

Adopted Non-Threshold (Carcinogenic) Dose-Response Values

To AECOM's knowledge, non-threshold dose-response criteria for oral and inhalation exposure to xylenes have not been published by Australian or other regulatory bodies. Potential health effects associated with oral and inhalation exposure to xylenes have therefore been assessed on the basis of threshold dose response criteria.

References

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Appendix K

Odour Scenario 1 Lower Basement

1. General Information:

Site: Barangaroo
 Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Client: Lend Lease
 Scenario: Scenario 1 - Lower Basement (Odour Based Calculations)

Header Colour (Defaults = Blue):
 Blue

2. Select Receptor:
 Commercial/Industrial

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐ Incidental Ingestion of Soil

☐ Dermal Contact with Soil

☐ Inhalation of Surface Soil-Derived Dust in Indoor Air

☐ Inhalation of Surface Soil-Derived Dust in Outdoor Air

☐ Inhalation of Surface Soil-Derived Vapours in Outdoor Air

☐ Inhalation of Soil-Derived Vapours From Excavation (USEPA 2002 method)

☐ Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

☐ Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐ Inhalation of Groundwater-Derived Vapours in Indoor Air

☐ Inhalation of Groundwater-Derived Vapours in Outdoor Air

☐ Ingestion of Potable Groundwater

☐ Incidental Ingestion of Groundwater (Bathing or Excavation)

☐ Dermal Contact with Groundwater (Bathing or Excavation)

☐ Inhalation of Groundwater Vapours during Irrigation/ Showering

☐ Ingestion of Vegetables Irrigated with Groundwater

☐ Inhalation of Groundwater Vapours (Where GW Enters Trench)

☒ Inhalation of vapour emissions from flowing water (groundwater in basement)

☐ Inhalation of Soil Vapour-Derived Vapours in Indoor Air

☐ Inhalation of Soil Vapour-Derived Vapours in Outdoor Air

☐ Soil RBSLs saturation limited?

☐ Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1 for media for which you want RBSLs):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05	348	
Aniline	1	1.00E-05	0.212	
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05	0.024	
Barium	1	1.00E-05	2.23	
Benz(a)anthracene		1.00E-05	1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene		1.00E-05	652	9.26
Benzo(b)fluoranthene		1.00E-05	587	8.33
Benzo(g,h,i)perylene		1.00E-05	305	4.22
Benzo(k)fluoranthene		1.00E-05	231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05	0.03	
Cadmium (Water)	1	1.00E-05	0.108	
Chromium(III), Insoluble Sal	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene		1.00E-05	771	9.78
Cobalt	1	1.00E-05	0.057	
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05	182	
Blank				
Dibenz(a,h)anthracene		1.00E-05	71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05	38	
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene		1.00E-05	2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene		1.00E-05	247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05	4.89	
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05	0.303	
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05	249	
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05	0.194	
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

6. Confirm/Modify Exposure Parameters:

	Units	Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child
General receptor parameters:					
Body weight	kg	70	13	70	13
Exposure duration	yr	64	6	64	6
Averaging time (carcinogens)	yr	70	70	70	70
Averaging time (non-carcinogens)	yr	64	6	64	6
Incidental Soil Ingestion					
Daily soil ingestion rate	mg/day				
Exposure frequency for soil ingestion	days/yr				
Fraction of daily soil intake from site	unitless				
Dermal Absorption of Soil					
Exposed skin surface area for soil contact	cm2				
Soil to skin adherence factor	mg/cm2				
Exposure frequency for dermal contact with soil	days/yr				
Indoor Inhalation					
Exposure time (indoor air)	hrs/day				
Exposure frequency (indoor air)	days/yr				
Particulate emission factor (indoor air)	m3/kg				
Outdoor Inhalation					
Exposure time (outdoor air)	hrs/day				
Exposure frequency (outdoor air)	days/yr				
Particulate emission factor (outdoor air)	m3/kg				
Potable Water Ingestion					
Potable water intake rate	L/day				
Exposure frequency for potable water intake	days/yr				
Incidental Water Ingestion					
Incidental ingestion rate	L/day				
Exposure frequency for incidental water ingestion	days/yr				
Dermal Contact with Water					
Exposed skin surface for water contact	cm2				
Exposure time for dermal water contact	hr/day				
Exposure frequency for dermal water contact	days/yr				
Vapour Inhalation Shower/ Sprinkler					
Exposure frequency	days/yr				
Exposure time	min/ day				
Inhalation rate	m3/hr				
Inhalation Absorption Adjustment Factor	mg/mg				
Lung retention factor	unitless				
Ingestion of Home Grown Produce					
Proportion of homegrown produce ingested					
Exposure frequency	days/year				
Inhalation of Vapours from Flowing Water					
Exposure time	hrs/day	1	1	1	1
Exposure frequency	days/year	350	350	350	350

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Calculation of Vapour Emissions from Water with Flow
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement (Odour Based Calculations) Scenario

PARAMETERS							Dimensions of Wet Section of Basement/ Impoundment												
Concrete permeability		(select from drop down list)		High permeability		Length (m)		35.0		Air exchange rate (exchanges/day)		9.60E+01							
Permeability Rate (m/day)		8.6 E-02				Width (m)		15.0		Windspeed (m/s)		if < 3.5m/sec							
Water Temperature (deg. C)		18.0				Depth of Water (m)		0.01		if = or > 3.5m/sec									
Dimensions of Basement / Impoundment							Fetch/ Depth (m) ratio of Wet Basement Section		1500										
Height (m)		2.5				Volume of wet basement/ impoundment (m3)		5.2500											
Width (m)		30.0				Area covered in water (m2)		525											
Depth (m)		30.0				Effective diameter of impoundment/ basement) (m)		25.9											
Volume total basement/ impoundment (m3)		2250				Volume of water entering basement (m³/sec)		5.25E-06											
Parameter Definition	Volatile	Chemical Concentration in Water (mg/L)	Molecular weight (g/mol)	Vapour Pressure (mmHg)	Vapour Pressure (atm)	Henry's Law Coefficient (unitless)	Henry's Law Coefficient (calculated)	Equilibrium Coefficient (at 25 deg C)	Diffusivity in Water (cm²/sec)	Schmidt Number on Gas Side (*)	Gas Phase Mass Transfer Coefficient (m/sec)	Schmidt Number on Liquid Side #	Liquid Phase Mass Transfer Coefficient (m/sec) **	Overall Mass Transfer Coefficient (m/s) (windspeed <3.5 m/s)	Diffusivity in Air (cm2/sec)	Equilibrium Concentration of water in Basement/ Impoundment (g/m³)	Air Emission Rate from Liquid Surface (g/sec)	Air Emission Rate from Liquid Surface (mg/day)	Adjusted Concentration in Basement Air (includes air exchange) (mg/m3)
		C	MW	Vap	Vap	unitless	atm.m3/g mol	K _{ow}	D _{water}	Sc _G	k _G	Sc _L	k _L	K	D _{air}	C _L		E	
Acenaphthene	Y	4.48	154	2.15E-03	2.83E-06	7.52E-03	1.80E-04	7.345E-03	8.33E-06	3.0E+00	1.052E-04	1.08E+03	2.74E-07	2.0E-07	0.0506	1.6E-01	1.67E-05	1.45E+03	6.70E-03
Acenaphthylene	Y	43.2	152	6.68E-03	8.79E-06	4.66E-03	1.11E-04	4.551E-03	6.98E-06	3.4E+00	9.725E-05	1.29E+03	2.44E-07	1.6E-07	0.045	1.7E+00	1.40E-04	1.21E+04	5.62E-02
Ammonia	Y	348	17	-	-	6.58E-04	1.57E-05	6.427E-04	1.10E-05	6.6E-01	2.884E-04	8.18E+02	3.30E-07	1.2E-07	0.228	1.0E+01	6.38E-04	5.51E+04	2.55E-01
Aniline	Y	0.212	93	4.90E-01	6.45E-04	8.26E-05	1.97E-06	8.067E-05	1.01E-05	1.8E+00	1.466E-04	8.91E-02	3.12E-07	1.1E-08	0.083	3.94E-08	3.40E+00	1.59E-05	-
Anthracene	Y	15.4	178	6.53E-06	8.59E-09	2.27E-03	5.42E-05	2.217E-03	7.85E-06	3.9E+00	8.836E-05	1.15E+03	2.64E-07	1.1E-07	0.039	5.6E-01	3.32E-05	2.87E+03	1.33E-02
Arsenic, inorganic	N	0.024	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	N	2.23	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	N	12.6	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	Y	40.2	78.1	9.48E+01	1.25E-01	2.27E-01	5.42E-03	2.217E-01	1.03E-05	1.7E+00	1.542E-04	8.74E+02	3.16E-07	3.1E-07	0.0895	1.2E+00	2.03E-04	1.75E+04	8.11E-02
Benz(b)fluoranthene	N	8.33	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	N	4.22	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	N	2.93	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	N	0.03	391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	N	0.108	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	N	9.78	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	N	0.057	58.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p	Y	436	108	1.10E-01	1.45E-04	3.50E-05	8.36E-07	3.418E-05	9.32E-06	2.1E+00	1.344E-04	9.66E+02	2.96E-07	4.5E-09	0.0729	1.4E+01	3.39E-05	2.93E+03	1.35E-02
Cresol, o	N	182	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	N	0.822	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	Y	10.2	168	2.48E-03	3.26E-06	8.71E-03	2.08E-04	8.507E-03	7.38E-06	3.7E+00	9.137E-05	1.22E+03	2.53E-07	1.9E-07	0.041	3.9E-01	3.89E-05	3.36E+03	1.55E-02
Dimethylphenol, 2,4-	Y	38	122	1.02E-01	1.34E-04	3.89E-05	9.29E-07	3.799E-05	8.31E-06	2.4E+00	1.208E-04	1.08E+03	2.74E-07	4.5E-09	0.0622	1.3E+00	3.17E-06	2.74E+02	1.27E-03
Ethylbenzene	Y	3.02	106	9.60E+00	1.26E-02	3.22E-01	7.69E-03	3.145E-01	8.46E-06	2.2E+00	1.289E-04	1.06E+03	2.77E-07	2.8E-07	0.0685	1.1E-01	1.52E-05	1.31E+03	6.08E-03
Fluoranthene	N	25.9	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	Y	21.1	166	6.00E-04	7.90E-07	3.93E-03	9.38E-05	3.838E-03	7.89E-06	3.4E+00	9.580E-05	1.14E+03	2.65E-07	1.5E-07	0.044	7.7E-01	6.21E-05	5.36E+03	2.48E-02
Indeno(1,2,3-cd)pyrene	N	3.05	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	N	187	55.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	N	0.555	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	N	4.89	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	Y	105	142	5.50E-02	7.24E-05	2.12E-02	5.06E-04	2.071E-02	7.78E-06	2.9E+00	1.077E-04	1.16E+03	2.62E-07	2.3E-07	0.0524	3.9E+00	4.75E-04	4.11E+04	1.90E-01
Naphthalene	Y	283	128	8.50E-02	1.12E-04	1.80E-02	4.30E-04	1.758E-02	8.38E-06	2.5E+00	1.186E-04	1.07E+03	2.75E-07	2.4E-07	0.0605	9.9E+00	1.27E-03	1.09E+05	5.07E-01
Nickel Soluble Salts	N	0.303	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	Y	74.1	178	1.21E-04	1.59E-07	1.73E-03	4.13E-05	1.690E-03	6.69E-06	4.4E+00	8.139E-05	1.35E+03	2.37E-07	8.7E-08	0.0345	3.0E+00	1.37E-04	1.18E+04	5.48E-02
Phenol	Y	249	94.1	3.50E-01	4.61E-04	1.36E-05	3.25E-07	1.328E-05	1.03E-05	1.8E+00	1.470E-04	8.74E+02	3.16E-07	1.9E-09	0.0834	7.6E+00	6.73E-06	6.73E+02	3.11E-03
Pyrene	Y	27.9	202	4.50E-06	5.92E-09	4.87E-04	1.16E-05	4.756E-04	7.25E-06	5.4E+00	7.043E-05	1.24E+03	2.50E-07	3.0E-08	0.0278	1.1E+00	1.66E-05	1.44E+03	6.66E-03
Styrene	Y	0.194	104	6.40E+00	8.42E-03	1.12E-01	2.67E-03	1.094E-01	8.78E-06	2.1E+00	1.321E-04	1.03E+03	2.84E-07	2.8E-07	0.0711	6.6E-03	9.65E-07	8.34E+01	3.86E-04
Toluene	Y	17.6	92.1	2.84E+01	3.74E-02	2.71E-01	6.47E-03	2.647E-01	9.20E-06	1.9E+00	1.403E-04	9.78E+02	2.93E-07	2.9E-07	0.0778	5.8E-01	8.87E-05	7.66E+03	3.55E-02
TPH C06-C09 aliphatic	Y	6.08	103	9.16E+01	1.21E-01	5.05E+01	1.21E+00	4.932E+01	1.00E-05	1.5E+00	1.660E-04	9.00E+02	3.10E-07	3.1E-07	0.1	1.9E-01	3.09E-05	2.67E+03	1.24E-02
TPH C10-C14 aliphatic	Y	1730	170	1.16E+00	1.53E-03	6.26E+01	1.49E+00	6.114E+01	1.00E-05	1.5E+00	1.660E-04	9.00E+02	3.10E-07	3.1E-07	0.1	5.4E+01	8.80E-03	7.76E+05	3.52E+00
TPH C10-C14 aromatic	Y	1730	136	1.16E+00	1.53E-03	1.41E-01	3.37E-03	1.377E-01	1.00E-05	1.5E+00	1.660E-04	9.00E+02	3.10E-07	3.1E-07	0.1	5.4E+01	8.68E-03	7.50E+05	3.47E+00
TPH C15-C28 aliphatic	n	1520	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	n	1520	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	n	332	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	N	332	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	Y	0.92	120	2.10E+00	2.76E-03	2.52E-01	6.02E-03	2.461E-01	7.92E-06	2.5E+00	1.188E-04	1.14E+03	2.65E-07	2.6E-07	0.0607	3.3E-02	4.61E-06	3.99E+02	1.85E-03
Vanadium and compounds	N	0.0228	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	Y	6.7	106	7.99E+00	1.05E-02	2.12E-01	5.06E-03	2.071E-01	9.90E-06	1.8E+00	1.486E-04	9.09E+02	3.08E-07	3.0E-07	0.0847	2.1E-01	3.37E-05	2.91E+03	1.35E-02

Notes:
Assumes viscosity of air at 25 deg C
(*) Adopted density and viscosity of air values are those published in USEPA Air Emissions for Wast and Waste Water Nov 1994. (viscosity = 1.81 x 10⁻⁴, density = 1.2 x 10⁻³)
** where windspeeds are greater than 3.25 m/s, F/D ratios greater than 51.2 and diffusivity of ether is 8.5 x 10⁻⁵
Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Summary of Derived RBSLs

[Back to User Input Sheet](#)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 1 - Lower Basement (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	-	-	-	-	-	-	1.47E+03	1.47E+03	-	1.47E+03	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	6.15E+05	6.15E+05	-	6.15E+05	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	1.41E+06	1.41E+06	-	1.41E+06	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	3.38E+05	3.38E+05	-	3.38E+05	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	-	-	-	-	-	-	9.97E+02	9.97E+02	-	9.97E+02	-	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	4.99E+03	4.99E+03	-	4.99E+03	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	6.22E+03	6.22E+03	-	6.22E+03	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	-	-	-	-	-	-	3.76E+01	3.76E+01	-	3.76E+01	>Sol	1.05E+02
Naphthalene	-	-	-	-	-	-	1.35E+02	1.35E+02	-	1.35E+02	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	3.08E+05	3.08E+05	-	3.08E+05	>Sol	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	1.71E+04	1.71E+04	-	1.71E+04	>Sol	1.94E-01
Toluene	-	-	-	-	-	-	9.36E+04	9.36E+04	-	9.36E+04	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	-	-	-	-	-	-	2.45E+04	2.45E+04	-	2.45E+04	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	-	-	-	-	-	-	1.35E+04	1.35E+04	-	1.35E+04	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

Pathways included in derivation of Soil Vapour RBSL:

Pathways included in derivation of Groundwater RBSL:

Health Risk Calculations - Vapours from Flowing Water
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement A (Residential Receptor) (Odour Based Calculations) Scenario

Chemical	Vapour Concentration in Basement/ Impoundment mg/m ³	Aqueous Solubility (mg/L)	Threshold Intake and Risk Calculations						
			Inhalation RFC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (L/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	6.70E-03	3.90E+00	5.04E-01	4.00E-02	2.68E-04	5.31E-04	4.00E-02	2.68E-04	5.31E-04
Acenaphthylene	5.62E-02	1.61E+01	-	4.00E-02	2.25E-03	-	4.00E-02	2.25E-03	-
Ammonia	2.55E-01	4.82E+05	1.80E+01	4.00E-02	1.02E-02	5.66E-04	4.00E-02	1.02E-02	5.66E-04
Aniline	1.58E-05	3.60E+04	4.19E+00	4.00E-02	6.30E-07	1.50E-07	4.00E-02	6.30E-07	1.50E-07
Anthracene	1.33E-02	4.34E-02	-	4.00E-02	5.31E-04	-	4.00E-02	5.31E-04	-
Arsenic, Inorganic	-	0.00E+00	-	-	-	-	-	-	-
Barium	-	0.00E+00	-	-	-	-	-	-	-
Benz(a)anthracene	-	9.40E-03	-	-	-	-	-	-	-
Benzene	8.11E-02	1.79E+03	1.09E+02	4.00E-02	3.24E-03	2.97E-05	4.00E-02	3.24E-03	2.97E-05
Benzo(a)pyrene	-	1.62E-03	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	1.50E-03	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	2.60E-04	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	8.00E-04	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	2.70E-01	-	-	-	-	-	-	-
Cadmium (Water)	-	0.00E+00	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Chromium(VI)	-	1.69E+06	-	-	-	-	-	-	-
Chrysene	-	2.00E-03	-	-	-	-	-	-	-
Cobalt	-	0.00E+00	-	-	-	-	-	-	-
Cresol, m-&p-	1.35E-02	2.27E+04	1.24E-03	4.00E-02	5.41E-04	4.37E-01	4.00E-02	5.41E-04	4.37E-01
Cresol, o-	-	2.59E+04	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	2.49E-03	-	-	-	-	-	-	-
Dibenzofuran	1.55E-02	3.10E+00	1.00E+00	4.00E-02	6.21E-04	6.21E-04	4.00E-02	6.21E-04	6.21E-04
Dimethylphenol, 2,4-	1.27E-03	7.87E+03	-	4.00E-02	5.07E-05	-	4.00E-02	5.07E-05	-
Ethylbenzene	6.08E-03	1.69E+02	2.00E+00	4.00E-02	2.43E-04	1.21E-04	4.00E-02	2.43E-04	1.21E-04
Fluoranthene	-	2.60E-01	-	-	-	-	-	-	-
Fluorene	2.48E-02	1.69E+00	-	4.00E-02	9.92E-04	-	4.00E-02	9.92E-04	-
Indeno(1,2,3-cd)pyrene	-	1.90E-04	-	-	-	-	-	-	-
Iron	-	0.00E+00	-	-	-	-	-	-	-
Lead and Compounds	-	0.00E+00	-	-	-	-	-	-	-
Manganese	-	0.00E+00	-	-	-	-	-	-	-
Methylnaphthalene, 2-	1.90E-01	2.46E+01	5.81E-02	4.00E-02	7.59E-03	1.31E-01	4.00E-02	7.59E-03	1.31E-01
Naphthalene	5.07E-01	3.10E+01	4.40E-01	4.00E-02	2.02E-02	4.60E-02	4.00E-02	2.02E-02	4.60E-02
Nickel Soluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Phenanthrene	5.48E-02	1.15E+00	-	4.00E-02	2.19E-03	-	4.00E-02	2.19E-03	-
Phenol	3.11E-03	8.28E+04	1.54E-01	4.00E-02	1.24E-04	8.08E-04	4.00E-02	1.24E-04	8.08E-04
Pyrene	6.66E-03	1.35E-01	-	4.00E-02	2.66E-04	-	4.00E-02	2.66E-04	-
Styrene	3.86E-04	3.10E+02	1.36E+00	4.00E-02	1.54E-05	1.13E-05	4.00E-02	1.54E-05	1.13E-05
Toluene	3.55E-02	5.26E+02	3.01E+01	4.00E-02	1.42E-03	4.70E-05	4.00E-02	1.42E-03	4.70E-05
TPH C06-C09 aliphatic	1.24E-02	1.18E+01	-	4.00E-02	4.94E-04	-	4.00E-02	4.94E-04	-
TPH C10-C14 aliphatic	3.52E+00	9.99E-02	-	4.00E-02	3.99E-03	-	4.00E-02	3.99E-03	-
TPH C10-C14 aromatic	3.47E+00	2.53E+01	-	4.00E-02	1.39E-01	-	4.00E-02	1.39E-01	-
TPH C15-C28 aliphatic	-	1.11E-04	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	1.06E+00	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	2.50E-06	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	6.60E-03	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.85E-03	5.70E+01	1.96E+00	4.00E-02	7.37E-05	3.76E-05	4.00E-02	7.37E-05	3.76E-05
Vanadium and compounds	-	-	-	-	-	-	-	-	-
Xylenes (total)	1.35E-02	1.06E+02	4.34E+00	4.00E-02	5.39E-04	1.24E-04	4.00E-02	5.39E-04	1.24E-04

TOTAL

6.17E-01

6.17E-01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement A (Residential Receptor) (Odour Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW vapours from flowing water unitless	TOTAL (All Pathways) unitless	GW vapours from flowing water unitless	Total Vapour Pathways L/mg	TOTAL (All Pathways) L/mg					GW vapours from flowing water %	TOTAL %
Acenaphthene	4.48	3.90E+00	5.31E-04	5.31E-04	1.36E-04	1.36E-04	1.36E-04	1.47E+03	5.31E-04	5.31E-04	1.47E+03	0.3%	0.27%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	5.66E-04	5.66E-04	1.63E-06	1.63E-06	1.63E-06	6.15E+05	7.84E-01	7.84E-01	6.15E+05	78.4%	78.41%
Aniline	0.212	3.60E+04	1.50E-07	1.50E-07	7.09E-07	7.09E-07	7.09E-07	1.41E+06	2.55E-02	2.55E-02	1.41E+06	2.6%	2.55%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	2.97E-05	2.97E-05	7.39E-07	7.39E-07	7.39E-07	3.38E+05	1.32E-03	1.32E-03	3.38E+05	0.5%	0.53%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	4.37E-01	4.37E-01	1.00E-03	1.00E-03	1.00E-03	9.97E+02	1.00E+00	-	9.97E+02	100.0%	100.00%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.21E-04	6.21E-04	2.00E-04	2.00E-04	2.00E-04	4.99E+03	6.21E-04	6.21E-04	4.99E+03	0.1%	0.06%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.21E-04	1.21E-04	4.02E-05	4.02E-05	4.02E-05	6.22E+03	6.80E-03	6.80E-03	6.22E+03	2.7%	2.72%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.31E-01	1.31E-01	5.31E-03	5.31E-03	5.31E-03	3.76E+01	1.31E-01	1.31E-01	3.76E+01	65.3%	65.35%
Naphthalene	283	3.10E+01	4.60E-02	4.60E-02	1.48E-03	1.48E-03	1.48E-03	1.35E+02	4.60E-02	4.60E-02	1.35E+02	23.0%	23.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	8.08E-04	8.08E-04	3.25E-06	3.25E-06	3.25E-06	3.08E+05	2.69E-01	2.69E-01	3.08E+05	26.9%	26.87%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.13E-05	1.13E-05	5.84E-05	5.84E-05	5.84E-05	1.71E+04	1.81E-02	1.81E-02	1.71E+04	1.8%	1.81%
Toluene	17.6	5.26E+02	4.70E-05	4.70E-05	2.67E-06	2.67E-06	2.67E-06	9.36E+04	1.41E-03	1.41E-03	9.36E+04	0.6%	0.56%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.76E-05	3.76E-05	4.08E-05	4.08E-05	4.08E-05	2.45E+04	2.33E-03	2.33E-03	2.45E+04	0.2%	0.23%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	1.24E-04	1.24E-04	1.86E-05	1.86E-05	1.86E-05	1.35E+04	1.97E-03	1.97E-03	1.35E+04	0.8%	0.79%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 1 - Lower Basement A (Residential Receptor) (Odour Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapurs from Flowing Water	TOTAL (All Pathways)	GW Vapour from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)					GW Vapours from Flowing Water	TOTAL
	mg/L	mg/L	unitless	unitless	unitless	L/mg	L/mg	mg/L			mg/L	%	%
Acenaphthene	4.48	3.90E+00	5.31E-04	5.31E-04	1.36E-04	1.36E-04	1.36E-04	1.47E+03	5.31E-04	5.31E-04	1.47E+03	0.3%	0.27%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	5.66E-04	5.66E-04	1.63E-06	1.63E-06	1.63E-06	6.15E+05	7.84E-01	7.84E-01	6.15E+05	78.4%	78.41%
Aniline	0.212	3.60E+04	1.50E-07	1.50E-07	7.09E-07	7.09E-07	7.09E-07	1.41E+06	2.55E-02	2.55E-02	1.41E+06	2.6%	2.55%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	2.97E-05	2.97E-05	7.39E-07	7.39E-07	7.39E-07	3.38E+05	1.32E-03	1.32E-03	3.38E+05	0.5%	0.53%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	4.37E-01	4.37E-01	1.00E-03	1.00E-03	1.00E-03	9.97E+02	1.00E+00	-	9.97E+02	100.0%	100.00%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.21E-04	6.21E-04	2.00E-04	2.00E-04	2.00E-04	4.99E+03	6.21E-04	6.21E-04	4.99E+03	0.1%	0.06%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.21E-04	1.21E-04	4.02E-05	4.02E-05	4.02E-05	6.22E+03	6.80E-03	6.80E-03	6.22E+03	2.7%	2.72%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.31E-01	1.31E-01	5.31E-03	5.31E-03	5.31E-03	3.76E+01	1.31E-01	1.31E-01	3.76E+01	65.3%	65.35%
Naphthalene	283	3.10E+01	4.60E-02	4.60E-02	1.48E-03	1.48E-03	1.48E-03	1.35E+02	4.60E-02	4.60E-02	1.35E+02	23.0%	23.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	8.08E-04	8.08E-04	3.25E-06	3.25E-06	3.25E-06	3.08E+05	2.69E-01	2.69E-01	3.08E+05	26.9%	26.87%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.13E-05	1.13E-05	5.84E-05	5.84E-05	5.84E-05	1.71E+04	1.81E-02	1.81E-02	1.71E+04	1.8%	1.81%
Toluene	17.6	5.26E+02	4.70E-05	4.70E-05	2.67E-06	2.67E-06	2.67E-06	9.36E+04	1.41E-03	1.41E-03	9.36E+04	0.6%	0.56%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.76E-05	3.76E-05	4.08E-05	4.08E-05	4.08E-05	2.45E+04	2.33E-03	2.33E-03	2.45E+04	0.2%	0.23%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	1.24E-04	1.24E-04	1.86E-05	1.86E-05	1.86E-05	1.35E+04	1.97E-03	1.97E-03	1.35E+04	0.8%	0.79%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix L

Odour Scenario 2 Upper Basement

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Land Lease
Scenario: Scenario 2 - Upper Basement (Odour Based Calculations)

Header Colour (Defaults = Blue):
Blue

2. Select Receptor:

Commercial/Industrial

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

Incidental Ingestion of Soil

Dermal Contact with Soil

Inhalation of Surface Soil-Derived Dust in Indoor Air

Inhalation of Surface Soil-Derived Dust in Outdoor Air

Inhalation of Soil-Derived Vapours From Excavation (USEPA 2002 method)

x Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

Inhalation of Groundwater-Derived Vapours in Indoor Air

Inhalation of Groundwater-Derived Vapours in Outdoor Air

Ingestion of Potable Groundwater

Incidental Ingestion of Groundwater (Bathing or Excavation)

Dermal Contact with Groundwater (Bathing or Excavation)

Inhalation of Groundwater Vapours during Irrigation/ Showering

Ingestion of Vegetables Irrigated with Groundwater

Inhalation of Groundwater Vapours (Where GW Enters Trench)

x Inhalation of vapour emissions from flowing water (groundwater in basement)

Inhalation of Soil Vapour-Derived Vapours in Indoor Air

Inhalation of Soil Vapour-Derived Vapours in Outdoor Air

Y Soil RBSLs saturation limited?
Y Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (If only calculating RBSLs, enter 1 for media for which you want RBSLs)	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁶ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benzo(a)anthracene		1.00E-05	1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene		1.00E-05	652	9.26
Benzo(b)fluoranthene		1.00E-05	587	8.33
Benzo(g,h,i)perylene		1.00E-05	305	4.22
Benzo(k)fluoranthene		1.00E-05	231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Sal	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene		1.00E-05	771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene		1.00E-05	71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene		1.00E-05	2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene		1.00E-05	247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

	Units	Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child

General receptor parameters:					
Body weight	kg	70	na	70	
Exposure duration	yr	30	na	30	
Averaging time (carcinogens)	yr	70	na	70	
Averaging time (non-carcinogens)	yr	30	na	30	

Incidental Soil Ingestion					
Daily soil ingestion rate	mg/day				
Exposure frequency for soil ingestion	days/yr				
Fraction of daily soil intake from site	unitless				

Dermal Absorption of Soil					
Exposed skin surface area for soil contact	cm2				
Soil to skin adherence factor	mg/cm2				
Exposure frequency for dermal contact with soil	days/yr				

Indoor Inhalation					
Exposure time (indoor air)	hrs/day	8		8	
Exposure frequency (indoor air)	days/yr	240		240	
Particulate emission factor (indoor air)	m3/kg				

Outdoor Inhalation					
Exposure time (outdoor air)	hrs/day				
Exposure frequency (outdoor air)	days/yr				
Particulate emission factor (outdoor air)	m3/kg				

Potable Water Ingestion					
Potable water intake rate	L/day				
Exposure frequency for potable water intake	days/yr				

Incidental Water Ingestion					
Incidental ingestion rate	L/day				
Exposure frequency for incidental water ingestion	days/yr				

Dermal Contact with Water					
Exposed skin surface for water contact	cm2				
Exposure time for dermal water contact	hr/day				
Exposure frequency for dermal water contact	days/yr				

Vapour Inhalation Shower/ Sprinkler					
Exposure frequency	days/yr				
Exposure time	min/ day				
Inhalation rate	m3/hr				
Inhalation Absorption Adjustment Factor	mg/mg				
Lung retention factor	unitless				

Ingestion of Home Grown Produce					
Proportion of homegrown produce ingested					
Exposure frequency	days/year				

Inhalation of Vapours from Flowing Water					
Exposure time	hrs/day	8	8	8	8
Exposure frequency	days/year	240	240	240	240

Vapour Modelling - Soil to Outdoor and Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	0.001	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100		0.001	HV	0.001	Negligible distance - assumes soil is adjacent building foundation.
				Sand and gravel (<12% fines)			Conservative assumption for mixed fill.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Vadose zone biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)	1875	LB	1875	Assumes 25 m by 25 m by 3 m high basement section, with soil vapour infiltration through upper 2 m of 2 of 4 walls only, ie volume = 1875 m3 and infiltration area = 100 m2. See text.
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	600 mm diaphragm outer wall assumed, as per LLD
Enclosed-space air exchange rate	1/s	0.000555556		0.001111111	ENCAER	1.11E-03	4 per hour, in accordance with AS1668.2
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.0002	NU	0.0002	USEPA (2004) default for basement foundation.
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	Assumes cracks in concrete are filled with sand.
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	wvchd	0.054	Assumes cracks in concrete are filled with sand.
<u>Convective vapour flow term</u>							
Calculate convective flow term?		Y		y	Conv	y	
							Negligible rate to account for assumption that advective flow not likely. Air flow will not be possible with wetted wall.
Convective flow rate (if specified directly)	cm3/sec			0.001			
Convective flow through slab (calculated)	cm3/sec	10.88		175.2668575	Qs	175.27	
Slab Area	cm2	700000		7.25E+06	Ab	7250000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019		0.0002	Nuc		
Soil vapour permeability	cm ²	1.00E-08		1.00E-07	kv	1.00E-07	
Indoor-outdoor pressure differential	g/cm-s ²	40		4.00E+01	dP	40	
Slab perimeter	cm	3400		1.00E+04	Xcrack	10000	
Depth below ground to bottom of slab	cm	15		2.00E+02	Zcrack	200	
Viscosity of air	g/cm-s	1.81E-04		1.81E-04	uair	1.81E-04	

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

(f) USEPA (2002) default (0.5 acre).

Vapour Modelling - Soil to Outdoor and Indoor Air
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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{soil}	D ^{water}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O/cc-air)	(mg/g-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Arsenic, inorganic	-	-	-	-	-	-	7.80E+01	-	N
Barium	-	-	-	-	-	-	1.37E+02	-	N
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Cadmium (Water)	-	-	-	-	-	-	1.12E+02	-	N
Chromium(III), Insoluble Salts	-	-	-	-	-	-	5.20E+01	-	N
Chromium(VI)	-	-	-	1.69E+06	-	-	5.20E+01	-	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cobalt	-	-	-	-	-	-	5.89E+01	-	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Iron	-	-	-	-	-	-	5.59E+01	-	N
Lead and Compounds	-	-	-	-	-	-	2.07E+02	-	N
Manganese	-	-	-	-	-	-	5.49E+01	-	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Nickel Soluble Salts	-	-	-	-	-	-	5.87E+01	-	N
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	N
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	N
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Vanadium and compounds	-	-	-	-	-	-	5.09E+01	-	N
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+02	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{soil}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{water}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1} (cm ² /s)	D _{s2} (cm ² /s)	D _{s3} (cm ² /s)	D _{soil} (cm ² /s)	D _{crack} (cm ² /s)	C _{sat} (mg/kg)	Convective Factor (unitless)	D _a (cm ² /s)	M _{excav} (g)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	3.94E+01	2.22E+02	3.66E-06	7.25E+04
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	1.63E+02	2.49E+02	2.02E-06	5.38E+04
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	1.87E+04	4.92E+01	3.75E-04	7.34E+05
Aniline	1.35E-02	-	-	1.35E-02	1.35E-02	6.23E+03	1.35E+02	3.86E-06	7.45E+04
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	1.42E+00	2.88E+02	2.62E-07	1.94E+04
Arsenic, Inorganic	NV	NV	NV	NV	NV	-	NV	NV	NV
Barium	NV	NV	NV	NV	NV	-	NV	NV	NV
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV	NV	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	6.59E+02	1.25E+02	5.35E-03	2.77E+06
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Cadmium (Water)	NV	NV	NV	NV	NV	-	NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV	NV	NV	NV	-	NV	NV	NV
Chromium(VI)	NV	NV	NV	NV	NV	-	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV	NV	NV
Cobalt	NV	NV	NV	NV	NV	-	NV	NV	NV
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	1.19E-02	1.44E+04	1.52E+02	3.95E-07	2.38E+04
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV	NV	NV
Blank	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	5.69E+01	2.74E+02	1.89E-06	5.21E+04
Dimethylphenol, 2,4-	1.01E-02	-	-	1.01E-02	1.01E-02	8.00E+03	1.79E+02	2.33E-07	1.83E+04
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	1.67E+02	1.64E+02	2.17E-03	1.77E+06
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	3.10E+01	2.55E+02	9.14E-07	3.62E+04
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV	NV	NV
Iron	NV	NV	NV	NV	NV	-	NV	NV	NV
Lead and Compounds	NV	NV	NV	NV	NV	-	NV	NV	NV
Manganese	NV	NV	NV	NV	NV	-	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	1.23E+02	2.14E+02	2.16E-05	1.76E+05
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	9.66E+01	1.85E+02	3.39E-05	2.21E+05
Nickel Soluble Salts	NV	NV	NV	NV	NV	-	NV	NV	NV
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	3.84E+01	3.25E+02	1.73E-07	1.58E+04
Phenol	1.38E-02	-	-	1.38E-02	1.38E-02	3.37E+04	1.31E+02	2.77E-07	2.00E+04
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.47E+01	4.03E+02	1.21E-08	4.17E+03
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	2.93E+02	1.58E+02	8.17E-04	1.08E+06
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	2.91E+02	1.44E+02	3.70E-03	2.31E+06
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	2.21E+02	1.12E+02	2.61E-02	6.13E+06
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.11E+02	1.12E+02	5.46E-04	8.86E+05
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.54E+02	1.12E+02	2.24E-04	5.68E+05
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	7.46E+01	1.85E+02	1.13E-03	1.28E+06
Vanadium and compounds	NV	NV	NV	NV	NV	-	NV	NV	NV
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	8.90E+01	1.32E+02	2.08E-03	1.73E+06

Definition of Parameters

D_s Effective diffusion coefficient in soil based on vapor-phase concentration
D_{crack} Effective diffusion coefficient through foundation cracks
C_{sat} Soil concentration at which dissolved pore-water and vapor phases become saturated

D_a = Apparent diffusivity (for construction scenario Volatilisation Factor)
M_{excav} = Cumulative unit mass emitted from excavation (Eq E-13 in USEPA, 2002).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1} (mgm ³ -air / mgkg-soil)	VF _{as2} (mgm ³ -air / mgkg-soil)	VF _{p (indoor)} (mgm ³ -air / mgkg-soil)	VF _{p (outdoor)} gim ³ -air / mgkg-s	VF _{samb} (mgm ³ -air / mgkg-soil)	VF _{seep} (mgm ³ -air / mgkg-soil)	VF _{excav} (mgm ³ -air / mgkg-soil)
Acenaphthene	1.17E-05	1.75E-05	-	-	3.35E-01	8.64E-06	-3.12E+08
Acenaphthylene	8.66E-06	1.75E-05	-	-	1.94E-01	5.36E-06	-2.32E+08
Ammonia	1.18E-04	1.75E-05	-	-	1.33E+01	1.96E-04	-3.16E+09
Aniline	1.20E-05	1.75E-05	-	-	2.74E-01	5.54E-06	-3.21E+08
Anthracene	3.12E-06	1.75E-05	-	-	2.67E-02	8.02E-07	-8.35E+07
Arsenic, Inorganic	NV	NV	-	-	NV	NV	NV
Barium	NV	NV	-	-	NV	NV	NV
Benz(a)anthracene	NV	NV	-	-	NV	NV	NV
Benzene	4.46E-04	1.75E-05	-	-	3.64E+02	7.15E-03	-1.19E+10
Benzo(a)pyrene	NV	NV	-	-	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	-	-	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	-	-	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	-	-	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	-	-	NV	NV	NV
Cadmium (Water)	NV	NV	-	-	NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV	-	-	NV	NV	NV
Chromium(VI)	NV	NV	-	-	NV	NV	NV
Chrysene	NV	NV	-	-	NV	NV	NV
Cobalt	NV	NV	-	-	NV	NV	NV
Cresol, m-&p-	3.84E-06	1.75E-05	-	-	3.01E-02	6.42E-07	-1.03E+08
Cresol, o-	NV	NV	-	-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	-	NV	NV	NV
Dibenzofuran	8.38E-06	1.75E-05	-	-	1.89E-01	5.51E-06	-2.24E+08
Dimethylphenol, 2,4-	2.95E-06	1.75E-05	-	-	1.93E-02	4.44E-07	-7.88E+07
Ethylbenzene	2.84E-04	1.75E-05	-	-	1.71E+02	3.79E-03	-7.61E+09
Fluoranthene	NV	NV	-	-	NV	NV	NV
Fluorene	5.84E-06	1.75E-05	-	-	8.90E-02	2.48E-06	-1.56E+08
Indeno(1,2,3-cd)pyrene	NV	NV	-	-	NV	NV	NV
Iron	NV	NV	-	-	NV	NV	NV
Lead and Compounds	NV	NV	-	-	NV	NV	NV
Manganese	NV	NV	-	-	NV	NV	NV
Methylnaphthalene, 2-	2.83E-05	1.75E-05	-	-	1.95E+00	4.92E-05	-7.59E+08
Naphthalene	3.55E-05	1.75E-05	-	-	2.86E+00	6.70E-05	-9.51E+08
Nickel Soluble Salts	NV	NV	-	-	NV	NV	NV
Phenanthrene	2.54E-06	1.75E-05	-	-	1.85E-02	6.00E-07	-6.80E+07
Phenol	3.21E-06	1.75E-05	-	-	1.94E-02	3.88E-07	-8.60E+07
Pyrene	6.72E-07	1.75E-05	-	-	1.39E-03	5.20E-08	-1.80E+07
Styrene	1.74E-04	1.75E-05	-	-	6.33E+01	1.37E-03	-4.67E+09
Toluene	3.71E-04	1.75E-05	-	-	2.73E+02	5.69E-03	-9.93E+09
TPH C06-C09 aliphatic	9.87E-04	1.75E-05	-	-	1.67E+03	3.13E-02	-2.64E+10
TPH C10-C14 aliphatic	1.43E-04	1.75E-05	-	-	3.48E+01	6.53E-04	-3.82E+09
TPH C10-C14 aromatic	9.14E-05	1.75E-05	-	-	1.43E+01	2.68E-04	-2.45E+09
TPH C15-C28 aliphatic	NV	NV	-	-	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	-	-	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	-	-	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	-	-	NV	NV	NV
Trimethylbenzene, 1,2,4-	2.05E-04	1.75E-05	-	-	9.53E+01	2.23E-03	-5.50E+09
Vanadium and compounds	NV	NV	-	-	NV	NV	NV
Xylenes (total)	2.78E-05	1.75E-05	-	-	1.46E+01	2.93E-04	-7.44E+09

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep}	Volatilization factor from soil to enclosed-space vapors
VF _{excav}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Calculation of Vapour Emissions from Water with Flow
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

PARAMETERS

Concrete permeability

(select from
drop down list)

High permeability

Permeability Rate (m/day)

8.6 E-02

Water Temperature (deg. C)

18.0

Dimensions of Basement / Impoundment

Height (m)

3.0

Width (m)

25.0

Depth (m)

25.0

Volume total basement/ impoundment (m3)

