

Appendix 3.14 Health Impact Assessment Non-Criteria Pollutants Results

For those non-criteria pollutants that are identified as carcinogenic, the risk is measured in the increase in the number of cancer cases per million population that is attributable to the identified pollutants. The cancer risk was calculated as:

Cancer Risk = EC x IUR

where EC = Time-weighted average concentration (i.e. concentrations due to the Project including background concentration) (µg/m³)
 IUR = the corresponding inhalation unit risk estimate for that TAP

and

EC = (CA x ED) / AT

where CA = change in annual average contaminant concentration in air (µg/m³)
 ED = exposure duration (years)
 AT = averaging time (lifetime in years)

Source: Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), 2009, EPA

(<http://www.epa.gov/oswer/riskassessment/ragsf/>).

As for the Third Runway Study the cancer risk guidelines are presumed. Conservative concentrations were predicted in the air quality modelling and were used for calculation of the health risks.

Scenario A	Annual Average	EC	IUR				Cancer Risk			
			WHO	IRIS	ATSDR	OEHHA	WHO	IRIS	ATSDR	OEHAA
Long term	ASR conc ⁽¹⁾	Exp Conc								
Naphthalene	3.06E-06	1.02E-07				3.40E-05				3.47E-12
Benzo(a)pyrene	7.12E-05	2.37E-06	8.7E-02							2.06E-07
Benzene	2.04E-06	6.80E-08	6.0E-06							4.08E-13
Ethylbenzene	3.35E-06	1.12E-07				2.50E-06				2.79E-13
Benzo(a)anthracene	5.57E-05	1.86E-06				1.1E-04				2.04E-10
Benzo(b)fluoranthene	5.90E-05	1.97E-06				1.1E-04				2.16E-10
Benzo(k)fluoranthene	5.08E-05	1.69E-06				1.1E-04				1.86E-10
Chrysene	4.24E-05	1.41E-06				1.1E-05				1.56E-11
Dibenzo(a,h)anthracene	1.90E-05	6.32E-07				1.2E-03				7.59E-10
Indeno(1,2,3-cd)pyrene	3.16E-05	1.05E-06				1.1E-04				1.16E-10
Tier 1 (Heavy Metals) [#]										
Arsenic	1.10E-04	3.67E-06	1.5E-03							5.50E-09
Cadmium	1.85E-05	6.18E-07		1.80E-03					1.11E-09	
Chromium (VI)	7.30E-05	2.43E-06	4.0E-02							9.74E-08
Nickel	6.79E-05	2.26E-06	3.8E-04							8.59E-10
Lead	2.55E-03	8.49E-05				1.20E-05				1.02E-09
Total Incremental Lifetime Cancer Risk (Reprovisioning Scenario A)										3.138E-07

Scenario B	Annual Average	EC	IUR				Cancer Risk			
			WHO	IRIS	ATSDR	OEHHA	WHO	IRIS	ATSDR	OEHAA
Long term	ASR conc ⁽¹⁾	Exp Conc								
Naphthalene	2.92E-06	9.73E-08				3.40E-05				3.31E-12
Benzo(a)pyrene	7.13E-05	2.38E-06	8.7E-02							2.07E-07
Benzene	1.88E-06	6.27E-08	6.0E-06							3.76E-13
Ethylbenzene	2.82E-06	9.40E-08				2.50E-06				2.35E-13
Benzo(a)anthracene	5.58E-05	1.86E-06				1.1E-04				2.05E-10
Benzo(b)fluoranthene	5.91E-05	1.97E-06				1.1E-04				2.17E-10
Benzo(k)fluoranthene	5.09E-05	1.70E-06				1.1E-04				1.87E-10
Chrysene	4.25E-05	1.42E-06				1.1E-05				1.56E-11
Dibenzo(a,h)anthracene	1.90E-05	6.33E-07				1.2E-03				7.60E-10
Indeno(1,2,3-cd)pyrene	3.16E-05	1.05E-06				1.1E-04				1.16E-10
Tier 1 (Heavy Metals) [#]										
Arsenic	1.10E-04	3.67E-06	1.5E-03							5.50E-09
Cadmium	1.85E-05	6.18E-07		1.80E-03					1.11E-09	
Chromium (VI)	7.30E-05	2.43E-06	4.0E-02							9.74E-08
Nickel	6.79E-05	2.26E-06	3.8E-04							8.59E-10
Lead	2.55E-03	8.49E-05				1.20E-05				1.02E-09
Total Incremental Lifetime Cancer Risk (Reprovisioning Scenario B)										3.142E-07