1875

Dimensions of Wet Section of Basement/ Impoundment

Length (m)

5.00

Width (m)

5.0

Depth of Water (m)

0.01

Fetch/ Depth (m) ratio of Wet Basement Section

500

Volume of wet basement/ impoundment (m3)

0.2500

Area covered in water (m2)

25

Effective diameter of impoundment/ basement (m)

5.6

Volume of water entering basement (m³/sec)

2.50E-07

Air exchange rate (exchanges/day)

9.60E+01

Windspeed (m/s)

if < 3.5m/sec

3.00E-02

if = or > 3.5m/sec

Parameter Definition	Volatile	Chemical Concentration in Water (mg/L)	Molecular weight (g/mol)	Vapour Pressure (mmHg)	Vapour Pressure (atm)	Henry's Law Coefficient (unitless)	Henry's Law Coefficient (calculated)	Equilibrium Coefficient (at 25 deg C)	Diffusivity in Water (cm²/sec)	Schmidt Number on Gas Side (*)	Gas Phase Mass Transfer Coefficient (m/sec)	Schmidt Number on Liquid Side #	Liquid Phase Mass Transfer Coefficient (m/sec) **	Overall Mass Transfer Coefficient (m/s) (windspeed <3.5 m/s)	Diffusivity in Air (cm²/sec)	Equilibrium Concentration of water in Basement/ Impoundment (g/m³)	Air Emission Rate from Liquid Surface (g/sec)	Air Emission Rate from Liquid Surface (mg/day)	Adjusted Concentration in Basement Air (includes air exchange) (mg/m3)
		C	MW	Vap	Vap	unitless	atm.m3/g mol	K _{ow}	D _{water}	Sc _G	k _G	Sc _L	k _L	K	D _{air}	C _L		E	
Acenaphthene	Y	4.48	154	2.15E-03	2.83E-06	7.52E-03	1.80E-04	7.345E-03	8.33E-06	3.0E+00	1.244E-04	1.08E+03	2.74E-07	2.1E-07	0.0506	1.6E-01	8.31E-07	7.18E+01	3.99E-04
Acenaphthylene	Y	43.2	152	6.68E-03	8.79E-06	4.66E-03	1.11E-04	4.551E-03	6.98E-06	3.4E+00	1.150E-04	1.29E+03	2.44E-07	1.7E-07	0.045	1.7E+00	7.08E-06	6.11E+02	3.40E-03
Ammonia	Y	348	17	6.98E-04	6.98E-04	1.57E-05	6.427E-04	1.10E-05	6.6E-01	3.410E-04	8.18E-02	3.30E-07	1.3E-07	0.228	1.0E+01	3.37E-06	2.91E+03	1.62E-02	
Aniline	Y	0.212	93.1	4.90E-01	6.45E-04	8.26E-05	1.97E-06	8.067E-05	1.01E-05	1.733E-04	1.8E+00	8.91E+02	3.12E-07	1.3E-08	0.083	6.6E-03	2.20E-09	1.90E-01	1.06E-06
Anthracene	Y	15.4	178	6.53E-06	8.59E-09	2.27E-03	5.42E-05	2.217E-03	7.85E-06	3.9E+00	1.045E-04	1.15E+03	2.64E-07	1.2E-07	0.039	5.6E-01	1.73E-06	1.50E+02	8.33E-04
Arsenic, inorganic	N	0.024	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	N	2.23	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	N	12.6	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	Y	40.2	78.1	9.48E+01	1.25E-01	2.27E-01	5.42E-03	2.217E-01	1.03E-05	1.7E+00	1.823E-04	8.74E+02	3.16E-07	3.1E-07	0.0895	1.2E+00	9.67E-06	8.35E+02	4.64E-03
Benzo(a)pyrene	N	9.26	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	N	8.33	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(e,h,i)perylene	N	4.22	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	N	2.93	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethoxyethyl)phalate	N	0.03	391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	N	0.108	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	N	9.78	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	N	0.057	58.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	Y	436	108	1.10E-01	1.45E-04	3.50E-05	8.36E-07	3.418E-05	9.32E-06	2.1E+00	1.588E-04	9.66E+02	2.90E-07	5.3E-09	0.0729	1.4E+01	1.90E-06	1.64E+02	9.13E-04
Cresol, o-	N	182	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	N	0.822	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	Y	10.2	168	2.48E-03	3.26E-06	8.71E-03	2.08E-04	8.507E-03	7.38E-06	3.7E+00	1.080E-04	1.22E+03	2.53E-07	2.0E-07	0.041	3.9E-01	1.92E-06	1.66E+02	9.23E-04
Dimethylphenol, 2,4-	Y	38	122	1.02E-01	1.34E-04	3.89E-05	9.29E-07	3.799E-05	8.31E-06	2.4E+00	1.428E-04	1.08E+03	2.74E-07	5.3E-09	0.0622	1.3E+00	1.78E-07	1.54E+01	8.55E-05
Ethylbenzene	Y	3.02	106	9.60E+00	1.26E-02	3.22E-01	7.69E-03	3.145E-01	8.46E-06	2.2E+00	1.524E-04	1.06E+03	2.77E-07	2.8E-07	0.0685	1.1E-01	7.25E-07	6.26E+01	3.48E-04
Fluoranthene	N	25.9	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	Y	21.1	166	6.00E-04	7.90E-07	3.93E-03	9.38E-05	3.838E-03	7.89E-06	3.4E+00	1.133E-04	1.14E+03	2.65E-07	1.6E-07	0.044	7.7E-01	3.16E-06	2.73E+02	1.52E-03
Indeno(1,2,3-cd)pyrene	N	3.05	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	N	187	55.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	N	0.555	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	N	4.89	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	Y	105	142	5.50E-02	7.24E-05	2.12E-02	5.06E-04	2.071E-02	7.78E-06	2.9E+00	1.273E-04	1.16E+03	2.62E-07	2.4E-07	0.0524	3.9E+00	2.30E-05	1.99E+03	1.10E-02
Naphthalene	Y	283	128	8.50E-02	1.12E-04	1.80E-02	4.30E-04	1.758E-02	8.38E-06	2.5E+00	1.402E-04	1.07E+03	2.75E-07	2.5E-07	0.0605	9.9E+00	6.14E-05	5.31E+03	2.95E-02
Nickel Soluble Salts	N	0.303	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	Y	74.1	178	1.21E-04	1.59E-07	1.73E-03	4.13E-05	1.690E-03	6.69E-06	4.4E+00	9.623E-05	1.35E+03	2.37E-07	9.6E-08	0.0345	3.0E+00	7.23E-06	6.25E+02	3.47E-03
Phenol	Y	249	94.1	3.50E-01	4.61E-04	1.36E-05	3.25E-07	1.328E-05	1.03E-05	1.8E+00	1.738E-04	8.74E+02	3.16E-07	2.3E-09	0.0834	7.6E+00	4.38E-07	3.78E+01	2.10E-04
Pyrene	Y	27.9	202	4.50E-06	5.92E-09	4.87E-04	1.16E-05	4.756E-04	7.25E-06	5.4E+00	8.326E-05	1.24E+03	2.50E-07	3.4E-08	0.0278	1.1E+00	9.17E-07	7.92E+01	4.40E-04
Styrene	Y	0.194	104	6.40E+00	8.42E-03	1.12E-01	2.67E-03	1.094E-01	8.78E-06	2.1E+00	1.562E-04	1.03E+03	2.84E-07	2.8E-07	0.0711	6.6E-03	4.61E-08	3.98E+00	2.21E-05
Toluene	Y	17.6	92.1	2.84E+01	3.74E-02	2.71E-01	6.47E-02	2.647E-01	9.30E-06	1.9E+00	1.659E-04	9.78E+02	2.93E-07	2.9E-07	0.0778	5.9E-01	4.23E-06	3.65E+02	2.03E-03
TPH C06-C09 aliphatic	Y	6.08	103	9.16E+01	1.21E-01	5.05E+01	1.21E+00	4.932E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.10E-07	3.1E-07	0.1	5.4E+01	1.47E-06	1.27E+02	7.07E-04
TPH C10-C14 aliphatic	Y	1730	170	1.16E+00	1.53E-03	6.26E+01	1.49E+00	6.114E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.10E-07	3.1E-07	0.1	5.4E+01	4.19E-04	3.62E+04	2.01E-01
TPH C10-C14 aromatic	Y	1730	136	1.16E+00	1.53E-03	1.41E-01	3.37E-03	1.377E-01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.10E-07	3.1E-07	0.1	5.4E+01	4.14E-04	3.58E+04	1.99E-01
TPH C15-C28 aliphatic	N	1520	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	N	1520	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	N	332	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	N	332	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	Y	0.92	120	2.10E+00	2.76E-03	2.52E-01	6.02E-03	2.461E-01	7.92E-06	2.5E+00	1.405E-04	1.14E+03	2.65E-07	2.6E-07	0.0607	3.3E-02	2.20E-07	1.90E+01	1.06E-04
Vanadium and compounds	N	0.0228	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	Y	6.7	106	7.99E+00	1.05E-02	2.12E-01	5.06E-03	2.071E-01	9.90E-06	1.8E+00	1.756E-04	9.09E+02	3.08E-07	3.1E-07	0.0847	2.1E-01	1.61E-06	1.39E+02	7.72E-04

Notes:

Assumes viscosity of air at 25 deg C

(*) Adopted density and viscosity of air values are those published in USEPA Air Emissions for Wast and Waste Water Nov 1994. (viscosity = 1.81 x 10⁻⁴, density = 1.2 x 10⁻³)

** where windspeeds are greater than 3.25 m/s, F/D ratios greater than 51.2 and diffusivity of ether is 8.5 x 10⁻⁵

Bold denotes soil groundwater SSTC has been proposed for human health and/or odour (see text for details)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	5.32E+04	-	-	5.32E+04	>Sat	5.11E+02	4.50E+03	-	-	4.50E+03	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	1.77E+06	-	-	1.77E+06	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	3.83E+06	-	-	3.83E+06	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1.74E+04	-	-	1.74E+04	>Sat	1.51E+03	1.08E+06	-	-	1.08E+06	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	8.80E+03	-	-	8.80E+03	-	2.29E+03	2.70E+03	-	-	2.70E+03	-	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	8.29E+05	-	-	8.29E+05	>Sat	2.77E+02	1.53E+04	-	-	1.53E+04	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	6.02E+02	-	-	6.02E+02	>Sat	2.61E+02	1.98E+04	-	-	1.98E+04	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	1.08E+03	-	-	1.08E+03	>Sat	7.65E+03	1.18E+02	-	-	1.18E+02	>Sol	1.05E+02
Naphthalene	5.99E+03	-	-	5.99E+03	>Sat	1.02E+04	4.22E+02	-	-	4.22E+02	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	8.32E+05	-	-	8.32E+05	>Sol	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	5.44E+04	-	-	5.44E+04	>Sol	1.94E-01
Toluene	6.04E+03	-	-	6.04E+03	>Sat	2.65E+03	2.98E+05	-	-	2.98E+05	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	4.01E+03	-	-	4.01E+03	>Sat	2.20E+02	7.81E+04	-	-	7.81E+04	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	1.69E+04	-	-	1.69E+04	>Sat	2.58E+03	4.29E+04	-	-	4.29E+04	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

Pathways included in derivation of Soil Vapour RBSL:

Pathways included in derivation of Groundwater RBSL:

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Indoor Air (mg/m3)/(mg/kg)	Vapour Concentration in Indoor Air (From Subsurface Soil) (mg/m3)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	511	3.94E+01	8.64E-06	3.40E-04	5.04E-01	1.89E-06	7.46E-05	1.48E-04
Acenaphthylene	1700	1.63E+02	5.36E-06	8.71E-04	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	8.02E-07	1.14E-06	-	-	-	-
Arsenic, Inorganic	-	-	NV	-	-	-	-	-
Barium	-	-	NV	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-
Benzene	1510	6.59E+02	7.15E-03	4.71E+00	1.09E+02	1.57E-03	1.03E+00	9.48E-03
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-
Cadmium (Water)	-	-	NV	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	NV	-	-	-	-	-
Chromium(VI)	2.3	-	NV	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-
Cobalt	-	-	NV	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	6.42E-07	1.47E-03	1.24E-03	1.41E-07	3.22E-04	2.60E-01
Cresol, o-	-	-	NV	-	-	-	-	-
Blank	-	-	NV	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-
Dibenzofuran	277	5.69E+01	5.51E-06	3.13E-04	1.00E+00	1.21E-06	6.87E-05	6.87E-05
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	3.79E-03	6.31E-01	2.00E+00	8.30E-04	1.38E-01	6.92E-02
Fluoranthene	2440	2.89E+01	NV	-	-	-	-	-
Fluorene	2100	3.10E+01	2.48E-06	7.71E-05	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-
Iron	60600	-	NV	-	-	-	-	-
Lead and Compounds	13600	-	NV	-	-	-	-	-
Manganese	-	-	NV	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.92E-05	6.05E-03	5.81E-02	1.08E-05	1.33E-03	2.28E-02
Naphthalene	10200	9.66E+01	6.70E-05	6.47E-03	4.40E-01	1.47E-05	1.42E-03	3.23E-03
Nickel Soluble Salts	-	-	NV	-	-	-	-	-
Phenanthrene	5180	3.84E+01	6.00E-07	2.31E-05	-	-	-	-
Phenol	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	5.20E-08	7.63E-07	-	-	-	-
Styrene	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	5.69E-03	1.65E+00	3.01E+01	1.25E-03	3.63E-01	1.20E-02
TPH C06-C09 aliphatic	593	2.21E+02	3.13E-02	6.91E+00	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	6.53E-04	7.26E-02	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	2.68E-04	4.14E-02	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.23E-03	1.67E-01	1.96E+00	4.90E-04	3.65E-02	1.86E-02
Vanadium and compounds	248	-	NV	-	-	-	-	-
Xylenes (total)	2576	8.90E+01	2.93E-04	2.61E-02	4.34E+00	6.42E-05	5.72E-03	1.32E-03

TOTAL

3.97E-01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Vapours from Flowing Water

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement (Residential Receptor) (Odour Based Calculations) Scenario

Chemical	Vapour Concentration in Basement/ Impoundment mg/m ³	Aqueous Solubility (mg/L)	Threshold Intake and Risk Calculations			
			Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	3.99E-04	3.90E+00	5.04E-01	2.19E-01	8.74E-05	1.74E-04
Acenaphthylene	3.40E-03	1.61E+01	-	2.19E-01	7.45E-04	-
Ammonia	1.62E-02	4.82E+05	1.80E+01	2.19E-01	3.54E-03	1.97E-04
Aniline	1.06E-06	3.60E+04	4.19E+00	2.19E-01	2.32E-07	5.53E-08
Anthracene	8.33E-04	4.34E-02	-	2.19E-01	1.82E-04	-
Arsenic, Inorganic	-	0.00E+00	-	-	-	-
Barium	-	0.00E+00	-	-	-	-
Benz(a)anthracene	-	9.40E-03	-	-	-	-
Benzene	4.64E-03	1.79E+03	1.09E+02	2.19E-01	1.02E-03	9.33E-06
Benzo(a)pyrene	-	1.62E-03	-	-	-	-
Benzo(b)fluoranthene	-	1.50E-03	-	-	-	-
Benzo(g,h,i)perylene	-	2.60E-04	-	-	-	-
Benzo(k)fluoranthene	-	8.00E-04	-	-	-	-
Bis(2-ethylhexyl)phalate	-	2.70E-01	-	-	-	-
Cadmium (Water)	-	0.00E+00	-	-	-	-
Chromium(III), Insoluble Salts	-	0.00E+00	-	-	-	-
Chromium(VI)	-	1.69E+06	-	-	-	-
Chrysene	-	2.00E-03	-	-	-	-
Cobalt	-	0.00E+00	-	-	-	-
Cresol, m-&p-	9.13E-04	2.27E+04	1.24E-03	2.19E-01	2.00E-04	1.62E-01
Cresol, o-	-	2.59E+04	-	-	-	-
Dibenz(a,h)anthracene	-	2.49E-03	-	-	-	-
Dibenzofuran	9.23E-04	3.10E+00	1.00E+00	2.19E-01	2.02E-04	2.02E-04
Dimethylphenol, 2,4-	8.55E-05	7.87E+03	-	2.19E-01	1.87E-05	-
Ethylbenzene	3.48E-04	1.69E+02	2.00E+00	2.19E-01	7.62E-05	3.81E-05
Fluoranthene	-	2.60E-01	-	-	-	-
Fluorene	1.52E-03	1.69E+00	-	2.19E-01	3.32E-04	-
Indeno(1,2,3-cd)pyrene	-	1.90E-04	-	-	-	-
Iron	-	0.00E+00	-	-	-	-
Lead and Compounds	-	0.00E+00	-	-	-	-
Manganese	-	0.00E+00	-	-	-	-
Methylnaphthalene, 2-	1.10E-02	2.46E+01	5.81E-02	2.19E-01	2.42E-03	4.16E-02
Naphthalene	2.95E-02	3.10E+01	4.40E-01	2.19E-01	6.46E-03	1.47E-02
Nickel Soluble Salts	-	0.00E+00	-	-	-	-
Phenanthrene	3.47E-03	1.15E+00	-	2.19E-01	7.61E-04	-
Phenol	2.10E-04	8.28E+04	1.54E-01	2.19E-01	4.61E-05	2.99E-04
Pyrene	4.40E-04	1.35E-01	-	2.19E-01	9.65E-05	-
Styrene	2.21E-05	3.10E+02	1.36E+00	2.19E-01	4.85E-06	3.56E-06
Toluene	2.03E-03	5.26E+02	3.01E+01	2.19E-01	4.45E-04	1.48E-05
TPH C06-C09 aliphatic	7.07E-04	1.18E+01	-	2.19E-01	1.55E-04	-
TPH C10-C14 aliphatic	2.01E-01	9.99E-02	-	2.19E-01	2.19E-02	-
TPH C10-C14 aromatic	1.99E-01	2.53E+01	-	2.19E-01	4.36E-02	-
TPH C15-C28 aliphatic	-	1.11E-04	-	-	-	-
TPH C15-C28 aromatic	-	1.06E+00	-	-	-	-
TPH C29-C36 aliphatic	-	2.50E-06	-	-	-	-
TPH C29-C36 aromatic	-	6.60E-03	-	-	-	-
Trimethylbenzene, 1,2,4-	1.06E-04	5.70E+01	1.96E+00	2.19E-01	2.31E-05	1.18E-05
Vanadium and compounds	-	-	-	-	-	-
Xylenes (total)	7.72E-04	1.06E+02	4.34E+00	2.19E-01	1.69E-04	3.90E-05

TOTAL

2.19E-01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 2 - Upper Basement (Odour Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	1.48E-04	1.48E-04	3.76E-06	3.76E-06	3.76E-06	5.32E+04	1.48E-04	1.48E-04	5.32E+04	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	9.48E-03	9.48E-03	1.44E-05	1.44E-05	1.44E-05	1.74E+04	9.48E-03	9.48E-03	1.74E+04	0.95%	0.95%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	2.60E-01	2.60E-01	1.14E-04	1.14E-04	1.14E-04	8.80E+03	1.00E+00	-	8.80E+03	100.00%	100.00%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	6.87E-05	6.87E-05	1.21E-06	1.21E-06	1.21E-06	8.29E+05	6.87E-05	6.87E-05	8.29E+05	0.01%	0.01%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	6.92E-02	6.92E-02	4.15E-04	4.15E-04	4.15E-04	6.02E+02	6.92E-02	6.92E-02	6.02E+02	6.92%	6.92%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	2.28E-02	2.28E-02	1.86E-04	1.86E-04	1.86E-04	1.08E+03	2.28E-02	2.28E-02	1.08E+03	2.28%	2.28%
Naphthalene	10200	9.66E+01	3.23E-03	3.23E-03	3.34E-05	3.34E-05	3.34E-05	5.99E+03	3.23E-03	3.23E-03	5.99E+03	0.32%	0.32%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	1.20E-02	1.20E-02	4.14E-05	4.14E-05	4.14E-05	6.04E+03	1.20E-02	1.20E-02	6.04E+03	1.20%	1.20%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	1.86E-02	1.86E-02	2.49E-04	2.49E-04	2.49E-04	4.01E+03	1.86E-02	1.86E-02	4.01E+03	1.86%	1.86%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+01	1.32E-03	1.32E-03	1.48E-05	1.48E-05	1.48E-05	1.69E+04	1.32E-03	1.32E-03	1.69E+04	0.13%	0.13%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 2 - Upper Basement (Residential Receptor) (Odour Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW vapours from flowing water unitless	TOTAL (All Pathways) unitless	GW vapours from flowing water unitless	Total Vapour Pathways L/mg	TOTAL (All Pathways) L/mg					GW vapours from flowing water %	TOTAL %
Acenaphthene	4.48	3.90E+00	1.74E-04	1.74E-04	4.45E-05	4.45E-05	4.45E-05	4.50E+03	1.74E-04	1.74E-04	4.50E+03	0.1%	0.09%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	1.97E-04	1.97E-04	5.66E-07	5.66E-07	5.66E-07	1.77E+06	2.73E-01	2.73E-01	1.77E+06	27.3%	27.27%
Aniline	0.212	3.60E+04	5.53E-08	5.53E-08	2.61E-07	2.61E-07	2.61E-07	3.83E+06	9.39E-03	9.39E-03	3.83E+06	0.9%	0.94%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	9.33E-06	9.33E-06	2.32E-07	2.32E-07	2.32E-07	1.08E+06	4.15E-04	4.15E-04	1.08E+06	0.2%	0.17%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	1.62E-01	1.62E-01	3.71E-04	3.71E-04	3.71E-04	2.70E+03	1.00E+00	-	2.70E+03	100.0%	100.00%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	2.02E-04	2.02E-04	6.53E-05	6.53E-05	6.53E-05	1.53E+04	2.02E-04	2.02E-04	1.53E+04	0.0%	0.02%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	3.81E-05	3.81E-05	1.26E-05	1.26E-05	1.26E-05	1.98E+04	2.13E-03	2.13E-03	1.98E+04	0.9%	0.85%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	4.16E-02	4.16E-02	1.69E-03	1.69E-03	1.69E-03	1.18E+02	4.16E-02	4.16E-02	1.18E+02	20.8%	20.82%
Naphthalene	283	3.10E+01	1.47E-02	1.47E-02	4.74E-04	4.74E-04	4.74E-04	4.22E+02	1.47E-02	1.47E-02	4.22E+02	7.3%	7.34%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	2.99E-04	2.99E-04	1.20E-06	1.20E-06	1.20E-06	8.32E+05	9.95E-02	9.95E-02	8.32E+05	9.9%	9.95%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	3.56E-06	3.56E-06	1.84E-05	1.84E-05	1.84E-05	5.44E+04	5.70E-03	5.70E-03	5.44E+04	0.6%	0.57%
Toluene	17.6	5.26E+02	1.48E-05	1.48E-05	8.38E-07	8.38E-07	8.38E-07	2.98E+05	4.41E-04	4.41E-04	2.98E+05	0.2%	0.18%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.18E-05	1.18E-05	1.28E-05	1.28E-05	1.28E-05	7.81E+04	7.30E-04	7.30E-04	7.81E+04	0.1%	0.07%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	3.90E-05	3.90E-05	5.83E-06	5.83E-06	5.83E-06	4.29E+04	6.18E-04	6.18E-04	4.29E+04	0.2%	0.25%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix M

Odour Scenario 3 Unpaved Rec

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Lend Lease
Scenario: Scenario 3 - Unpaved Recreational (Odour Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Recreational User

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways
☐ Incidental Ingestion of Soil
☐ Dermal Contact with Soil
☐ Inhalation of Surface Soil-Derived Dust in Indoor Air
☐ Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐ Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☒ Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☒ Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways
☐ Inhalation of Groundwater-Derived Vapours in Indoor Air
☒ Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐ Ingestion of Potable Groundwater
☐ Incidental Ingestion of Groundwater (Bathing or Excavation)
☐ Dermal Contact with Groundwater (Bathing or Excavation)
☐ Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐ Soil RBSLs saturation limited?
☐ Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.20	1.00E-05	511	4.48
Acenaphthylene	0.20	1.00E-05	1700	43.2
Ammonia	1.00	1.00E-05		348
Aniline	1.00	1.00E-05		0.212
Anthracene	0.20	1.00E-05	2150	15.4
Arsenic, Inorganic	1.00	1.00E-05		0.024
Barium	1.00	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1.00	1.00E-05		0.03
Cadmium (Water)	1.00	1.00E-05		0.108
Chromium(III), Insoluble Salts	1.00	1.00E-05	210	0.102
Chromium(VI)	1.00	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1.00	1.00E-05		0.057
Cresol, m-&p-	1.00	1.00E-05	2290	436
Cresol, o-	1.00	1.00E-05		182
		Blank		
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1.00	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1.00	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.20	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1.00	1.00E-05	60600	187
Lead and Compounds	1.00	1.00E-05	13600	0.555
Manganese	1.00	1.00E-05		4.89
Methylnaphthalene, 2-	0.20	1.00E-05	7650	105
Naphthalene	0.20	1.00E-05	10200	283
Nickel Soluble Salts	1.00	1.00E-05		0.303
Phenanthrene	0.20	1.00E-05	5180	74.1
Phenol	1.00	1.00E-05		249
Pyrene	0.20	1.00E-05	2640	27.9
Styrene	1.00	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.13	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.13	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.13	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.13	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.13	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.13	1.00E-05	20600	332
TPH C29-C36 aromatic	0.13	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1.00	1.00E-05	220	0.92
Vanadium and compounds	1.00	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

		Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:		Units					
Body weight	kg	70	13	70		70	13
Exposure duration	yr	30	6	64	6	64	6
Averaging time (carcinogens)	yr	70	70	70	70	70	70
Averaging time (non-carcinogens)	yr	30	6	64	6	64	6
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	25	100			25	100
Exposure frequency for soil ingestion	days/yr	350	350			350	350
Fraction of daily soil intake from site	unitless	0.5	0.5			0.5	0.5
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	3600	2100			3600	2100
Soil to skin adherence factor	mg/cm2	0.5	0.5			0.5	0.5
Exposure frequency for dermal contact with soil	days/yr	350	350			350	350
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	0	0			0	0
Exposure frequency (indoor air)	days/yr	350	350			350	350
Particulate emission factor (indoor air)	m3/kg	NA	NA			NA	NA
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	2	2	2	2	2	2
Exposure frequency (outdoor air)	days/yr	350	350	365	365	365	365
Particulate emission factor (outdoor air)	m3/kg	1.36E+09	1.36E+09			1.36E+09	1.36E+09
Potable Water Ingestion							
Potable water intake rate	L/day	0	0			0	0
Exposure frequency for potable water intake	days/yr	350	350			350	350
Incidental Water Ingestion							
Incidental ingestion rate	L/day	NA	NA			NA	NA
Exposure frequency for incidental water ingestion	days/yr	350	350			350	350
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	18150	6880			18150	6880
Exposure time for dermal water contact	hr/day	1	1			1	1
Exposure frequency for dermal water contact	days/yr	350	350			350	350

~Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	200	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295		183	HV	183	Groundwater assumed to be at a depth of 2 m based on groundwater data for the Site.
				Sand (<12% fines)			The soil type above groundwater across the site consists of fill (mostly sand and gravel), thus sand has conservatively been assumed as the main soil type in this scenario.
SCS Soil Type:							
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm ³ /cm ³	0.38		0.375	TPOR	0.375	
Adjustment for vadose zone biodegradation	unitless	1		10	BioA_GW	10	Adjustment for biodegradation in unpaved areas; see text
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):				Sand (<12% fines)			As above
Thickness of capillary fringe	cm	5		17	hcap	17	
Volumetric air content in capillary fringe soils	cc/cc	0.038		0.122	VAC	0.122	
Volumetric water content in capillary fringe soils	cc/cc	0.342		0.253	vwccap	0.253	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(e)	378	windsp	378	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(f)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

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B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/L-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	4.91E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	Y
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Const	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

Chemical	D _{s1} (cm ² /s)	D _{s2}	D _{s3}	D _{soil}	D _{crack} (cm ² /s)	D _{cap} (cm ² /s)	D _{ws} (cm ² /s)	Convective Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	3.96E-03	4.07E-04	3.12E-03	3.10E+01
Acenaphthylene	7.28E-03	-	-	7.28E-03	3.52E-03	4.00E-04	2.96E-03	3.49E+01
Ammonia	3.69E-02	-	-	3.69E-02	1.79E-02	2.69E-03	1.77E-02	6.86E+00
Aniline	1.35E-02	-	-	1.35E-02	7.20E-03	9.48E-03	1.30E-02	1.70E+01
Anthracene	6.31E-03	-	-	6.31E-03	3.06E-03	5.05E-04	3.19E-03	4.00E+01
Benz(a)anthracene	8.25E-03	-	-	8.25E-03	4.09E-03	1.67E-03	6.18E-03	3.00E+01
Benzene	1.45E-02	-	-	1.45E-02	6.98E-03	5.81E-04	4.77E-03	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	7.27E-03	2.00E-02	1.23E-02	1.69E+01
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	3.20E-03	3.26E-04	2.51E-03	3.83E+01
Dimethylphenol, 2,4-	1.01E-02	-	-	1.01E-02	6.12E-03	1.60E-02	1.05E-02	2.00E+01
Ethylbenzene	1.11E-02	-	-	1.11E-02	5.35E-03	4.44E-04	3.65E-03	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	3.45E-03	4.31E-04	3.07E-03	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	4.09E-03	3.65E-04	2.93E-03	3.00E+01
Naphthalene	9.78E-03	-	-	9.78E-03	4.72E-03	4.24E-04	3.40E-03	2.60E+01
Phenanthrene	5.58E-03	-	-	5.58E-03	2.72E-03	5.05E-04	3.01E-03	4.52E+01
Phenol	1.38E-02	-	-	1.38E-02	1.10E-02	5.60E-02	1.48E-02	1.11E+01
Pyrene	4.50E-03	-	-	4.50E-03	2.26E-03	1.27E-03	3.70E-03	5.43E+01
Styrene	1.15E-02	-	-	1.15E-02	5.55E-03	4.64E-04	3.81E-03	2.21E+01
Toluene	1.26E-02	-	-	1.26E-02	6.07E-03	5.04E-04	4.14E-03	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	6.45E-04	5.31E-03	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	6.45E-04	5.31E-03	1.57E+01
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	7.80E-03	6.50E-04	5.34E-03	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	4.74E-03	3.94E-04	3.24E-03	2.59E+01
Xylenes (total)	1.37E-02	-	-	1.37E-02	6.61E-03	5.50E-04	4.52E-03	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{ws}	Effective diffusion coefficient between groundwater and soil surface

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp} (mg/m ³ -air / mg/L-H ₂ O)	VF _{wamb} (mg/m ³ -air / mg/L-H ₂ O)	VF _{trench} (mg/m ³ -air / mg/L-water)
Acenaphthene	1.41E-04	6.98E-07	4.41E-06
Acenaphthylene	8.47E-05	4.10E-07	4.41E-06
Ammonia	2.09E-05	3.47E-07	4.41E-06
Aniline	2.49E-06	3.20E-08	4.41E-06
Anthracene	4.29E-05	2.15E-07	4.41E-06
Benz(a)anthracene	1.22E-05	9.03E-08	4.41E-06
Benzene	5.13E-03	3.22E-05	4.41E-06
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m-&p-	1.04E-06	1.28E-08	4.41E-06
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	1.45E-04	6.51E-07	4.41E-06
Dimethylphenol, 2,4-	1.12E-06	1.21E-08	4.41E-06
Ethylbenzene	6.48E-03	3.50E-05	4.41E-06
Fluoranthene	NV	NV	NV
Fluorene	7.28E-05	3.59E-07	4.41E-06
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	3.84E-04	1.85E-06	4.41E-06
Naphthalene	3.51E-04	1.82E-06	4.41E-06
Phenanthrene	3.17E-05	1.55E-07	4.41E-06
Phenol	4.19E-07	5.97E-09	4.41E-06
Pyrene	9.87E-06	5.36E-08	4.41E-06
Styrene	2.30E-03	1.27E-05	4.41E-06
Toluene	5.78E-03	3.34E-05	4.41E-06
TPH C06-C09 aliphatic	1.19E+00	7.98E-03	4.41E-06
TPH C10-C14 aliphatic	1.47E+00	9.89E-03	4.41E-06
TPH C10-C14 aromatic	3.32E-03	2.24E-05	4.41E-06
TPH C15-C28 aliphatic	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	4.79E-03	2.43E-05	4.41E-06
Xylenes (total)	4.68E-03	2.85E-05	4.41E-06

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	50	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100		50	HV	50	It has been assumed that contamination will be present at a minimum depth of 0.5 m as aesthetic factors will ensure that contaminated soils are unlikely to be present in the surficial soil layers.
				Sand (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay, therefore sand has been conservatively assumed in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Biodegradation adjustment	unitless	1		10	BioA	10	Adjustment for biodegradation in unpaved areas; see
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(c)	378	windsp	378	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(d)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.
<u>Other</u>							
Averaging time for surface emission vapour flux	sec	1.89E+08	(e)		atvapor	1.89E+08	Defaults to receptor exposure duration

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	4.91E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	Y
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1} (cm ² /s)	D _{s2}	D _{s3}	D _{soil}	D _{crack} (cm ² /s)	C _{sat} mol/kg	Convective Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	3.96E-03	3.94E+01	3.10E+01
Acenaphthylene	7.28E-03	-	-	7.28E-03	3.52E-03	1.63E+02	3.49E+01
Ammonia	3.69E-02	-	-	3.69E-02	1.79E-02	1.87E+04	6.86E+00
Aniline	1.35E-02	-	-	1.35E-02	7.20E-03	6.23E+03	1.70E+01
Anthracene	6.31E-03	-	-	6.31E-03	3.06E-03	1.42E+00	4.00E+01
Benz(a)anthracene	8.25E-03	-	-	8.25E-03	4.09E-03	3.33E+00	3.00E+01
Benzene	1.45E-02	-	-	1.45E-02	6.98E-03	6.59E+02	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	7.27E-03	1.44E+04	1.69E+01
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	3.20E-03	5.69E+01	3.83E+01
Dimethylphenol, 2,4-	1.01E-02	-	-	1.01E-02	6.12E-03	8.00E+03	2.00E+01
Ethylbenzene	1.11E-02	-	-	1.11E-02	5.35E-03	1.67E+02	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	-	-	7.11E-03	3.45E-03	3.10E+01	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	4.09E-03	1.23E+02	3.00E+01
Naphthalene	9.78E-03	-	-	9.78E-03	4.72E-03	9.66E+01	2.60E+01
Phenanthrene	5.58E-03	-	-	5.58E-03	2.72E-03	3.84E+01	4.52E+01
Phenol	1.38E-02	-	-	1.38E-02	1.10E-02	3.37E+04	1.11E+01
Pyrene	4.50E-03	-	-	4.50E-03	2.26E-03	1.47E+01	5.43E+01
Styrene	1.15E-02	-	-	1.15E-02	5.55E-03	2.93E+02	2.21E+01
Toluene	1.26E-02	-	-	1.26E-02	6.07E-03	2.91E+02	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	2.21E+02	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.11E+02	1.57E+01
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.54E+02	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	4.74E-03	7.46E+01	2.59E+01
Xylenes (total)	1.37E-02	-	-	1.37E-02	6.61E-03	8.90E+00	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

Vapour Modelling - Soil to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario

D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1} (mg/m ³ -air / mg/kg-soil)	VF _{as2} (mg/m ³ -air / mg/kg-soil)	VF _{p (indoor)} (mg/m ³ -air / mg/kg-soil)	VF _{p (outdoor)} (m ² -air / mg/kg)	VF _{samb} (mg/m ³ -air / mg/kg-soil)	VF _{seep} (mg/m ³ -air / mg/kg-soil)
Acenaphthene	1.55E-06	5.22E-05	-	7.35E-10	7.26E-07	2.54E-05
Acenaphthylene	1.15E-06	5.22E-05	-	7.35E-10	4.00E-07	1.56E-05
Ammonia	1.57E-05	5.22E-05	-	7.35E-10	7.43E-05	6.19E-04
Aniline	1.60E-06	5.22E-05	-	7.35E-10	7.66E-07	1.68E-05
Anthracene	4.16E-07	5.22E-05	-	7.35E-10	5.19E-08	2.30E-06
Benz(a)anthracene	6.73E-08	5.22E-05	-	7.35E-10	1.36E-09	4.73E-08
Benzene	5.94E-05	5.22E-05	-	7.35E-10	1.06E-04	2.18E-03
Benzo(a)pyrene	NV	NV	-	7.35E-10	NV	NV
Benzo(b)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Benzo(g,h,i)perylene	NV	NV	-	7.35E-10	NV	NV
Benzo(k)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	-	7.35E-10	NV	NV
Chrysene	NV	NV	-	7.35E-10	NV	NV
Cresol, m-&p-	5.11E-07	5.22E-05	-	7.35E-10	7.84E-08	1.94E-06
Cresol, o-	NV	NV	-	7.35E-10	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	7.35E-10	NV	NV
Dibenzofuran	1.12E-06	5.22E-05	-	7.35E-10	3.74E-07	1.58E-05
Dimethylphenol, 2,4-	3.92E-07	5.22E-05	-	7.35E-10	4.62E-08	1.33E-06
Ethylbenzene	3.78E-05	5.22E-05	-	7.35E-10	4.30E-05	1.14E-03
Fluoranthene	NV	NV	-	7.35E-10	NV	NV
Fluorene	7.77E-07	5.22E-05	-	7.35E-10	1.81E-07	7.20E-06
Indeno(1,2,3-cd)pyrene	NV	NV	-	7.35E-10	NV	NV
Methylnaphthalene, 2-	3.77E-06	5.22E-05	-	7.35E-10	4.28E-06	1.45E-04
Naphthalene	4.73E-06	5.22E-05	-	7.35E-10	6.73E-07	2.00E-05
Phenanthrene	3.38E-07	5.22E-05	-	7.35E-10	3.44E-08	1.69E-06
Phenol	4.28E-07	5.22E-05	-	7.35E-10	5.50E-08	1.18E-06
Pyrene	8.94E-08	5.22E-05	-	7.35E-10	2.40E-09	1.43E-07
Styrene	2.32E-05	5.22E-05	-	7.35E-10	1.62E-04	4.14E-03
Toluene	4.94E-05	5.22E-05	-	7.35E-10	7.34E-05	1.72E-03
TPH C06-C09 aliphatic	1.31E-04	5.22E-05	-	7.35E-10	5.19E-04	9.59E-03
TPH C10-C14 aliphatic	1.90E-05	5.22E-05	-	7.35E-10	1.08E-05	2.00E-04
TPH C10-C14 aromatic	1.22E-05	5.22E-05	-	7.35E-10	4.45E-06	8.23E-05
TPH C15-C28 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C15-C28 aromatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aromatic	NV	NV	-	7.35E-10	NV	NV
Trimethylbenzene, 1,2,4-	2.73E-05	5.22E-05	-	7.35E-10	2.25E-05	6.65E-04
Xylenes (total)	3.70E-05	5.22E-05	-	7.35E-10	4.12E-05	8.91E-04

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

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Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	1.67E+06	1.67E+06	-	1.67E+06	>Sat	5.11E+02	1.73E+06	1.73E+06	-	1.73E+06	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	6.22E+08	6.22E+08	-	6.22E+08	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	1.57E+09	1.57E+09	-	1.57E+09	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	3.07E+06	3.07E+06	-	3.07E+06	>Sat	1.51E+03	1.01E+07	1.01E+07	-	1.01E+07	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	1.90E+05	1.90E+05	-	1.90E+05	>Sat	2.29E+03	1.16E+06	1.16E+06	-	1.16E+06	>Sol	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	3.20E+07	3.20E+07	-	3.20E+07	>Sat	2.77E+02	1.84E+07	1.84E+07	-	1.84E+07	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	1.39E+05	1.39E+05	-	1.39E+05	>Sat	2.61E+02	1.72E+05	1.72E+05	-	1.72E+05	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	3.26E+04	3.26E+04	-	3.26E+04	>Sat	7.65E+03	7.54E+04	7.54E+04	-	7.54E+04	>Sol	1.05E+02
Naphthalene	1.57E+06	1.57E+06	-	1.57E+06	>Sat	1.02E+04	5.79E+05	5.79E+05	-	5.79E+05	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	3.09E+08	3.09E+08	-	3.09E+08	>Sol	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	1.29E+06	1.29E+06	-	1.29E+06	>Sol	1.94E-01
Toluene	1.23E+06	1.23E+06	-	1.23E+06	>Sat	2.65E+03	2.70E+06	2.70E+06	-	2.70E+06	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.05E+06	1.05E+06	-	1.05E+06	>Sat	2.20E+02	9.71E+05	9.71E+05	-	9.71E+05	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	3.16E+05	3.16E+05	-	3.16E+05	>Sat	2.58E+03	4.57E+05	4.57E+05	-	4.57E+05	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater-Derived Vapours in Outdoor Air

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Outdoor Air [(mg/m ³)/(mg/kg)]	Vapour Concentration in Outdoor Air (From Subsurface Soil) (mg/m ³)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (kg/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (kg/m ³)	Child Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Child) (unitless)
Acenaphthene	511	3.94E+01	7.26E-07	2.86E-05	5.04E-01	6.05E-08	2.38E-06	4.72E-06	6.05E-08	2.38E-06	4.72E-06
Acenaphthylene	1700	1.63E+02	4.00E-07	6.50E-05	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	5.19E-08	7.40E-08	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	1.36E-09	4.53E-09	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	1.06E-04	7.00E-02	1.09E+02	8.84E-06	5.83E-03	5.37E-05	8.84E-06	5.83E-03	5.37E-05
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	7.84E-08	1.79E-04	1.24E-03	6.53E-09	1.50E-05	1.21E-02	6.53E-09	1.50E-05	1.21E-02
Cresol, o-	-	-	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	3.74E-07	2.13E-05	1.00E+00	3.12E-08	1.78E-06	1.78E-06	3.12E-08	1.78E-06	1.78E-06
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.30E-05	7.17E-03	2.00E+00	3.58E-06	5.98E-04	2.99E-04	3.58E-06	5.98E-04	2.99E-04
Fluoranthene	2440	2.89E+01	NV	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	1.81E-07	5.62E-06	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.28E-06	5.26E-04	5.81E-02	3.57E-07	4.38E-05	7.54E-04	3.57E-07	4.38E-05	7.54E-04
Naphthalene	10200	9.66E+01	6.73E-07	6.50E-05	4.40E-01	5.60E-08	5.41E-06	1.23E-05	5.60E-08	5.41E-06	1.23E-05
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	3.44E-08	1.32E-06	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	2.40E-09	3.52E-08	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	7.34E-05	2.13E-02	3.01E+01	6.12E-06	1.78E-03	5.90E-05	6.12E-06	1.78E-03	5.90E-05
TPH C06-C09 aliphatic	593	2.21E+02	5.19E-04	1.15E-01	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	1.08E-05	1.20E-03	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	4.45E-06	6.87E-04	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.25E-05	1.68E-03	1.96E+00	1.87E-06	1.40E-04	7.12E-05	1.87E-06	1.40E-04	7.12E-05
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	4.12E-05	3.66E-04	4.34E+00	3.43E-06	3.05E-05	7.04E-06	3.43E-06	3.05E-05	7.04E-06

TOTAL

1.33E-02

1.33E-02

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Outdoor Air
 Barangaroo
 Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Outdoor Air [(mg/m3)/(mg/L)]	Vapour Concentration in Outdoor Air (From Subsurface Groundwater) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (L/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	4.48	3.90E+00	6.98E-07	2.72E-06	5.04E-01	5.82E-08	2.27E-07	4.50E-07	5.82E-08	2.27E-07	4.50E-07
Acenaphthylene	43.2	1.61E+01	4.10E-07	6.60E-06	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	3.47E-07	1.21E-04	1.80E+01	2.89E-08	1.01E-05	5.60E-07	2.89E-08	1.01E-05	5.60E-07
Aniline	0.212	3.60E+04	3.20E-08	6.78E-09	4.19E+00	2.66E-09	5.65E-10	1.35E-10	2.66E-09	5.65E-10	1.35E-10
Anthracene	15.4	4.34E-02	2.15E-07	9.35E-09	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	9.03E-08	8.49E-10	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.22E-05	1.30E-03	1.09E+02	2.69E-06	1.08E-04	9.94E-07	2.69E-06	1.08E-04	9.94E-07
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	1.28E-08	5.60E-06	1.24E-03	1.07E-09	4.66E-07	3.77E-04	1.07E-09	4.66E-07	3.77E-04
Cresol, o-	182	2.59E+04	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.51E-07	2.02E-06	1.00E+00	5.42E-08	1.68E-07	1.68E-07	5.42E-08	1.68E-07	1.68E-07
Dimethylphenol, 2,4-	38	7.87E+03	1.21E-08	4.61E-07	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	3.50E-05	1.06E-04	2.00E+00	2.91E-06	8.80E-06	4.40E-06	2.91E-06	8.80E-06	4.40E-06
Fluoranthene	25.9	2.60E-01	NV	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.59E-07	6.06E-07	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.85E-06	4.55E-05	5.81E-02	1.54E-07	3.79E-06	6.53E-05	1.54E-07	3.79E-06	6.53E-05
Naphthalene	283	3.10E+01	1.82E-06	5.65E-05	4.40E-01	1.52E-07	4.71E-06	1.07E-05	1.52E-07	4.71E-06	1.07E-05
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.55E-07	1.78E-07	-	-	-	-	-	-	-
Phenol	249	8.28E+04	5.97E-09	1.49E-06	1.54E-01	4.98E-10	1.24E-07	8.05E-07	4.98E-10	1.24E-07	8.05E-07
Pyrene	27.9	1.35E-01	5.36E-08	7.24E-09	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.27E-05	2.46E-06	1.36E+00	1.06E-06	2.05E-07	1.51E-07	1.06E-06	2.05E-07	1.51E-07
Toluene	17.6	5.26E+02	3.34E-05	5.88E-04	3.01E+01	2.79E-06	4.90E-05	1.63E-06	2.79E-06	4.90E-05	1.63E-06
TPH C06-C09 aliphatic	6.08	1.18E+01	7.98E-03	4.85E-02	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	9.89E-03	9.88E-04	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	2.24E-05	5.67E-04	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	NV	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	NV	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	2.43E-05	2.23E-05	1.96E+00	2.02E-06	1.86E-06	9.48E-07	2.02E-06	1.86E-06	9.48E-07
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	2.85E-05	1.91E-04	4.34E+00	2.37E-06	1.59E-05	3.67E-06	2.37E-06	1.59E-05	3.67E-06

TOTAL

4.66E-04

4.66E-04

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	4.72E-06	4.72E-06	1.20E-07	1.20E-07	1.20E-07	1.67E+06	4.72E-06	4.72E-06	1.67E+06	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.37E-05	5.37E-05	8.14E-08	8.14E-08	8.14E-08	3.07E+06	5.37E-05	5.37E-05	3.07E+06	0.02%	0.02%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.21E-02	1.21E-02	5.27E-06	5.27E-06	5.27E-06	1.90E+05	7.57E-02	7.57E-02	1.90E+05	7.57%	7.57%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.78E-06	1.78E-06	3.12E-08	3.12E-08	3.12E-08	3.20E+07	1.78E-06	1.78E-06	3.20E+07	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	2.99E-04	2.99E-04	1.79E-06	1.79E-06	1.79E-06	1.39E+05	2.99E-04	2.99E-04	1.39E+05	0.12%	0.12%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	7.54E-04	7.54E-04	6.14E-06	6.14E-06	6.14E-06	3.26E+04	7.54E-04	7.54E-04	3.26E+04	0.38%	0.38%
Naphthalene	10200	9.66E+01	1.23E-05	1.23E-05	1.27E-07	1.27E-07	1.27E-07	1.57E+06	1.23E-05	1.23E-05	1.57E+06	0.01%	0.01%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	5.90E-05	5.90E-05	2.03E-07	2.03E-07	2.03E-07	1.23E+06	5.90E-05	5.90E-05	1.23E+06	0.02%	0.02%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	7.12E-05	7.12E-05	9.54E-07	9.54E-07	9.54E-07	1.05E+06	7.12E-05	7.12E-05	1.05E+06	0.01%	0.01%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	7.04E-06	7.04E-06	7.91E-07	7.91E-07	7.91E-07	3.16E+05	7.04E-06	7.04E-06	3.16E+05	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Child Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL (%)	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg	HI	HI	mg/kg	%	%
Acenaphthene	511	3.94E+01	4.72E-06	4.72E-06	1.20E-07	1.20E-07	1.20E-07	1.67E+06	4.72E-06	4.72E-06	1.67E+06	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.37E-05	5.37E-05	8.14E-08	8.14E-08	8.14E-08	3.07E+06	5.37E-05	5.37E-05	3.07E+06	0.02%	0.02%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.21E-02	1.21E-02	5.27E-06	5.27E-06	5.27E-06	1.90E+05	7.57E-02	7.57E-02	1.90E+05	7.57%	7.57%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.78E-06	1.78E-06	3.12E-08	3.12E-08	3.12E-08	3.20E+07	1.78E-06	1.78E-06	3.20E+07	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	2.99E-04	2.99E-04	1.79E-06	1.79E-06	1.79E-06	1.39E+05	2.99E-04	2.99E-04	1.39E+05	0.12%	0.12%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	7.54E-04	7.54E-04	6.14E-06	6.14E-06	6.14E-06	3.26E+04	7.54E-04	7.54E-04	3.26E+04	0.38%	0.38%
Naphthalene	10200	9.66E+01	1.23E-05	1.23E-05	1.27E-07	1.27E-07	1.27E-07	1.57E+06	1.23E-05	1.23E-05	1.57E+06	0.01%	0.01%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	5.90E-05	5.90E-05	2.03E-07	2.03E-07	2.03E-07	1.23E+06	5.90E-05	5.90E-05	1.23E+06	0.02%	0.02%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	7.12E-05	7.12E-05	9.54E-07	9.54E-07	9.54E-07	1.05E+06	7.12E-05	7.12E-05	1.05E+06	0.01%	0.01%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	7.04E-06	7.04E-06	7.91E-07	7.91E-07	7.91E-07	3.16E+05	7.04E-06	7.04E-06	3.16E+05	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario



Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour unitless	TOTAL (All Pathways) unitless	GW to Outdoor Vapour L/mg	Total Vapour Pathways L/mg	TOTAL (All Pathways) L/mg					GW to Outdoor Vapour %	TOTAL %
Acenaphthene	4.48	3.90E+00	4.50E-07	4.50E-07	1.15E-07	1.15E-07	1.15E-07	1.73E+06	4.50E-07	4.50E-07	1.73E+06	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	5.60E-07	5.60E-07	1.61E-09	1.61E-09	1.61E-09	6.22E+08	7.75E-04	7.75E-04	6.22E+08	0.08%	0.08%
Aniline	0.212	3.60E+04	1.35E-10	1.35E-10	6.36E-10	6.36E-10	6.36E-10	1.57E+09	2.29E-05	2.29E-05	1.57E+09	0.00%	0.00%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	9.94E-07	9.94E-07	2.47E-08	2.47E-08	2.47E-08	1.01E+07	4.43E-05	4.43E-05	1.01E+07	0.02%	0.02%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	3.77E-04	3.77E-04	8.64E-07	8.64E-07	8.64E-07	1.16E+06	1.96E-02	1.96E-02	1.16E+06	1.96%	1.96%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	1.68E-07	1.68E-07	5.42E-08	5.42E-08	5.42E-08	1.84E+07	1.68E-07	1.68E-07	1.84E+07	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	4.40E-06	4.40E-06	1.46E-06	1.46E-06	1.46E-06	1.72E+05	2.46E-04	2.46E-04	1.72E+05	0.10%	0.10%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	6.53E-05	6.53E-05	2.65E-06	2.65E-06	2.65E-06	7.54E+04	6.53E-05	6.53E-05	7.54E+04	0.03%	0.03%
Naphthalene	283	3.10E+01	1.07E-05	1.07E-05	3.45E-07	3.45E-07	3.45E-07	5.79E+05	1.07E-05	1.07E-05	5.79E+05	0.01%	0.01%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	8.05E-07	8.05E-07	3.23E-09	3.23E-09	3.23E-09	3.09E+08	2.68E-04	2.68E-04	3.09E+08	0.03%	0.03%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.51E-07	1.51E-07	7.78E-07	7.78E-07	7.78E-07	1.29E+06	2.41E-04	2.41E-04	1.29E+06	0.02%	0.02%
Toluene	17.6	5.26E+02	1.63E-06	1.63E-06	9.24E-08	9.24E-08	9.24E-08	2.70E+06	4.86E-05	4.86E-05	2.70E+06	0.02%	0.02%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	9.48E-07	9.48E-07	1.03E-06	1.03E-06	1.03E-06	9.71E+05	5.87E-05	5.87E-05	9.71E+05	0.01%	0.01%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	3.67E-06	3.67E-06	5.48E-07	5.48E-07	5.48E-07	4.57E+05	5.80E-06	5.80E-06	4.57E+05	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 3 - Unpaved Recreational (Odour Based Calculations) Scenario



Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Outdoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg				mg/L	%	%
Acenaphthene	4.48	3.90E+00	4.50E-07	4.50E-07	1.15E-07	1.15E-07	1.15E-07	1.73E+06	4.50E-07	4.50E-07	1.73E+06	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	5.60E-07	5.60E-07	1.61E-09	1.61E-09	1.61E-09	6.22E+08	7.75E-04	7.75E-04	6.22E+08	0.08%	0.08%
Aniline	0.212	3.60E+04	1.35E-10	1.35E-10	6.36E-10	6.36E-10	6.36E-10	1.57E+09	2.29E-05	2.29E-05	1.57E+09	0.00%	0.00%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	9.94E-07	9.94E-07	2.47E-08	2.47E-08	2.47E-08	1.01E+07	4.43E-05	4.43E-05	1.01E+07	0.02%	0.02%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	3.77E-04	3.77E-04	8.64E-07	8.64E-07	8.64E-07	1.16E+06	1.96E-02	1.96E-02	1.16E+06	1.96%	1.96%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	1.68E-07	1.68E-07	5.42E-08	5.42E-08	5.42E-08	1.84E+07	1.68E-07	1.68E-07	1.84E+07	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	4.40E-06	4.40E-06	1.46E-06	1.46E-06	1.46E-06	1.72E+05	2.46E-04	2.46E-04	1.72E+05	0.10%	0.10%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	6.53E-05	6.53E-05	2.65E-06	2.65E-06	2.65E-06	7.54E+04	6.53E-05	6.53E-05	7.54E+04	0.03%	0.03%
Naphthalene	283	3.10E+01	1.07E-05	1.07E-05	3.45E-07	3.45E-07	3.45E-07	5.79E+05	1.07E-05	1.07E-05	5.79E+05	0.01%	0.01%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	8.05E-07	8.05E-07	3.23E-09	3.23E-09	3.23E-09	3.09E+08	2.68E-04	2.68E-04	3.09E+08	0.03%	0.03%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.51E-07	1.51E-07	7.78E-07	7.78E-07	7.78E-07	1.29E+06	2.41E-04	2.41E-04	1.29E+06	0.02%	0.02%
Toluene	17.6	5.26E+02	1.63E-06	1.63E-06	9.24E-08	9.24E-08	9.24E-08	2.70E+06	4.86E-05	4.86E-05	2.70E+06	0.02%	0.02%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	9.48E-07	9.48E-07	1.03E-06	1.03E-06	1.03E-06	9.71E+05	5.87E-05	5.87E-05	9.71E+05	0.01%	0.01%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	3.67E-06	3.67E-06	5.48E-07	5.48E-07	5.48E-07	4.57E+05	5.80E-06	5.80E-06	4.57E+05	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix N

Odour Scenario 4 Paved Rec

1. General Information:

Site: Barangaroo
 Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Client: Lend Lease
 Scenario: Scenario 4 - Paved Recreation (Odour Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Recreational User

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐	Incidental Ingestion of Soil
☐	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☒	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐	Inhalation of Groundwater-Derived Vapours in Indoor Air
☒	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☐	Incidental Ingestion of Groundwater (Bathing or Excavation)
☐	Dermal Contact with Groundwater (Bathing or Excavation)
☐	Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐	Y	Soil RBSLs saturation limited?
☐	Y	Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.20	1.00E-05	511	4.48
Acenaphthylene	0.20	1.00E-05	1700	43.2
Ammonia	1.00	1.00E-05		348
Aniline	1.00	1.00E-05		0.212
Anthracene	0.20	1.00E-05	2150	15.4
Arsenic, Inorganic	1.00	1.00E-05		0.024
Barium	1.00	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1.00	1.00E-05		0.03
Cadmium (Water)	1.00	1.00E-05		0.108
Chromium(III), Insoluble Salts	1.00	1.00E-05	210	0.102
Chromium(VI)	1.00	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1.00	1.00E-05		0.057
Cresol, m-&p-	1.00	1.00E-05	2290	436
Cresol, o-	1.00	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1.00	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1.00	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.20	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1.00	1.00E-05	60600	187
Lead and Compounds	1.00	1.00E-05	13600	0.555
Manganese	1.00	1.00E-05		4.89
Methylnaphthalene, 2-	0.20	1.00E-05	7650	105
Naphthalene	0.20	1.00E-05	10200	283
Nickel Soluble Salts	1.00	1.00E-05		0.303
Phenanthrene	0.20	1.00E-05	5180	74.1
Phenol	1.00	1.00E-05		249
Pyrene	0.20	1.00E-05	2640	27.9
Styrene	1.00	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.13	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.13	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.13	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.13	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.13	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.13	1.00E-05	20600	332
TPH C29-C36 aromatic	0.13	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1.00	1.00E-05	220	0.92
Vanadium and compounds	1.00	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

		Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:		Units					
Body weight	kg	70	13	70	13	70	13
Exposure duration	yr	30	6	64	6	64	6
Averaging time (carcinogens)	yr	70	70	70	70	70	70
Averaging time (non-carcinogens)	yr	30	6	64	6	64	6
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	25	100			25	100
Exposure frequency for soil ingestion	days/yr	350	350			350	350
Fraction of daily soil intake from site	unitless	0.5	0.5			0.5	0.5
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	3600	2100			3600	2100
Soil to skin adherence factor	mg/cm2	0.5	0.5			0.5	0.5
Exposure frequency for dermal contact with soil	days/yr	350	350			350	350
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	0	0			0	0
Exposure frequency (indoor air)	days/yr	350	350			350	350
Particulate emission factor (indoor air)	m3/kg	NA	NA			NA	NA
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	2	2	2	2	2	2
Exposure frequency (outdoor air)	days/yr	350	350	365	365	365	365
Particulate emission factor (outdoor air)	m3/kg	1.36E+09	#####			1.36E+09	1.36E+09
Potable Water Ingestion							
Potable water intake rate	L/day	0	0			0	0
Exposure frequency for potable water intake	days/yr	350	350			350	350
Incidental Water Ingestion							
Incidental ingestion rate	L/day	NA	NA			NA	NA
Exposure frequency for incidental water ingestio	days/yr	350	350			350	350
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	18150	6880			18150	6880
Exposure time for dermal water contact	hr/day	1	1			1	1
Exposure frequency for dermal water contact	days/yr	350	350			350	350

~Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

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Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	200	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295		173	HV	173	Groundwater assumed to be at a depth of 2 m based on groundwater data for the Site.
				Sand (<12% fines)			The soil type above groundwater across the site consists of fill (mostly sand and gravel), thus sand has conservatively been assumed as the main soil type in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm ³ /cm ³	0.38		0.375	TPOR	0.375	
Adjustment for vadose zone biodegradation	unitless	1		10	BioA_GW	10	Adjustment for biodegradation in unpaved areas; see text
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm			10	Hvtwo	10	Assumed thickness of concrete pavings in the public open space area.
				User Specified (Enter values in 'Soil Data' worksheet)			Porosities for concrete have been assumed to be sand (multiplied by 1%).
SCS Soil Type:							
Air-filled porosity (volumetric)	cm ³ /cm ³	NA		0.00321	VACS2	0.00321	
Water-filled porosity (volumetric)	cm ³ /cm ³	NA		0.00054	wvcvz2	0.00054	
Total soil porosity	cm ³ /cm ³	NA		0.00375	TPOR2	0.00375	
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):				Sand (<12% fines)			As above.
Thickness of capillary fringe	cm	5		17	hcap	17	
Volumetric air content in capillary fringe soils	cc/cc	0.038		0.122	VAC	0.122	
Volumetric water content in capillary fringe soils	cc/cc	0.342		0.253	wccap	0.253	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(e)	378.3	windsp	378.3	Based on the average annual 9am and 3pm windspeeds measured at Observatory Point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(f)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

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Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc (cm ² /g)	Kd (cm ² /g)	H' (cc-H ₂ O / cc-air)	S (mg/l-water)	D ^{air} (cm ² /s)	D ^{wat} (cm ² /s)	MW (g/mol)	VP (mmHg)	Volatile?
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benzo(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E-01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Consta	MW	Molecular weight
S	Solubility	VP	Vapopur pressure

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Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

C. Chemical-Specific Diffusion Coefficients

Chemical	D _{s1} (cm ² /s)	D _{s2}	D _{s3}	D _{soil}	D _{crack} (cm ² /s)	D _{cap} (cm ² /s)	D _{ws} (cm ² /s)	Convective Factor (unless)
Acenaphthene	8.18E-03	1.79E-05	-	3.16E-04	3.96E-03	4.07E-04	3.22E-04	3.10E+01
Acenaphthylene	7.28E-03	1.59E-05	-	2.81E-04	3.52E-03	4.00E-04	2.88E-04	3.49E+01
Ammonia	3.69E-02	8.07E-05	-	1.42E-03	1.79E-02	2.69E-03	1.48E-03	6.86E+00
Aniline	1.35E-02	2.95E-05	-	5.20E-04	7.20E-03	9.48E-03	5.65E-04	1.70E+01
Anthracene	6.31E-03	1.38E-05	-	2.43E-04	3.06E-03	5.05E-04	2.54E-04	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	1.45E-02	3.17E-05	-	5.58E-04	6.98E-03	5.81E-04	5.60E-04	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	1.19E-02	2.60E-05	-	4.59E-04	7.27E-03	2.00E-02	5.01E-04	1.69E+01
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	6.63E-03	1.45E-05	-	2.56E-04	3.20E-03	3.26E-04	2.60E-04	3.83E+01
Dimethylphenol, 2,4-	1.01E-02	2.22E-05	-	3.91E-04	6.12E-03	1.60E-02	4.27E-04	2.00E+01
Ethylbenzene	1.11E-02	2.42E-05	-	4.27E-04	5.35E-03	4.44E-04	4.29E-04	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	7.11E-03	1.56E-05	-	2.74E-04	3.45E-03	4.31E-04	2.83E-04	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	1.85E-05	-	3.27E-04	4.09E-03	3.65E-04	3.30E-04	3.00E+01
Naphthalene	9.78E-03	2.14E-05	-	3.77E-04	4.72E-03	4.24E-04	3.81E-04	2.60E+01
Phenanthrene	5.58E-03	1.22E-05	-	2.15E-04	2.72E-03	5.05E-04	2.26E-04	4.52E+01
Phenol	1.38E-02	3.02E-05	-	5.33E-04	1.10E-02	5.60E-02	5.82E-04	1.11E+01
Pyrene	4.50E-03	9.85E-06	-	1.74E-04	2.26E-03	1.27E-03	1.87E-04	5.43E+01
Styrene	1.15E-02	2.51E-05	-	4.43E-04	5.55E-03	4.64E-04	4.45E-04	2.21E+01
Toluene	1.26E-02	2.75E-05	-	4.85E-04	6.07E-03	5.04E-04	4.87E-04	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	3.54E-05	-	6.24E-04	7.80E-03	6.45E-04	6.25E-04	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	3.54E-05	-	6.24E-04	7.80E-03	6.45E-04	6.25E-04	1.57E+01
TPH C10-C14 aromatic	1.62E-02	3.54E-05	-	6.24E-04	7.80E-03	6.50E-04	6.26E-04	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	2.15E-05	-	3.79E-04	4.74E-03	3.94E-04	3.80E-04	2.59E+01
Xylenes (total)	1.37E-02	3.00E-05	-	5.28E-04	6.61E-03	5.50E-04	5.30E-04	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{ws}	Effective diffusion coefficient between groundwater and soil surface

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp} (mgm ⁻³ -air / mg/L-H ₂ O)	VF _{wamb} (mgm ⁻³ -air / mg/L-H ₂ O)	VF _{trench} (mgm ⁻³ -air / mg/L-water)
Acenaphthene	2.63E-04	7.19E-08	4.41E-06
Acenaphthylene	1.47E-04	3.99E-08	4.41E-06
Ammonia	7.92E-05	2.90E-08	4.41E-06
Aniline	4.74E-06	1.39E-09	4.41E-06
Anthracene	6.41E-05	1.72E-08	4.41E-06
Benz(a)anthracene	NV	NV	NV
Benzene	1.29E-02	3.78E-06	4.41E-06
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m-&p-	1.81E-06	5.21E-10	4.41E-06
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	2.51E-04	6.75E-08	4.41E-06
Dimethylphenol, 2,4-	1.75E-06	4.94E-10	4.41E-06
Ethylbenzene	1.46E-02	4.10E-06	4.41E-06
Fluoranthene	NV	NV	NV
Fluorene	1.22E-04	3.31E-08	4.41E-06
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	7.58E-04	2.08E-07	4.41E-06
Naphthalene	7.33E-04	2.04E-07	4.41E-06
Phenanthrene	4.38E-05	1.16E-08	4.41E-06
Phenol	7.99E-07	2.35E-10	4.41E-06
Pyrene	1.03E-05	2.71E-09	4.41E-06
Styrene	5.23E-03	1.48E-06	4.41E-06
Toluene	1.37E-02	3.92E-06	4.41E-06
TPH C06-C09 aliphatic	3.15E+00	9.39E-04	4.41E-06
TPH C10-C14 aliphatic	3.91E+00	1.16E-03	4.41E-06
TPH C10-C14 aromatic	8.81E-03	2.62E-06	4.41E-06
TPH C15-C28 aliphatic	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	1.02E-02	2.85E-06	4.41E-06
Xylenes (total)	1.15E-02	3.34E-06	4.41E-06

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

Vapour Modelling - Soil to Outdoor and Indoor Air

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Barangaroo

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Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	10.01	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100		0.01	HV	0.01	Assumes that contaminated soils are located directly below concrete pavings.
				Sand (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay, therefore sand has been conservatively assumed in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Biodegradation adjustment	unitless	1		10	BioA	10	Conservatively assumes no soil vapour biodegradation
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm			10	Hvtwo	10	Assumed thickness of concrete pavings in the public open space area.
				User Specified (Enter values in 'Soil Data' worksheet)			Porosities for concrete have been assumed to be sand (multiplied by 1%).
SCS Soil Type:							
Air-filled porosity (volumetric)	cm3/cm3	NA		0.00321	VACS2	0.00321	
Water-filled porosity (volumetric)	cm3/cm3	NA		0.00054	wvcvz2	0.00054	
Total soil porosity	cm3/cm3	NA		0.00375	TPOR2	0.00375	
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	225	(c)	378.3	windsp	378.3	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site).
Width of source area parallel to wind or groundwater flow direction	cm	4500	(d)	4500	WSA	4500	Conservative default.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes vapours mixed within 2m of ground.
<u>Other</u>							
Averaging time for surface emission vapour flux	sec	1.89E+08	(e)		atvapor	1.89E+08	Defaults to receptor exposure duration

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1} (cm ² /s)	D _{s2}	D _{s3}	D _{soil}	D _{crack} (cm ² /s)	C _{sat} mg/kg	Convective Factor (unitless)
Acenaphthene	8.18E-03	1.79E-05	-	1.79E-05	3.96E-03	3.94E+01	3.10E+01
Acenaphthylene	7.28E-03	1.59E-05	-	1.59E-05	3.52E-03	1.63E+02	3.49E+01
Ammonia	3.69E-02	8.07E-05	-	8.07E-05	1.79E-02	1.87E+04	6.86E+00
Aniline	1.35E-02	2.95E-05	-	2.95E-05	7.20E-03	6.23E+03	1.70E+01
Anthracene	6.31E-03	1.38E-05	-	1.38E-05	3.06E-03	1.42E+00	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	3.17E-05	-	3.17E-05	6.98E-03	6.59E+02	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m-&p-	1.19E-02	2.60E-05	-	2.61E-05	7.27E-03	1.44E+04	1.69E+01
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	1.45E-05	-	1.45E-05	3.20E-03	5.69E+01	3.83E+01
Dimethylphenol, 2,4-	1.01E-02	2.22E-05	-	2.22E-05	6.12E-03	8.00E+03	2.00E+01
Ethylbenzene	1.11E-02	2.42E-05	-	2.43E-05	5.35E-03	1.67E+02	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	1.56E-05	-	1.56E-05	3.45E-03	3.10E+01	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	1.85E-05	-	1.86E-05	4.09E-03	1.23E+02	3.00E+01
Naphthalene	9.78E-03	2.14E-05	-	2.14E-05	4.72E-03	9.66E+01	2.60E+01
Phenanthrene	5.58E-03	1.22E-05	-	1.22E-05	2.72E-03	3.84E+01	4.52E+01
Phenol	1.38E-02	3.02E-05	-	3.02E-05	1.10E-02	3.37E+04	1.11E+01
Pyrene	4.50E-03	9.85E-06	-	9.86E-06	2.26E-03	1.47E+01	5.43E+01
Styrene	1.15E-02	2.51E-05	-	2.52E-05	5.55E-03	2.93E+02	2.21E+01
Toluene	1.26E-02	2.75E-05	-	2.75E-05	6.07E-03	2.91E+02	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	3.54E-05	-	3.54E-05	7.80E-03	2.21E+02	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	3.54E-05	-	3.54E-05	7.80E-03	1.11E+02	1.57E+01
TPH C10-C14 aromatic	1.62E-02	3.54E-05	-	3.54E-05	7.80E-03	1.54E+02	1.57E+01
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	2.15E-05	-	2.15E-05	4.74E-03	7.46E+01	2.59E+01
Xylenes (total)	1.37E-02	3.00E-05	-	3.00E-05	6.61E-03	8.90E+00	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1} (mg/m ³ -air / mg/kg-soil)	VF _{as2} (mg/m ³ -air / mg/kg-soil)	VF _{p (indoor)} (mg/m ³ -air / mg/kg-soil)	VF _{p (outdoor)} (m ³ -air / mg/kg)	VF _{samb} (mg/m ³ -air / mg/kg-soil)	VF _{seep1} (mg/m ³ -air / mg/kg-soil)
Acenaphthene	7.26E-08	5.22E-05	-	7.35E-10	7.93E-09	2.87E-06
Acenaphthylene	5.39E-08	5.22E-05	-	7.35E-10	4.37E-09	1.60E-06
Ammonia	7.35E-07	5.22E-05	-	7.35E-10	8.12E-07	2.16E-04
Aniline	7.46E-08	5.22E-05	-	7.35E-10	8.37E-09	2.84E-06
Anthracene	1.94E-08	5.22E-05	-	7.35E-10	5.67E-10	2.10E-07
Benz(a)anthracene	NV	NV	-	7.35E-10	NV	NV
Benzene	2.78E-06	5.22E-05	-	7.35E-10	1.16E-06	3.89E-04
Benzo(a)pyrene	NV	NV	-	7.35E-10	NV	NV
Benzo(b)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Benzo(g,h,i)perylene	NV	NV	-	7.35E-10	NV	NV
Benzo(k)fluoranthene	NV	NV	-	7.35E-10	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	-	7.35E-10	NV	NV
Chrysene	NV	NV	-	7.35E-10	NV	NV
Cresol, m-&p-	2.39E-08	5.22E-05	-	7.35E-10	8.57E-10	2.96E-07
Cresol, o-	NV	NV	-	7.35E-10	NV	NV
Dibenz(a,h)anthracene	NV	NV	-	7.35E-10	NV	NV
Dibenzofuran	5.22E-08	5.22E-05	-	7.35E-10	4.09E-09	1.51E-06
Dimethylphenol, 2,4-	1.83E-08	5.22E-05	-	7.35E-10	5.05E-10	1.78E-07
Ethylbenzene	1.77E-06	5.22E-05	-	7.35E-10	4.70E-07	1.64E-04
Fluoranthene	NV	NV	-	7.35E-10	NV	NV
Fluorene	3.63E-08	5.22E-05	-	7.35E-10	1.98E-09	7.27E-07
Indeno(1,2,3-cd)pyrene	NV	NV	-	7.35E-10	NV	NV
Methylnaphthalene, 2-	1.76E-07	5.22E-05	-	7.35E-10	4.68E-08	1.69E-05
Naphthalene	2.21E-07	5.22E-05	-	7.35E-10	7.35E-09	2.61E-06
Phenanthrene	1.58E-08	5.22E-05	-	7.35E-10	3.76E-10	1.41E-07
Phenol	2.00E-08	5.22E-05	-	7.35E-10	6.01E-10	2.03E-07
Pyrene	4.18E-09	5.22E-05	-	7.35E-10	2.63E-11	9.96E-09
Styrene	1.09E-06	5.22E-05	-	7.35E-10	1.77E-06	6.15E-04
Toluene	2.31E-06	5.22E-05	-	7.35E-10	8.02E-06	2.75E-03
TPH C06-C09 aliphatic	6.14E-06	5.22E-05	-	7.35E-10	5.67E-06	1.86E-03
TPH C10-C14 aliphatic	8.88E-07	5.22E-05	-	7.35E-10	1.18E-07	3.89E-05
TPH C10-C14 aromatic	5.69E-07	5.22E-05	-	7.35E-10	4.86E-08	1.60E-05
TPH C15-C28 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C15-C28 aromatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aliphatic	NV	NV	-	7.35E-10	NV	NV
TPH C29-C36 aromatic	NV	NV	-	7.35E-10	NV	NV
Trimethylbenzene, 1,2,4-	1.28E-06	5.22E-05	-	7.35E-10	2.46E-07	8.71E-05
Xylenes (total)	1.73E-06	5.22E-05	-	7.35E-10	4.50E-07	1.52E-04

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	1.52E+08	1.52E+08	-	1.52E+08	>Sat	5.11E+02	1.68E+07	1.68E+07	-	1.68E+07	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	7.45E+09	7.45E+09	-	7.45E+09	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	3.62E+10	3.62E+10	-	3.62E+10	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	2.82E+08	2.82E+08	-	2.82E+08	>Sat	1.51E+03	8.65E+07	8.65E+07	-	8.65E+07	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	1.73E+07	1.73E+07	-	1.73E+07	>Sat	2.29E+03	2.85E+07	2.85E+07	-	2.85E+07	>Sol	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	2.93E+09	2.93E+09	-	2.93E+09	>Sat	2.77E+02	1.78E+08	1.78E+08	-	1.78E+08	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	1.28E+07	1.28E+07	-	1.28E+07	>Sat	2.61E+02	1.46E+06	1.46E+06	-	1.46E+06	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	2.98E+06	2.98E+06	-	2.98E+06	>Sat	7.65E+03	6.71E+05	6.71E+05	-	6.71E+05	>Sol	1.05E+02
Naphthalene	1.44E+08	1.44E+08	-	1.44E+08	>Sat	1.02E+04	5.18E+06	5.18E+06	-	5.18E+06	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	7.85E+09	7.85E+09	-	7.85E+09	>Sol	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	1.10E+07	1.10E+07	-	1.10E+07	>Sol	1.94E-01
Toluene	1.13E+07	1.13E+07	-	1.13E+07	>Sat	2.65E+03	2.30E+07	2.30E+07	-	2.30E+07	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	9.59E+07	9.59E+07	-	9.59E+07	>Sat	2.20E+02	8.28E+06	8.28E+06	-	8.28E+06	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2.89E+07	2.89E+07	-	2.89E+07	>Sat	2.58E+03	3.89E+06	3.89E+06	-	3.89E+06	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater-Derived Vapours in Outdoor Air

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Outdoor Air [(mg/m3)/(mg/kg)]	Vapour Concentration in Outdoor Air (From Subsurface Soil) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (kg/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	511	3.94E+01	7.93E-09	3.12E-07	5.04E-01	6.61E-10	2.60E-08	5.16E-08	6.61E-10	2.60E-08	5.16E-08
Acenaphthylene	1700	1.63E+02	4.37E-09	7.10E-07	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	5.67E-10	8.08E-10	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	1.16E-06	7.65E-04	1.09E+02	9.67E-08	6.37E-05	5.85E-07	9.67E-08	6.37E-05	5.85E-07
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	8.57E-10	1.96E-06	1.24E-03	7.14E-11	1.63E-07	1.32E-04	7.14E-11	1.63E-07	1.32E-04
Cresol, o-	-	-	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	4.09E-09	2.33E-07	1.00E+00	3.41E-10	1.94E-08	1.94E-08	3.41E-10	1.94E-08	1.94E-08
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.70E-07	7.84E-05	2.00E+00	3.92E-08	6.53E-06	3.27E-06	3.92E-08	6.53E-06	3.27E-06
Fluoranthene	2440	2.89E+01	NV	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	1.98E-09	6.15E-08	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.68E-08	5.75E-06	5.81E-02	3.90E-09	4.79E-07	8.25E-06	3.90E-09	4.79E-07	8.25E-06
Naphthalene	10200	9.66E+01	7.35E-09	7.10E-07	4.40E-01	6.13E-10	5.92E-08	1.34E-07	6.13E-10	5.92E-08	1.34E-07
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	3.76E-10	1.44E-08	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	2.63E-11	3.85E-10	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	8.02E-06	2.33E-03	3.01E+01	6.68E-07	1.94E-04	6.45E-06	6.68E-07	1.94E-04	6.45E-06
TPH C06-C09 aliphatic	593	2.21E+02	5.67E-06	1.25E-03	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	1.18E-07	1.32E-05	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	4.86E-08	7.50E-06	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.46E-07	1.83E-05	1.96E+00	2.05E-08	1.53E-06	7.79E-07	2.05E-08	1.53E-06	7.79E-07
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	4.50E-07	4.00E-06	4.34E+00	3.75E-08	3.34E-07	7.70E-08	3.75E-08	3.34E-07	7.70E-08

TOTAL

1.52E-04

1.52E-04

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Outdoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Outdoor Air [(mg/m ³)/(mg/L)]	Vapour Concentration in Outdoor Air (From Subsurface Groundwater) (mg/m ³)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (L/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (L/m ³)	Child Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Child) (unitless)
Acenaphthene	4.48	3.90E+00	7.19E-08	2.81E-07	5.04E-01	6.00E-09	2.34E-08	4.64E-08	6.00E-09	2.34E-08	4.64E-08
Acenaphthylene	43.2	1.61E+01	3.99E-08	6.42E-07	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	2.90E-08	1.01E-05	1.80E+01	2.42E-09	8.41E-07	4.67E-08	2.42E-09	8.41E-07	4.67E-08
Aniline	0.212	3.60E+04	1.39E-09	2.94E-10	4.19E+00	1.16E-10	2.45E-11	5.85E-12	1.16E-10	2.45E-11	5.85E-12
Anthracene	15.4	4.34E-02	1.72E-08	7.46E-10	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.78E-06	1.52E-04	1.09E+02	3.15E-07	1.27E-05	1.16E-07	3.15E-07	1.27E-05	1.16E-07
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	5.21E-10	2.27E-07	1.24E-03	4.34E-11	1.89E-08	1.53E-05	4.34E-11	1.89E-08	1.53E-05
Cresol, o-	182	2.59E+04	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.75E-08	2.09E-07	1.00E+00	5.62E-09	1.74E-08	1.74E-08	5.62E-09	1.74E-08	1.74E-08
Dimethylphenol, 2,4-	38	7.87E+03	4.94E-10	1.88E-08	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	4.10E-06	1.24E-05	2.00E+00	3.42E-07	1.03E-06	5.16E-07	3.42E-07	1.03E-06	5.16E-07
Fluoranthene	25.9	2.60E-01	NV	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	3.31E-08	5.59E-08	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	2.08E-07	5.11E-06	5.81E-02	1.73E-08	4.26E-07	7.33E-06	1.73E-08	4.26E-07	7.33E-06
Naphthalene	283	3.10E+01	2.04E-07	6.32E-06	4.40E-01	1.70E-08	5.27E-07	1.20E-06	1.70E-08	5.27E-07	1.20E-06
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.16E-08	1.34E-08	-	-	-	-	-	-	-
Phenol	249	8.28E+04	2.35E-10	5.86E-08	1.54E-01	1.96E-11	4.88E-09	3.17E-08	1.96E-11	4.88E-09	3.17E-08
Pyrene	27.9	1.35E-01	2.71E-09	3.66E-10	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.48E-06	2.88E-07	1.36E+00	1.24E-07	2.40E-08	1.76E-08	1.24E-07	2.40E-08	1.76E-08
Toluene	17.6	5.26E+02	3.92E-06	6.90E-05	3.01E+01	3.27E-07	5.75E-06	1.91E-07	3.27E-07	5.75E-06	1.91E-07
TPH C06-C09 aliphatic	6.08	1.18E+01	9.39E-04	5.71E-03	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	1.16E-03	1.16E-04	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	2.62E-06	6.64E-05	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	NV	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	NV	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	2.85E-06	2.62E-06	1.96E+00	2.37E-07	2.18E-07	1.11E-07	2.37E-07	2.18E-07	1.11E-07
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	3.34E-06	2.24E-05	4.34E+00	2.78E-07	1.87E-06	4.30E-07	2.78E-07	1.87E-06	4.30E-07