Scenario C	Annual Average	EC	IUR				Cancer Risk			
			WHO	IRIS	ATSDR	OEHHA	WHO	IRIS	ATSDR	OEHAA
Long term	ASR conc ⁽¹⁾	Exp Conc								
Naphthalene	4.64E-06	1.55E-07				3.40E-05				5.26E-12
Benzo(a)pyrene	1.01E-04	3.35E-06	8.7E-02							2.92E-07
Benzene	2.65E-06	8.83E-08	6.0E-06							5.30E-13
Ethylbenzene	4.39E-06	1.46E-07				2.50E-06				3.66E-13
Benzo(a)anthracene	6.38E-05	2.13E-06				1.1E-04				2.34E-10
Benzo(b)fluoranthene	9.38E-05	3.13E-06				1.1E-04				3.44E-10
Benzo(k)fluoranthene	6.07E-05	2.02E-06				1.1E-04				2.23E-10
Chrysene	5.79E-05	1.93E-06				1.1E-05				2.12E-11
Dibenzo(a,h)anthracene	2.57E-05	8.55E-07				1.2E-03				1.03E-09
Indeno(1,2,3-cd)pyrene	4.37E-05	1.46E-06				1.1E-04				1.60E-10
Tier 1 (Heavy Metals) [#]										
Arsenic	1.10E-04	3.67E-06	1.5E-03							5.50E-09
Cadmium	1.85E-05	6.18E-07		1.80E-03					1.11E-09	
Chromium (VI)	7.30E-05	2.43E-06	4.0E-02							9.74E-08
Nickel	6.79E-05	2.26E-06	3.8E-04							8.59E-10
Lead	2.55E-03	8.49E-05				1.20E-05				1.02E-09
Total Incremental Lifetime Cancer Risk (Reprovisioning Scenario C)										3.995E-07

(1) Concentration of pollutant from project contribution

(2) For hydrocarbons, refer to Appendix 3.12 for the concentration details for different Scenarios

(3) For heavy metals, the concentrations are obtained from RSP results (refer to Appendix 3.11)

#: Annual average of heavy metals are the same for all three reprovisioning options A, B and C. It is calculated based on Tier 1 mitigated RSP annual results which assumed that entire site is active at one time and is considered conservative.

Shaded cell means maximum of total incremental lifetime cancer risk within Reprovisioning Scenario A, B and C.

For all non-criteria pollutants, health risks from inhalation were evaluated against the exposure levels as identified in **Table 3.2** where if the concentration predicted at the ASR is less than the reference, then health effects are not anticipated.

Hydrocarbons ⁽²⁾						
Scenario A Excluding planned ASR internal to KTCDA						
	Hourly		Daily		Annual	
Tier 1	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria
Naphthalene	7.21E-01	5.00E+02	5.33E-01	2.25E+01	3.37E-01	1.00E+01
Phenanthrene	4.10E-02	5.00E-01	3.00E-02	7.10E-01	1.79E-02	5.00E-02
Anthracene	5.02E-03	5.00E-01	N/A	-	1.21E-03	5.00E-02
Fluoranthene	1.80E-02	5.00E-01	N/A	-	3.18E-03	5.00E-02
Pyrene	1.81E-02	5.00E-01	5.75E-03	7.10E-01	2.50E-03	5.00E-02
Benzo(a)pyrene	1.19E-02	3.00E-02	N/A	-	2.46E-04	3.00E-04
Benzene	6.60E+00	2.70E+01	4.94E+00	2.90E+01	1.61E+00	3.00E+01
Toluene	2.70E+01	1.50E+04	1.64E+01	3.75E+03	5.42E+00	5.00E+03
Ethylbenzene	6.50E+00	8.67E+04	5.06E+00	2.17E+04	1.34E+00	1.00E+03
Xylenes (Total)	2.36E+01	7.37E+03	1.15E+01	8.82E+03	2.64E+00	1.00E+02
Acenaphthylene	2.08E-02	1.00E+00	N/A	-	6.87E-03	1.00E-01
Acenaphthene	7.03E-02	1.00E+00	N/A	-	2.41E-02	1.00E-01
Fluorene	1.91E-02	1.00E+01	N/A	-	6.20E-03	1.00E+00
Chrysene	8.49E-03	3.60E-01	2.11E-03	2.40E-01	4.21E-04	5.00E-02
Benzo(a)anthracene	1.12E-02	5.00E-01	1.85E-03	3.60E-01	2.74E-04	5.00E-02
Benzo(b)fluoranthene	1.05E-02	3.60E-01	N/A	-	3.66E-04	5.00E-02
Benzo(k)fluoranthene	8.48E-03	5.00E-01	N/A	-	1.77E-04	5.00E-02
Dibenzo(a,h)anthracene	2.97E-03	5.00E-01	N/A	-	4.23E-05	5.00E-02
Indeno(1,2,3-cd)pyrene	6.17E-03	5.00E-01	N/A	-	2.87E-04	5.00E-02
Benzo(g,h,i)perylene	8.28E-03	5.00E-01	N/A	-	3.67E-04	5.00E-02
Scenario A Planned ASRs internal to KTCDA only						
	Hourly		Daily		Annual	
Tier 1	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria
Naphthalene	7.21E-01	5.00E+02	5.33E-01	2.25E+01	3.37E-01	1.00E+01
Phenanthrene	3.71E-02	5.00E-01	2.95E-02	7.10E-01	1.79E-02	5.00E-02
Anthracene	3.39E-03	5.00E-01	N/A	-	1.19E-03	5.00E-02
Fluoranthene	1.23E-02	5.00E-01	N/A	-	3.11E-03	5.00E-02
Pyrene	1.08E-02	5.00E-01	4.78E-03	7.10E-01	2.46E-03	5.00E-02
Benzo(a)pyrene	8.10E-03	3.00E-02	N/A	-	2.32E-04	3.00E-04
Benzene	6.60E+00	2.70E+01	4.94E+00	2.90E+01	1.61E+00	3.00E+01
Toluene	2.70E+01	1.50E+04	1.64E+01	3.75E+03	5.42E+00	5.00E+03
Ethylbenzene	6.50E+00	8.67E+04	5.06E+00	2.17E+04	1.34E+00	1.00E+03
Xylenes (Total)	2.36E+01	7.37E+03	1.15E+01	8.82E+03	2.64E+00	1.00E+02
Acenaphthylene	1.93E-02	1.00E+00	N/A	-	6.86E-03	1.00E-01
Acenaphthene	7.01E-02	1.00E+00	N/A	-	2.41E-02	1.00E-01
Fluorene	1.81E-02	1.00E+01	N/A	-	6.20E-03	1.00E+00
Chrysene	5.68E-03	3.60E-01	1.71E-03	2.40E-01	4.08E-04	5.00E-02
Benzo(a)anthracene	6.57E-03	5.00E-01	1.24E-03	3.60E-01	2.49E-04	5.00E-02
Benzo(b)fluoranthene	7.96E-03	3.60E-01	N/A	-	3.60E-04	5.00E-02
Benzo(k)fluoranthene	5.49E-03	5.00E-01	N/A	-	1.65E-04	5.00E-02
Dibenzo(a,h)anthracene	2.14E-03	5.00E-01	N/A	-	4.00E-05	5.00E-02
Indeno(1,2,3-cd)pyrene	4.76E-03	5.00E-01	N/A	-	2.83E-04	5.00E-02
Benzo(g,h,i)perylene	7.90E-03	5.00E-01	N/A	-	3.75E-04	5.00E-02