TOTAL

2.53E-05

2.53E-05

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	5.16E-08	5.16E-08	1.31E-09	1.31E-09	1.31E-09	1.52E+08	5.16E-08	5.16E-08	1.52E+08	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.85E-07	5.85E-07	8.87E-10	8.87E-10	8.87E-10	2.82E+08	5.85E-07	5.85E-07	2.82E+08	0.00%	0.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.32E-04	1.32E-04	5.76E-08	5.76E-08	5.76E-08	1.73E+07	8.28E-04	8.28E-04	1.73E+07	0.08%	0.08%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.94E-08	1.94E-08	3.41E-10	3.41E-10	3.41E-10	2.93E+09	1.94E-08	1.94E-08	2.93E+09	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	3.27E-06	3.27E-06	1.96E-08	1.96E-08	1.96E-08	1.28E+07	3.27E-06	3.27E-06	1.28E+07	0.00%	0.00%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	8.25E-06	8.25E-06	6.71E-08	6.71E-08	6.71E-08	2.98E+06	8.25E-06	8.25E-06	2.98E+06	0.00%	0.00%
Naphthalene	10200	9.66E+01	1.34E-07	1.34E-07	1.39E-09	1.39E-09	1.39E-09	1.44E+08	1.34E-07	1.34E-07	1.44E+08	0.00%	0.00%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	6.45E-06	6.45E-06	2.22E-08	2.22E-08	2.22E-08	1.13E+07	6.45E-06	6.45E-06	1.13E+07	0.00%	0.00%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	7.79E-07	7.79E-07	1.04E-08	1.04E-08	1.04E-08	9.59E+07	7.79E-07	7.79E-07	9.59E+07	0.00%	0.00%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	7.70E-08	7.70E-08	8.65E-09	8.65E-09	8.65E-09	2.89E+07	7.70E-08	7.70E-08	2.89E+07	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Child Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL (%)	
			Vapours from Subsurface Soil Outdoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Outdoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg	HI	HI	mg/kg	%	%
Acenaphthene	511	3.94E+01	5.16E-08	5.16E-08	1.31E-09	1.31E-09	1.31E-09	1.52E+08	5.16E-08	5.16E-08	1.52E+08	0.00%	0.00%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.85E-07	5.85E-07	8.87E-10	8.87E-10	8.87E-10	2.82E+08	5.85E-07	5.85E-07	2.82E+08	0.00%	0.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.32E-04	1.32E-04	5.76E-08	5.76E-08	5.76E-08	1.73E+07	8.28E-04	8.28E-04	1.73E+07	0.08%	0.08%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.94E-08	1.94E-08	3.41E-10	3.41E-10	3.41E-10	2.93E+09	1.94E-08	1.94E-08	2.93E+09	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	3.27E-06	3.27E-06	1.96E-08	1.96E-08	1.96E-08	1.28E+07	3.27E-06	3.27E-06	1.28E+07	0.00%	0.00%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	8.25E-06	8.25E-06	6.71E-08	6.71E-08	6.71E-08	2.98E+06	8.25E-06	8.25E-06	2.98E+06	0.00%	0.00%
Naphthalene	10200	9.66E+01	1.34E-07	1.34E-07	1.39E-09	1.39E-09	1.39E-09	1.44E+08	1.34E-07	1.34E-07	1.44E+08	0.00%	0.00%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	6.45E-06	6.45E-06	2.22E-08	2.22E-08	2.22E-08	1.13E+07	6.45E-06	6.45E-06	1.13E+07	0.00%	0.00%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	7.79E-07	7.79E-07	1.04E-08	1.04E-08	1.04E-08	9.59E+07	7.79E-07	7.79E-07	9.59E+07	0.00%	0.00%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	7.70E-08	7.70E-08	8.65E-09	8.65E-09	8.65E-09	2.89E+07	7.70E-08	7.70E-08	2.89E+07	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4- Paved Recreation (Odour Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Vapour	TOTAL (All Pathways)					GW to Outdoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg	mg/L				%	%
Acenaphthene	4.48	3.90E+00	4.64E-08	4.64E-08	1.19E-08	1.19E-08	1.19E-08	1.68E+07	4.64E-08	4.64E-08	1.68E+07	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	4.67E-08	4.67E-08	1.34E-10	1.34E-10	1.34E-10	7.45E+09	6.47E-05	6.47E-05	7.45E+09	0.01%	0.01%
Aniline	0.212	3.60E+04	5.85E-12	5.85E-12	2.76E-11	2.76E-11	2.76E-11	3.62E+10	9.94E-07	9.94E-07	3.62E+10	0.00%	0.00%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.16E-07	1.16E-07	2.89E-09	2.89E-09	2.89E-09	8.65E+07	5.17E-06	5.17E-06	8.65E+07	0.00%	0.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Sal	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	1.53E-05	1.53E-05	3.51E-08	3.51E-08	3.51E-08	2.85E+07	7.96E-04	7.96E-04	2.85E+07	0.08%	0.08%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	1.74E-08	1.74E-08	5.62E-09	5.62E-09	5.62E-09	1.78E+08	1.74E-08	1.74E-08	1.78E+08	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	5.16E-07	5.16E-07	1.71E-07	1.71E-07	1.71E-07	1.46E+06	2.89E-05	2.89E-05	1.46E+06	0.01%	0.01%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	7.33E-06	7.33E-06	2.98E-07	2.98E-07	2.98E-07	6.71E+05	7.33E-06	7.33E-06	6.71E+05	0.00%	0.00%
Naphthalene	283	3.10E+01	1.20E-06	1.20E-06	3.86E-08	3.86E-08	3.86E-08	5.18E+06	1.20E-06	1.20E-06	5.18E+06	0.00%	0.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	3.17E-08	3.17E-08	1.27E-10	1.27E-10	1.27E-10	7.85E+09	1.05E-05	1.05E-05	7.85E+09	0.00%	0.00%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.76E-08	1.76E-08	9.08E-08	9.08E-08	9.08E-08	1.10E+07	2.82E-05	2.82E-05	1.10E+07	0.00%	0.00%
Toluene	17.6	5.26E+02	1.91E-07	1.91E-07	1.08E-08	1.08E-08	1.08E-08	2.30E+07	5.71E-06	5.71E-06	2.30E+07	0.00%	0.00%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.11E-07	1.11E-07	1.21E-07	1.21E-07	1.21E-07	8.28E+06	6.89E-06	6.89E-06	8.28E+06	0.00%	0.00%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	4.30E-07	4.30E-07	6.42E-08	6.42E-08	6.42E-08	3.89E+06	6.81E-07	6.81E-07	3.89E+06	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 4 - Paved Recreation (Odour Based Calculations) Scenario



Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Outdoor Vapour	TOTAL (All Pathways)	GW to Outdoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Outdoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg				mg/L	%	%
Acenaphthene	4.48	3.90E+00	4.64E-08	4.64E-08	1.19E-08	1.19E-08	1.19E-08	1.68E+07	4.64E-08	4.64E-08	1.68E+07	0.00%	0.00%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	4.67E-08	4.67E-08	1.34E-10	1.34E-10	1.34E-10	7.45E+09	6.47E-05	6.47E-05	7.45E+09	0.01%	0.01%
Aniline	0.212	3.60E+04	5.85E-12	5.85E-12	2.76E-11	2.76E-11	2.76E-11	3.62E+10	9.94E-07	9.94E-07	3.62E+10	0.00%	0.00%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.16E-07	1.16E-07	2.89E-09	2.89E-09	2.89E-09	8.65E+07	5.17E-06	5.17E-06	8.65E+07	0.00%	0.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Sal	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	1.53E-05	1.53E-05	3.51E-08	3.51E-08	3.51E-08	2.85E+07	7.96E-04	7.96E-04	2.85E+07	0.08%	0.08%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	1.74E-08	1.74E-08	5.62E-09	5.62E-09	5.62E-09	1.78E+08	1.74E-08	1.74E-08	1.78E+08	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	5.16E-07	5.16E-07	1.71E-07	1.71E-07	1.71E-07	1.46E+06	2.89E-05	2.89E-05	1.46E+06	0.01%	0.01%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	7.33E-06	7.33E-06	2.98E-07	2.98E-07	2.98E-07	6.71E+05	7.33E-06	7.33E-06	6.71E+05	0.00%	0.00%
Naphthalene	283	3.10E+01	1.20E-06	1.20E-06	3.86E-08	3.86E-08	3.86E-08	5.18E+06	1.20E-06	1.20E-06	5.18E+06	0.00%	0.00%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	3.17E-08	3.17E-08	1.27E-10	1.27E-10	1.27E-10	7.85E+09	1.05E-05	1.05E-05	7.85E+09	0.00%	0.00%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.76E-08	1.76E-08	9.08E-08	9.08E-08	9.08E-08	1.10E+07	2.82E-05	2.82E-05	1.10E+07	0.00%	0.00%
Toluene	17.6	5.26E+02	1.91E-07	1.91E-07	1.08E-08	1.08E-08	1.08E-08	2.30E+07	5.71E-06	5.71E-06	2.30E+07	0.00%	0.00%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-03	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	1.11E-07	1.11E-07	1.21E-07	1.21E-07	1.21E-07	8.28E+06	6.89E-06	6.89E-06	8.28E+06	0.00%	0.00%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	4.30E-07	4.30E-07	6.42E-08	6.42E-08	6.42E-08	3.89E+06	6.81E-07	6.81E-07	3.89E+06	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix O

Odour Scenario 5 Comm

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Lend Lease
Scenario: Scenario 5 - Commercial Slab on Ground (Odour Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Commercial/Industrial

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐	Incidental Ingestion of Soil
☐	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☒	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☒	Inhalation of Groundwater-Derived Vapours in Indoor Air
☐	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☐	Incidental Ingestion of Groundwater (Bathing or Excavation)
☐	Dermal Contact with Groundwater (Bathing or Excavation)
☐	Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐	Soil RBSLs saturation limited?
☐	Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.20	1.00E-05	511	4.48
Acenaphthylene	0.20	1.00E-05	1700	43.2
Ammonia	1.00	1.00E-05		348
Aniline	1.00	1.00E-05		0.212
Anthracene	0.20	1.00E-05	2150	15.4
Arsenic, Inorganic	1.00	1.00E-05		0.024
Barium	1.00	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1.00	1.00E-05		0.03
Cadmium (Water)	1.00	1.00E-05		0.108
Chromium(III), Insoluble Salts	1.00	1.00E-05	210	0.102
Chromium(VI)	1.00	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1.00	1.00E-05		0.057
Cresol, m-&p-	1.00	1.00E-05	2290	436
Cresol, o-	1.00	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1.00	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1.00	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.20	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1.00	1.00E-05	60600	187
Lead and Compounds	1.00	1.00E-05	13600	0.555
Manganese	1.00	1.00E-05		4.89
Methylnaphthalene, 2-	0.20	1.00E-05	7650	105
Naphthalene	0.20	1.00E-05	10200	283
Nickel Soluble Salts	1.00	1.00E-05		0.303
Phenanthrene	0.20	1.00E-05	5180	74.1
Phenol	1.00	1.00E-05		249
Pyrene	0.20	1.00E-05	2640	27.9
Styrene	1.00	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.13	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.13	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.13	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.13	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.13	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.13	1.00E-05	20600	332
TPH C29-C36 aromatic	0.13	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1.00	1.00E-05	220	0.92
Vanadium and compounds	1.00	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

		Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
General receptor parameters:							
Units							
Body weight	kg	70	N/A	70		70	N/A
Exposure duration	yr	25	N/A	30		30	N/A
Averaging time (carcinogens)	yr	70	N/A	70		70	N/A
Averaging time (non-carcinogens)	yr	25	N/A	30		30	N/A
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	NA	N/A			NA	N/A
Exposure frequency for soil ingestion	days/yr	240	N/A			240	N/A
Fraction of daily soil intake from site	unitless	1	N/A			1	N/A
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm2	NA	N/A			NA	N/A
Soil to skin adherence factor	mg/cm2	0.5	N/A			0.5	N/A
Exposure frequency for dermal contact with soil	days/yr	240	N/A			240	N/A
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	8	N/A	8		8	N/A
Exposure frequency (indoor air)	days/yr	240	N/A	240		240	N/A
Particulate emission factor (indoor air)	m3/kg	1.81E+09	N/A			1.81E+09	N/A
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	NA	N/A			NA	N/A
Exposure frequency (outdoor air)	days/yr	240	N/A			240	N/A
Particulate emission factor (outdoor air)	m3/kg	1.36E+09	N/A			1.36E+09	N/A
Potable Water Ingestion							
Potable water intake rate	L/day	2	N/A			2	N/A
Exposure frequency for potable water intake	days/yr	240	N/A			240	N/A
Incidental Water Ingestion							
Incidental ingestion rate	L/day	0	N/A			0	N/A
Exposure frequency for incidental water ingestion	days/yr	240	N/A			240	N/A
Dermal Contact with Water							
Exposed skin surface for water contact	cm2	NA	N/A			NA	N/A
Exposure time for dermal water contact	hr/day	NA	N/A			NA	N/A
Exposure frequency for dermal water contact	days/yr	240	N/A			240	N/A

-Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

Vapour Modelling - Groundwater to Outdoor and Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	200	Autocalculates from layer thicknesses
<u>Vadose Zone, Layer 1</u>							
Thickness	cm	295		183	HV	183	Groundwater assumed to be at a depth of 2 m based on groundwater data for the Site.
				Sand (<12% fines)			The soil type above groundwater across the site consists of fill (mostly sand and gravel), thus sand has conservatively been assumed as the main soil type in this scenario
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm ³ /cm ³	0.38		0.375	TPOR	0.375	
<u>Capillary Fringe</u>							
SCS Soil Type (aquifer unit):				Sand (<12% fines)			As above
Thickness of capillary fringe	cm	5		17	hcap	17	
Volumetric air content in capillary fringe soils	cc/cc	0.038		0.122	VAC	0.122	
Volumetric water content in capillary fringe soils	cc/cc	0.342		0.253	wccap	0.253	
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)	300	LB	300	ASTM (2002) default.
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	Default - considered conservative for Australian bldg practices.
Enclosed-space air exchange rate	1/s	0.000555556		0.000555556	ENCAER	5.56E-04	2 Air exchanges per hour for commercial buildings
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.00038	NU	0.00038	USEPA (2004) default crack fraction for slab on grade.
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	USEPA (2004) Sand values.
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	wcfnf	0.054	USEPA (2004) Sand values.
<u>Convective vapour flow term</u>							
Calculate convective flow term? (ENTER Y or N)		Y		N	Conv	N	
Convective flow rate (if specified directly)	cm ³ /sec			0.001			
Convective flow through slab (calculated)	cm ³ /sec	10.88			Qs	0.00	
Slab Area	cm ²	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc	0.0019	
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	Viscosity of air at 20 deg C.

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

Vapour Modelling - Groundwater to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc (cm ² /g)	Kd (cm ² /g)	H' (cc-H ₂ O / cc-air)	S (mg/L-water)	D ^{air} (cm ² /s)	D ^{wat} (cm ² /s)	MW (g/mol)	VP (mm-Hg)	Volatile?
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E+03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Const	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

C. Chemical-Specific Diffusion Coefficients

Chemical	D _{s1} (cm ² /s)	D _{s2}	D _{s3}	D _{soil}	D _{crack} (cm ² /s)	D _{cap} (cm ² /s)	D _{vs} (cm ² /s)	Convective Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	4.07E-04	3.12E-03	6.89E-03
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	4.00E-04	2.96E-03	7.75E-03
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	2.69E-03	1.77E-02	1.53E-03
Aniline	1.35E-02	-	-	1.35E-02	1.35E-02	9.48E-03	1.30E-02	4.19E-03
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	5.05E-04	3.19E-03	8.94E-03
Benz(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzenes	1.45E-02	-	-	1.45E-02	1.45E-02	5.81E-04	4.77E-03	3.90E-03
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	1.19E-02	2.00E-02	1.23E-02	4.74E-03
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	3.26E-04	2.51E-03	8.51E-03
Dimethylphenol, 2,4-	1.01E-02	-	-	1.01E-02	1.01E-02	1.60E-02	1.05E-02	5.56E-03
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	4.44E-04	3.65E-03	5.09E-03
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	4.31E-04	3.07E-03	7.93E-03
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	3.65E-04	2.93E-03	6.66E-03
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	4.24E-04	3.40E-03	5.77E-03
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	5.05E-04	3.01E-03	1.01E-02
Phenol	1.38E-02	-	-	1.38E-02	1.38E-02	5.60E-02	1.48E-02	4.08E-03
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.27E-03	3.70E-03	1.25E-02
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	4.64E-04	3.81E-03	4.91E-03
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	5.04E-04	4.14E-03	4.48E-03
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	6.45E-04	5.31E-03	3.49E-03
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	6.45E-04	5.31E-03	3.49E-03
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	6.50E-04	5.34E-03	3.49E-03
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	3.94E-04	3.24E-03	5.75E-03
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	5.50E-04	4.52E-03	4.12E-03

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{vs}	Effective diffusion coefficient between groundwater and soil surface

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{wesp1} (mg/m ³ air / mg/L H ₂ O)	VF _{wamb} (mg/m ³ air / mg/L H ₂ O)	VF _{trench} (mg/m ³ air / mg/L water)
Acenaphthene	9.26E-06	1.17E-05	7.41E-06
Acenaphthylene	5.11E-06	6.89E-06	7.41E-06
Ammonia	3.65E-06	5.84E-06	7.41E-06
Aniline	1.69E-07	5.37E-07	7.41E-06
Anthracene	2.16E-06	3.62E-06	7.41E-06
Benz(a)anthracene	NV	NV	NV
Benzenes	4.93E-04	5.41E-04	7.41E-06
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m-&p-	6.31E-08	2.16E-07	7.41E-06
Cresol, o-	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	8.70E-06	1.09E-05	7.41E-06
Dimethylphenol, 2,4-	5.99E-08	2.04E-07	7.41E-06
Ethylbenzene	5.35E-04	5.87E-04	7.41E-06
Fluoranthene	NV	NV	NV
Fluorene	4.22E-06	6.03E-06	7.41E-06
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	2.70E-05	3.11E-05	7.41E-06
Naphthalene	2.65E-05	3.06E-05	7.41E-06
Phenanthrene	1.46E-06	2.60E-06	7.41E-06
Phenol	2.85E-08	1.00E-07	7.41E-06
Pyrene	3.33E-07	9.01E-07	7.41E-06
Styrene	1.93E-04	2.13E-04	7.41E-06
Toluene	5.11E-04	5.61E-04	7.41E-06
TPH C06-C09 aliphatic	1.22E-01	1.34E-01	7.41E-06
TPH C10-C14 aliphatic	1.52E-01	1.66E-01	7.41E-06
TPH C10-C14 aromatic	3.42E-04	3.76E-04	7.41E-06
TPH C15-C28 aliphatic	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	3.71E-04	4.08E-04	7.41E-06
Xylenes (total)	4.35E-04	4.79E-04	7.41E-06

Definition of Parameters

VF _{wesp1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{wesp2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{wamb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

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Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	0.001	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100		0.001	HV	0.001	Assumes that contaminated soils are located directly below building slab.
				Sand (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay, therefore sand has been conservatively assumed in this scenario.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	vwc vz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)	300	LB	300	ASTM (2002) default.
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	Default - considered conservative for Australian bldg practices.
Enclosed-space air exchange rate	1/s	0.000555556		0.000555556	ENCAER	5.56E-04	2 Air exchanges commercial building
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.00038	NU	0.00038	USEPA (2004) default crack fraction for slab on grade.
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	USEPA (2004) Sand values.
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	vwc fnd	0.054	USEPA (2004) Sand values.
<u>Convective vapour flow term</u>							
Calculate convective flow term?		Y		N	Conv	N	
Convective flow rate (if specified directly)	cm3/sec			0.001			
Convective flow through slab (calculated)	cm3/sec	10.88					
Slab Area	cm2	700000			Qs	0.00	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Ab	700000	
Soil vapour permeability	cm ²	1.00E-08			Nuc		
Indoor-outdoor pressure differential	g/cm-s ²	40			kv	1.00E-08	
Slab perimeter	cm	3400			dP	40	
Depth to bottom of slab	cm	15			Xcrack	3400	
Viscosity of air	g/cm-s	1.81E-04			Zcrack	15	
					uair	1.81E-04	

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	K _{oc}	K _d	H'	S	D ^{air}	D ^{wat}	MW	VP	Volatile?
	(cm ³ /g)	(cm ³ /g)	(ccH ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

K _{oc}	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
K _d	Soil-water partition coefficient	D ^{wat}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1} (cm ² /s)	D _{s2}	D _{s3}	D _{soil}	D _{crack} (cm ² /s)	C _{sat} mg/kg	Convective Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	3.94E+01	6.89E-03
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	1.63E+02	7.75E-03
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	1.87E+04	1.53E-03
Aniline	1.35E-02	-	-	1.35E-02	1.35E-02	6.23E+03	4.19E-03
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	1.42E+00	8.94E-03
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	6.59E+02	3.90E-03
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	1.19E-02	1.44E+04	4.74E-03
Cresol, o-	NV	NV	NV	NV	NV	1.67E+04	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	5.69E+01	8.51E-03
Dimethylphenol, 2,4-	1.01E-02	-	-	1.01E-02	1.01E-02	8.00E+03	5.56E-03
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	1.67E+02	5.09E-03
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	3.10E+01	7.93E-03
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	1.23E+02	6.66E-03
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	9.66E+01	5.77E-03
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	3.84E+01	1.01E-02
Phenol	1.38E-02	-	-	1.38E-02	1.38E-02	3.37E+04	4.08E-03
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.47E+01	1.25E-02
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	2.93E+02	4.91E-03
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	2.91E+02	4.48E-03
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	2.21E+02	3.49E-03
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.11E+02	3.49E-03
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.54E+02	3.49E-03
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	7.46E+01	5.75E-03
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	8.90E+00	4.12E-03

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

Vapour Modelling - Soil to Outdoor and Indoor Air

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1} (mg/m ³ -air / mg/kg-soil)	VF _{as2} (mg/m ³ -air / mg/kg-soil)	VF _{p (indoor)} (mg/m ³ -air / mg/kg-soil)	VF _{p (outdoor)} (m ³ -air / mg/kg)	VF _{samb} (mg/m ³ -air / mg/kg-soil)	VF _{seep1} (mg/m ³ -air / mg/kg-soil)
Acenaphthene	1.17E-05	1.75E-05	5.51E-10	7.35E-10	3.35E-01	9.30E-07
Acenaphthylene	8.66E-06	1.75E-05	5.51E-10	7.35E-10	1.94E-01	5.13E-07
Ammonia	1.18E-04	1.75E-05	5.51E-10	7.35E-10	1.33E+01	9.50E-05
Aniline	1.20E-05	1.75E-05	5.51E-10	7.35E-10	2.74E-01	9.80E-07
Anthracene	3.12E-06	1.75E-05	5.51E-10	7.35E-10	2.67E-02	6.66E-08
Benz(a)anthracene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzene	4.46E-04	1.75E-05	5.51E-10	7.35E-10	3.64E+01	1.36E-04
Benzo(a)pyrene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzo(b)fluoranthene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzo(g,h,i)perylene	NV	NV	5.51E-10	7.35E-10	NV	NV
Benzo(k)fluoranthene	NV	NV	5.51E-10	7.35E-10	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	5.51E-10	7.35E-10	NV	NV
Chrysene	NV	NV	5.51E-10	7.35E-10	NV	NV
Cresol, m-&p-	3.84E-06	1.75E-05	5.51E-10	7.35E-10	3.01E-02	1.00E-07
Cresol, o-	NV	NV	5.51E-10	7.35E-10	NV	NV
Dibenz(a,h)anthracene	NV	NV	5.51E-10	7.35E-10	NV	NV
Dibenzofuran	8.38E-06	1.75E-05	5.51E-10	7.35E-10	1.89E-01	4.80E-07
Dimethylphenol, 2,4-	2.95E-06	1.75E-05	5.51E-10	7.35E-10	1.93E-02	5.92E-08
Ethylbenzene	2.84E-04	1.75E-05	5.51E-10	7.35E-10	1.71E+01	5.51E-05
Fluoranthene	NV	NV	5.51E-10	7.35E-10	NV	NV
Fluorene	5.84E-06	1.75E-05	5.51E-10	7.35E-10	8.90E-02	2.32E-07
Indeno(1,2,3-cd)pyrene	NV	NV	5.51E-10	7.35E-10	NV	NV
Methylnaphthalene, 2-	2.83E-05	1.75E-05	5.51E-10	7.35E-10	1.95E+00	5.48E-06
Naphthalene	3.55E-05	1.75E-05	5.51E-10	7.35E-10	2.86E-01	8.61E-07
Phenanthrene	2.54E-06	1.75E-05	5.51E-10	7.35E-10	1.85E-02	4.41E-08
Phenol	3.21E-06	1.75E-05	5.51E-10	7.35E-10	1.94E-02	7.03E-08
Pyrene	6.72E-07	1.75E-05	5.51E-10	7.35E-10	1.39E-03	3.09E-09
Styrene	1.74E-04	1.75E-05	5.51E-10	7.35E-10	6.33E+01	2.07E-04
Toluene	3.71E-04	1.75E-05	5.51E-10	7.35E-10	2.73E+01	9.39E-05
TPH C06-C09 aliphatic	9.87E-04	1.75E-05	5.51E-10	7.35E-10	1.67E+02	6.63E-04
TPH C10-C14 aliphatic	1.43E-04	1.75E-05	5.51E-10	7.35E-10	3.48E+00	1.39E-05
TPH C10-C14 aromatic	9.14E-05	1.75E-05	5.51E-10	7.35E-10	1.43E+00	5.69E-06
TPH C15-C28 aliphatic	NV	NV	5.51E-10	7.35E-10	NV	NV
TPH C15-C28 aromatic	NV	NV	5.51E-10	7.35E-10	NV	NV
TPH C29-C36 aliphatic	NV	NV	5.51E-10	7.35E-10	NV	NV
TPH C29-C36 aromatic	NV	NV	5.51E-10	7.35E-10	NV	NV
Trimethylbenzene, 1,2,4-	2.05E-04	1.75E-05	5.51E-10	7.35E-10	9.53E+00	2.88E-05
Xylenes (total)	2.78E-04	1.75E-05	5.51E-10	7.35E-10	1.46E+01	5.27E-05

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{seep1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	4.95E+05	-	-	4.95E+05	>Sat	5.11E+02	4.97E+04	-	-	4.97E+04	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	2.25E+07	-	-	2.25E+07	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	1.13E+08	-	-	1.13E+08	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	9.16E+05	-	-	9.16E+05	>Sat	1.51E+03	2.52E+05	-	-	2.52E+05	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	5.63E+04	-	-	5.63E+04	>Sat	2.29E+03	8.95E+04	-	-	8.95E+04	>Sol	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	9.50E+06	-	-	9.50E+06	>Sat	2.77E+02	5.25E+05	-	-	5.25E+05	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	4.14E+04	-	-	4.14E+04	>Sat	2.61E+02	4.26E+03	-	-	4.26E+03	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	9.67E+03	-	-	9.67E+03	>Sat	7.65E+03	1.96E+03	-	-	1.96E+03	>Sol	1.05E+02
Naphthalene	4.66E+05	-	-	4.66E+05	>Sat	1.02E+04	1.52E+04	-	-	1.52E+04	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	2.47E+07	-	-	2.47E+07	>Sol	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	3.21E+04	-	-	3.21E+04	>Sol	1.94E-01
Toluene	3.66E+05	-	-	3.66E+05	>Sat	2.65E+03	6.72E+04	-	-	6.72E+04	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	3.11E+05	-	-	3.11E+05	>Sat	2.20E+02	2.41E+04	-	-	2.41E+04	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	9.39E+04	-	-	9.39E+04	>Sat	2.58E+03	1.14E+04	-	-	1.14E+04	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater-Derived Vapours in Indoor Air

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
Barangaroo
Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario



Chemical	Soil Conc. (mg/kg)	C _{sat} (mg/kg)	Volatilisation Factor from Subsurface Soil to Indoor Air (mg/m ³)/(mg/kg)	Vapour Concentration in Indoor Air (From Subsurface Soil) (mg/m ³)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (kg/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)
Acenaphthene	511	3.94E+01	9.30E-07	3.66E-05	5.04E-01	2.04E-07	8.02E-06	1.59E-05
Acenaphthylene	1700	1.63E+02	5.13E-07	8.33E-05	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	6.66E-08	9.49E-08	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-
Benzene	1510	6.59E+02	1.36E-04	8.95E-02	1.09E+02	2.98E-05	1.96E-02	1.80E-04
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.00E-07	2.30E-04	1.24E-03	2.20E-08	5.03E-05	4.07E-02
Cresol, o-	-	-	NV	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-
Dibenzofuran	277	5.69E+01	4.80E-07	2.73E-05	1.00E+00	1.05E-07	5.99E-06	5.99E-06
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	5.51E-05	9.18E-03	2.00E+00	1.21E-05	2.01E-03	1.01E-03
Fluoranthene	2440	2.89E+01	NV	-	-	-	-	-
Fluorene	2100	3.10E+01	2.32E-07	7.21E-06	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	5.48E-06	6.74E-04	5.81E-02	1.20E-06	1.48E-04	2.54E-03
Naphthalene	10200	9.66E+01	8.61E-07	8.32E-05	4.40E-01	1.89E-07	1.82E-05	4.14E-05
Nickel Soluble Salts	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	4.41E-08	1.70E-06	-	-	-	-
Phenol	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	3.09E-09	4.53E-08	-	-	-	-
Styrene	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	9.39E-05	2.73E-02	3.01E+01	2.06E-05	5.99E-03	1.99E-04
TPH C06-C09 aliphatic	593	2.21E+02	6.63E-04	1.47E-01	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	1.39E-05	1.54E-03	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	5.69E-06	8.78E-04	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.88E-05	2.15E-03	1.96E+00	6.31E-06	4.71E-04	2.40E-04
Vanadium and compounds	248	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	5.27E-05	4.69E-04	4.34E+00	1.15E-05	1.03E-04	2.37E-05

TOTAL 4.49E-02

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Indoor Air
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario



Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Indoor Air [(mg/m ³)/(mg/L)]	Vapour Concentration in Indoor Air (From Subsurface Groundwater) (mg/m ³)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (L/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)
Acenaphthene	4.48	3.90E+00	9.26E-06	3.61E-05	5.04E-01	2.03E-06	7.91E-06	1.57E-05
Acenaphthylene	43.2	1.61E+01	5.11E-06	8.23E-05	-	-	-	-
Ammonia	348	4.82E+05	3.65E-06	1.27E-03	1.80E+01	8.00E-07	2.79E-04	1.55E-05
Aniline	0.212	3.60E+04	1.69E-07	3.57E-08	4.19E+00	3.70E-08	7.83E-09	1.87E-09
Anthracene	15.4	4.34E-02	2.16E-06	9.39E-08	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-
Benzene	40.2	1.79E+03	4.93E-04	1.98E-02	1.09E+02	1.08E-04	4.34E-03	3.98E-05
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	NV	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	NV	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	6.31E-08	2.75E-05	1.24E-03	1.38E-08	6.03E-06	4.87E-03
Cresol, o-	182	2.59E+04	NV	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.70E-06	2.70E-05	1.00E+00	1.91E-06	5.91E-06	5.91E-06
Dimethylphenol, 2,4-	38	7.87E+03	5.99E-08	2.27E-06	-	-	-	-
Ethylbenzene	3.02	1.69E+02	5.35E-04	1.62E-03	2.00E+00	1.17E-04	3.54E-04	1.77E-04
Fluoranthene	25.9	2.60E-01	NV	-	-	-	-	-
Fluorene	21.1	1.69E+00	4.22E-06	7.13E-06	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	2.70E-05	6.64E-04	5.81E-02	5.92E-06	1.46E-04	2.50E-03
Naphthalene	283	3.10E+01	2.65E-05	8.20E-04	4.40E-01	5.80E-06	1.80E-04	4.08E-04
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	1.46E-06	1.68E-06	-	-	-	-
Phenol	249	8.28E+04	2.85E-08	7.09E-06	1.54E-01	6.24E-09	1.55E-06	1.01E-05
Pyrene	27.9	1.35E-01	3.33E-07	4.50E-08	-	-	-	-
Styrene	0.194	3.10E+02	1.93E-04	3.75E-05	1.36E+00	4.23E-05	8.21E-06	6.04E-06
Toluene	17.6	5.26E+02	5.11E-04	9.00E-03	3.01E+01	1.12E-04	1.97E-03	6.55E-05
TPH C06-C09 aliphatic	6.08	1.18E+01	1.22E-01	7.44E-01	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	1.52E-01	1.52E-02	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	3.42E-04	8.65E-03	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	NV	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	NV	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	NV	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	NV	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.71E-04	3.42E-04	1.96E+00	8.14E-05	7.49E-05	3.81E-05
Vanadium and compounds	0.0228	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	4.35E-04	2.92E-03	4.34E+00	9.54E-05	6.39E-04	1.47E-04

TOTAL

8.31E-03

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	1.59E-05	1.59E-05	4.04E-07	4.04E-07	4.04E-07	4.95E+05	1.59E-05	1.59E-05	4.95E+05	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	1.80E-04	1.80E-04	2.73E-07	2.73E-07	2.73E-07	9.16E+05	1.80E-04	1.80E-04	9.16E+05	0.07%	0.07%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	4.07E-02	4.07E-02	1.78E-05	1.78E-05	1.78E-05	5.63E+04	2.55E-01	2.55E-01	5.63E+04	25.49%	25.49%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	5.99E-06	5.99E-06	1.05E-07	1.05E-07	1.05E-07	9.50E+06	5.99E-06	5.99E-06	9.50E+06	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	1.01E-03	1.01E-03	6.03E-06	6.03E-06	6.03E-06	4.14E+04	1.01E-03	1.01E-03	4.14E+04	0.40%	0.40%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	2.54E-03	2.54E-03	2.07E-05	2.07E-05	2.07E-05	9.67E+03	2.54E-03	2.54E-03	9.67E+03	1.27%	1.27%
Naphthalene	10200	9.66E+01	4.14E-05	4.14E-05	4.29E-07	4.29E-07	4.29E-07	4.66E+05	4.14E-05	4.14E-05	4.66E+05	0.02%	0.02%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	1.99E-04	1.99E-04	6.83E-07	6.83E-07	6.83E-07	3.66E+05	1.99E-04	1.99E-04	3.66E+05	0.08%	0.08%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.40E-04	2.40E-04	3.21E-06	3.21E-06	3.21E-06	3.11E+05	2.40E-04	2.40E-04	3.11E+05	0.02%	0.02%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	2.37E-05	2.37E-05	2.66E-06	2.66E-06	2.66E-06	9.39E+04	2.37E-05	2.37E-05	9.39E+04	0.01%	0.01%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 5 - Commercial Slab on Ground (Odour Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Indoor Vapour	TOTAL (All Pathways)	GW to Indoor Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Indoor Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	1.57E-05	1.57E-05	4.03E-06	4.03E-06	4.03E-06	4.97E+04	1.57E-05	1.57E-05	4.97E+04	0.01%	0.01%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	1.55E-05	1.55E-05	4.45E-08	4.45E-08	4.45E-08	2.25E+07	2.14E-02	2.14E-02	2.25E+07	2.14%	2.14%
Aniline	0.212	3.60E+04	1.87E-09	1.87E-09	8.82E-09	8.82E-09	8.82E-09	1.13E+08	3.17E-04	3.17E-04	1.13E+08	0.03%	0.03%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	3.98E-05	3.98E-05	9.91E-07	9.91E-07	9.91E-07	2.52E+05	1.77E-03	1.77E-03	2.52E+05	0.71%	0.71%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	4.87E-03	4.87E-03	1.12E-05	1.12E-05	1.12E-05	8.95E+04	2.54E-01	2.54E-01	8.95E+04	25.37%	25.37%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	5.91E-06	5.91E-06	1.91E-06	1.91E-06	1.91E-06	5.25E+05	5.91E-06	5.91E-06	5.25E+05	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.77E-04	1.77E-04	5.86E-05	5.86E-05	5.86E-05	4.26E+03	9.91E-03	9.91E-03	4.26E+03	3.96%	3.96%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	2.50E-03	2.50E-03	1.02E-04	1.02E-04	1.02E-04	1.96E+03	2.50E-03	2.50E-03	1.96E+03	1.25%	1.25%
Naphthalene	283	3.10E+01	4.08E-04	4.08E-04	1.32E-05	1.32E-05	1.32E-05	1.52E+04	4.08E-04	4.08E-04	1.52E+04	0.20%	0.20%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	1.01E-05	1.01E-05	4.05E-08	4.05E-08	4.05E-08	2.47E+07	3.36E-03	3.36E-03	2.47E+07	0.34%	0.34%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	6.04E-06	6.04E-06	3.11E-05	3.11E-05	3.11E-05	3.21E+04	9.65E-03	9.65E-03	3.21E+04	0.97%	0.97%
Toluene	17.6	5.26E+02	6.55E-05	6.55E-05	3.72E-06	3.72E-06	3.72E-06	6.72E+04	1.96E-03	1.96E-03	6.72E+04	0.78%	0.78%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.81E-05	3.81E-05	4.14E-05	4.14E-05	4.14E-05	2.41E+04	2.36E-03	2.36E-03	2.41E+04	0.24%	0.24%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	1.47E-04	1.47E-04	2.20E-05	2.20E-05	2.20E-05	1.14E+04	2.33E-04	2.33E-04	1.14E+04	0.09%	0.09%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix P

Odour Scenario 6 IntMain

1. General Information:

Site: Barangaroo
Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Client: Lend Lease
Scenario: Scenario 6 - Intrusive Maintenance (Odour Based Calculations)

Header Colour (Defaults = Blue):

2. Select Receptor:

Construction/Excavation Worker

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways
☐ Incidental Ingestion of Soil
☐ Dermal Contact with Soil
☐ Inhalation of Surface Soil-Derived Dust in Indoor Air
☒ Inhalation of Surface Soil-Derived Dust in Outdoor Air
☒ Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐ Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways
☐ Inhalation of Groundwater-Derived Vapours in Indoor Air
☐ Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐ Ingestion of Potable Groundwater
☐ Incidental Ingestion of Groundwater (Bathing or Excavation)
☐ Dermal Contact with Groundwater (Bathing or Excavation)
☒ Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐ Soil RBSLs saturation limited?
☒ Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene	0	0.00E+00	1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene	1	1.00E-05	652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene	0.2	1.00E-05	2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

	Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
	Adult	Child	Adult	Child	Adult	Child
General receptor parameters:						
	Units					
Body weight	kg	70	N/A	70		70 N/A
Exposure duration	yr	1	N/A	1		1 N/A
Averaging time (carcinogens)	yr	70	N/A	70		70 N/A
Averaging time (non-carcinogens)	yr	1	N/A	1		1 N/A
Incidental Soil Ingestion						
Daily soil ingestion rate	mg/day	200	N/A			200 N/A
Exposure frequency for soil ingestion	days/yr	240	N/A			240 N/A
Fraction of daily soil intake from site	unitless	1	N/A			1 N/A
Dermal Absorption of Soil						
Exposed skin surface area for soil contact	cm2	5000	N/A			5000 N/A
Soil to skin adherence factor	mg/cm2	0.5	N/A			0.5 N/A
Exposure frequency for dermal contact with soil	days/yr	240	N/A			240 N/A
Indoor Inhalation						
Exposure time (indoor air)	hrs/day	NA	N/A			NA N/A
Exposure frequency (indoor air)	days/yr	240	N/A			240 N/A
Particulate emission factor (indoor air)	m3/kg	NA	N/A			NA N/A
Outdoor Inhalation						
Exposure time (outdoor air)	hrs/day	8	N/A	8		8 N/A
Exposure frequency (outdoor air)	days/yr	240	N/A	15		15 N/A
Particulate emission factor (outdoor air)	m3/kg	1.00E+05	N/A	3.60E+07		3.60E+07 N/A
Potable Water Ingestion						
Potable water intake rate	L/day	0	N/A			0 N/A
Exposure frequency for potable water intake	days/yr	240	N/A			240 N/A
Incidental Water Ingestion						
Incidental ingestion rate	L/day	0.05	N/A			0.05 N/A
Exposure frequency for incidental water ingestion	days/yr	240	N/A			240 N/A
Dermal Contact with Water						
Exposed skin surface for water contact	cm2	6510	N/A			6510 N/A
Exposure time for dermal water contact	hr/day	8	N/A			8 N/A
Exposure frequency for dermal water contact	days/yr	240	N/A			240 N/A

* USEPA (2002)

USEPA (1997) (Exposure factors handbook) - based on assumption that head, forearms and hands will be exposed. 50th percentile data

** USEPA (1997) (Exposure factors handbook) - based on assumption that head legs and feet only would be contacting water. 50th percentile

-Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	300	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295			HV	295	
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01			OC	0.01	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26			VACS	0.26	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12			wvcvz	0.12	
Total soil porosity	cm ³ /cm ³	0.38			TPOR	0.38	
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm				Hvtwo		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm ³ /cm ³	NA			VACS2	NA	
Water-filled porosity (volumetric)	cm ³ /cm ³	NA			wvcvz2	NA	
Total soil porosity	cm ³ /cm ³	NA			TPOR2	NA	
<u>Convective vapour flow term</u>							
Calculate convective flow term? (ENTER Y or N)		Y			Conv	Y	
Convective flow rate (if specified directly)	cm ³ /sec						
Convective flow through slab (calculated)	cm ³ /sec	10.88			Qs	10.88	
Slab Area	cm ²	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc	0.0019	
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	Viscosity of air at 20 deg C.
<u>Additional Trench Characteristics (for GW level above base of trench, i.e., assumes groundwater flows into trench)</u>							
Groundwater seepage velocity (into trench)	cm/sec	1.50E-04	(c)	1.50E-04	Vgw	0.00015	Default for permeable fill (max expected for sandy/gravelly aquifer).
Depth of groundwater in trench	cm	50		50	Dgw	50	Assumes gw may be present at 2 mbgl (on average) and trench depth of 1.5 mbgl.
Dimension of trench (length or width) perpendicular to GW flow	cm	200	(d)	200	WSAtrench	200	Maximum assumed trench dimension.
Flow rate of groundwater in trench	cm ³ /sec				Qgw	1.5	Calculated from above three parameters.
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	22.5	(e)	37.8	windsp	37.8	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site), divided by 10.
Width of source area parallel to wind or groundwater flow direction	cm	600	(f)	600	WSA	600	2 m deep and 2 m long trench.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes all vapours mixed w/in trench.

- (a) Building Code of Australia minimum ceiling height for habitable dwelling.
 (b) USEPA (2004) upper limit of range for slab on grade foundation.
 (c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)
 (d) Assumes trench is 2 m long.
 (e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.
 (f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

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B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc (cm ² /g)	Kd (cm ² /g)	H' (cc-l/g (cc-air))	S (mg/kg-mg)	D ^{air} (cm ² /s)	D ^{soil} (cm ² /s)	MW (g/mol)	VP (mmHg)	Volatile?
Acenaphthene	5.03E+03	5.03E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	154E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	5.03E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	152E+02	6.68E-03	Y
Ammonia	3.10E+00	3.10E-02	6.58E-04	4.82E+05	2.28E-01	1.10E-05	170E+01	-	Y
Aniline	7.02E+01	7.02E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	931E+01	4.90E-01	Y
Anthracene	1.64E+04	1.64E+02	2.27E-03	4.34E-02	3.90E-02	7.85E-06	178E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	1.77E+03	1.37E-04	9.40E-03	5.10E-02	9.00E-06	228E+02	2.10E-07	N
Benzene	1.46E+02	1.46E+00	2.27E-01	1.79E+03	8.95E-02	1.03E-05	781E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	5.87E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	252E+02	5.49E-09	Y
Benzo(b)fluoranthene	5.99E+05	5.99E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	252E+02	5.00E-07	Y
Benzo(g,h,i)perylene	1.95E+06	1.95E+04	1.35E-05	2.60E-04	4.90E-02	5.56E-06	276E+02	1.00E-10	Y
Benzo(k)fluoranthene	5.87E+05	5.87E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	252E+02	9.65E-10	Y
Bis(2-ethylhexyl)phthalate	1.20E+05	1.20E+03	1.10E-05	2.70E-01	3.51E-02	3.66E-06	391E+02	1.42E-07	Y
Chrysene	1.81E+05	1.81E+03	2.14E-04	2.00E-03	2.48E-02	6.21E-06	228E+02	6.23E-09	Y
Cresol, m-&p-	3.00E+02	3.00E+00	3.50E-05	2.27E+04	7.29E-02	9.32E-06	108E+02	1.10E-01	Y
Cresol, o-	3.07E+02	3.07E+00	4.91E-05	2.59E+04	7.28E-02	9.32E-06	108E+02	1.70E-01	Y
Dibenz(a,h)anthracene	1.91E+06	1.91E+04	5.76E-06	2.49E-03	2.00E-02	5.24E-06	278E+02	9.55E-10	Y
Dibenzofuran	9.16E+03	9.16E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	168E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	4.92E+00	3.89E-05	7.87E+03	6.22E-02	8.31E-06	122E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	4.46E+00	3.22E-01	1.69E+02	6.85E-02	8.46E-06	106E+02	9.60E+00	Y
Fluoranthene	5.55E+04	5.55E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	202E+02	9.22E-06	Y
Fluorene	9.16E+03	9.16E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	166E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	1.95E+04	1.42E-05	1.90E-04	2.30E-02	4.41E-06	276E+02	1.25E-10	Y
Methylnaphthalene, 2-	2.48E+03	2.48E+01	2.12E-02	2.46E+01	5.24E-02	7.78E-06	142E+02	5.50E-02	Y
Naphthalene	1.54E+03	1.54E+01	1.80E-02	3.10E+01	6.05E-02	8.38E-06	128E+02	8.50E-02	Y
Phenanthrene	1.67E+04	1.67E+02	1.73E-03	1.15E+00	3.45E-02	6.69E-06	178E+02	1.21E-04	Y
Phenol	1.87E+02	1.87E+00	1.36E-05	8.28E+04	8.34E-02	1.03E-05	941E+01	3.50E-01	Y
Pyrene	5.43E+04	5.43E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	202E+02	4.50E-06	Y
Styrene	4.46E+02	4.46E+00	1.12E-01	3.10E+02	7.11E-02	8.78E-06	104E+02	6.40E+00	Y
Toluene	2.34E+02	2.34E+00	2.71E-01	5.26E+02	7.78E-02	9.20E-06	921E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	4.47E+01	5.05E+01	1.18E+01	1.00E-01	1.00E-05	103E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	5.50E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	170E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	3.02E+01	1.41E-01	2.53E+01	1.00E-01	1.00E-05	136E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	3.16E+06	8.27E+01	1.11E-04	1.00E-01	1.00E-05	260E+02	5.93E-03	Y
TPH C15-C28 aromatic	3.79E+04	3.79E+02	4.90E-03	1.06E+00	1.00E-01	1.00E-05	209E+02	5.51E-03	Y
TPH C29-C36 aliphatic	6.31E+08	6.31E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	270E+02	8.36E-04	Y
TPH C29-C36 aromatic	1.26E+05	1.26E+03	1.70E-05	6.60E-03	1.00E-01	1.00E-05	240E+02	3.34E-07	Y
Trimethylbenzene, 1,2,4-	6.14E+02	6.14E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	120E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	3.83E+00	2.12E-01	1.06E+01	8.47E-02	9.90E-06	106E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

Chemical	D _{soil} (cm ² /s)	D _{crack}	D _{cap}	D _{soil}	D _{crack}	D _{soil}	D _{soil}	Convective
	(cm ² /s)				(cm ² /s)	(cm ² /s)	(cm ² /s)	(m/s)
Acenaphthene	3.96E-03	-	-	3.96E-03	3.96E-03	2.22E-04	3.09E-03	3.10E+01
Acenaphthylene	3.52E-03	-	-	3.52E-03	3.52E-03	2.97E-04	2.98E-03	3.49E+01
Ammonia	1.79E-02	-	-	1.79E-02	1.79E-02	3.28E-03	1.67E-02	6.86E+00
Aniline	7.20E-03	-	-	7.20E-03	7.20E-03	2.38E-02	7.29E-03	1.70E+01
Anthracene	3.06E-03	-	-	3.06E-03	3.06E-03	6.77E-04	2.89E-03	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	6.98E-03	-	-	6.98E-03	6.98E-03	2.04E-05	1.04E-03	1.76E+01
Benzo(a)pyrene	6.22E-03	-	-	6.22E-03	6.22E-03	9.36E-02	6.31E-03	1.97E+01
Benzo(b)fluoranthene	2.99E-03	-	-	2.99E-03	2.99E-03	4.02E-02	3.04E-03	4.10E+01
Benzo(g,h,i)perylene	6.27E-03	-	-	6.27E-03	6.27E-03	8.01E-02	6.37E-03	1.96E+01
Benzo(k)fluoranthene	3.15E-03	-	-	3.15E-03	3.15E-03	4.52E-02	3.20E-03	3.90E+01
Bis(2-ethylhexyl)phthalate	4.72E-03	-	-	4.72E-03	4.72E-03	6.47E-02	4.79E-03	2.60E+01
Chrysene	2.11E-03	-	-	2.11E-03	2.11E-03	5.65E-03	2.13E-03	5.82E+01
Cresol, m-&p-	7.27E-03	-	-	7.27E-03	7.27E-03	5.18E-02	7.38E-03	1.69E+01
Cresol, o-	6.81E-03	-	-	6.81E-03	6.81E-03	3.69E-02	6.90E-03	1.80E+01
Dibenz(a,h)anthracene	6.97E-03	-	-	6.97E-03	6.97E-03	1.77E-01	7.08E-03	1.76E+01
Dibenzofuran	3.20E-03	-	-	3.20E-03	3.20E-03	1.70E-04	2.47E-03	3.83E+01
Dimethylphenol, 2,4-	6.12E-03	-	-	6.12E-03	6.12E-03	4.15E-02	6.21E-03	2.00E+01
Ethylbenzene	5.35E-03	-	-	5.35E-03	5.35E-03	1.40E-05	7.26E-04	2.30E+01
Fluoranthene	2.46E-03	-	-	2.46E-03	2.46E-03	3.41E-03	2.47E-03	4.99E+01
Fluorene	3.45E-03	-	-	3.45E-03	3.45E-03	3.96E-04	3.05E-03	3.56E+01
Indeno(1,2,3-cd)pyrene	3.64E-03	-	-	3.64E-03	3.64E-03	6.04E-02	3.70E-03	3.37E+01
Methylnaphthalene, 2-	4.09E-03	-	-	4.09E-03	4.09E-03	7.81E-05	2.20E-03	3.00E+01
Naphthalene	4.72E-03	-	-	4.72E-03	4.72E-03	9.83E-05	2.65E-03	2.60E+01
Phenanthrene	2.72E-03	-	-	2.72E-03	2.72E-03	7.56E-04	2.60E-03	4.52E+01
Phenol	1.10E-02	-	-	1.10E-02	1.10E-02	1.47E-01	1.12E-02	1.11E+01
Pyrene	2.26E-03	-	-	2.26E-03	2.26E-03	2.90E-03	2.27E-03	5.43E+01
Styrene	5.55E-03	-	-	5.55E-03	5.55E-03	2.44E-05	1.16E-03	2.21E+01
Toluene	6.07E-03	-	-	6.07E-03	6.07E-03	1.66E-05	8.60E-04	2.02E+01
TPH C06-C09 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.30E-05	7.08E-04	1.57E+01
TPH C10-C14 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.08E-04	1.57E+01
TPH C10-C14 aromatic	7.80E-03	-	-	7.80E-03	7.80E-03	2.67E-05	1.33E-03	1.57E+01
TPH C15-C28 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.07E-04	1.57E+01
TPH C15-C28 aromatic	7.82E-03	-	-	7.82E-03	7.82E-03	4.10E-04	6.01E-03	1.57E+01
TPH C29-C36 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.07E-04	1.57E+01
TPH C29-C36 aromatic	1.13E-02	-	-	1.13E-02	1.13E-02	1.14E-01	1.15E-02	1.09E+01
Trimethylbenzene, 1,2,4-	4.74E-03	-	-	4.74E-03	4.74E-03	1.40E-05	7.13E-04	2.59E+01
Xylenes (total)	6.61E-03	-	-	6.61E-03	6.61E-03	2.00E-05	1.02E-03	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{soil}	Effective diffusion coefficient between groundwater and soil surface

Vapour Modelling - Groundwater to Outdoor and Indoor Air

Barangaroo

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Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{weat} (mg/m ³ air / mg/L H ₂ O)	VF _{weatb} (mg/m ³ air / mg/L H ₂ O)	VF _{trench} (mg/m ³ air / mg/L water)
Acenaphthene	1.12E-03	6.15E-06	3.31E-04
Acenaphthylene	6.78E-04	3.68E-06	3.31E-04
Ammonia	1.92E-04	2.90E-06	3.31E-04
Aniline	1.88E-05	1.59E-07	3.31E-04
Anthracene	3.24E-04	1.74E-06	3.31E-04
Benz(a)anthracene	NV	NV	NV
Benzene	1.55E-02	6.27E-05	3.31E-04
Benzo(a)pyrene	4.01E-06	3.12E-08	3.31E-04
Benzo(b)fluoranthene	3.96E-06	2.16E-08	3.31E-04
Benzo(g,h,i)perylene	2.91E-06	2.27E-08	3.31E-04
Benzo(k)fluoranthene	3.63E-06	2.02E-08	3.31E-04
Bis(2-ethylhexyl)phthalate	2.08E-06	1.39E-08	3.31E-04
Chrysene	2.50E-05	1.21E-07	3.31E-04
Cresol, m-&p-	8.00E-06	6.83E-08	3.31E-04
Cresol, o-	1.09E-05	8.97E-08	3.31E-04
Dibenz(a,h)anthracene	1.30E-06	1.08E-08	3.31E-04
Dibenzofuran	1.13E-03	5.69E-06	3.31E-04
Dimethylphenol, 2,4-	8.29E-06	6.39E-08	3.31E-04
Ethylbenzene	1.62E-02	6.18E-05	3.31E-04
Fluoranthene	4.68E-05	2.37E-07	3.31E-04
Fluorene	5.80E-04	3.17E-06	3.31E-04
Indeno(1,2,3-cd)pyrene	2.34E-06	1.39E-08	3.31E-04
Methylnaphthalene, 2-	2.54E-03	1.24E-05	3.31E-04
Naphthalene	2.43E-03	1.26E-05	3.31E-04
Phenanthrene	2.31E-04	1.19E-06	3.31E-04
Phenol	3.58E-06	4.02E-08	3.31E-04
Pyrene	5.94E-05	2.92E-07	3.31E-04
Styrene	8.34E-03	3.45E-05	3.31E-04
Toluene	1.57E-02	6.16E-05	3.31E-04
TPH C06-C09 aliphatic	2.48E+00	9.46E-03	3.31E-04
TPH C10-C14 aliphatic	3.08E+00	1.17E-02	3.31E-04
TPH C10-C14 aromatic	1.17E-02	4.97E-05	3.31E-04
TPH C15-C28 aliphatic	4.06E+00	1.55E-02	3.31E-04
TPH C15-C28 aromatic	1.03E-03	7.79E-06	3.31E-04
TPH C29-C36 aliphatic	4.18E+00	1.59E-02	3.31E-04
TPH C29-C36 aromatic	4.51E-06	5.16E-08	3.31E-04
Trimethylbenzene, 1,2,4-	1.25E-02	4.75E-05	3.31E-04
Xylenes (total)	1.42E-02	5.72E-05	3.31E-04

Definition of Parameters

VF _{weat1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{weat2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{weatb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

Vapour Modelling - Soil to Outdoor and Indoor Air

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Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100		2000	LDSSZ	2000	Large value assumed in order to eliminate mass limiting in surface soil emission model.
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	100	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1 (soil type where source is)</u>							
Thickness	cm	100			HV	100	
				Sand and gravel (<12% fines)			The majority of fill across the site has been identified as sand and gravel with some clay.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<u>Outdoor Air Characteristics</u>							
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	22.5	(c)	37.8	windsp	37.8	Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site), divided by 10.
Width of source area parallel to wind or groundwater flow direction	cm	600	(d)	600	WSA	600	2 m deep and 2 m long trench.
Ambient air mixing zone height	cm	200		200	AAMZH	200	Assumes all vapours mixed w/in trench.
<u>Other</u>							
Averaging time for surface emission vapour flux	sec	3.15E+07	(e)		atvapor	3.15E+07	Defaults to receptor exposure duration

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

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Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{soil}	MW	VP	Volatile?
	(cm ² /d)	(cm ² /d)	(cc-H ₂ /cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	Y
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	Y
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	Y
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	Y
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	Y
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	Y
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	Y
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	Y
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	Y
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	Y
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	Y
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	Y
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	Y
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	Y
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	Y
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	Y
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	Y
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.25E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{s1}	D _{s2}	D _{s3}	D _{soil}	D _{crack}	C _{sat}	Convective
	(cm ² /s)				(cm ² /s)	mg/kg	Factor (unitless)
Acenaphthene	8.18E-03	-	-	8.18E-03	3.96E-03	3.94E+01	3.10E+01
Acenaphthylene	7.28E-03	-	-	7.28E-03	3.52E-03	1.63E+02	3.49E+01
Ammonia	3.69E-02	-	-	3.69E-02	1.79E-02	1.87E+04	6.86E+00
Aniline	1.35E-02	-	-	1.35E-02	7.20E-03	6.23E+03	1.70E+01
Anthracene	6.31E-03	-	-	6.31E-03	3.06E-03	1.42E+00	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV
Benzene	1.45E-02	-	-	1.45E-02	6.98E-03	6.59E+02	1.76E+01
Benzo(a)pyrene	7.16E-03	-	-	7.16E-03	6.22E-03	1.90E+00	1.97E+01
Benzo(b)fluoranthene	3.74E-03	-	-	3.74E-03	2.99E-03	1.80E+00	4.10E+01
Benzo(a,h,i)perylene	8.10E-03	-	-	8.10E-03	6.27E-03	1.01E+00	1.96E+01
Benzo(k)fluoranthene	3.75E-03	-	-	3.75E-03	3.15E-03	9.39E-01	3.90E+01
Bis(2-ethylhexyl)phthalate	5.82E-03	-	-	5.82E-03	4.72E-03	6.48E+01	2.60E+01
Chrysene	4.02E-03	-	-	4.02E-03	2.11E-03	7.24E-01	5.82E+01
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	7.27E-03	1.44E+04	1.69E+01
Cresol, o-	1.18E-02	-	-	1.18E-02	6.81E-03	1.67E+04	1.80E+01
Dibenz(a,h)anthracene	3.62E-03	-	-	3.62E-03	6.97E-03	9.51E+00	1.76E+01
Dibenzofuran	6.63E-03	-	-	6.63E-03	3.20E-03	5.69E+01	3.83E+01
Dimethylphenol, 2,4-	1.01E-02	-	-	1.01E-02	6.12E-03	8.00E+03	2.00E+01
Ethylbenzene	1.11E-02	-	-	1.11E-02	5.35E-03	1.67E+02	2.30E+01
Fluoranthene	4.89E-03	-	-	4.89E-03	2.46E-03	2.89E+01	4.99E+01
Fluorene	7.11E-03	-	-	7.11E-03	3.45E-03	3.10E+01	3.56E+01
Indeno(1,2,3-cd)pyrene	3.85E-03	-	-	3.85E-03	3.64E-03	7.41E-01	3.37E+01
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	4.09E-03	1.23E+02	3.00E+01
Naphthalene	9.78E-03	-	-	9.78E-03	4.72E-03	9.66E+01	2.60E+01
Phenanthrene	5.58E-03	-	-	5.58E-03	2.72E-03	3.84E+01	4.52E+01
Phenol	1.38E-02	-	-	1.38E-02	1.10E-02	3.37E+04	1.11E+01
Pyrene	4.50E-03	-	-	4.50E-03	2.26E-03	1.47E+01	5.43E+01
Styrene	1.15E-02	-	-	1.15E-02	5.55E-03	2.93E+02	2.21E+01
Toluene	1.26E-02	-	-	1.26E-02	6.07E-03	2.91E+02	2.02E+01
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	2.21E+02	1.57E+01
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.11E+02	1.57E+01
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	7.80E-03	1.54E+02	1.57E+01
TPH C15-C28 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	7.02E+01	1.57E+01
TPH C15-C28 aromatic	1.62E-02	-	-	1.62E-02	7.82E-03	8.04E+01	1.57E+01
TPH C29-C36 aliphatic	1.62E-02	-	-	1.62E-02	7.80E-03	3.16E+00	1.57E+01
TPH C29-C36 aromatic	1.64E-02	-	-	1.64E-02	1.13E-02	1.66E+00	1.09E+01
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	4.74E-03	7.46E+01	2.59E+01
Xylenes (total)	1.37E-02	-	-	1.37E-02	6.61E-03	8.90E+00	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
C _{sat}	Soil concentration at which dissolved pore-water and vapor phases become saturated

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as1} (mg/m ³ -air / mg/kg-soil)	VF _{as2} (mg/m ³ -air / mg/kg-soil)	VF _{p (indoor)} (mg/m ³ -air / mg/kg-soil)	VF _{p (outdoor)} (mg/m ³ -air / mg/kg-soil)	VF _{samb} (mg/m ³ -air / mg/kg-soil)	VF _{sssp1} (mg/m ³ -air / mg/kg-soil)
Acenaphthene	5.07E-05	8.36E-03	-	2.78E-08	4.84E-06	2.34E-04
Acenaphthylene	3.77E-05	8.36E-03	-	2.78E-08	2.67E-06	1.42E-04
Ammonia	5.13E-04	8.36E-03	-	2.78E-08	4.95E-04	6.07E-03
Aniline	5.21E-05	8.36E-03	-	2.78E-08	5.11E-06	1.60E-04
Anthracene	1.36E-05	8.36E-03	-	2.78E-08	3.46E-07	2.07E-05
Benz(a)anthracene	NV	NV	-	2.78E-08	NV	NV
Benzene	1.94E-03	8.36E-03	-	2.78E-08	7.07E-04	2.08E-02
Benzo(a)pyrene	2.19E-07	8.36E-03	-	2.78E-08	9.05E-11	4.88E-09
Benzo(b)fluoranthene	1.88E-07	8.36E-03	-	2.78E-08	6.67E-11	5.92E-09
Benzo(a,h)perylene	1.09E-07	8.36E-03	-	2.78E-08	2.22E-11	1.08E-09
Benzo(k)fluoranthene	1.80E-07	8.36E-03	-	2.78E-08	6.06E-11	5.37E-09
Bis(2-ethylhexyl)phthalate	3.36E-07	8.36E-03	-	2.78E-08	2.12E-10	1.35E-08
Chrysene	1.00E-06	8.36E-03	-	2.78E-08	1.89E-09	1.59E-07
Cresol, m-&p-	1.67E-05	8.36E-03	-	2.78E-08	5.23E-07	1.83E-05
Cresol, o-	1.95E-05	8.36E-03	-	2.78E-08	7.14E-07	2.50E-05
Dibenz(a,h)anthracene	4.80E-08	8.36E-03	-	2.78E-08	4.33E-12	3.94E-10
Dibenzofuran	3.64E-05	8.36E-03	-	2.78E-08	2.50E-06	1.43E-04
Dimethylphenol, 2,4-	1.28E-05	8.36E-03	-	2.78E-08	3.08E-07	1.24E-05
Ethylbenzene	1.24E-03	8.36E-03	-	2.78E-08	2.87E-04	1.07E-02
Fluoranthene	2.59E-06	8.36E-03	-	2.78E-08	1.27E-08	9.23E-07
Fluorene	2.54E-05	8.36E-03	-	2.78E-08	1.21E-06	6.55E-05
Indeno(1,2,3-cd)pyrene	7.70E-08	8.36E-03	-	2.78E-08	1.11E-11	9.68E-10
Methylnaphthalene, 2-	1.23E-04	8.36E-03	-	2.78E-08	2.85E-05	1.34E-03
Naphthalene	1.54E-04	8.36E-03	-	2.78E-08	4.48E-06	1.86E-04
Phenanthrene	1.10E-05	8.36E-03	-	2.78E-08	2.29E-07	1.51E-05
Phenol	1.40E-05	8.36E-03	-	2.78E-08	3.67E-07	1.12E-05
Pyrene	2.92E-06	8.36E-03	-	2.78E-08	1.60E-08	1.24E-06
Styrene	7.58E-04	8.36E-03	-	2.78E-08	1.08E-03	3.89E-02
Toluene	1.61E-03	8.36E-03	-	2.78E-08	4.89E-04	1.63E-02
TPH C06-C09 aliphatic	4.29E-03	8.36E-03	-	2.78E-08	3.46E-03	9.17E-02
TPH C10-C14 aliphatic	6.20E-04	8.36E-03	-	2.78E-08	7.22E-05	1.92E-03
TPH C10-C14 aromatic	3.97E-04	8.36E-03	-	2.78E-08	2.97E-05	7.87E-04
TPH C15-C28 aliphatic	2.99E-05	8.36E-03	-	2.78E-08	1.68E-06	4.45E-05
TPH C15-C28 aromatic	2.10E-05	8.36E-03	-	2.78E-08	8.29E-07	2.20E-05
TPH C29-C36 aliphatic	2.14E-05	8.36E-03	-	2.78E-08	8.64E-07	2.29E-05
TPH C29-C36 aromatic	6.84E-07	8.36E-03	-	2.78E-08	8.79E-10	2.30E-08
Trimethylbenzene, 1,2,4-	8.93E-04	8.36E-03	-	2.78E-08	1.50E-04	6.20E-03
Xylenes (total)	1.21E-03	8.36E-03	-	2.78E-08	2.74E-04	8.46E-03

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{samb}	Volatilization factor from subsurface soils to ambient air
VF _{sssp1}	Volatilization factor from soil to enclosed-space vapors
VF _{trench}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	2.65E+08	-	-	2.65E+08	-	5.11E+02	2.22E+04	-	-	2.22E+04	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	3.97E+06	-	-	3.97E+06	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	9.25E+05	-	-	9.25E+05	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	7.16E+10	-	-	7.16E+10	-	1.51E+03	6.02E+06	-	-	6.02E+06	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salt	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	5.41E+03	-	-	5.41E+03	-	2.29E+03	2.73E+02	-	-	2.73E+02	-	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	2.63E+09	-	-	2.63E+09	-	2.77E+02	2.21E+05	-	-	2.21E+05	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	1.31E+09	-	-	1.31E+09	-	2.61E+02	1.10E+05	-	-	1.10E+05	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	3.00E+07	-	-	3.00E+07	-	7.65E+03	2.57E+03	-	-	2.57E+03	>Sol	1.05E+02
Naphthalene	2.31E+08	-	-	2.31E+08	-	1.02E+04	1.94E+04	-	-	1.94E+04	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	3.40E+04	-	-	3.40E+04	-	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	3.00E+05	-	-	3.00E+05	>Sol	1.94E-01
Toluene	1.98E+10	-	-	1.98E+10	-	2.65E+03	1.66E+06	-	-	1.66E+06	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	5.16E+09	-	-	5.16E+09	-	2.20E+02	4.33E+05	-	-	4.33E+05	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2.85E+09	-	-	2.85E+09	-	2.58E+03	2.39E+05	-	-	2.39E+05	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

- x Inhalation of Soil-Derived Dust in Outdoor Air
- x Inhalation of Surface Soil-Derived Vapours in Outdoor Air

Pathways included in derivation of Groundwater RBSL:

- x Inhalation of Groundwater Vapours (Where GW Enters Trench)

Health Risk Calculations - Inhalation of Soil-Derived Particulates in Outdoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

Chemical	Soil Conc (mg/kg)	Particulate Concentration in Outdoor Air (From Surface Soil) (m3/kg)	Threshold Intake and Risk Calculations			
			Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	511	2.78E-08	5.04E-01	3.81E-10	1.94E-07	3.86E-07
Acenaphthylene	1700	2.78E-08	-	-	-	-
Ammonia	-	-	-	-	-	-
Aniline	-	-	-	-	-	-
Anthracene	2150	2.78E-08	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Benz(a)anthracene	1470	2.78E-08	-	-	-	-
Benzene	1510	2.78E-08	1.09E+02	3.81E-10	5.75E-07	5.27E-09
Benzo(a)pyrene	652	2.78E-08	-	-	-	-
Benzo(b)fluoranthene	587	2.78E-08	-	-	-	-
Benzo(g,h,i)perylene	305	2.78E-08	-	-	-	-
Benzo(k)fluoranthene	231	2.78E-08	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	2.78E-08	-	-	-	-
Chromium(VI)	2.3	2.78E-08	-	-	-	-
Chrysene	771	2.78E-08	-	-	-	-
Cobalt	-	-	-	-	-	-
Cresol, m-&p-	2290	2.78E-08	1.24E-03	3.81E-10	8.71E-07	7.04E-04
Cresol, o-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	2.78E-08	-	-	-	-
Dibenzofuran	277	2.78E-08	1.00E+00	3.81E-10	1.05E-07	1.05E-07
Dimethylphenol, 2,4-	-	-	-	-	-	-
Ethylbenzene	261	2.78E-08	2.00E+00	3.81E-10	9.93E-08	4.97E-08
Fluoranthene	2440	2.78E-08	-	-	-	-
Fluorene	2100	2.78E-08	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	2.78E-08	-	-	-	-
Iron	60600	2.78E-08	-	-	-	-
Lead and Compounds	13600	2.78E-08	-	-	-	-
Manganese	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	2.78E-08	5.81E-02	3.81E-10	2.91E-06	5.01E-05
Naphthalene	10200	2.78E-08	4.40E-01	3.81E-10	3.88E-06	8.82E-06
Nickel Soluble Salts	-	-	-	-	-	-
Phenanthrene	5180	2.78E-08	-	-	-	-
Phenol	-	-	-	-	-	-
Pyrene	2640	2.78E-08	-	-	-	-
Styrene	-	-	-	-	-	-
Toluene	2650	2.78E-08	3.01E+01	3.81E-10	1.01E-06	3.35E-08
TPH C06-C09 aliphatic	593	2.78E-08	-	-	-	-
TPH C10-C14 aliphatic	69400	2.78E-08	-	-	-	-
TPH C10-C14 aromatic	69400	2.78E-08	-	-	-	-
TPH C15-C28 aliphatic	93200	2.78E-08	-	-	-	-
TPH C15-C28 aromatic	93200	2.78E-08	-	-	-	-
TPH C29-C36 aliphatic	20600	2.78E-08	-	-	-	-
TPH C29-C36 aromatic	20600	2.78E-08	-	-	-	-
Trimethylbenzene, 1,2,4-	220	2.78E-08	1.96E+00	3.81E-10	8.37E-08	4.26E-08
Vanadium and compounds	248	2.78E-08	-	-	-	-
Xylenes (total)	2576	2.78E-08	4.34E+00	3.81E-10	9.80E-07	2.26E-07

TOTAL

7.63E-04

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Inhalation of Surface Soil-Derived Vapours in Outdoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	C _{sat} (mg/kg)	Volatilisation Factor from Subsurface Soil to Outdoor Air [(mg/m ³)/(mg/kg)]	Vapour Concentration in Outdoor Air (From Surface Soil) (mg/m ³)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (kg/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)
Acenaphthene	511	3.94E+01	5.07E-05	2.00E-03	5.04E-01	6.95E-07	2.74E-05	5.43E-05
Acenaphthylene	1700	1.63E+02	3.77E-05	6.12E-03	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	1.36E-05	1.93E-05	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-
Benzene	1510	6.59E+02	1.94E-03	1.28E+00	1.09E+02	2.66E-05	1.75E-02	1.61E-04
Benzo(a)pyrene	652	1.90E+00	2.19E-07	4.17E-07	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	1.88E-07	3.39E-07	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	1.09E-07	1.10E-07	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	1.80E-07	1.69E-07	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	1.00E-06	7.26E-07	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.67E-05	3.82E-02	1.24E-03	2.28E-07	5.23E-04	4.22E-01
Cresol, o-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	4.80E-08	4.57E-07	-	-	-	-
Dibenzofuran	277	5.69E+01	3.64E-05	2.07E-03	1.00E+00	4.99E-07	2.84E-05	2.84E-05
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	1.24E-03	2.06E-01	2.00E+00	1.69E-05	2.82E-03	1.41E-03
Fluoranthene	2440	2.89E+01	2.59E-06	7.49E-05	-	-	-	-
Fluorene	2100	3.10E+01	2.54E-05	7.87E-04	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	7.70E-08	5.70E-08	-	-	-	-
Iron	60600	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	1.23E-04	1.51E-02	5.81E-02	1.69E-06	2.07E-04	3.57E-03
Naphthalene	10200	9.66E+01	1.54E-04	1.49E-02	4.40E-01	2.12E-06	2.04E-04	4.65E-04
Nickel Soluble Salts	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	1.10E-05	4.25E-04	-	-	-	-
Phenol	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	2.92E-06	4.28E-05	-	-	-	-
Styrene	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	1.61E-03	4.69E-01	3.01E+01	2.21E-05	6.43E-03	2.13E-04
TPH C06-C09 aliphatic	593	2.21E+02	4.29E-03	9.48E-01	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	6.20E-04	6.89E-02	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	3.97E-04	6.13E-02	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	2.99E-05	2.10E-03	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	2.10E-05	1.69E-03	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	2.14E-05	6.77E-05	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	6.84E-07	1.14E-06	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	8.93E-04	6.67E-02	1.96E+00	1.22E-05	9.13E-04	4.65E-04
Vanadium and compounds	248	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	1.21E-03	1.08E-02	4.34E+00	1.66E-05	1.47E-04	3.40E-05

TOTAL

4.29E-01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Trench Air (where groundwater enters trench)

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Trench Air (where GW enters trench) [(mg/m ³)/(mg/L)]	Vapour Concentration in Trench Air (from GW within trench) (mg/m ³)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m ³)	Adult Exposure Factor (threshold) (L/m ³)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m ³)	Hazard Index (Adult) (unitless)
Acenaphthene	4.48	3.90E+00	3.31E-04	1.29E-03	5.04E-01	4.53E-06	1.77E-05	3.51E-05
Acenaphthylene	43.2	1.61E+01	3.31E-04	5.32E-03	-	-	-	-
Ammonia	348	4.82E+05	3.31E-04	1.15E-01	1.80E+01	4.53E-06	1.58E-03	8.76E-05
Aniline	0.212	3.60E+04	3.31E-04	7.01E-05	4.19E+00	4.53E-06	9.60E-07	2.29E-07
Anthracene	15.4	4.34E-02	3.31E-04	1.44E-05	-	-	-	-
Arsenic, Inorganic	0.024	-	NV	-	-	-	-	-
Barium	2.23	-	NV	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-
Benzene	40.2	1.79E+03	3.31E-04	1.33E-02	1.09E+02	4.53E-06	1.82E-04	1.67E-06
Benzo(a)pyrene	9.26	1.62E-03	3.31E-04	5.36E-07	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	3.31E-04	4.96E-07	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	3.31E-04	8.60E-08	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	3.31E-04	2.65E-07	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	3.31E-04	9.92E-06	-	-	-	-
Cadmium (Water)	0.108	-	NV	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	NV	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	NV	-	-	-	-	-
Chrysene	9.78	2.00E-03	3.31E-04	6.61E-07	-	-	-	-
Cobalt	0.057	-	NV	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	3.31E-04	1.44E-01	1.24E-03	4.53E-06	1.98E-03	1.59E+00
Cresol, o-	182	2.59E+04	3.31E-04	6.02E-02	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	3.31E-04	8.23E-07	-	-	-	-
Dibenzofuran	10.2	3.10E+00	3.31E-04	1.03E-03	1.00E+00	4.53E-06	1.40E-05	1.40E-05
Dimethylphenol, 2,4-	38	7.87E+03	3.31E-04	1.26E-02	-	-	-	-
Ethylbenzene	3.02	1.69E+02	3.31E-04	9.99E-04	2.00E+00	4.53E-06	1.37E-05	6.84E-06
Fluoranthene	25.9	2.60E-01	3.31E-04	8.60E-05	-	-	-	-
Fluorene	21.1	1.69E+00	3.31E-04	5.59E-04	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	3.31E-04	6.28E-08	-	-	-	-
Iron	187	-	NV	-	-	-	-	-
Lead and Compounds	0.555	-	NV	-	-	-	-	-
Manganese	4.89	-	NV	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	3.31E-04	8.13E-03	5.81E-02	4.53E-06	1.11E-04	1.92E-03
Naphthalene	283	3.10E+01	3.31E-04	1.03E-02	4.40E-01	4.53E-06	1.40E-04	3.19E-04
Nickel Soluble Salts	0.303	-	NV	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	3.31E-04	3.80E-04	-	-	-	-
Phenol	249	8.28E+04	3.31E-04	8.23E-02	1.54E-01	4.53E-06	1.13E-03	7.33E-03
Pyrene	27.9	1.35E-01	3.31E-04	4.46E-05	-	-	-	-
Styrene	0.194	3.10E+02	3.31E-04	6.42E-05	1.36E+00	4.53E-06	8.79E-07	6.46E-07
Toluene	17.6	5.26E+02	3.31E-04	5.82E-03	3.01E+01	4.53E-06	7.97E-05	2.65E-06
TPH C06-C09 aliphatic	6.08	1.18E+01	3.31E-04	2.01E-03	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	3.31E-04	3.30E-05	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	3.31E-04	8.37E-03	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	3.31E-04	3.67E-08	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	3.31E-04	3.51E-04	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	3.31E-04	8.27E-10	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	3.31E-04	2.18E-06	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.31E-04	3.04E-04	1.96E+00	4.53E-06	4.17E-06	2.12E-06
Vanadium and compounds	0.0228	-	NV	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	3.31E-04	2.22E-03	4.34E+00	4.53E-06	3.04E-05	7.00E-06

TOTAL

1.60E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario



Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)			Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)					RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Revised RBSL (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL		
			Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	TOTAL (All Pathways)	Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	Total Non-Vapour Pathways	Total Vapour Pathways	TOTAL (All Pathways)						Dust Inhalation Outdoors	Vapours from Surface Soil Outdoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	unitless	kg/mg	kg/mg	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	mg/kg	%	%	%
Acenaphthene	511	3.94E+01	3.86E-07	5.43E-05	5.47E-05	7.55E-10	1.38E-06	7.55E-10	1.38E-06	1.38E-06	1.45E+05	1.64E-04	5.43E-05	2.65E+08	2.65E+08	99.97%	0.03%	100.00%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	5.27E-09	1.61E-04	1.61E-04	3.49E-12	2.44E-07	3.49E-12	2.44E-07	2.44E-07	1.03E+06	1.64E-04	1.61E-04	7.16E+10	7.16E+10	99.94%	0.06%	100.00%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Sa	210	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	7.04E-04	4.22E-01	4.23E-01	3.07E-07	1.84E-04	3.07E-07	1.84E-04	1.85E-04	5.41E+03	1.00E+00	-	-	5.41E+03	0.17%	99.83%	100.00%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	1.05E-07	2.84E-05	2.85E-05	3.81E-10	4.99E-07	3.81E-10	4.99E-07	5.00E-07	2.00E+06	7.90E-04	2.84E-05	2.63E+09	2.63E+09	100.00%	0.00%	100.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	4.97E-08	1.41E-03	1.41E-03	1.90E-10	8.46E-06	1.90E-10	8.46E-06	8.46E-06	2.95E+04	1.42E-03	1.41E-03	1.31E+09	1.31E+09	99.44%	0.56%	100.00%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	5.01E-05	3.57E-03	3.62E-03	6.55E-09	2.90E-05	6.55E-09	2.90E-05	2.91E-05	6.88E+03	3.62E-03	3.57E-03	3.00E+07	3.00E+07	98.21%	1.79%	100.00%
Naphthalene	10200	9.66E+01	8.82E-06	4.65E-04	4.73E-04	8.65E-10	4.81E-06	8.65E-10	4.81E-06	4.81E-06	4.16E+04	5.01E-04	4.65E-04	2.31E+08	2.31E+08	99.77%	0.23%	100.00%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	3.35E-08	2.13E-04	2.13E-04	1.26E-11	7.33E-07	1.26E-11	7.33E-07	7.33E-07	3.41E+05	2.18E-04	2.13E-04	1.98E+10	1.98E+10	99.91%	0.09%	100.00%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	4.26E-08	4.65E-04	4.65E-04	1.94E-10	6.23E-06	1.94E-10	6.23E-06	6.23E-06	1.60E+05	4.96E-04	4.65E-04	5.16E+09	5.16E+09	99.95%	0.05%	100.00%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+00	2.26E-07	3.40E-05	3.42E-05	8.78E-11	3.82E-06	8.78E-11	3.82E-06	3.82E-06	6.55E+04	3.97E-05	3.40E-05	2.85E+09	2.85E+09	99.99%	0.01%	100.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 6 - Intrusive Maintenance (Odour Based Calculations) Scenario



Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit) mg/L	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW to Trench Vapour	TOTAL (All Pathways)	GW to Trench Vapour	Total Vapour Pathways	TOTAL (All Pathways)					GW to Trench Vapour	TOTAL
			unitless	unitless	L/mg	L/mg	L/mg					%	%
Acenaphthene	4.48	3.90E+00	3.51E-05	3.51E-05	8.99E-06	8.99E-06	8.99E-06	2.22E+04	3.51E-05	3.51E-05	2.22E+04	0.02%	0.02%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	8.76E-05	8.76E-05	2.52E-07	2.52E-07	2.52E-07	3.97E+06	1.21E-01	1.21E-01	3.97E+06	12.13%	12.13%
Aniline	0.212	3.60E+04	2.29E-07	2.29E-07	1.08E-06	1.08E-06	1.08E-06	9.25E+05	3.89E-02	3.89E-02	9.25E+05	3.89%	3.89%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.67E-06	1.67E-06	4.16E-08	4.16E-08	4.16E-08	6.02E+06	7.44E-05	7.44E-05	6.02E+06	0.03%	0.03%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	1.59E+00	1.59E+00	3.66E-03	3.66E-03	3.66E-03	2.73E+02	1.00E+00	-	2.73E+02	100.00%	100.00%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	1.40E-05	1.40E-05	4.53E-06	4.53E-06	4.53E-06	2.21E+05	1.40E-05	1.40E-05	2.21E+05	0.00%	0.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	6.84E-06	6.84E-06	2.26E-06	2.26E-06	2.26E-06	1.10E+05	3.83E-04	3.83E-04	1.10E+05	0.15%	0.15%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.92E-03	1.92E-03	7.80E-05	7.80E-05	7.80E-05	2.57E+03	1.92E-03	1.92E-03	2.57E+03	0.96%	0.96%
Naphthalene	283	3.10E+01	3.19E-04	3.19E-04	1.03E-05	1.03E-05	1.03E-05	1.94E+04	3.19E-04	3.19E-04	1.94E+04	0.16%	0.16%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	7.33E-03	7.33E-03	2.94E-05	2.94E-05	2.94E-05	3.40E+04	1.00E+00	-	3.40E+04	100.00%	100.00%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	6.46E-07	6.46E-07	3.33E-06	3.33E-06	3.33E-06	3.00E+05	1.03E-03	1.03E-03	3.00E+05	0.10%	0.10%
Toluene	17.6	5.26E+02	2.65E-06	2.65E-06	1.50E-07	1.50E-07	1.50E-07	1.66E+06	7.91E-05	7.91E-05	1.66E+06	0.03%	0.03%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	2.12E-06	2.12E-06	2.31E-06	2.31E-06	2.31E-06	4.33E+05	1.32E-04	1.32E-04	4.33E+05	0.01%	0.01%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	7.00E-06	7.00E-06	1.04E-06	1.04E-06	1.04E-06	2.39E+05	1.11E-05	1.11E-05	2.39E+05	0.00%	0.00%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix Q

Odour Scenario 7 HDRes

1. General Information:

Site:

Barangaroo

Address:

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Client:

Lend Lease

Scenario:

Scenario 7 - High Density Residential (Odour Based Calculations)

Header Colour (Defaults = Blue):

Blue

2. Select Receptor:

Residential (High Density/Minimal Soil Access)

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐

Incidental Ingestion of Soil

☐

Dermal Contact with Soil

☐

Inhalation of Surface Soil-Derived Dust in Indoor Air

☐

Inhalation of Surface Soil-Derived Dust in Outdoor Air

☐

Inhalation of Surface Soil-Derived Vapours in Outdoor Air

☐

Inhalation of Soil-Derived Vapours From Excavation (USEPA 2002 method)

☒

Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

☐

Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐

Inhalation of Groundwater-Derived Vapours in Indoor Air

☐

Inhalation of Groundwater-Derived Vapours in Outdoor Air

☐

Ingestion of Potable Groundwater

☐

Incidental Ingestion of Groundwater (Bathing or Excavation)

☐

Dermal Contact with Groundwater (Bathing or Excavation)

☐

Inhalation of Groundwater Vapours during Irrigation/ Showering

☐

Ingestion of Vegetables Irrigated with Groundwater

☐

Inhalation of Groundwater Vapours (Where GW Enters Trench)

☒

Inhalation of vapour emissions from flowing water (groundwater in basement)

☐

Inhalation of Soil Vapour-Derived Vapours in Indoor Air

☐

Inhalation of Soil Vapour-Derived Vapours in Outdoor Air

☐

Y Soil RBSLs saturation limited?

☐

Y Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (if only calculating RBSLs, enter 1 for media for which you want RBSLs):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene			1470	12.6
Benzene	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene			652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m-&p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Blank				
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene			2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

5. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

		Site-Specific Value (leave blank to use default value)		Justification	Value Used in Calculations	
		Adult	Child		Adult	Child
General receptor parameters:						
Units						
Body weight	kg	70	13		70	13
Exposure duration	yr	64	6		64	6
Averaging time (carcinogens)	yr	70	70		70	70
Averaging time (non-carcinogens)	yr	64	6		64	6
Incidental Soil Ingestion						
Daily soil ingestion rate	mg/day					
Exposure frequency for soil ingestion	days/yr					
Fraction of daily soil intake from site	unitless					
Dermal Absorption of Soil						
Exposed skin surface area for soil contact	cm2					
Soil to skin adherence factor	mg/cm2					
Exposure frequency for dermal contact with soil	days/yr					
Indoor Inhalation						
Exposure time (indoor air)	hrs/day	24	24		24	24
Exposure frequency (indoor air)	days/yr	350	350		350	350
Particulate emission factor (indoor air)	m3/kg					
Outdoor Inhalation						
Exposure time (outdoor air)	hrs/day					
Exposure frequency (outdoor air)	days/yr					
Particulate emission factor (outdoor air)	m3/kg					
Potable Water Ingestion						
Potable water intake rate	L/day					
Exposure frequency for potable water intake	days/yr					
Incidental Water Ingestion						
Incidental ingestion rate	L/day					
Exposure frequency for incidental water ingestion	days/yr					
Dermal Contact with Water						
Exposed skin surface for water contact	cm2					
Exposure time for dermal water contact	hr/day					
Exposure frequency for dermal water contact	days/yr					
Vapour Inhalation Shower/ Sprinkler						
Exposure frequency	days/yr					
Exposure time	min/ day					
Inhalation rate	m3/hr					
Inhalation Absorption Adjustment Factor	mg/mg					
Lung retention factor	unitless					
Ingestion of Home Grown Produce						
Proportion of homegrown produce ingested						
Exposure frequency	days/year					
Inhalation of Vapours from Flowing Water						
Exposure time	hrs/day	24	24		24	24
Exposure frequency	days/year	350	350		350	350

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting Shell default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Lower depth of surficial soil zone	cm	100			LDSSZ	100	
Depth to subsurface soil sources (below building, ground surface or trench)	cm	100			LS	0.001	Autocalculates from layer thicknesses
<i>Vadose Zone Layer 1 (soil type where source is)</i>							
Thickness	cm	100		0.001	HV	0.001	Negligible distance - assumes soil is adjacent building foundation
				Sand and gravel (<12% fines)			Conservative assumption for mixed fill.
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01		0.002	OC	0.002	
Soil bulk density	g/cm3	1.7		1.66	sbd	1.66	
Air-filled porosity (volumetric)	cm3/cm3	0.26		0.321	VACS	0.321	
Water-filled porosity (volumetric)	cm3/cm3	0.12		0.054	wvcvz	0.054	
Total soil porosity	cm3/cm3	0.38		0.375	TPOR	0.375	
Vapour phase source partitioning adjustment	unitless	1		10	VPPA	10	Adjustment for vapour partitioning; see text.
Vadose zone biodegradation adjustment	unitless	1		1	BioA	1	Conservatively assumes no soil vapour biodegradation
<i>Building Characteristics</i>							
Enclosed-space volume/infiltration area (ratio)	cm	240	(a)	1875	LB	1875	Assumes vapours are mixed through 25 m by 25 m by 3 m high basement section separately. Soil vapour infiltration through upper 2 m of 2 of 4 basement walls only, ie volume = 25*25*(3)=1875 m3 and infiltration area = 100 m2. See text.
Enclosed-space foundation or wall thickness	cm	15		15	Lcrack	15	Conservative Default, ASTM 2002
Enclosed-space air exchange rate	1/s	0.000138889		0.0011111111	ENCAER	1.11E-03	4 per hour, considered likely average ventilation rate between carpark and overlying level.
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)	0.0002	NU	0.0002	USEPA (2004) default for basement foundation.
Volumetric air content in found./wall cracks	cc/cc	0.26		0.321	VACF	0.321	Assumes cracks in concrete are filled with sand
Volumetric water content in found./wall cracks	cc/cc	0.12		0.054	wvcfd	0.054	Assumes cracks in concrete are filled with sand
Basement to First Floor Attenuation Factor	unitless	10		10	FFAs	10	Dilution effect between basement and first floor
<i>Convective vapour flow term</i>							
Calculate convective flow term?	Y			83	Conv	Y	Default USEPA 2004 5L/ min
Convective flow rate (if specified directly)	cm3/sec						
Convective flow through slab (calculated)	cm3/sec	10.88		166.7335948	Qs	166.73	
Slab Area	cm2	700000		7250000	Ab	7250000	Area through which vapours may enter (conservatively includes
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019		0.0002	Nuc		
Soil vapour permeability	cm ²	1.00E-08		1.00E-07	kv	1.00E-07	Conservative default for coarse sand/gravel
Indoor-outdoor pressure differential	g/cm-s ²	40		40	dP	40	USEPA (2004b) default
Slab perimeter	cm	3400		10000	Xcrack	10000	Perimeter of basement footprint.
Depth below ground to bottom of slab	cm	15		300	Zcrack	300	Advection occurring to max depth of 2 m.
Viscosity of air	g/cm-s	1.81E-04		1.81E-04	uair	1.81E-04	Viscosity of air at 20 C

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(d) For construction/excavation worker, default is 400 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

(e) Equals exposure duration for selected receptor. For residential scenario, shortest (child) exposure duration is selected for conservative purposes.

(f) USEPA (2002) default (0.5 acre).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

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B. Chemical-Specific Fate and Transport Parameters

CHEMICAL	Koc	Kd	H'	S	D ^{air}	D ^{soil}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc-H ₂ O / cc-air)	(mg/l-water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	1.01E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	1.01E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	6.20E-03	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	1.40E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	3.28E+01	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Arsenic, Inorganic	-	-	-	-	-	-	7.80E+01	-	N
Barium	-	-	-	-	-	-	1.37E+02	-	N
Benz(a)anthracene	1.77E+05	3.54E+02	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	2.92E-01	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	1.17E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	1.20E+03	2.69E-05	1.50E-03	2.28E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	3.90E+03	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	1.17E+03	2.39E-05	8.00E-04	2.28E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Cadmium (Water)	-	-	-	-	-	-	1.12E+02	-	N
Chromium(III), Insoluble Salts	-	-	-	-	-	-	5.20E+01	-	N
Chromium(VI)	-	-	-	1.69E+06	-	-	5.20E+01	-	N
Chrysene	1.81E+05	3.62E+02	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cobalt	-	-	-	-	-	-	5.89E+01	-	N
Cresol, m-&p-	3.00E+02	6.00E-01	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	Y
Cresol, o-	3.07E+02	6.14E-01	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	Y
Blank	1.20E+05	2.40E+02	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Dibenz(a,h)anthracene	1.91E+06	3.82E+03	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	1.83E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	9.84E-01	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	8.92E-01	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	1.11E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	1.83E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	3.90E+03	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Iron	-	-	-	-	-	-	5.59E+01	-	N
Lead and Compounds	-	-	-	-	-	-	2.07E+02	-	N
Manganese	-	-	-	-	-	-	5.49E+01	-	N
Methylnaphthalene, 2-	2.48E+03	4.96E+00	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	3.08E+00	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Nickel Soluble Salts	-	-	-	-	-	-	5.87E+01	-	N
Phenanthrene	1.67E+04	3.34E+01	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	3.74E-01	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	1.09E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	8.92E-01	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	4.68E-01	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	8.94E+00	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	1.10E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	6.04E+00	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	6.32E+05	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	n
TPH C15-C28 aromatic	3.79E+04	7.58E+01	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	n
TPH C29-C36 aliphatic	6.31E+08	1.26E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	n
TPH C29-C36 aromatic	1.26E+05	2.52E+02	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	1.23E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Vanadium and compounds	-	-	-	-	-	-	5.09E+01	-	N
Xylenes (total)	3.83E+02	7.66E-01	2.12E-01	1.06E+02	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

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C. Chemical-Specific Diffusion Coefficients

CHEMICAL	D _{soil} (cm ² /s)	D _{crack} (cm ² /s)	D _{soil} (cm ² /s)	D _{soil} (cm ² /s)	D _{crack} (cm ² /s)	C _{sat} (mg/kg)	Convective Factor (unitless)	D _a (cm ² /s)	M _{excav} (t)
Acenaphthene	8.18E-03	-	-	8.18E-03	8.18E-03	3.94E+01	2.11E+02	3.66E-06	7.25E+04
Acenaphthylene	7.28E-03	-	-	7.28E-03	7.28E-03	1.63E+02	2.37E+02	2.02E-06	5.38E+04
Ammonia	3.69E-02	-	-	3.69E-02	3.69E-02	1.87E+04	4.68E+01	3.75E-04	7.34E+05
Aniline	NV	NV	NV	NV	NV	6.23E+03	NV	NV	NV
Anthracene	6.31E-03	-	-	6.31E-03	6.31E-03	1.42E+00	2.74E+02	2.62E-07	1.94E+04
Arsenic, Inorganic	NV	NV	NV	NV	NV		NV	NV	NV
Barium	NV	NV	NV	NV	NV		NV	NV	NV
Benz(a)anthracene	NV	NV	NV	NV	NV	3.33E+00	NV	NV	NV
Benzene	1.45E-02	-	-	1.45E-02	1.45E-02	6.59E+02	1.19E+02	5.35E-03	2.77E+06
Benzo(a)pyrene	NV	NV	NV	NV	NV	1.90E+00	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	1.80E+00	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	1.01E+00	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	9.39E-01	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Cadmium (Water)	NV	NV	NV	NV	NV		NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV	NV	NV	NV		NV	NV	NV
Chromium(VI)	NV	NV	NV	NV	NV		NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	7.24E-01	NV	NV	NV
Cobalt	NV	NV	NV	NV	NV		NV	NV	NV
Cresol, m-&p-	1.19E-02	-	-	1.19E-02	1.19E-02	1.44E+04	1.45E+02	3.95E-07	2.38E+04
Cresol, o-	1.18E-02	-	-	1.18E-02	1.18E-02	1.67E+04	1.46E+02	5.40E-07	2.79E+04
Blank	NV	NV	NV	NV	NV	6.48E+01	NV	NV	NV
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	9.51E+00	NV	NV	NV
Dibenzofuran	6.63E-03	-	-	6.63E-03	6.63E-03	5.69E+01	2.60E+02	1.89E-06	5.21E+04
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	8.00E+03	NV	NV	NV
Ethylbenzene	1.11E-02	-	-	1.11E-02	1.11E-02	1.67E+02	1.56E+02	2.17E-03	1.77E+06
Fluoranthene	NV	NV	NV	NV	NV	2.89E+01	NV	NV	NV
Fluorene	7.11E-03	-	-	7.11E-03	7.11E-03	3.10E+01	2.42E+02	9.14E-07	3.62E+04
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	7.41E-01	NV	NV	NV
Iron	NV	NV	NV	NV	NV		NV	NV	NV
Lead and Compounds	NV	NV	NV	NV	NV		NV	NV	NV
Manganese	NV	NV	NV	NV	NV		NV	NV	NV
Methylnaphthalene, 2-	8.47E-03	-	-	8.47E-03	8.47E-03	1.23E+02	2.04E+02	2.16E-05	1.76E+05
Naphthalene	9.78E-03	-	-	9.78E-03	9.78E-03	9.66E+01	1.76E+02	3.39E-05	2.21E+05
Nickel Soluble Salts	NV	NV	NV	NV	NV		NV	NV	NV
Phenanthrene	5.58E-03	-	-	5.58E-03	5.58E-03	3.84E+01	3.09E+02	1.73E-07	1.58E+04
Phenol	NV	NV	NV	NV	NV	3.37E+04	NV	NV	NV
Pyrene	4.50E-03	-	-	4.50E-03	4.50E-03	1.47E+01	3.83E+02	1.21E-08	4.17E+03
Styrene	1.15E-02	-	-	1.15E-02	1.15E-02	2.93E+02	1.50E+02	8.17E-04	1.08E+06
Toluene	1.26E-02	-	-	1.26E-02	1.26E-02	2.91E+02	1.37E+02	3.70E-03	2.31E+06
TPH C06-C09 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	2.21E+02	1.07E+02	2.61E-02	6.13E+06
TPH C10-C14 aliphatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.11E+02	1.07E+02	5.46E-04	8.86E+05
TPH C10-C14 aromatic	1.62E-02	-	-	1.62E-02	1.62E-02	1.54E+02	1.07E+02	2.24E-04	5.68E+05
TPH C15-C28 aliphatic	NV	NV	NV	NV	NV	7.02E+01	NV	NV	NV
TPH C15-C28 aromatic	NV	NV	NV	NV	NV	8.04E+01	NV	NV	NV
TPH C29-C36 aliphatic	NV	NV	NV	NV	NV	3.16E+00	NV	NV	NV
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	1.66E+00	NV	NV	NV
Trimethylbenzene, 1,2,4-	9.81E-03	-	-	9.81E-03	9.81E-03	7.46E+01	1.76E+02	1.13E-03	1.28E+06
Vanadium and compounds	NV	NV	NV	NV	NV		NV	NV	NV
Xylenes (total)	1.37E-02	-	-	1.37E-02	1.37E-02	8.90E+01	1.26E+02	2.08E-03	1.73E+06

Definition of Parameters

D_s Effective diffusion coefficient in soil based on vapor-phase concentration
D_{crack} Effective diffusion coefficient through foundation cracks
C_{sat} Soil concentration at which dissolved pore-water and vapor phases become saturated

D_a = Apparent diffusivity (for construction scenario Volatilisation Factor)
M_{excav} = Cumulative unit mass emitted from excavation (Eq E-13 in USEPA, 2002).

Vapour Modelling - Soil to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

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D. Chemical-Specific Volatilisation Factors

CHEMICAL	VF _{as} (mg/m ³ -air / mg/kg-soil)	VF _{so} (mg/m ³ -air / mg/kg-soil)	VF _{p (indoor)} (mg/m ³ -air / mg/kg-soil)	VF _{p (outdoor)} (mg/m ³ -air / mg/kg-soil)	VF _{se} (mg/m ³ -air / mg/kg-soil)	VF _{se} (mg/m ³ -air / mg/kg-soil)	VF _{excav} (mg/m ³ -air / mg/kg-soil)
Acenaphthene	2.61E-06	8.77E-05			3.35E-02	8.22E-07	-3.12E+08
Acenaphthylene	1.94E-06	8.77E-05			1.94E-02	5.10E-07	-2.32E+08
Ammonia	2.64E-05	8.77E-05			1.33E+00	1.87E-05	-3.16E+09
Aniline	NV	NV			NV	NV	NV
Anthracene	6.98E-07	8.77E-05			2.67E-03	7.63E-08	-8.35E+07
Arsenic, Inorganic	NV	NV			NV	NV	NV
Barium	NV	NV			NV	NV	NV
Benz(a)anthracene	NV	NV			NV	NV	NV
Benzene	9.98E-05	8.77E-05			3.64E+01	6.80E-04	-1.19E+10
Benzo(a)pyrene	NV	NV			NV	NV	NV
Benzo(b)fluoranthene	NV	NV			NV	NV	NV
Benzo(g,h,i)perylene	NV	NV			NV	NV	NV
Benzo(k)fluoranthene	NV	NV			NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV			NV	NV	NV
Cadmium (Water)	NV	NV			NV	NV	NV
Chromium(III), Insoluble Salts	NV	NV			NV	NV	NV
Chromium(VI)	NV	NV			NV	NV	NV
Chrysene	NV	NV			NV	NV	NV
Cobalt	NV	NV			NV	NV	NV
Cresol, m-&p-	8.58E-07	8.77E-05			3.01E-03	6.11E-08	-1.03E+08
Cresol, o-	1.00E-06	8.77E-05			4.12E-03	8.38E-08	-1.20E+08
Blank	NV	NV			NV	NV	NV
Dibenz(a,h)anthracene	NV	NV			NV	NV	NV
Dibenzofuran	1.87E-06	8.77E-05			1.89E-02	5.24E-07	-2.24E+08
Dimethylphenol, 2,4-	NV	NV			NV	NV	NV
Ethylbenzene	6.35E-05	8.77E-05			1.71E+01	3.60E-04	-7.61E+09
Fluoranthene	NV	NV			NV	NV	NV
Fluorene	1.30E-06	8.77E-05			8.90E-03	2.36E-07	-1.56E+08
Indeno(1,2,3-cd)pyrene	NV	NV			NV	NV	NV
Iron	NV	NV			NV	NV	NV
Lead and Compounds	NV	NV			NV	NV	NV
Manganese	NV	NV			NV	NV	NV
Methylnaphthalene, 2-	6.34E-06	8.77E-05			1.95E-01	4.68E-06	-7.59E+08
Naphthalene	7.95E-06	8.77E-05			2.86E-01	6.38E-06	-9.51E+08
Nickel Soluble Salts	NV	NV			NV	NV	NV
Phenanthrene	5.68E-07	8.77E-05			1.85E-03	5.71E-08	-6.80E+07
Phenol	NV	NV			NV	NV	NV
Pyrene	1.50E-07	8.77E-05			1.39E-04	4.95E-09	-1.80E+07
Styrene	3.90E-05	8.77E-05			6.33E+00	1.31E-04	-4.67E+09
Toluene	8.30E-05	8.77E-05			2.73E+01	5.41E-04	-9.93E+09
TPH C06-C09 aliphatic	2.21E-04	8.77E-05			1.67E+02	2.98E-03	-2.64E+10
TPH C10-C14 aliphatic	3.19E-05	8.77E-05			3.48E+00	6.21E-05	-3.82E+09
TPH C10-C14 aromatic	2.04E-05	8.77E-05			1.43E+00	2.55E-05	-2.45E+09
TPH C15-C28 aliphatic	NV	NV			NV	NV	NV
TPH C15-C28 aromatic	NV	NV			NV	NV	NV
TPH C29-C36 aliphatic	NV	NV			NV	NV	NV
TPH C29-C36 aromatic	NV	NV			NV	NV	NV
Trimethylbenzene, 1,2,4-	4.59E-05	8.77E-05			9.53E+00	2.12E-04	-5.50E+09
Vanadium and compounds	NV	NV			NV	NV	NV
Xylenes (total)	6.22E-05	8.77E-05			1.46E+01	2.79E-04	-7.44E+09

Definition of Parameters

VF _{as}	Volatilization factor from surficial soils to ambient air (vapors) - use lower of two values
VF _p	Volatilization factor from surficial soils to ambient air (particulates)
VF _{se}	Volatilization factor from subsurface soils to ambient air
VF _{se}	Volatilization factor from soil to enclosed-space vapors
VF _{excav}	Volatilisation factor from subsurface soil to trench air (where soil contamination is below base of trench)

Calculation of Vapour Emissions from Water with Flow
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Residential Receptor) (Odour Based Calculations) Scenario

PARAMETERS

Concrete permeability	(select from drop down list)	High permeability
Permeability Rate (m/day)		8.6.E-02
Water Temperature (deg. C)		18.0
Dimensions of Basement / Impoundment		
Height (m)		3.0
Width (m)		25.0
Depth (m)		25.0
Volume total basement/ impoundment (m3)		1875

Dimensions of Wet Section of Basement/ Impoundment

Length (m)	5.0
Width (m)	5.0
Depth of Water (m)	0.01
Fetch/ Depth (m) ratio of Wet Basement Section	500
Volume of wet basement/ impoundment (m3)	0.2500
Area covered in water (m2)	25
Effective diameter of impoundment/ basement) (m)	5.6
Volume of water entering basement (m³/sec)	2.50E-07

Air exchange rate (exchanges/day)

Windspeed (m/s)	if < 3.5 m/sec	9.60E+01
	if = or > 3.5 m/sec	3.00E-02

Basement to first floor attenuation factor

	10

Parameter Definition	Volatile	Chemical Concentration in Water (mg/L)	Molecular weight (g/mol)	Vapour Pressure (mmHg)	Vapour Pressure (atm)	Henry's Law Coefficient (unitless)	Henry's Law Coefficient (calculated)	Equilibrium Coefficient (at 25 deg C)	Diffusivity in Water (cm²/sec)	Schmidt Number on Gas Side (*)	Gas Phase Mass Transfer Coefficient (m/sec)	Schmidt Number on Liquid Side #	Liquid Phase Mass Transfer Coefficient (m/s) <3.5 m/s	Overall Mass Transfer Coefficient (m/s) (windspeed <3.5 m/s)	Adopted Liquid Mass Transfer Coefficient (m/s)	Overall Mass Transfer Coefficient (m/s)	Diffusivity in Air (cm²/sec)	Equilibrium Concentration of water in Basement/ Impoundment (g/m³)	Air Emission Rate from Liquid Surface (g/sec)	Air Emission Rate from Liquid Surface (mg/day)	Adjusted Concentration in Basement Air (includes air exchange) (mg/m3)
		C	MW	Vap	Vap	unitless	atm.m3/g mol	K _{ow}	D _{water}	Sc _G	k _G	Sc _L	K _L	K	K _L	K	D _{air}	C _L	E	E	
Acenaphthene	Y	4.48	154	2.15E-03	2.83E-06	7.52E-03	1.80E-04	7.345E-03	8.33E-06	3.0E+00	1.244E-04	1.08E+03	2.7E-07	2.1E-07	2.7E-07	2.1E-07	0.0506	1.6E-01	8.31E-07	7.18E+01	3.99E-05
Acenaphthylene	Y	43.2	152	6.68E-03	8.79E-06	4.66E-03	1.11E-04	4.551E-03	6.98E-06	3.4E+00	1.150E-04	1.29E+03	2.4E-07	1.7E-07	2.4E-07	1.7E-07	0.045	1.7E+00	7.08E-06	6.11E+02	3.40E-04
Ammonia	Y	348	17	-	-	6.58E-04	1.57E-05	6.427E-04	1.10E-05	6.6E-01	3.410E-04	8.18E+02	3.3E-07	1.3E-07	3.3E-07	1.3E-07	0.228	1.0E+01	3.37E-05	2.91E+03	1.62E-03
Aniline	Y	0.212	93.1	4.90E-01	6.45E-04	8.26E-05	1.47E-05	8.067E-05	1.01E-05	1.8E+00	1.733E-04	8.91E+02	3.1E-07	1.3E-08	3.1E-07	1.3E-08	0.083	6.6E-03	2.20E-09	1.90E-01	1.06E-07
Anthracene	Y	15.4	178	6.53E-06	8.59E-09	2.27E-03	5.42E-05	2.217E-03	7.85E-06	3.9E+00	1.045E-04	1.15E+03	2.6E-07	1.2E-07	2.6E-07	1.2E-07	0.039	5.6E-01	1.73E-06	1.50E+02	8.33E-05
Arsenic, Inorganic	N	0.024	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	N	2.23	137	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	N	12.6	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	Y	40.2	78.1	9.48E+01	1.25E-01	2.27E-01	5.42E-03	2.217E-01	1.03E-05	1.7E+00	1.823E-04	8.74E+02	3.2E-07	3.1E-07	3.2E-07	3.1E-07	0.0895	1.2E+00	9.67E-06	8.35E+02	4.64E-04
Benzo(a)pyrene	N	9.26	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	N	8.33	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	N	4.22	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	N	2.93	252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	N	0.03	391	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	N	0.108	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	N	0.102	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	N	9.78	228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	N	0.057	58.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	Y	436	108	1.10E-01	1.45E-04	3.50E-05	8.36E-07	3.418E-05	9.32E-06	2.1E+00	1.588E-04	9.66E+02	3.0E-07	5.3E-09	3.0E-07	5.3E-09	0.0729	1.4E+01	1.90E-06	1.64E+02	9.13E-05
Cresol, o-	N	182	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	N	0.822	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	Y	10.2	168	2.48E-03	3.26E-06	8.71E-03	2.08E-04	8.507E-03	7.38E-06	3.7E+00	1.080E-04	1.22E+03	2.5E-07	2.0E-07	2.5E-07	2.0E-07	0.041	3.9E-01	1.92E-06	1.66E+02	9.23E-05
Dimethylphenol, 2,4-	N	38	122	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	Y	3.02	106	9.60E+00	1.26E-02	3.22E-01	7.69E-03	3.145E-01	8.46E-06	2.2E+00	1.524E-04	1.06E+03	2.8E-07	2.8E-07	2.8E-07	2.8E-07	0.0685	1.1E-01	7.25E-07	6.26E+01	3.48E-05
Fluoranthene	N	25.9	202	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	Y	21.1	166	6.00E-04	7.90E-07	3.93E-03	9.38E-05	3.838E-03	7.89E-06	3.4E+00	1.133E-04	1.14E+03	2.6E-07	1.6E-07	2.6E-07	1.6E-07	0.044	7.7E-01	3.16E-06	2.73E+02	1.52E-04
Indeno(1,2,3-cd)pyrene	N	3.05	276	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	N	187	55.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	N	0.555	207	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	N	4.89	54.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	Y	105	142	5.50E-02	7.24E-05	2.12E-02	5.06E-04	2.071E-02	7.78E-06	2.9E+00	1.273E-04	1.16E+03	2.6E-07	2.4E-07	2.6E-07	2.4E-07	0.0524	3.9E+00	2.30E-05	1.99E+03	1.10E-03
Naphthalene	Y	283	128	8.50E-02	1.12E-04	1.80E-02	4.30E-04	1.758E-02	8.38E-06	2.5E+00	1.402E-04	1.07E+03	2.8E-07	2.5E-07	2.8E-07	2.5E-07	0.0605	9.9E+00	6.14E-05	5.31E+03	2.95E-03
Nickel Soluble Salts	N	0.303	58.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	Y	74.1	178	1.21E-04	1.59E-07	1.73E-03	4.13E-05	1.690E-03	6.69E-06	4.4E+00	9.623E-05	1.35E+03	2.4E-07	9.6E-08	2.4E-07	9.6E-08	0.0345	3.0E+00	7.23E-06	6.25E+02	3.47E-04
Phenol	Y	249	94.1	3.50E-01	4.61E-04	1.36E-05	3.25E-07	1.328E-05	1.03E-05	1.8E+00	1.738E-04	8.74E+02	3.2E-07	2.3E-09	3.2E-07	2.3E-09	0.0834	7.6E+00	4.38E-07	3.78E+01	2.10E-05
Pyrene	Y	27.9	202	4.50E-06	5.92E-09	4.87E-04	1.16E-05	4.756E-04	7.25E-06	5.4E+00	8.326E-05	1.24E+03	2.5E-07	3.4E-08	2.5E-07	3.4E-08	0.0278	1.1E+00	9.17E-07	1.92E+01	4.40E-05
Styrene	Y	0.194	104	6.40E+00	8.42E-03	1.12E-01	1.094E-01	1.094E-01	8.78E-06	2.1E+00	1.562E-04	1.03E+03	2.9E-07	2.8E-07	2.9E-07	2.8E-07	0.0711	6.6E-01	4.61E-08	3.98E+00	2.21E-06
Toluene	Y	17.6	92.1	2.84E+01	3.74E-02	2.71E-01	6.47E-03	2.647E-01	9.20E-06	1.9E+00	1.659E-04	9.78E+02	2.9E-07	2.9E-07	2.9E-07	2.9E-07	0.0778	5.8E-01	4.23E-06	3.85E+02	2.03E-04
TPH C06-C09 aliphatic	Y	6.08	103	9.18E+01	1.21E-01	5.05E+01	1.21E+00	4.932E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	1.9E-01	1.47E-06	1.27E+02	7.07E-05
TPH C10-C14 aliphatic	Y	1730	170	1.16E+00	1.53E-03	6.26E+01	1.49E+00	6.114E+01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	4.19E-04	3.62E+04	2.01E-02
TPH C10-C14 aromatic	Y	1730	136	1.16E+00	1.53E-03	1.41E-01	3.37E-03	1.377E-01	1.00E-05	1.5E+00	1.963E-04	9.00E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.1	5.4E+01	4.14E-04	3.58E+04	1.99E-02
TPH C15-C28 aliphatic	n	1520	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	n	1520	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	n	332	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	n	332	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	Y	0.92	120	2.10E+00	2.76E-03	2.52E-01	6.02E-03	2.461E-01	7.92E-06	2.5E+00	1.405E-04	1.14E+03	2.7E-07	2.6E-07	2.7E-07	2.6E-07	0.0607	3.3E-02	2.20E-07	1.90E+01	1.06E-05
Vanadium and compounds	N	0.0228	50.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	Y	6.7	106	7.99E+00	1.05E-02	2.12E-01	5.06E-03	2.071E-01	9.90E-06	1.8E+00	1.756E-04	9.09E+02	3.1E-07	3.1E-07	3.1E-07	3.1E-07	0.0847	2.1E-01	1.61E-06	1.39E+02	7.72E-05

Notes:

Assumes viscosity of air at 25 deg C

(*) Adopted density and viscosity of air values are those published in USEPA Air Emissions for Wast and Waste Water Nov 1994. (viscosity = 1.81 x 10⁻⁴, density = 1.2 x 10⁻³)

** where windspeeds are greater than 3.25 m/s, F/D ratios greater than 51.2 and diffusivity of ether is 8.5 x 10⁻⁵

where viscosity of water is assumed to be 9 x 10⁻³ g/cm per sec and density of water 1g/cm³.

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Summary of Derived RBSLs

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Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	1.28E+05	6.39E+05	-	1.28E+05	>Sat	5.11E+02	1.03E+04	1.03E+04	-	1.03E+04	>Sol	4.48E+00
Acenaphthylene	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	4.04E+06	4.04E+06	-	4.04E+06	>Sol	3.48E+02
Aniline	-	-	-	-	-	-	8.76E+06	8.76E+06	-	8.76E+06	>Sol	2.12E-01
Anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	4.18E+04	1.67E+05	-	4.18E+04	>Sat	1.51E+03	2.46E+06	2.46E+06	-	2.46E+06	>Sol	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2.11E+04	2.11E+04	-	2.11E+04	>Sat	2.29E+03	6.17E+03	6.17E+03	-	6.17E+03	-	4.36E+02
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	1.99E+06	1.99E+06	-	1.99E+06	>Sat	2.77E+02	3.50E+04	3.50E+04	-	3.50E+04	>Sol	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	1.45E+03	5.79E+03	-	1.45E+03	>Sat	2.61E+02	4.53E+04	4.53E+04	-	4.53E+04	>Sol	3.02E+00
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	2.59E+03	1.29E+04	-	2.59E+03	>Sat	7.65E+03	2.70E+02	2.70E+02	-	2.70E+02	>Sol	1.05E+02
Naphthalene	1.44E+04	7.20E+04	-	1.44E+04	>Sat	1.02E+04	9.65E+02	9.65E+02	-	9.65E+02	>Sol	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	1.90E+06	1.90E+06	-	1.90E+06	>Sol	2.49E+02
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	1.24E+05	1.24E+05	-	1.24E+05	>Sol	1.94E-01
Toluene	1.45E+04	5.81E+04	-	1.45E+04	>Sat	2.65E+03	6.82E+05	6.82E+05	-	6.82E+05	>Sol	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	9.64E+03	9.64E+03	-	9.64E+03	>Sat	2.20E+02	1.78E+05	1.78E+05	-	1.78E+05	>Sol	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	4.05E+03	-	-	4.05E+03	>Sat	2.58E+03	9.81E+04	9.81E+04	-	9.81E+04	>Sol	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Pathways included in derivation of Soil RBSL:

Pathways included in derivation of Soil Vapour RBSL:

Pathways included in derivation of Groundwater RBSL:

Health Risk Calculations - Inhalation of Subsurface Soil-Derived Vapours in Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Soil Conc. (mg/kg)	Csat (mg/kg)	Volatilisation Factor from Subsurface Soil to Indoor Air (mg/m3)/(mg/kg)	Vapour Concentration in Indoor Air (From Subsurface Soil) (mg/m3)	Threshold Intake and Risk Calculations						
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (kg/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)	Child Exposure Factor (threshold) (kg/m3)	Child Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Child) (unitless)
Acenaphthene	511	3.94E+01	8.22E-07	3.24E-05	5.04E-01	7.89E-07	3.10E-05	6.16E-05	7.89E-07	3.10E-05	6.16E-05
Acenaphthylene	1700	1.63E+02	5.10E-07	8.28E-05	-	-	-	-	-	-	-
Ammonia	-	-	NV	-	-	-	-	-	-	-	-
Aniline	-	-	NV	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	7.63E-08	1.09E-07	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	NV	-	-	-	-	-	-	-	-
Barium	-	-	NV	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	NV	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	6.80E-04	4.49E-01	1.09E+02	6.52E-04	4.30E-01	3.95E-03	6.52E-04	4.30E-01	3.95E-03
Benzo(a)pyrene	652	1.90E+00	NV	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	NV	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	NV	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	NV	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	NV	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	NV	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	NV	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	NV	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	NV	-	-	-	-	-	-	-	-
Cobalt	-	-	NV	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	6.11E-08	1.40E-04	1.24E-03	5.86E-08	1.34E-04	1.08E-01	5.86E-08	1.34E-04	1.08E-01
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-
Blank	-	-	NV	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	NV	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	5.24E-07	2.98E-05	1.00E+00	5.02E-07	2.86E-05	2.86E-05	5.02E-07	2.86E-05	2.86E-05
Dimethylphenol, 2,4-	-	-	NV	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	3.60E-04	6.01E-02	2.00E+00	3.45E-04	5.76E-02	2.88E-02	3.45E-04	5.76E-02	2.88E-02
Fluoranthene	2440	2.89E+01	NV	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	2.36E-07	7.33E-06	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	NV	-	-	-	-	-	-	-	-
Iron	60600	-	NV	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	NV	-	-	-	-	-	-	-	-
Manganese	-	-	NV	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	4.68E-06	5.76E-04	5.81E-02	4.49E-06	5.52E-04	9.50E-03	4.49E-06	5.52E-04	9.50E-03
Naphthalene	10200	9.66E+01	6.38E-06	6.16E-04	4.40E-01	6.11E-06	5.91E-04	1.34E-03	6.11E-06	5.91E-04	1.34E-03
Nickel Soluble Salts	-	-	NV	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	5.71E-08	2.20E-06	-	-	-	-	-	-	-
Phenol	-	-	NV	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	4.95E-09	7.26E-08	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	5.41E-04	1.57E-01	3.01E+01	5.19E-04	1.51E-01	5.01E-03	5.19E-04	1.51E-01	5.01E-03
TPH C06-C09 aliphatic	593	2.21E+02	2.98E-03	6.58E-01	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	6.21E-05	6.90E-03	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	2.55E-05	3.94E-03	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	NV	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	NV	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	NV	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	2.12E-04	1.59E-02	1.96E+00	2.04E-04	1.52E-02	7.74E-03	2.04E-04	1.52E-02	7.74E-03
Vanadium and compounds	248	-	NV	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+01	2.79E-04	2.48E-02	4.34E+00	2.67E-04	2.38E-02	5.49E-03	2.67E-04	2.38E-02	5.49E-03
	-	-	-	-	-	-	-	-	-	-	-

TOTAL

1.70E-01

1.70E-01

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Health Risk Calculations - Vapours from Flowing Water
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Vapour Concentration in Basement/ Impoundment	Aqueous Solubility	Threshold Intake and Risk Calculations						
			Inhalation RfC	Adult Exposure Factor (threshold)	Adult Exposure Adjusted Air Concentration (threshold)	Hazard Index (Adult)	Child Exposure Factor (threshold)	Child Exposure Adjusted Air Concentration (threshold)	Hazard Index (Child)
	mg/m ³	(mg/L)	(mg/m3)	(L/m3)	(mg/m3)	(unitless)	(L/m3)	(mg/m3)	(unitless)
Acenaphthene	3.99E-05	3.90E+00	5.04E-01	9.59E-01	3.83E-05	7.59E-05	9.59E-01	3.83E-05	7.59E-05
Acenaphthylene	3.40E-04	1.61E+01							
Ammonia	1.62E-03	4.82E+05	1.80E+01	9.59E-01	1.55E-03	8.61E-05	9.59E-01	1.55E-03	8.61E-05
Aniline	1.06E-07	3.60E+04	4.19E+00	9.59E-01	1.01E-07	2.42E-08	9.59E-01	1.01E-07	2.42E-08
Anthracene	8.33E-05	4.34E-02							
Arsenic, Inorganic	-	0.00E+00	-	-	-	-	-	-	-
Barium	-	0.00E+00	-	-	-	-	-	-	-
Benz(a)anthracene	-	9.40E-03	-	-	-	-	-	-	-
Benzene	4.64E-04	1.79E+03	1.09E+02	9.59E-01	4.45E-04	4.08E-06	9.59E-01	4.45E-04	4.08E-06
Benzo(a)pyrene	-	1.62E-03	-	-	-	-	-	-	-
Benzo(b)fluoranthene	-	1.50E-03	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	2.60E-04	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	8.00E-04	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	2.70E-01	-	-	-	-	-	-	-
Cadmium (Water)	-	0.00E+00	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Chromium(VI)	-	1.69E+06	-	-	-	-	-	-	-
Chrysene	-	2.00E-03	-	-	-	-	-	-	-
Cobalt	-	0.00E+00	-	-	-	-	-	-	-
Cresol, m-&p-	9.13E-05	2.27E+04	1.24E-03	9.59E-01	8.75E-05	7.07E-02	9.59E-01	8.75E-05	7.07E-02
Cresol, o-	-	2.59E+04	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	2.49E-03	-	-	-	-	-	-	-
Dibenzofuran	9.23E-05	3.10E+00	1.00E+00	9.59E-01	8.85E-05	8.85E-05	9.59E-01	8.85E-05	8.85E-05
Dimethylphenol, 2,4-	-	7.87E+03	-	-	-	-	-	-	-
Ethylbenzene	3.48E-05	1.69E+02	2.00E+00	9.59E-01	3.33E-05	1.67E-05	9.59E-01	3.33E-05	1.67E-05
Fluoranthene	-	2.60E-01	-	-	-	-	-	-	-
Fluorene	1.52E-04	1.69E+00							
Indeno(1,2,3-cd)pyrene	-	1.90E-04	-	-	-	-	-	-	-
Iron	-	0.00E+00	-	-	-	-	-	-	-
Lead and Compounds	-	0.00E+00	-	-	-	-	-	-	-
Manganese	-	0.00E+00	-	-	-	-	-	-	-
Methylnaphthalene, 2-	1.10E-03	2.46E+01	5.81E-02	9.59E-01	1.06E-03	1.82E-02	9.59E-01	1.06E-03	1.82E-02
Naphthalene	2.95E-03	3.10E+01	4.40E-01	9.59E-01	2.83E-03	6.42E-03	9.59E-01	2.83E-03	6.42E-03
Nickel Soluble Salts	-	0.00E+00	-	-	-	-	-	-	-
Phenanthrene	3.47E-04	1.15E+00							
Phenol	2.10E-05	8.28E+04	1.54E-01	9.59E-01	2.01E-05	1.31E-04	9.59E-01	2.01E-05	1.31E-04
Pyrene	4.40E-05	1.35E-01							
Styrene	2.21E-06	3.10E+02	1.36E+00	9.59E-01	2.12E-06	1.56E-06	9.59E-01	2.12E-06	1.56E-06
Toluene	2.03E-04	5.26E+02	3.01E+01	9.59E-01	1.95E-04	6.46E-06	9.59E-01	1.95E-04	6.46E-06
TPH C06-C09 aliphatic	7.07E-05	1.18E+01							
TPH C10-C14 aliphatic	2.01E-02	9.99E-02							
TPH C10-C14 aromatic	1.99E-02	2.53E+01							
TPH C15-C28 aliphatic	-	1.11E-04	-	-	-	-	-	-	-
TPH C15-C28 aromatic	-	1.06E+00	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	-	2.50E-06	-	-	-	-	-	-	-
TPH C29-C36 aromatic	-	6.60E-03	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	1.06E-05	5.70E+01	1.96E+00	9.59E-01	1.01E-05	5.16E-06	9.59E-01	1.01E-05	5.16E-06
Vanadium and compounds	-	-	-	-	-	-	-	-	-
Xylenes (total)	7.72E-05	1.06E+02	4.34E+00	9.59E-01	7.40E-05	1.71E-05	9.59E-01	7.40E-05	1.71E-05
TOTAL						9.58E-02		9.58E-02	

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Adult Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Risk at RBSL (with sat)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)					Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg			mg/kg	%	%
Acenaphthene	511	3.94E+01	6.16E-05	6.16E-05	1.57E-06	1.57E-06	1.57E-06	1.28E+05	6.16E-05	6.16E-05	1.28E+05	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	3.95E-03	3.95E-03	5.98E-06	5.98E-06	5.98E-06	4.18E+04	3.95E-03	3.95E-03	4.18E+04	0.39%	0.39%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Sal	210	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.08E-01	1.08E-01	4.73E-05	4.73E-05	4.73E-05	2.11E+04	6.79E-01	6.79E-01	2.11E+04	67.91%	67.91%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blank	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	2.86E-05	2.86E-05	5.02E-07	5.02E-07	5.02E-07	1.99E+06	2.86E-05	2.86E-05	1.99E+06	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	2.88E-02	2.88E-02	1.73E-04	1.73E-04	1.73E-04	1.45E+03	2.88E-02	2.88E-02	1.45E+03	2.88%	2.88%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	9.50E-03	9.50E-03	7.73E-05	7.73E-05	7.73E-05	2.59E+03	9.50E-03	9.50E-03	2.59E+03	0.95%	0.95%
Naphthalene	10200	9.66E+01	1.34E-03	1.34E-03	1.39E-05	1.39E-05	1.39E-05	1.44E+04	1.34E-03	1.34E-03	1.44E+04	0.13%	0.13%
Nickel Soluble Salts	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	5180	3.84E+01	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	1.47E+01	-	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	2.91E+02	5.01E-03	5.01E-03	1.72E-05	1.72E-05	1.72E-05	1.45E+04	5.01E-03	5.01E-03	1.45E+04	0.50%	0.50%
TPH C06-C09 aliphatic	593	2.21E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	1.11E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	69400	1.54E+02	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	7.02E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	8.04E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	3.16E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	1.66E+00	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	7.46E+01	7.74E-03	7.74E-03	1.04E-04	1.04E-04	1.04E-04	9.64E+03	7.74E-03	7.74E-03	9.64E+03	0.77%	0.77%
Vanadium and compounds	248	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	8.90E+01	5.49E-03	5.49E-03	6.17E-05	6.17E-05	6.17E-05	4.05E+03	5.49E-03	5.49E-03	4.05E+03	0.55%	0.55%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Soil RBSL Derivation - Child Threshold Health Effects

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Csoil	Csat	Risk at Input Soil Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity) (kg/mg)			RBSL (assumes no sat limit)	Vapour Only Risk at Csat (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL (%)	
			Vapours from Subsurface Soil Indoors	TOTAL (All Pathways)	Vapours from Subsurface Soil Indoors	Total Vapour Pathways	TOTAL (All Pathways)				Vapours from Subsurface Soil Indoors	TOTAL
	mg/kg	mg/kg	unitless	unitless	kg/mg	kg/mg	kg/mg	mg/kg	HI	mg/kg	%	%
Acenaphthene	511	3.94E+01	6.16E-05	6.16E-05	1.57E-06	1.57E-06	1.57E-06	6.39E+05	6.16E-05	6.39E+05	0.01%	0.01%
Acenaphthylene	1700	1.63E+02	-	-	-	-	-	-	-	-	-	-
Ammonia	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	2150	1.42E+00	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	1470	3.33E+00	-	-	-	-	-	-	-	-	-	-
Benzene	1510	6.59E+02	3.95E-03	3.95E-03	5.98E-06	5.98E-06	5.98E-06	1.67E+05	3.95E-03	1.67E+05	0.39%	0.39%
Benzo(a)pyrene	652	1.90E+00	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	587	1.80E+00	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	305	1.01E+00	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	231	9.39E-01	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	210	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	2.3	-	-	-	-	-	-	-	-	-	-	-
Chrysene	771	7.24E-01	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	2290	1.44E+04	1.08E-01	1.08E-01	4.73E-05	4.73E-05	4.73E-05	2.11E+04	6.79E-01	2.11E+04	67.91%	67.91%
Cresol, o-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	71.4	9.51E+00	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	277	5.69E+01	2.86E-05	2.86E-05	5.02E-07	5.02E-07	5.02E-07	1.99E+06	2.86E-05	1.99E+06	0.00%	0.00%
Dimethylphenol, 2,4-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	261	1.67E+02	2.88E-02	2.88E-02	1.73E-04	1.73E-04	1.73E-04	5.79E+03	2.88E-02	5.79E+03	2.88%	2.88%
Fluoranthene	2440	2.89E+01	-	-	-	-	-	-	-	-	-	-
Fluorene	2100	3.10E+01	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	247	7.41E-01	-	-	-	-	-	-	-	-	-	-
Iron	60600	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	13600	-	-	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	7650	1.23E+02	9.50E-03	9.50E-03	7.73E-05	7.73E-05	7.73E-05	1.29E+04	9.50E-03	1.29E+04	0.95%	0.95%
Naphthalene	10200	9.66E+01	1.34E-03	1.34E-03	1.39E-05	1.39E-05	1.39E-05	7.20E+04	1.34E-03	7.20E+04	0.13%	0.13%
Phenol	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	2640	3.84E+01	-	-	-	-	-	-	-	-	-	-
Styrene	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	2650	1.47E+01	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	593	2.93E+02	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	69400	2.91E+02	5.01E-03	5.01E-03	1.72E-05	1.72E-05	1.72E-05	5.81E+04	5.01E-03	5.81E+04	0.50%	0.50%
TPH C10-C14 aromatic	69400	2.21E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	93200	1.11E+02	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	93200	1.54E+02	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	20600	7.02E+01	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	20600	8.04E+01	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	220	3.16E+00	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	248	1.66E+00	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	2576	7.46E+01	7.74E-03	7.74E-03	1.04E-04	1.04E-04	1.04E-04	9.64E+03	7.74E-03	9.64E+03	0.77%	0.77%
	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	5.49E-03	5.49E-03	#DIV/0!	#DIV/0!	#DIV/0!	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Adult Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL mg/L	Pathway Contributions to Total Estimated Risk at RBSL	
			GW vapours from flowing water	TOTAL (All Pathways)	GW vapours from flowing water	Total Vapour Pathways	TOTAL (All Pathways)					GW vapours from flowing water	TOTAL
Acenaphthene	4.48	3.90E+00	7.59E-05	7.59E-05	1.95E-05	1.95E-05	1.95E-05	1.03E+04	7.59E-05	7.59E-05	1.03E+04	0.0%	0.04%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	8.61E-05	8.61E-05	2.48E-07	2.48E-07	2.48E-07	4.04E+06	1.19E-01	1.19E-01	4.04E+06	11.9%	11.93%
Aniline	0.212	3.60E+04	2.42E-08	2.42E-08	1.14E-07	1.14E-07	1.14E-07	8.76E+06	4.11E-03	4.11E-03	8.76E+06	0.4%	0.41%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	4.08E-06	4.08E-06	1.02E-07	1.02E-07	1.02E-07	2.46E+06	1.82E-04	1.82E-04	2.46E+06	0.1%	0.07%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	7.07E-02	7.07E-02	1.62E-04	1.62E-04	1.62E-04	6.17E+03	1.00E+00	-	6.17E+03	100.0%	100.00%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.85E-05	8.85E-05	2.86E-05	2.86E-05	2.86E-05	3.50E+04	8.85E-05	8.85E-05	3.50E+04	0.0%	0.01%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.67E-05	1.67E-05	5.52E-06	5.52E-06	5.52E-06	4.53E+04	9.33E-04	9.33E-04	4.53E+04	0.4%	0.37%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.82E-02	1.82E-02	7.41E-04	7.41E-04	7.41E-04	2.70E+02	1.82E-02	1.82E-02	2.70E+02	9.1%	9.11%
Naphthalene	283	3.10E+01	6.42E-03	6.42E-03	2.07E-04	2.07E-04	2.07E-04	9.65E+02	6.42E-03	6.42E-03	9.65E+02	3.2%	3.21%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	1.31E-04	1.31E-04	5.26E-07	5.26E-07	5.26E-07	1.90E+06	4.35E-02	4.35E-02	1.90E+06	4.4%	4.35%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.56E-06	1.56E-06	8.04E-06	8.04E-06	8.04E-06	1.24E+05	2.49E-03	2.49E-03	1.24E+05	0.2%	0.25%
Toluene	17.6	5.26E+02	6.46E-06	6.46E-06	3.67E-07	3.67E-07	3.67E-07	6.82E+05	1.93E-04	1.93E-04	6.82E+05	0.1%	0.08%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	5.16E-06	5.16E-06	5.61E-06	5.61E-06	5.61E-06	1.78E+05	3.20E-04	3.20E-04	1.78E+05	0.0%	0.03%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	1.71E-05	1.71E-05	2.55E-06	2.55E-06	2.55E-06	9.81E+04	2.70E-04	2.70E-04	9.81E+04	0.1%	0.11%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Groundwater RBSL Derivation - Child Threshold Health Effects
Barangaroo
Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
Scenario 7 - High Density Residential (Odour Based Calculations) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (Hazard Index)		Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)			RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL	
			GW Vapours from Flowing Water	TOTAL (All Pathways)	GW Vapour from Flowing Water	Total Vapour Pathways	TOTAL (All Pathways)					GW Vapours from Flowing Water	TOTAL
			unitless	unitless	unitless	L/mg	L/mg				mg/L	%	%
Acenaphthene	4.48	3.90E+00	7.59E-05	7.59E-05	1.95E-05	1.95E-05	1.95E-05	1.03E+04	7.59E-05	7.59E-05	1.03E+04	0.0%	0.04%
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	8.61E-05	8.61E-05	2.48E-07	2.48E-07	2.48E-07	4.04E+06	1.19E-01	1.19E-01	4.04E+06	11.9%	11.93%
Aniline	0.212	3.60E+04	2.42E-08	2.42E-08	1.14E-07	1.14E-07	1.14E-07	8.76E+06	4.11E-03	4.11E-03	8.76E+06	0.4%	0.41%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	4.08E-06	4.08E-06	1.02E-07	1.02E-07	1.02E-07	2.46E+06	1.82E-04	1.82E-04	2.46E+06	0.1%	0.07%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	7.07E-02	7.07E-02	1.62E-04	1.62E-04	1.62E-04	6.17E+03	1.00E+00	-	6.17E+03	100.0%	100.00%
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	8.85E-05	8.85E-05	2.86E-05	2.86E-05	2.86E-05	3.50E+04	8.85E-05	8.85E-05	3.50E+04	0.0%	0.01%
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	1.67E-05	1.67E-05	5.52E-06	5.52E-06	5.52E-06	4.53E+04	9.33E-04	9.33E-04	4.53E+04	0.4%	0.37%
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-
Iron	187	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	1.82E-02	1.82E-02	7.41E-04	7.41E-04	7.41E-04	2.70E+02	1.82E-02	1.82E-02	2.70E+02	9.1%	9.11%
Naphthalene	283	3.10E+01	6.42E-03	6.42E-03	2.07E-04	2.07E-04	2.07E-04	9.65E+02	6.42E-03	6.42E-03	9.65E+02	3.2%	3.21%
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	1.31E-04	1.31E-04	5.26E-07	5.26E-07	5.26E-07	1.90E+06	4.35E-02	4.35E-02	1.90E+06	4.4%	4.35%
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	1.56E-06	1.56E-06	8.04E-06	8.04E-06	8.04E-06	1.24E+05	2.49E-03	2.49E-03	1.24E+05	0.2%	0.25%
Toluene	17.6	5.26E+02	6.46E-06	6.46E-06	3.67E-07	3.67E-07	3.67E-07	6.82E+05	1.93E-04	1.93E-04	6.82E+05	0.1%	0.08%
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	5.16E-06	5.16E-06	5.61E-06	5.61E-06	5.61E-06	1.78E+05	3.20E-04	3.20E-04	1.78E+05	0.0%	0.03%
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+02	1.71E-05	1.71E-05	2.55E-06	2.55E-06	2.55E-06	9.81E+04	2.70E-04	2.70E-04	9.81E+04	0.1%	0.11%

Bold denotes soil/ groundwater SSTC has been proposed for human health and/or odour (see text for details)

Appendix R

Sensitivity Analysis

Selection of Chemicals of Concern

Reported chemicals in soil and groundwater samples collected from the Site were screened against relevant human health based guideline values. Chemicals were included or excluded as chemicals of potential concern at the Site based on this screening. The justification for inclusion or exclusion of chemicals is included in Table 1 and Table 2 below.

Table 1 CoPC Selection in Groundwater

Chemical	Maximum Concentration (mg/L)	Number of Locations Reported above LOR	Adopted Guideline (mg/L)	Further Assessed (Y/N)	Volatile (Y/N)	Comments
1,2,4-Trimethylbenzene	0.92	12	0.015 (c)	Y	Y	
1-Naphthylamine	91	1	NA	N	N	This chemical has not been further assessed in the current HHERA as 1-Naphthylamine was only reported in a single location (BH200/MW200) across the Site. This location reported significant concentrations of TPH, PAH and BTEX and this it is considered appropriate to assume that remediation of the site for these compounds is likely to result in reduction or removal of 1-naphthylamine from the site.
2,4-dimethylphenol	38	32	0.73 (c)	Y	N	
2-methylnaphthalene	105	19	0.15 (c)	Y	Y	
2-methylphenol	182	38	1.8	Y	N	
2-picoline	0.129	3	NA	N	N	This chemical has not been further assessed in the current HHERA as AECOM is not aware of any suitably published peer reviewed toxicity data relevant for use in modelling exposures. 2-Picoline was only reported in 3 locations across the Site and thus it was not considered to be a significant contaminant. Further assessment of the locations at which 2-picoline was reported indicates that remediation of soils for BTEX, TPH and PAH is likely to result in reduction or removal of this chemical from soils at the Site.
3&4-methylphenol	436	27	NA	Y	N	
3-methylcholanthrene	0.131	1	0.0000031 (c)	N	N	This chemical was not further assessed as a CoPC at the Site as it was only detected above guidelines at a single location. This location has significant concentrations of PAH and TPH and thus it has been assumed that remediation for these compounds will result in a reduction of the concentration of this chemical at this single location.
Acenaphthene	4.48	45	2.2 (c)	Y	Y	
Acenaphthylene	43.2	52	NA	Y	Y	
Ammonia	287 (converted from ammonia as N)	73	NA	Y	Y	
Aniline	0.212	5	0.012 (c)	Y	N	
Anthracene	15.4	43	11 (c)	Y	Y	
Arsenic	0.024	96	0.007 (a)	Y	N	
Barium	2.42	33	0.7 (a)	Y	N	
Benz(a)anthracene	12.6	35	0.000029 (c)	Y	N	
Benzene	41	57	0.001 (a)	Y	Y	
Benzo(a)pyrene	9.26	40	0.01 (a)	Y	N	
Benzo(b)fluoranthene	8.33	24	0.000029 (c)	Y	N	
Benzo(e)pyrene	0.0003	1	NA	N	N	This compound was not assessed further as it was only reported to be present at a single location (MW20) at the limit of reporting. It has been assumed that remediation undertaken in this area will reduce the concentration of this compound at the Site.
Benzo(g,h,i)perylene	4.22	22	NA	Y	N	
Benzo(k)fluoranthene	3.67	17	0.00029 (c)	Y	N	
Bis(2-ethylhexyl)phthalate	0.03	4	0.01 (a)	Y	N	
Cadmium	0.124	80	0.002 (a)	Y	N	
Carbazole	4.6	20	NA	N	N	Review of the 18 locations at which this chemical was reported above the laboratory limit of reporting indicates that remediation of TPH, PAH and BTEX is likely to result in reduction or removal of carbazole from soils across the Site. There is limited toxicological information available for this compound, and given its co-location, further consideration is not warranted.
Chromium (III and VI)	0.102	32	0.05 (b)	Y	N	Maximum reported Chromium (III and VI) concentration in groundwater has been assumed for derivation of both Chromium III and Chromium VI SSTCs.
Chromium (VI)	0.019	7	0.05 (a)	Y	N	See above note.
Chrysene	9.78	32	0.0029 (c)	Y	N	

Chemical	Maximum Concentration (mg/L)	Number of Locations Reported above LOR	Adopted Guideline (mg/L)	Further Assessed (Y/N)	Volatile (Y/N)	Comments
Cobalt	0.06	29	0.011 (c)	Y	N	
Cyanide (free)	0.053	9	NA	Y	N	This compound has not been assessed further as a CoPC, please see note below Table 1.
Cyanide (total)	18.6	21	0.08 (a)	Y	Y	
Dibenz(a,h)anthracene	0.82	10	0.0000029 (c)	Y	N	
Dibenzofuran	10.2	18	0.037 (c)	Y	Y	
Ethylbenzene	3.02	42	0.3 (a)	Y	Y	
Fluoranthene	25.9	58	1.5 (c)	Y	N	
Fluorene	21.4	48	1.5 (c)	Y	Y	
Indeno(1,2,3-c,d)pyrene	3.05	21	0.000029 (c)	Y	N	
Lead	0.56	89	10 (b)	Y	N	
Manganese	4.89	33	0.5 (a)	Y	N	
Mercury	0.0011	20	0.001 (a)	N	Y	Mercury was only reported in two locations above adopted guidelines. Both of these locations have also been reported to contain considerable concentrations of BTEX, PAH and TPH and thus it has been assumed that remediation for these groups of chemicals will result in a reduction in the concentration of mercury present at the Site.
Naphthalene	283	64	0.00014 (c)	Y	Y	
Nickel	0.303	120	0.02	Y	N	
Perylene	0.0001	1	NA	N	N	This compound has not been assessed further as it was reported in one location only (MW20), at the LOR. It has been assumed that remediation for other compounds will result in removal of this chemical from the Site.
Phenanthrene	74.1	59	NA	Y	Y	
Phenol	392	25	11 (c)	Y	N	
Phenolics (total)	2.78	3	NA	N	N	This analyte is considered to be covered by analysis of individual phenol compounds across the site and thus these compounds have been assessed separately.
Pyrene	27.9	62	1.1 (c)	Y	Y	
Styrene	0.194	8	0.03 (a)	Y	Y	
Toluene	17.6	40	0.8 (a)	Y	Y	
TPH C10-C14	1730	54	NA	Y	Y	
TPH C15-C28	1520	70	NA	Y	N	
TPH C29-C36	332	58	NA	Y	N	
TPH C6-C9	73.6	43	NA	Y	Y	
Vanadium	0.023	24	0.0026 (c)	Y	N	
Xylenes	6.7	48	0.6 (a)	Y	Y	
It should be noted that compounds such as sulphate, nitrate, nitrite, methane, total cations, total anions, chloride, ferrous iron, nitrogen, chloride, sulphur, iron, calcium, magnesium and potassium have not been further considered as CoPC as they are not considered to be toxic compounds and have been included in the analytical suite for samples from this site to provide information on the soil conditions beneath the Site and for ecological screening purposes.						

Note:
Guidelines adopted for this screening are as follows:
(a) NHMRC (2004). Australian Drinking Water Guidelines, for protection of human health.
(b) WHO (2006). Drinking Water Guidelines.
(c) USEPA (2010) Regional Screening Levels, for tapwater quality.

Where NA is listed in the guideline column, it indicates that no guideline was available for that compound. These chemicals have been included/excluded on a chemical by chemical basis. This screening has involved assessment of the number of locations at which this compound has been reported, the concentration of other chemicals of concern at these locations and their relative toxicity to reported CoPCs.

Carbazole, 2-picoline and 1-naphthylamine have been excluded as CoPC as the Site because of the following:

- Wells in which carbazole, 2-picoline and 1-naphthylamine were detected also contained significant concentrations of BTEX, TPH and PAHs.
- These compounds were reported at the following locations, all of which were reported to have significant concentrations of other toxic CoPC:
Carbazole: MW69, MW40, IT1_Mid, IT1_Deep, IT2_Mid, IT2_Deep, MW08, MW60, MW74, MW15, MW200, MW204S, MW205, MW206, MW209, MW54, MW62, BH3 (MW3), MW61 (AECOM_BH61), MW210.
2-Picoline: MW54, MW204S, MW15.
1-Naphthylamine: MW200 only.

As these compounds are not considered carcinogenic (IARC Classification of 3) it is not considered appropriate to include them with the carcinogenic PAHs using a TEF. In all locations where these compounds have been reported, significant concentrations of PAHs and TPHs have been reported and thus it is considered reasonable to assume that remediation of the site will result in a reduction of the concentration and frequency at which these compounds are reported.

Cyanide has not been assessed further as a CoPC in groundwater for the following reasons:

- Numerous studies have been undertaken to investigate the presence of cyanide in soil and groundwater at former gasworks sites. These studies have demonstrated that the most dominant species of cyanide present in soil and groundwater at former gasworks sites are the relatively nontoxic strong metal-cyanide complexes (primarily the iron-complexed species). These studies have demonstrated that free cyanide is generally not detectable in soils or groundwater collected from former gasworks sites. This is also the case at the current Site.
- The presence of significant concentrations of iron in soil and groundwater at the site indicates that it is highly likely that the majority of the cyanide present at the site would be bonds tightly to iron forming non-toxic complexes.
- It has also been shown that high pH (alkaline conditions) increases the stability (retention) of cyanide complexes in soils. The average pH reported in soils at the Site is 7.5 with a range of 4.8 to 11.2: average pH in groundwater is 7 with a range of 4 to 8. These results indicate that conditions in the soil at the site tend to be more alkaline in nature. Therefore, cyanide complexes present are not likely to readily release free cyanide.
- Given the reported site conditions, it is therefore considered that the modelling that has been undertaken assuming 100% free cyanide is conservative despite limitations of the J&E based modelling that was undertaken.

Table 2 CoPC Selection in Soil

Chemical	Maximum Concentration (mg/kg)	Number of Locations Reported above LOR	Adopted Guideline (mg/kg)	Further Assessed (Y/N)	Volatile (Y/N)	Comments
Benzene	1510	102	1 (b)	Y	Y	
Ethylbenzene	261	61	50 (b)	Y	Y	
Toluene	2650	82	130 (b)	Y	Y	
Xylenes	2576	88	25 (b)	Y	Y	
Vanadium	248	302	5.5 (c)	Y	N	
Chromium (III and VI)	309	930	200 (b)	Y	N	
Chromium (VI)	2.3	4	0.29 (c)	Y	N	
Iron	118 000	68	55 000 (c)	Y	N	
2-methylnaphthalene	7650	34	310 (c)	Y	Y	
Acenaphthene	511	137	3400 (c)	Y	Y	It should be noted that this compound has been included as a CoPC for further consideration because the total PAH concentration in soils is above adopted screening criteria and thus assessment of all PAHs has been included as a conservative measure.
Acenaphthylene	1700	228	NA	Y	Y	
Anthracene	2150	272	17000 (c)	Y	Y	It should be noted that this compound has been included as a CoPC for further consideration because the total PAH concentration in soils is above adopted screening criteria and thus assessment of all PAHs has been included as a conservative measure.
Benz(a)anthracene	1470	354	0.15 (c)	Y	N	
Benzo(a)pyrene	652	339	2 (a)	Y	N	
Benzo(b)fluoranthene	824	303	0.15 (c)	Y	N	
Benzo(k)fluoranthene	324	225	1.5 (c)	Y	N	
Benzo(g,h,i)fluoranthene	305	295	NA	Y	N	
Chrysene	771	334	15 (c)	Y	N	
Dibenz(a,h)anthracene	72.5	142	0.015 (c)	Y	N	
Fluoranthene	2 440	409	2300 (c)	Y	N	
Fluorene	2 100	190	2300 (c)	Y	Y	
Indeno(1,2,3-c,d)pyrene	247	263	3.6 (c)	Y	N	
Naphthalene	10 200	211	3.6 (c)	Y	Y	
Phenanthrene	5 180	376	NA	Y	Y	
Pyrene	2640	419	1700 (c)	Y	Y	
4-(dimethylamino)azobenzene	1.3	1	0.11 (c)	N	N	This compound was only reported above adopted screening criteria in a single location (BH48_14.5-14.7). As this compound is present only in a location reported to have considerable concentrations of BTEX, PAH and TPH it is considered likely that remediation criteria derived for these compounds will be protective of human health for this chemical.
3,3-Dichlorobenzidine	1.6	1	1.1 (c)	N	N	This compound was only reported above adopted screening criteria in a single location (BH48_14.5-14.7). As this compound is not volatile and is only present at

Chemical	Maximum Concentration (mg/kg)	Number of Locations Reported above LOR	Adopted Guideline (mg/kg)	Further Assessed (Y/N)	Volatile (Y/N)	Comments
						depth it is not considered likely to pose a risk to human health or the environment.
Dibenzofuran	327	21	78 (c)	Y	Y	
Lead	13 600	864	600 (a)	Y	N	
1,2,4-Trimethylbenzene	220	20	62 (c)	Y	Y	
4-aminobiphenyl	1.2	1	0.023	N	N	This compound was only reported to be present at a single location (BH55_2.2-2.4). It is considered appropriate to assume that remediation criteria developed for BTEX, PAH and TPH reported at this location will be protective of human health and thus the presence of this compound at this single location will not result in a significant risk.
3&4-methylphenol	2290	44	NA	Y	N	
4-chloro-3-methylphenol	1.3	1	NA	N	N	This compound has not been assessed further as it was only detected above LOR in a single location. (BH59_3.4-3,5). This location has been reported to contain significant concentrations of TPH, PAH and BTEX and thus it is considered appropriate to assume that remediation for this compound will result in removal of this compound from this location.
Carbazole	186	18	NA	N	N	Review of the 18 locations at which this chemical was reported above the laboratory limit of reporting indicates that remediation of TPH, PAH and BTEX is likely to result in reduction or removal of carbazole from soils across the Site. There is limited toxicological information available for this compound, and given its co-location, further consideration is not warranted.
1-naphthylamine	1.4	1	NA	N	N	This chemical has not been further assessed in the current HHERA as 1-Naphthylamine was only reported in a single location (BH200/MW200) across the Site. This location reported significant concentrations of TPH, PAH and BTEX and this it is considered appropriate to assume that remediation of the site for these compounds is likely to result in reduction or removal of 1-naphthylamine from the site.
2-picoline	33.9	3	NA	N	N	This chemical has not been further assessed in the current HHERA as AECOM is not aware of any suitably published peer reviewed toxicity data relevant for use in modelling exposures. 2-Picoline was only reported in 3 locations across the Site and thus it was not considered to be a significant contaminant. Further assessment of the locations at which 2-picoline was reported indicates that remediation of soils for BTEX, TPH and PAH is likely to result in reduction or removal of this chemical from soils at the Site.
Endosulfan sulphate	4.2	1	NA	N	N	This compound has only been reported at a single location (BH59_3.4-3.5), this location also contains significant concentrations of TPH (all fractions), PAH and BTEX. Thus it is considered that clean-up criteria derived for carcinogenic PAH and for TPH should cover the potential human health risks potentially associated with the presence of this compound.
Pirimphos Ethyl	1.4	1	NA	N	N	This compound has only been reported above LOR in a single location (BH59_3.4-3.5) and thus it is not considered likely to pose a risk to human health and has thus not been considered further.
TPH C6-C9	7590	85	65 (b)	Y	Y	
TPH C10-C14	69 400	104	NA	Y	Y	
TPH C15-C28	93 200	266	NA	Y	N	
TPH C29-C36	20 600	230	NA	Y	N	

Note:

Guidelines adopted for this screening are as follows:

- (a) NEPC (1999). Health Investigations for Residential Soils (National Environmental Protection Measure (NEPM)).
- (b) NSW EPA (1994). Guidelines for assessing service station sites.
- (c) USEPA (2010) Regional Screening Levels, for residential soils.

Where NA is listed in the guideline column, it indicates that no guideline was available for that compound. These chemicals have been included/excluded on a chemical by chemical basis. This screening has involved assessment of the number of locations at which this compound has been reported, the concentration of other chemicals of concern at these locations and their relative toxicity to reported CoPCs.

1. General Information:

Site: Barangaroo
 Address: Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Client: Lend Lease
 Scenario: Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA)

Header Colour (Defaults = Blue):

2. Select Receptor:

Construction/Excavation Worker

3. Select Exposure Pathways to Include:

Enter "x" in box, or select from dropdown box.

Soil Pathways

☐	Incidental Ingestion of Soil
☐	Dermal Contact with Soil
☐	Inhalation of Surface Soil-Derived Dust in Indoor Air
☐	Inhalation of Surface Soil-Derived Dust in Outdoor Air
☐	Inhalation of Surface Soil-Derived Vapours in Outdoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Indoor Air
☐	Inhalation of Subsurface Soil-Derived Vapours in Outdoor Air

Groundwater Pathways

☐	Inhalation of Groundwater-Derived Vapours in Indoor Air
☐	Inhalation of Groundwater-Derived Vapours in Outdoor Air
☐	Ingestion of Potable Groundwater
☒	Incidental Ingestion of Groundwater (Bathing or Excavation)
☒	Dermal Contact with Groundwater (Bathing or Excavation)
☒	Inhalation of Groundwater Vapours (Where GW Enters Trench)

☐ Soil RBSLs saturation limited?☐ Groundwater RBSLs solubility limited?

4. Select Chemicals for Quantitative Assessment:	Target Hazard Index	Target Cancer Risk	5. Enter Chemical Concentrations (If only calculating RBSLs, enter 1):	
	default = 1 (or manually overwrite)	default = 1x10 ⁻⁵ (or manually overwrite)	Soil (mg/kg)	Groundwater (mg/L)
Acenaphthene	0.2	1.00E-05	511	4.48
Acenaphthylene	0.2	1.00E-05	1700	43.2
Ammonia	1	1.00E-05		348
Aniline	1	1.00E-05		0.212
Anthracene	0.2	1.00E-05	2150	15.4
Arsenic, Inorganic	1	1.00E-05		0.024
Barium	1	1.00E-05		2.23
Benz(a)anthracene	0	0.00E+00	1470	12.6
Benzenes	0.25	1.00E-05	1510	40.2
Benzo(a)pyrene	1	1.00E-05	652	9.26
Benzo(b)fluoranthene			587	8.33
Benzo(g,h,i)perylene			305	4.22
Benzo(k)fluoranthene			231	2.93
Bis(2-ethylhexyl)phthalate	1	1.00E-05		0.03
Cadmium (Water)	1	1.00E-05		0.108
Chromium(III), Insoluble Salts	1	1.00E-05	210	0.102
Chromium(VI)	1	1.00E-05	2.3	0.102
Chrysene			771	9.78
Cobalt	1	1.00E-05		0.057
Cresol, m- & p-	1	1.00E-05	2290	436
Cresol, o-	1	1.00E-05		182
Cyanide (CN-)	1	1.00E-05		18.6
Dibenz(a,h)anthracene			71.4	0.822
Dibenzofuran	1	1.00E-05	277	10.2
Dimethylphenol, 2,4-	1	1.00E-05		38
Ethylbenzene	0.25	1.00E-05	261	3.02
Fluoranthene	0.2	1.00E-05	2440	25.9
Fluorene	0.2	1.00E-05	2100	21.1
Indeno(1,2,3-cd)pyrene			247	3.05
Iron	1	1.00E-05	60600	187
Lead and Compounds	1	1.00E-05	13600	0.555
Manganese	1	1.00E-05		4.89
Methylnaphthalene, 2-	0.2	1.00E-05	7650	105
Naphthalene	0.2	1.00E-05	10200	283
Nickel Soluble Salts	1	1.00E-05		0.303
Phenanthrene	0.2	1.00E-05	5180	74.1
Phenol	1	1.00E-05		249
Pyrene	0.2	1.00E-05	2640	27.9
Styrene	1	1.00E-05		0.194
Toluene	0.25	1.00E-05	2650	17.6
TPH C06-C09 aliphatic	0.125	1.00E-05	593	6.08
TPH C10-C14 aliphatic	0.125	1.00E-05	69400	1730
TPH C10-C14 aromatic	0.125	1.00E-05	69400	1730
TPH C15-C28 aliphatic	0.125	1.00E-05	93200	1520
TPH C15-C28 aromatic	0.125	1.00E-05	93200	1520
TPH C29-C36 aliphatic	0.125	1.00E-05	20600	332
TPH C29-C36 aromatic	0.125	1.00E-05	20600	332
Trimethylbenzene, 1,2,4-	1	1.00E-05	220	0.92
Vanadium and compounds	1	1.00E-05	248	0.0228
Xylenes (total)	0.25	1.00E-05	2576	6.7

Bold denotes soil/ groundwater SSTC has been proposed (see text for details)

6. Confirm/Modify Exposure Parameters:

[Link to Exposure Defaults and Sources](#)

General receptor parameters:	Units	Default Value		Site-Specific Value (leave blank to use default value)		Value Used in Calculations	
		Adult	Child	Adult	Child	Adult	Child
Body weight	kg	70	N/A	70		70	N/A
Exposure duration	yr	1	N/A	1		1	N/A
Averaging time (carcinogens)	yr	70	N/A	70		70	N/A
Averaging time (non-carcinogens)	yr	1	N/A	1		1	N/A
Incidental Soil Ingestion							
Daily soil ingestion rate	mg/day	200	N/A	330		330	N/A
Exposure frequency for soil ingestion	days/yr	240	N/A	15		15	N/A
Fraction of daily soil intake from site	unitless	1	N/A	1		1	N/A
Dermal Absorption of Soil							
Exposed skin surface area for soil contact	cm ²	5000	N/A	3600		3600	N/A
Soil to skin adherence factor	mg/cm ²	0.5	N/A	1.5		1.5	N/A
Exposure frequency for dermal contact with soil	days/yr	240	N/A	15		15	N/A
Indoor Inhalation							
Exposure time (indoor air)	hrs/day	NA	N/A			NA	N/A
Exposure frequency (indoor air)	days/yr	240	N/A			240	N/A
Particulate emission factor (indoor air)	m ³ /kg	NA	N/A			NA	N/A
Outdoor Inhalation							
Exposure time (outdoor air)	hrs/day	8	N/A	8		8	N/A
Exposure frequency (outdoor air)	days/yr	240	N/A	15		15	N/A
Particulate emission factor (outdoor air)	m ³ /kg	1.00E+05	N/A	3.60E+07		3.60E+07	N/A
Potable Water Ingestion							
Potable water intake rate	L/day	0	N/A			0	N/A
Exposure frequency for potable water intake	days/yr	240	N/A			240	N/A
Incidental Water Ingestion							
Incidental ingestion rate	L/day	0.05	N/A	0.005		0.005	N/A
Exposure frequency for incidental water ingestion	days/yr	240	N/A	15		15	N/A
Dermal Contact with Water							
Exposed skin surface for water contact	cm ²	6510	N/A	3870		3870	N/A
Exposure time for dermal water contact	hr/day	8	N/A	1		1	N/A
Exposure frequency for dermal water contact	days/yr	240	N/A	15		15	N/A

* USEPA (2002)

USEPA (1997) (Exposure factors handbook) - based on assumption that head, forearms and hands will be exposed. 50th percentile data

** USEPA (1997) (Exposure factors handbook) - based on assumption that lower legs and feet only would be contacting water. 50th percentile

-Chromium (III) and Chromium (VI) concentrations are total chromium concentrations detected in groundwater

Vapour Modelling - Groundwater to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

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A. Model Input Parameters

Parameter Definition	Units	Default Value (Shell 2007 unless otherwise noted)	Notes	Site-Specific Value (leave blank if adopting default)	Label	Adopted Value for Model	Justification for Site-specific value, if applicable
Depth to groundwater (below building, ground surface or trench)	cm	300			LGW	300	Autocalculates from layer thicknesses
<u>Vadose Zone Layer 1</u>							
Thickness	cm	295			HV	295	
SCS Soil Type:							
Fraction of organic carbon	unitless	0.01			OC	0.01	
Air-filled porosity (volumetric)	cm ³ /cm ³	0.26			VACS	0.26	
Water-filled porosity (volumetric)	cm ³ /cm ³	0.12			vwcvz	0.12	
Total soil porosity	cm ³ /cm ³	0.38			TPOR	0.38	
<u>Vadose Zone Layer 2 (lens)</u>							
Thickness	cm				Hvtwo		
SCS Soil Type:							
Air-filled porosity (volumetric)	cm ³ /cm ³	NA			VACS2	NA	
Water-filled porosity (volumetric)	cm ³ /cm ³	NA			vwcvz2	NA	
Total soil porosity	cm ³ /cm ³	NA			TPOR2	NA	
<u>Building Characteristics</u>							
Enclosed-space volume/infiltration area (ratio)	cm	300	(a)		LB	300	
Enclosed-space foundation or wall thickness	cm	15			Lorack	15	
Enclosed-space air exchange rate	1/s	0.000138889			ENCAER	1.39E-04	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019	(b)		NU	0.0019	
Volumetric air content in found./wall cracks	cc/cc	0.26			VACF	0.26	
Volumetric water content in found./wall cracks	cc/cc	0.12			vwcfnd	0.12	
<u>Convective vapour flow term</u>							
Calculate convective flow term? (ENTER Y or N)		Y			Conv	Y	
Convective flow rate (if specified directly)	cm ³ /sec						
Convective flow through slab (calculated)	cm ³ /sec	10.88			Qs	10.88	
Slab Area	cm ²	700000			Ab	700000	
Areal fraction of cracks in foundations/walls	cm ² -cracks/cm ² -total area	0.0019			Nuc	0.0019	
Soil vapour permeability	cm ²	1.00E-08			kv	1.00E-08	
Indoor-outdoor pressure differential	g/cm-s ²	40			dP	40	
Slab perimeter	cm	3400			Xcrack	3400	
Depth to bottom of slab	cm	15			Zcrack	15	
Viscosity of air	g/cm-s	1.81E-04			uair	1.81E-04	Viscosity of air at 20 deg C.
<u>Additional Trench Characteristics (for GW level above base of trench, i.e., assumes groundwater flows into trench)</u>							
Groundwater seepage velocity (into trench)	cm/sec	1.50E-04	(c)	1.50E-04	Vgw	0.00015	default for permeable fill (max expected for
Depth of groundwater in trench	cm	50		50	Dgw	50	assumes gw may be present at 2 mbgl (on average) and
Dimension of trench (length or width) perpendicular to GW flow	cm	200	(d)	200	WSAtrench	200	maximum assumed trench dimension
Flow rate of groundwater in trench	cm ³ /sec				Qgw	1.5	Calculated from above three parameters
<u>Outdoor Air Characteristics</u>							
							Based on the average annual 9am and 3pm windspeeds measured at observatory point in Sydney (note that this is the closest Bureau of Meteorology wind recording location to the Site), divided by 10
Wind speed in outdoor mixing zone (ambient air or trench, as appropriate)	cm/s	22.5	(e)	37.8	windsp	37.8	2 m deep and 2 m long trench
Width of source area parallel to wind or groundwater flow direction	cm	600	(f)	600	WSA	600	assumes all vapours mixed w/in trench
Ambient air mixing zone height	cm	200		200	AAMZH	200	

(a) Building Code of Australia minimum ceiling height for habitable dwelling.

(b) USEPA (2004) upper limit of range for slab on grade foundation.

(c) Conservative estimate of maximum expected velocity for a sandy or gravelly aquifer (50ft/day = 13 m/day)

(d) Assumes trench is 2 m long.

(e) If receptor is construction/excavation worker, wind speed is default wind speed of 225 cm/s reduced by factor of 10 to account for reduced wind circulation within excavation. For other receptors, wind speed is default of 225 cm/s.

(f) For construction/excavation worker, default is 600 cm (assumes trench is 2 m long and 2 m deep, and vapours enter through both walls and floor). For other receptors, Shell (2007) default of 4500 cm is assumed.

Vapour Modelling - Groundwater to Outdoor and Indoor Air

Barangaroo

Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000

Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

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B. Chemical-Specific Fate and Transport Parameters

Chemical	Koc	Kd	H'	S	D ^{air}	D ^{soil}	MW	VP	Volatile?
	(cm ² /g)	(cm ² /g)	(cc H ₂ O / cc soil)	(mg/g water)	(cm ² /s)	(cm ² /s)	(g/mol)	(mmHg)	
Acenaphthene	5.03E+03	5.03E+01	7.52E-03	3.90E+00	5.06E-02	8.33E-06	1.54E+02	2.15E-03	Y
Acenaphthylene	5.03E+03	5.03E+01	4.66E-03	1.61E+01	4.50E-02	6.98E-06	1.52E+02	6.68E-03	Y
Ammonia	3.10E+00	3.10E-02	6.58E-04	4.82E+05	2.28E-01	1.10E-05	1.70E+01	-	Y
Aniline	7.02E+01	7.02E-01	8.26E-05	3.60E+04	8.30E-02	1.01E-05	9.31E+01	4.90E-01	N
Anthracene	1.64E+04	1.64E+02	2.27E-03	4.34E-02	3.90E-02	7.85E-06	1.78E+02	6.53E-06	Y
Benz(a)anthracene	1.77E+05	1.77E+03	1.37E-04	9.40E-03	5.10E-02	9.00E-06	2.28E+02	2.10E-07	N
Benzene	1.46E+02	1.46E+00	2.27E-01	1.79E+03	8.95E-02	1.03E-05	7.81E+01	9.48E+01	Y
Benzo(a)pyrene	5.87E+05	5.87E+03	1.87E-05	1.62E-03	4.30E-02	9.00E-06	2.52E+02	5.49E-09	N
Benzo(b)fluoranthene	5.99E+05	5.99E+03	2.69E-05	1.50E-03	2.26E-02	5.56E-06	2.52E+02	5.00E-07	N
Benzo(g,h,i)perylene	1.95E+06	1.95E+04	1.35E-05	2.60E-04	4.90E-02	5.56E-06	2.76E+02	1.00E-10	N
Benzo(k)fluoranthene	5.87E+05	5.87E+03	2.39E-05	8.00E-04	2.26E-02	5.56E-06	2.52E+02	9.65E-10	N
Bis(2-ethylhexyl)phthalate	1.20E+05	1.20E+03	1.10E-05	2.70E-01	3.51E-02	3.66E-06	3.91E+02	1.42E-07	N
Chrysene	1.81E+05	1.81E+03	2.14E-04	2.00E-03	2.48E-02	6.21E-06	2.28E+02	6.23E-09	N
Cresol, m-&p-	3.00E+02	3.00E+00	3.50E-05	2.27E+04	7.29E-02	9.32E-06	1.08E+02	1.10E-01	N
Cresol, o-	3.07E+02	3.07E+00	4.91E-05	2.59E+04	7.28E-02	9.32E-06	1.08E+02	1.70E-01	N
Cyanide (CN ⁻)	2.84E+00	2.84E-02	5.44E-03	1.00E+06	2.11E-01	2.46E-05	2.70E+01	7.42E+02	Y
Dibenzo(a,h)anthracene	1.91E+06	1.91E+04	5.76E-06	2.49E-03	2.00E-02	5.24E-06	2.78E+02	9.55E-10	N
Dibenzofuran	9.16E+03	9.16E+01	8.71E-03	3.10E+00	4.10E-02	7.38E-06	1.68E+02	2.48E-03	Y
Dimethylphenol, 2,4-	4.92E+02	4.92E+00	3.89E-05	7.87E+03	6.22E-02	8.31E-06	1.22E+02	1.02E-01	N
Ethylbenzene	4.46E+02	4.46E+00	3.22E-01	1.69E+02	6.85E-02	8.46E-06	1.06E+02	9.60E+00	Y
Fluoranthene	5.55E+04	5.55E+02	3.62E-04	2.60E-01	3.02E-02	6.35E-06	2.02E+02	9.22E-06	N
Fluorene	9.16E+03	9.16E+01	3.93E-03	1.69E+00	4.40E-02	7.89E-06	1.66E+02	6.00E-04	Y
Indeno(1,2,3-cd)pyrene	1.95E+06	1.95E+04	1.42E-05	1.90E-04	2.30E-02	4.41E-06	2.76E+02	1.25E-10	N
Methyl(naphthalene, 2-	2.48E+03	2.48E+01	2.12E-02	2.46E+01	5.24E-02	7.78E-06	1.42E+02	5.50E-02	Y
Naphthalene	1.54E+03	1.54E+01	1.80E-02	3.10E+01	6.05E-02	8.38E-06	1.28E+02	8.50E-02	Y
Phenanthrene	1.67E+04	1.67E+02	1.73E-03	1.15E+00	3.45E-02	6.69E-06	1.78E+02	1.21E-04	Y
Phenol	1.87E+02	1.87E+00	1.36E-05	8.28E+04	8.34E-02	1.03E-05	9.41E+01	3.50E-01	N
Pyrene	5.43E+04	5.43E+02	4.87E-04	1.35E-01	2.78E-02	7.25E-06	2.02E+02	4.50E-06	Y
Styrene	4.46E+02	4.46E+00	1.12E-01	3.10E+02	7.11E-02	8.78E-06	1.04E+02	6.40E+00	Y
Toluene	2.34E+02	2.34E+00	2.71E-01	5.26E+02	7.78E-02	9.20E-06	9.21E+01	2.84E+01	Y
TPH C06-C09 aliphatic	4.47E+03	4.47E+01	5.05E+01	1.18E+01	1.00E-01	1.00E-05	1.03E+02	9.16E+01	Y
TPH C10-C14 aliphatic	5.50E+05	5.50E+03	6.26E+01	9.99E-02	1.00E-01	1.00E-05	1.70E+02	1.16E+00	Y
TPH C10-C14 aromatic	3.02E+03	3.02E+01	1.41E-01	2.53E+01	1.00E-01	1.00E-05	1.36E+02	1.16E+00	Y
TPH C15-C28 aliphatic	3.16E+08	3.16E+06	8.27E+01	1.11E-04	1.00E-01	1.00E-05	2.60E+02	5.93E-03	Y
TPH C15-C28 aromatic	3.79E+04	3.79E+02	4.90E-03	1.06E+00	1.00E-01	1.00E-05	2.09E+02	5.51E-03	Y
TPH C29-C36 aliphatic	6.31E+08	6.31E+06	8.50E+01	2.50E-06	1.00E-01	1.00E-05	2.70E+02	8.36E-04	Y
TPH C29-C36 aromatic	1.26E+05	1.26E+03	1.70E-05	6.60E-03	1.00E-01	1.00E-05	2.40E+02	3.34E-07	N
Trimethylbenzene, 1,2,4-	6.14E+02	6.14E+00	2.52E-01	5.70E+01	6.07E-02	7.92E-06	1.20E+02	2.10E+00	Y
Xylenes (total)	3.83E+02	3.83E+00	2.12E-01	1.06E+01	8.47E-02	9.90E-06	1.06E+02	7.99E+00	Y

Definition of Parameters

Koc	Organic carbon partition coefficient	D ^{air}	Diffusion coefficient in air
Kd	Soil-water partition coefficient	D ^{soil}	Diffusion coefficient in water
H'	Dimensionless Henry's Law Constant	MW	Molecular weight
S	Solubility	VP	Vapour pressure

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C. Chemical-Specific Diffusion Coefficients

Chemical	D _{soil} (cm²/s)	D _{crack}	D _{cap}	D _{soil}	D _{crack} (cm²/s)	D _{cap} (cm²/s)	D _{soil} (cm²/s)	Convective Factor (unitless)
Acenaphthene	3.96E-03	-	-	3.96E-03	3.96E-03	2.22E-04	3.09E-03	3.10E+01
Acenaphthylene	3.52E-03	-	-	3.52E-03	3.52E-03	2.97E-04	2.98E-03	3.49E+01
Ammonia	1.79E-02	-	-	1.79E-02	1.79E-02	3.28E-03	1.67E-02	6.86E+00
Aniline	NV	NV	NV	NV	NV	NV	NV	NV
Anthracene	3.06E-03	-	-	3.06E-03	3.06E-03	6.77E-04	2.89E-03	4.00E+01
Benz(a)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Benzene	6.98E-03	-	-	6.98E-03	6.98E-03	2.04E-05	1.04E-03	1.76E+01
Benzo(a)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV	NV	NV	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV	NV	NV	NV	NV	NV
Chrysene	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, m-&p-	NV	NV	NV	NV	NV	NV	NV	NV
Cresol, o-	NV	NV	NV	NV	NV	NV	NV	NV
Cyanide (CN)	1.65E-02	-	-	1.65E-02	1.65E-02	9.06E-04	1.28E-02	7.44E+00
Dibenz(a,h)anthracene	NV	NV	NV	NV	NV	NV	NV	NV
Dibenzofuran	3.20E-03	-	-	3.20E-03	3.20E-03	1.70E-04	2.47E-03	3.83E+01
Dimethylphenol, 2,4-	NV	NV	NV	NV	NV	NV	NV	NV
Ethylbenzene	5.35E-03	-	-	5.35E-03	5.35E-03	1.40E-05	7.26E-04	2.30E+01
Fluoranthene	NV	NV	NV	NV	NV	NV	NV	NV
Fluorene	3.45E-03	-	-	3.45E-03	3.45E-03	3.96E-04	3.05E-03	3.56E+01
Indeno(1,2,3-cd)pyrene	NV	NV	NV	NV	NV	NV	NV	NV
Methylnaphthalene, 2-	4.09E-03	-	-	4.09E-03	4.09E-03	7.81E-05	2.20E-03	3.00E+01
Naphthalene	4.72E-03	-	-	4.72E-03	4.72E-03	9.83E-05	2.65E-03	2.60E+01
Phenanthrene	2.72E-03	-	-	2.72E-03	2.72E-03	7.56E-04	2.60E-03	4.52E+01
Phenol	NV	NV	NV	NV	NV	NV	NV	NV
Pyrene	2.26E-03	-	-	2.26E-03	2.26E-03	2.90E-03	2.27E-03	5.43E+01
Styrene	5.55E-03	-	-	5.55E-03	5.55E-03	2.44E-05	1.16E-03	2.21E+01
Toluene	6.07E-03	-	-	6.07E-03	6.07E-03	1.66E-05	8.60E-04	2.02E+01
TPH C06-C09 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.30E-05	7.08E-04	1.57E+01
TPH C10-C14 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.08E-04	1.57E+01
TPH C10-C14 aromatic	7.80E-03	-	-	7.80E-03	7.80E-03	2.67E-05	1.33E-03	1.57E+01
TPH C15-C28 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.07E-04	1.57E+01
TPH C15-C28 aromatic	7.82E-03	-	-	7.82E-03	7.82E-03	4.10E-04	6.01E-03	1.57E+01
TPH C29-C36 aliphatic	7.80E-03	-	-	7.80E-03	7.80E-03	1.29E-05	7.07E-04	1.57E+01
TPH C29-C36 aromatic	NV	NV	NV	NV	NV	NV	NV	NV
Trimethylbenzene, 1,2,4-	4.74E-03	-	-	4.74E-03	4.74E-03	1.40E-05	7.13E-04	2.59E+01
Xylenes (total)	6.61E-03	-	-	6.61E-03	6.61E-03	2.00E-05	1.02E-03	1.86E+01

Definition of Parameters

D _s	Effective diffusion coefficient in soil based on vapor-phase concentration
D _{crack}	Effective diffusion coefficient through foundation cracks
D _{cap}	Effective diffusion coefficient through capillary fringe
D _{soil}	Effective diffusion coefficient between groundwater and soil surface

Vapour Modelling - Groundwater to Outdoor and Indoor Air

Barangaroo

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Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

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D. Chemical-Specific Volatilisation Factors

Chemical	VF _{seep} (mgm ⁻³ -air / mg/L-H ₂ O)	VF _{amb} (mgm ⁻³ -air / mg/L-H ₂ O)	VF _{trench} (mgm ⁻³ -air / mg/L-water)
Acenaphthene	1.12E-03	6.15E-06	3.31E-04
Acenaphthylene	6.78E-04	3.68E-06	3.31E-04
Ammonia	1.92E-04	2.90E-06	3.31E-04
Aniline	NV	NV	NV
Anthracene	3.24E-04	1.74E-06	3.31E-04
Benz(a)anthracene	NV	NV	NV
Benzene	1.55E-02	6.27E-05	3.31E-04
Benzo(a)pyrene	NV	NV	NV
Benzo(b)fluoranthene	NV	NV	NV
Benzo(g,h,i)perylene	NV	NV	NV
Benzo(k)fluoranthene	NV	NV	NV
Bis(2-ethylhexyl)phthalate	NV	NV	NV
Chrysene	NV	NV	NV
Cresol, m- & p-	NV	NV	NV
Cresol, o-	NV	NV	NV
Cyanide (CN)	1.49E-03	1.84E-05	3.31E-04
Dibenz(a,h)anthracene	NV	NV	NV
Dibenzofuran	1.13E-03	5.69E-06	3.31E-04
Dimethylphenol, 2,4-	NV	NV	NV
Ethylbenzene	1.62E-02	6.18E-05	3.31E-04
Fluoranthene	NV	NV	NV
Fluorene	5.80E-04	3.17E-06	3.31E-04
Indeno(1,2,3-cd)pyrene	NV	NV	NV
Methylnaphthalene, 2-	2.54E-03	1.24E-05	3.31E-04
Naphthalene	2.43E-03	1.26E-05	3.31E-04
Phenanthrene	2.31E-04	1.19E-06	3.31E-04
Phenol	NV	NV	NV
Pyrene	5.94E-05	2.92E-07	3.31E-04
Styrene	8.34E-03	3.45E-05	3.31E-04
Toluene	1.57E-02	6.16E-05	3.31E-04
TPH C06-C09 aliphatic	2.48E+00	9.46E-03	3.31E-04
TPH C10-C14 aliphatic	3.08E+00	1.17E-02	3.31E-04
TPH C10-C14 aromatic	1.17E-02	4.97E-05	3.31E-04
TPH C15-C28 aliphatic	4.06E+00	1.55E-02	3.31E-04
TPH C15-C28 aromatic	1.03E-03	7.79E-06	3.31E-04
TPH C29-C36 aliphatic	4.18E+00	1.59E-02	3.31E-04
TPH C29-C36 aromatic	NV	NV	NV
Trimethylbenzene, 1,2,4-	1.25E-02	4.75E-05	3.31E-04
Xylenes (total)	1.42E-02	5.72E-05	3.31E-04

Definition of Parameters

VF _{seep1}	Volatilization factor from groundwater to enclosed-space vapors - no convective transport
VF _{seep2}	Volatilization factor from groundwater to enclosed-space vapors - with convective transport
VF _{amb}	Volatilization factor from groundwater to ambient (outdoor) vapors
VF _{trench}	Volatilisation factor from groundwater to trench air (where groundwater seeps into trench - this is mass limited value based on estimated rate of groundwater flow into trench)

Summary of Derived RBSLs

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Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

Chemical	Soil RBSLs (mg/kg)						Groundwater RBSLs (mg/L)					
	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Saturation Limited?	Site Concentration	Adult Threshold	Child Threshold	Non-Threshold (Lifetime)	Adopted RBSL (Lowest)	Solubility Limited?	Site Concentration
Acenaphthene	-	-	-	-	-	-	6.05E+01	-	-	6.05E+01	-	4.48E+00
Acenaphthylene	-	-	-	-	-	-	5.71E+01	-	-	5.71E+01	-	4.32E+01
Ammonia	-	-	-	-	-	-	1.53E+04	-	-	1.53E+04	-	3.48E+02
Aniline	-	-	-	-	-	-	9.77E+02	-	1.71E+04	9.77E+02	-	2.12E-01
Anthracene	-	-	-	-	-	-	1.84E+02	-	-	1.84E+02	-	1.54E+01
Arsenic, Inorganic	-	-	-	-	-	-	3.84E+02	-	-	3.84E+02	-	2.40E-02
Barium	-	-	-	-	-	-	5.65E+02	-	-	5.65E+02	-	2.23E+00
Benz(a)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	3.38E+00	-	5.32E+02	3.38E+00	-	4.02E+01
Benzo(a)pyrene	-	-	-	-	-	-	-	-	1.73E-02	1.73E-02	-	9.26E+00
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	-	-	-	-	-	-	9.73E+00	-	-	9.73E+00	-	3.00E-02
Cadmium (Water)	-	-	-	-	-	-	1.45E+01	-	-	1.45E+01	-	1.08E-01
Chromium(III), Insoluble Salts	-	-	-	-	-	-	8.44E+03	-	-	8.44E+03	-	1.02E-01
Chromium(VI)	-	-	-	-	-	-	7.58E+00	-	-	7.58E+00	-	1.02E-01
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	2.60E+02	-	-	2.60E+02	-	5.70E-02
Cresol, m-&p-	-	-	-	-	-	-	4.86E+03	-	-	4.86E+03	-	4.36E+02
Cresol, o-	-	-	-	-	-	-	4.92E+03	-	-	4.92E+03	-	1.82E+02
Cyanide (CN-)	-	-	-	-	-	-	2.02E+03	-	-	2.02E+03	-	1.86E+01
Dibenz(a,h)anthracene	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	-	-	-	-	-	-	2.67E+02	-	-	2.67E+02	-	1.02E+01
Dimethylphenol, 2,4-	-	-	-	-	-	-	7.22E+02	-	-	7.22E+02	-	3.80E+01
Ethylbenzene	-	-	-	-	-	-	2.11E+02	-	-	2.11E+02	-	3.02E+00
Fluoranthene	-	-	-	-	-	-	1.14E+01	-	-	1.14E+01	-	2.59E+01
Fluorene	-	-	-	-	-	-	3.16E+01	-	-	3.16E+01	-	2.11E+01
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	-	-	-	-	-	-	1.11E+03	-	-	1.11E+03	-	5.55E-01
Manganese	-	-	-	-	-	-	2.39E+03	-	-	2.39E+03	-	4.89E+00
Methylnaphthalene, 2-	-	-	-	-	-	-	3.77E+01	-	-	3.77E+01	-	1.05E+02
Naphthalene	-	-	-	-	-	-	2.88E+01	-	-	2.88E+01	-	2.83E+02
Nickel Soluble Salts	-	-	-	-	-	-	3.50E+02	-	-	3.50E+02	-	3.03E-01
Phenanthrene	-	-	-	-	-	-	3.63E+01	-	-	3.63E+01	-	7.41E+01
Phenol	-	-	-	-	-	-	2.34E+04	-	-	2.34E+04	-	2.49E+02
Pyrene	-	-	-	-	-	-	1.31E+01	-	-	1.31E+01	-	2.79E+01
Styrene	-	-	-	-	-	-	8.79E+01	-	-	8.79E+01	-	1.94E-01
Toluene	-	-	-	-	-	-	7.56E+02	-	-	7.56E+02	-	1.76E+01
TPH C06-C09 aliphatic	-	-	-	-	-	-	1.39E+03	-	-	1.39E+03	-	6.08E+00
TPH C10-C14 aliphatic	-	-	-	-	-	-	4.26E+00	-	-	4.26E+00	-	1.73E+03
TPH C10-C14 aromatic	-	-	-	-	-	-	1.70E+01	-	-	1.70E+01	-	1.73E+03
TPH C15-C28 aliphatic	-	-	-	-	-	-	2.17E+02	-	-	2.17E+02	-	1.52E+03
TPH C15-C28 aromatic	-	-	-	-	-	-	4.62E+00	-	-	4.62E+00	-	1.52E+03
TPH C29-C36 aliphatic	-	-	-	-	-	-	2.47E+02	-	-	2.47E+02	-	3.32E+02
TPH C29-C36 aromatic	-	-	-	-	-	-	2.51E+00	-	-	2.51E+00	-	3.32E+02
Trimethylbenzene, 1,2,4-	-	-	-	-	-	-	1.55E+03	-	-	1.55E+03	-	9.20E-01
Vanadium and compounds	-	-	-	-	-	-	9.60E+02	-	-	9.60E+02	-	2.28E-02
Xylenes (total)	-	-	-	-	-	-	4.07E+02	-	-	4.07E+02	-	6.70E+00

Bold denotes soil/ groundwater SSTC has been proposed (see text for details)

Pathways included in derivation of Soil RBSL:

SSTL for carcinogenic PAH's is included in SSTL for BaP

Pathways included in derivation of Groundwater RBSL:

- x Incidental Ingestion of Groundwater (Bathing or Excavation)
- x Dermal Contact with Groundwater (Bathing or Excavation)
- x Inhalation of Groundwater Vapours (Where GW Enters Trench)

Health Risk Calculations - Inhalation of Groundwater-Derived Vapours in Trench Air (where groundwater enters trench)

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Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

Chemical	Groundwater Concentration (mg/L)	Aqueous Solubility (mg/L)	Volatilisation Factor from Groundwater to Trench Air (where GW enters trench) [(mg/m3)/(mg/L)]	Vapour Concentration in Trench Air (from GW within trench) (mg/m3)	Threshold Intake and Risk Calculations			
					Inhalation RfC (mg/m3)	Adult Exposure Factor (threshold) (L/m3)	Adult Exposure Adjusted Air Concentration (threshold) (mg/m3)	Hazard Index (Adult) (unitless)
Acenaphthene	4.48	3.90E+00	3.31E-04	1.29E-03	2.10E-01	4.53E-06	1.77E-05	8.41E-05
Acenaphthylene	43.2	1.61E+01	3.31E-04	5.32E-03	2.10E-01	4.53E-06	7.29E-05	3.47E-04
Ammonia	348	4.82E+05	3.31E-04	1.15E-01	6.95E-02	4.53E-06	1.58E-03	2.27E-02
Aniline	0.212	3.60E+04	NV	-	1.00E-03	-	-	-
Anthracene	15.4	4.34E-02	3.31E-04	1.44E-05	1.05E+00	4.53E-06	1.97E-07	1.87E-07
Arsenic, Inorganic	0.024	-	NV	-	1.00E-03	-	-	-
Barium	2.23	-	NV	-	5.00E-04	-	-	-
Benzo(a)anthracene	12.6	9.40E-03	NV	-	-	-	-	-
Benzene	40.2	1.79E+03	3.31E-04	1.33E-02	9.60E-03	4.53E-06	1.82E-04	1.90E-02
Benzo(a)pyrene	9.26	1.62E-03	NV	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	NV	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	NV	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	NV	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	NV	-	8.75E-02	-	-	-
Cadmium (Water)	0.108	-	NV	-	3.00E-04	-	-	-
Chromium(III), Insoluble Salts	0.102	-	NV	-	1.00E-04	-	-	-
Chromium(VI)	0.102	1.69E+06	NV	-	1.00E-04	-	-	-
Chrysene	9.78	2.00E-03	NV	-	-	-	-	-
Cobalt	0.057	-	NV	-	1.00E-04	-	-	-
Cresol, m-&p-	436	2.27E+04	NV	-	6.00E-01	-	-	-
Cresol, o-	182	2.59E+04	NV	-	6.00E-01	-	-	-
Cyanide (CN-)	18.6	1.00E+06	3.31E-04	6.15E-03	4.20E-02	4.53E-06	8.43E-05	2.01E-03
Dibenz(a,h)anthracene	0.822	2.49E-03	NV	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	3.31E-04	1.03E-03	2.10E-01	4.53E-06	1.40E-05	6.69E-05
Dimethylphenol, 2,4-	38	7.87E+03	NV	-	7.00E-02	-	-	-
Ethylbenzene	3.02	1.69E+02	3.31E-04	9.99E-04	1.30E+00	4.53E-06	1.37E-05	1.05E-05
Fluoranthene	25.9	2.60E-01	NV	-	1.40E-01	-	-	-
Fluorene	21.1	1.69E+00	3.31E-04	5.59E-04	1.40E-01	4.53E-06	7.66E-06	5.47E-05
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	NV	-	-	-	-	-
Lead and Compounds	0.555	-	NV	-	5.00E-04	-	-	-
Manganese	4.89	-	NV	-	1.50E-04	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	3.31E-04	8.13E-03	1.40E-01	4.53E-06	1.11E-04	7.96E-04
Naphthalene	283	3.10E+01	3.31E-04	1.03E-02	3.00E-03	4.53E-06	1.40E-04	4.68E-02
Nickel Soluble Salts	0.303	-	NV	-	9.00E-05	-	-	-
Phenanthrene	74.1	1.15E+00	3.31E-04	3.80E-04	2.10E-01	4.53E-06	5.21E-06	2.48E-05
Phenol	249	8.28E+04	NV	-	2.00E-01	-	-	-
Pyrene	27.9	1.35E-01	3.31E-04	4.46E-05	1.05E-01	4.53E-06	6.12E-07	5.82E-06
Styrene	0.194	3.10E-02	3.31E-04	6.42E-05	2.60E-01	4.53E-06	8.79E-07	3.38E-06
Toluene	17.6	5.26E+02	3.31E-04	5.82E-03	5.00E+00	4.53E-06	7.97E-05	1.59E-05
TPH C06-C09 aliphatic	6.08	1.18E+01	3.31E-04	2.01E-03	1.84E+01	4.53E-06	2.75E-05	1.50E-06
TPH C10-C14 aliphatic	1730	9.99E-02	3.31E-04	3.30E-05	1.00E+00	4.53E-06	4.53E-07	4.53E-07
TPH C10-C14 aromatic	1730	2.53E+01	3.31E-04	8.37E-03	2.00E-01	4.53E-06	1.15E-04	5.73E-04
TPH C15-C28 aliphatic	1520	1.11E-04	3.31E-04	3.67E-08	7.00E+00	4.53E-06	5.03E-10	7.18E-11
TPH C15-C28 aromatic	1520	1.06E+00	3.31E-04	3.51E-04	1.05E-01	4.53E-06	4.80E-06	4.57E-05
TPH C29-C36 aliphatic	332	2.50E-06	3.31E-04	8.27E-10	7.00E+00	4.53E-06	1.13E-11	1.62E-12
TPH C29-C36 aromatic	332	6.60E-03	NV	-	1.05E-01	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	3.31E-04	3.04E-04	7.00E-03	4.53E-06	4.17E-06	5.95E-04
Vanadium and compounds	0.0228	-	NV	-	1.00E-03	-	-	-
Xylenes (total)	6.7	1.06E+01	3.31E-04	2.22E-03	2.20E-01	4.53E-06	3.04E-05	1.38E-04

Bold denotes soil/ groundwater SSTC has been proposed (see text for details)

TOTAL

9.32E-02

[illegible]

1.56E-08

Chemical	Groundwater Concentration (mg/L)	Dermal Permeability Constant (kp) (cm/hr)	Threshold Intake and Risk Calculations			
			Dermal RfD (mg/kg/day)	Adult Intake Factor (threshold) (L/kg/day)	Adult Intake (threshold) (mg/kg/day)	Hazard Index (Adult) (unitless)
Acenaphthene	4.48	0.086	6.00E-02	1.95E-04	8.75E-04	1.46E-02
Acenaphthylene	43.2	0.0911	6.00E-02	2.07E-04	8.94E-03	1.49E-01
Ammonia	348	0.001	-	-	-	-
Aniline	0.212	0.00186	7.00E-03	4.23E-06	8.96E-07	1.28E-04
Anthracene	15.4	0.142	3.00E-01	3.23E-04	4.97E-03	1.66E-02
Arsenic, Inorganic	0.024	0.001	2.00E-03	2.27E-06	5.45E-08	2.73E-05
Barium	2.23	0.001	1.40E-03	2.27E-06	5.07E-06	3.62E-03
Benz(a)anthracene	12.6	0.552	-	-	-	-
Benzene	40.2	0.0149	5.00E-04	3.39E-05	1.36E-03	2.72E+00
Benzo(a)pyrene	9.26	0.713	-	-	-	-
Benzo(b)fluoranthene	8.33	0.417	-	-	-	-
Benzo(g,h,i)perylene	4.22	1.12	-	-	-	-
Benzo(k)fluoranthene	2.93	0.691	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	1.13	2.50E-02	2.57E-03	7.70E-05	3.08E-03
Cadmium (Water)	0.108	0.001	3.50E-05	2.27E-06	2.45E-07	7.01E-03
Chromium(III), Insoluble Salts	0.102	0.001	1.95E-02	2.27E-06	2.32E-07	1.19E-05
Chromium(VI)	0.102	0.002	3.50E-05	4.54E-06	4.63E-07	1.32E-02
Chrysene	9.78	0.596	-	-	-	-
Cobalt	0.057	0.0004	1.00E-03	9.09E-07	5.18E-08	5.18E-05
Cresol, m-&p-	436	0.00777	1.00E-01	1.77E-05	7.70E-03	7.70E-02
Cresol, o-	182	0.00766	1.00E-01	1.74E-05	3.17E-03	3.17E-02
Cyanide (CN-)	18.6	0.000754	1.20E-02	1.71E-06	3.19E-05	2.66E-03
Dibenz(a,h)anthracene	0.822	0.953	-	-	-	-
Dibenzofuran	10.2	0.0975	6.00E-02	2.22E-04	2.26E-03	3.77E-02
Dimethylphenol, 2,4-	38	0.0109	2.00E-02	2.48E-05	9.41E-04	4.71E-02
Ethylbenzene	3.02	0.0493	9.71E-02	1.12E-04	3.38E-04	3.48E-03
Fluoranthene	25.9	0.308	4.00E-02	7.00E-04	1.81E-02	4.53E-01
Fluorene	21.1	0.11	4.00E-02	2.50E-04	5.27E-03	1.32E-01
Indeno(1,2,3-cd)pyrene	3.05	1.24	-	-	-	-
Lead and Compounds	0.555	0.0001	3.50E-03	2.27E-07	1.26E-07	3.60E-05
Manganese	4.89	0.001	5.72E-03	2.27E-06	1.11E-05	1.94E-03
Methylnaphthalene, 2-	105	0.0917	4.00E-02	2.08E-04	2.19E-02	5.47E-01
Naphthalene	283	0.0466	2.00E-02	1.06E-04	3.00E-02	1.50E+00
Nickel Soluble Salts	0.303	0.0002	2.00E-04	4.54E-07	1.38E-07	6.88E-04
Phenanthrene	74.1	0.144	6.00E-02	3.27E-04	2.42E-02	4.04E-01
Phenol	249	0.00434	3.00E-01	9.86E-06	2.46E-03	8.18E-03
Pyrene	27.9	0.201	3.00E-02	4.57E-04	1.27E-02	4.25E-01
Styrene	0.194	0.0372	7.70E-03	8.45E-05	1.64E-05	2.13E-03
Toluene	17.6	0.0311	2.23E-01	7.07E-05	1.24E-03	5.58E-03
TPH C06-C09 aliphatic	6.08	0.196	5.00E+00	4.45E-04	2.71E-03	5.42E-04
TPH C10-C14 aliphatic	1730	1.29	1.00E-01	2.93E-03	5.07E+00	5.07E+01
TPH C10-C14 aromatic	1730	0.128	4.00E-02	2.91E-04	5.03E-01	1.26E+01
TPH C15-C28 aliphatic	1520	0.506	2.00E+00	1.15E-03	1.75E+00	8.74E-01
TPH C15-C28 aromatic	1520	0.356	3.00E-02	8.09E-04	1.23E+00	4.10E+01
TPH C29-C36 aliphatic	332	0.444	2.00E+00	1.01E-03	3.35E-01	1.67E-01
TPH C29-C36 aromatic	332	0.655	3.00E-02	1.49E-03	4.94E-01	1.65E+01
Trimethylbenzene, 1,2,4-	0.92	0.0857	-	-	-	-
Vanadium and compounds	0.0228	0.001	5.00E-03	2.27E-06	5.18E-08	1.04E-05
Xylenes (total)	6.7	0.0471	1.79E-01	1.07E-04	7.17E-04	4.01E-03

TOTAL

1.28E+02

[illegible]

5.39E-03

Groundwater RBSL Derivation - Adult Threshold Health Effects
 Barangaroo
 Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

Chemical	Cgw mg/L	Solubility mg/L	Risk at Input Groundwater Concentration (Hazard				Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)						RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Vapour Only Risk at Sol (if necessary)	Revised RBSL (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL			
			GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL (All Pathways)	GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	Total Non- Vapour Pathways	Total Vapour Pathways	TOTAL (All Pathways)						GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL
			unitless	unitless	unitless	unitless	L/mg	L/mg	L/mg	L/mg	L/mg	L/mg						%	%	%	%
Acenaphthene	4.48	3.90E+00	8.41E-05	2.19E-04	1.46E-02	1.49E-02	2.16E-05	4.89E-05	3.26E-03	3.31E-03	2.16E-05	3.33E-03	6.01E+01	1.99E-01	8.41E-05	6.05E+01	6.05E+01	0.04%	1.48%	98.48%	100.00%
Acenaphthylene	43.2	1.61E+01	3.47E-04	2.11E-03	1.49E-01	1.51E-01	2.16E-05	4.89E-05	3.45E-03	3.50E-03	2.16E-05	3.52E-03	5.68E+01	1.99E-01	3.47E-04	5.71E+01	5.71E+01	0.17%	1.40%	98.43%	100.00%
Ammonia	348	4.82E+05	2.27E-02	-	-	2.27E-02	6.52E-05	-	-	-	6.52E-05	6.52E-05	1.53E+04	1.00E+00	-	-	1.53E+04	100.00%	-	-	100.00%
Aniline	0.212	3.60E+04	-	8.89E-05	1.28E-04	2.17E-04	-	4.19E-04	6.04E-04	1.02E-03	-	1.02E-03	9.77E+02	1.00E+00	-	-	9.77E+02	-	40.99%	59.01%	100.00%
Anthracene	15.4	4.34E-02	1.87E-07	1.51E-04	1.66E-02	1.67E-02	4.31E-06	9.78E-06	1.08E-03	1.09E-03	4.31E-06	1.09E-03	1.84E+02	1.99E-01	1.87E-07	1.84E+02	1.84E+02	0.00%	0.90%	99.10%	100.00%
Arsenic, Inorganic	0.024	-	-	3.52E-05	2.73E-05	6.25E-05	-	1.47E-03	1.14E-03	2.60E-03	-	2.60E-03	3.84E+02	1.00E+00	-	-	3.84E+02	-	56.37%	43.63%	100.00%
Barium	2.23	-	-	3.27E-04	3.62E-03	3.95E-03	-	1.47E-04	1.62E-03	1.77E-03	-	1.77E-03	5.65E+02	1.00E+00	-	-	5.65E+02	-	8.29%	91.71%	100.00%
Benz(a)anthracene	12.6	9.40E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	40.2	1.79E+03	1.90E-02	2.36E-01	2.72E+00	2.98E+00	4.72E-04	5.87E-03	6.77E-02	7.36E-02	4.72E-04	7.40E-02	3.38E+00	2.50E-01	-	-	3.38E+00	0.64%	7.93%	91.43%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	8.33	1.50E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	4.22	2.60E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	2.93	8.00E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl)phalate	0.03	2.70E-01	-	3.52E-06	3.08E-03	3.08E-03	-	1.17E-04	1.03E-01	1.03E-01	-	1.03E-01	9.73E+00	1.00E+00	-	-	9.73E+00	-	0.11%	99.89%	100.00%
Cadmium (Water)	0.108	-	-	4.53E-04	7.01E-03	7.46E-03	-	4.19E-03	6.49E-02	6.91E-02	-	6.91E-02	1.45E+01	1.00E+00	-	-	1.45E+01	-	6.07%	93.93%	100.00%
Chromium(III), Insoluble Salts	0.102	-	-	2.00E-07	1.19E-05	1.21E-05	-	1.96E-06	1.17E-04	1.18E-04	-	1.18E-04	8.44E+03	1.00E+00	-	-	8.44E+03	-	1.65%	98.35%	100.00%
Chromium(VI)	0.102	1.69E+06	-	2.14E-04	1.32E-02	1.35E-02	-	2.10E-03	1.30E-01	1.32E-01	-	1.32E-01	7.58E+00	1.00E+00	-	-	7.58E+00	-	1.59%	98.41%	100.00%
Chrysene	9.78	2.00E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	0.057	-	-	1.67E-04	5.18E-05	2.19E-04	-	2.94E-03	9.09E-04	3.84E-03	-	3.84E-03	2.60E+02	1.00E+00	-	-	2.60E+02	-	76.36%	23.64%	100.00%
Cresol, m-&p-	436	2.27E+04	-	1.28E-02	7.70E-02	8.98E-02	-	2.94E-05	1.77E-04	2.06E-04	-	2.06E-04	4.86E+03	1.00E+00	-	-	4.86E+03	-	14.26%	85.74%	100.00%
Cresol, o-	182	2.59E+04	-	5.34E-03	3.17E-02	3.70E-02	-	2.94E-05	1.74E-04	2.03E-04	-	2.03E-04	4.92E+03	1.00E+00	-	-	4.92E+03	-	14.43%	85.57%	100.00%
Cyanide (CN-)	18.6	1.00E+06	2.01E-03	4.55E-03	2.66E-03	9.21E-03	1.08E-04	2.45E-04	1.43E-04	3.87E-04	1.08E-04	4.95E-04	2.02E+03	1.00E+00	-	-	2.02E+03	21.78%	49.39%	28.83%	100.00%
Dibenz(a,h)anthracene	0.822	2.49E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzofuran	10.2	3.10E+00	6.69E-05	4.99E-04	3.77E-02	3.82E-02	2.16E-05	4.89E-05	3.69E-03	3.74E-03	2.16E-05	3.76E-03	2.66E+02	9.94E-01	6.69E-05	2.67E+02	2.67E+02	0.01%	1.31%	98.69%	100.00%
Dimethylphenol, 2,4-	38	7.87E+03	-	5.58E-03	4.71E-02	5.26E-02	-	1.47E-04	1.24E-03	1.39E-03	-	1.39E-03	7.22E+02	1.00E+00	-	-	7.22E+02	-	10.60%	89.40%	100.00%
Ethylbenzene	3.02	1.69E+02	1.05E-05	9.13E-05	3.48E-03	3.59E-03	3.48E-06	3.02E-05	1.15E-03	1.18E-03	3.48E-06	1.19E-03	2.11E+02	2.50E-01	5.89E-04	2.11E+02	2.11E+02	0.24%	2.55%	97.22%	100.00%
Fluoranthene	25.9	2.60E-01	-	1.90E-03	4.53E-01	4.55E-01	-	7.34E-05	1.75E-02	1.76E-02	-	1.76E-02	1.14E+01	2.00E-01	-	-	1.14E+01	-	0.42%	99.58%	100.00%
Fluorene	21.1	1.69E+00	5.47E-05	1.55E-03	1.32E-01	1.33E-01	3.24E-05	7.34E-05	6.25E-03	6.32E-03	3.24E-05	6.35E-03	3.15E+01	1.99E-01	5.47E-05	3.16E+01	3.16E+01	0.03%	1.16%	98.81%	100.00%
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lead and Compounds	0.555	-	-	4.65E-04	3.60E-05	5.02E-04	-	8.39E-04	6.49E-05	9.04E-04	-	9.04E-04	1.11E+03	1.00E+00	-	-	1.11E+03	-	92.82%	7.18%	100.00%
Manganese	4.89	-	-	1.00E-04	1.94E-03	2.04E-03	-	2.05E-05	3.97E-04	4.18E-04	-	4.18E-04	2.39E+03	1.00E+00	-	-	2.39E+03	-	4.91%	95.09%	100.00%
Methylnaphthalene, 2-	105	2.46E+01	7.96E-04	7.71E-03	5.47E-01	5.55E-01	3.24E-05	7.34E-05	5.21E-03	5.28E-03	3.24E-05	5.31E-03	3.76E+01	2.00E-01	7.96E-04	3.77E+01	3.77E+01	0.40%	1.38%	98.22%	100.00%
Naphthalene	283	3.10E+01	4.68E-02	4.15E-02	1.50E+00	1.59E+00	1.51E-03	1.47E-04	5.29E-03	5.44E-03	1.51E-03	6.95E-03	2.88E+01	2.00E-01	-	-	2.88E+01	21.72%	2.11%	76.16%	100.00%
Nickel Soluble Salts	0.303	-	-	1.78E-04	6.88E-04	8.66E-04	-	5.87E-04	2.27E-03	2.86E-03	-	2.86E-03	3.50E+02	1.00E+00	-	-	3.50E+02	-	20.53%	79.47%	100.00%
Phenanthrene	74.1	1.15E+00	2.48E-05	3.63E-03	4.04E-01	4.08E-01	2.16E-05	4.89E-05	5.45E-03	5.50E-03	2.16E-05	5.52E-03	3.62E+01	1.99E-01	2.48E-05	3.63E+01	3.63E+01	0.01%	0.89%	99.10%	100.00%
Phenol	249	8.28E+04	-	2.44E-03	8.18E-03	1.06E-02	-	9.78E-06	3.29E-05	4.27E-05	-	4.27E-05	2.34E+04	1.00E+00	-	-	2.34E+04	-	22.94%	77.06%	100.00%
Pyrene	27.9	1.35E-01	5.82E-06	2.73E-03	4.25E-01	4.27E-01	4.31E-05	9.78E-05	1.52E-02	1.53E-02	4.31E-05	1.54E-02	1.30E+01	1.99E-01	5.82E-06	1.31E+01	1.31E+01	0.00%	0.64%	99.36%	100.00%
Styrene	0.194	3.10E+02	3.38E-06	7.40E-05	2.13E-03	2.21E-03	1.74E-05	3.81E-04	1.10E-02	1.14E-02	1.74E-05	1.14E-02	8.79E+01	1.00E+00	-	-	8.79E+01	0.15%	3.35%	96.50%	100.00%
Toluene	17.6	5.26E+02	1.59E-05	2.32E-04	5.58E-03	5.82E-03	9.06E-07	1.32E-05	3.17E-04	3.30E-04	9.06E-07	3.31E-04	7.55E+02	2.50E-01	4.77E-04	7.56E+02	7.56E+02	0.19%	3.98%	95.83%	100.00%
TPH C06-C09 aliphatic	6.08	1.18E+01	1.50E-06	3.57E-06	5.42E-04	5.47E-04	2.46E-07	5.87E-07	8.91E-05	8.97E-05	2.46E-07	8.99E-05	1.39E+03	1.25E-01	2.91E-06	1.39E+03	1.39E+03	0.00%	0.65%	99.34%	100.00%
TPH C10-C14 aliphatic	1730	9.99E-02	4.53E-07	5.08E-02	5.07E+01	5.08E+01	4.53E-06	2.94E-05	2.93E-02	2.93											

Groundwater RBSL Derivation - Non-Threshold Health Effects
 Barangaroo
 Wharf 8, Hickson Road (Sussex Street), Barangaroo, NSW 2000
 Scenario 6 - Intrusive Maintenance (Post-Development) (Risk Based Calculations: KNAFLA) Scenario

Chemical	Cgw	Solubility	Risk at Input Groundwater Concentration (ILCR)				Risk/Soil Concentration (i.e., pathway specific factor for exposure and toxicity)					RBSL (assumes no sol limit)	Risk at RBSL (with sol)	Revised RBSL (if necessary)	Adopted RBSL	Pathway Contributions to Total Estimated Risk at RBSL			
			GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL (All Pathways)	GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	Total Non-Vapour Pathways	Total Vapour Pathways					GW to Trench Vapour	Incidental Ingestion of GW	Dermal Contact with GW	TOTAL
	mg/L	mg/L	unitless	unitless	unitless	unitless	L/mg	L/mg	L/mg	L/mg	L/mg	mg/L		mg/L	mg/L	%	%	%	%
Acenaphthene	4.48	3.90E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	43.2	1.61E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ammonia	348	4.82E+05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aniline	0.212	3.60E+04	-	5.07E-11	7.30E-11	1.24E-10	-	2.39E-10	3.44E-10	5.83E-10	5.83E-10	1.71E+04	1.00E-05	-	1.71E+04	-	40.99%	59.01%	100.00%
Anthracene	15.4	4.34E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Inorganic	0.024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	2.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	12.6	9.40E-03	-	2.27E-08	9.71E-06	9.73E-06	-	1.80E-09	7.70E-07	7.72E-07	7.72E-07	-	-	1.29E+01	1.29E+01	-	0.23%	99.77%	100.00%
Benzene	40.2	1.79E+03	1.56E-08	5.90E-08	6.80E-07	7.55E-07	3.88E-10	1.47E-09	1.69E-08	1.84E-08	3.88E-10	5.32E+02	1.00E-05	-	5.32E+02	2.07%	7.81%	90.12%	100.00%
Benzo(a)pyrene	9.26	1.62E-03	-	1.67E-07	5.36E-03	5.36E-03	-	1.80E-08	5.79E-04	5.79E-04	-	1.73E-02	1.00E-05	-	1.73E-02	-	0.00%	100.00%	100.00%
Benzo(b)fluoranthene	8.33	1.50E-03	-	1.50E-08	4.85E-06	4.86E-06	-	1.80E-09	5.82E-07	5.84E-07	-	-	-	-	-	-	-	-	-
Benzo(a,h)perylene	4.22	2.60E-04	-	7.61E-10	6.60E-07	6.60E-07	-	1.80E-10	1.56E-07	1.56E-07	-	-	-	6.39E+01	6.39E+01	-	0.12%	99.88%	100.00%
Benzo(k)fluoranthene	2.93	8.00E-04	-	5.28E-09	2.83E-06	2.83E-06	-	1.80E-09	9.64E-07	9.66E-07	-	-	-	1.03E+01	1.03E+01	-	0.19%	99.81%	100.00%
Bis(2-ethylhexyl)phthalate	0.03	2.70E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium (Water)	0.108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(III), Insoluble Salts	0.102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chromium(VI)	0.102	1.69E+06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	9.78	2.00E-03	-	1.76E-09	8.14E-07	8.15E-07	-	1.80E-10	8.32E-08	8.34E-08	8.34E-08	-	-	1.20E+02	1.20E+02	-	0.22%	99.78%	100.00%
Cobalt	0.057	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, m-&p-	436	2.27E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cresol, o-	182	2.59E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide (CN-)	18.6	1.00E+06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	0.822	2.49E-03	-	1.48E-08	1.09E-05	1.09E-05	-	1.80E-08	1.33E-05	1.33E-05	1.33E-05	-	-	7.51E-01	7.51E-01	-	0.14%	99.86%	100.00%
Dibenzofuran	10.2	3.10E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dimethylphenol, 2,4-	38	7.87E+03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	3.02	1.69E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	25.9	2.60E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	21.1	1.69E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	3.05	1.90E-04	-	5.50E-09	5.28E-06	5.28E-06	-	1.80E-09	1.73E-06	1.73E-06	1.73E-06	-	-	5.77E+00	5.77E+00	-	0.10%	99.90%	100.00%
Lead and Compounds	0.555	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	4.89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylnaphthalene, 2-	105	2.46E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	283	3.10E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nickel Soluble Salts	0.303	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	74.1	1.15E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	249	8.28E+04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	27.9	1.35E-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Styrene	0.194	3.10E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	17.6	5.25E+02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C06-C09 aliphatic	6.08	1.18E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aliphatic	1730	9.99E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C10-C14 aromatic	1730	2.53E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aliphatic	1520	1.11E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C15-C28 aromatic	1520	1.06E+00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aliphatic	332	2.50E-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH C29-C36 aromatic	332	6.60E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trimethylbenzene, 1,2,4-	0.92	5.70E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium and compounds	0.0228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Xylenes (total)	6.7	1.06E+01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Bold denotes soil/ groundwater SSTC has been proposed (see text for details)

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6.94E-01

2.92E-07