Scenario B	Hourly		Daily		Annual	
	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria
Tier 1						
Naphthalene	7.21E-01	5.00E+02	5.33E-01	2.25E+01	3.37E-01	1.00E+01
Phenanthrene	4.15E-02	5.00E-01	3.01E-02	7.10E-01	1.79E-02	5.00E-02
Anthracene	5.27E-03	5.00E-01	N/A	-	1.21E-03	5.00E-02
Fluoranthene	1.90E-02	5.00E-01	N/A	-	3.18E-03	5.00E-02
Pyrene	1.94E-02	5.00E-01	5.91E-03	7.10E-01	2.50E-03	5.00E-02
Benzo(a)pyrene	1.30E-02	3.00E-02	N/A	-	2.46E-04	3.00E-04
Benzene	6.60E+00	2.70E+01	4.94E+00	2.90E+01	1.61E+00	3.00E+01
Toluene	2.70E+01	1.50E+04	1.64E+01	3.75E+03	5.42E+00	5.00E+03
Ethylbenzene	6.50E+00	8.67E+04	5.06E+00	2.17E+04	1.34E+00	1.00E+03
Xylenes (Total)	2.36E+01	7.37E+03	1.15E+01	8.82E+03	2.64E+00	1.00E+02
Acenaphthylene	2.67E-02	1.00E+00	N/A	-	6.87E-03	1.00E-01
Acenaphthene	7.15E-02	1.00E+00	N/A	-	2.41E-02	1.00E-01
Fluorene	2.23E-02	1.00E+01	N/A	-	6.20E-03	1.00E+00
Chrysene	3.25E-02	3.60E-01	4.94E-03	2.40E-01	4.21E-04	5.00E-02
Benzo(a)anthracene	3.54E-02	5.00E-01	4.71E-03	3.60E-01	2.74E-04	5.00E-02
Benzo(b)fluoranthene	7.29E-02	3.60E-01	N/A	-	3.67E-04	5.00E-02
Benzo(k)fluoranthene	1.93E-02	5.00E-01	N/A	-	1.77E-04	5.00E-02
Dibenzo(a,h)anthracene	1.14E-02	5.00E-01	N/A	-	4.23E-05	5.00E-02
Indeno(1,2,3-cd)pyrene	2.35E-02	5.00E-01	N/A	-	2.87E-04	5.00E-02
Benzo(g,h,i)perylene	3.21E-02	5.00E-01	N/A	-	3.68E-04	5.00E-02

Scenario C	Hourly		Daily		Annual	
	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria
Tier 1						
Naphthalene	7.22E-01	5.00E+02	5.33E-01	2.25E+01	3.37E-01	1.00E+01
Phenanthrene	4.21E-02	5.00E-01	3.02E-02	7.10E-01	1.79E-02	5.00E-02
Anthracene	5.68E-03	5.00E-01	N/A	-	1.22E-03	5.00E-02
Fluoranthene	2.17E-02	5.00E-01	N/A	-	3.25E-03	5.00E-02
Pyrene	2.26E-02	5.00E-01	6.17E-03	7.10E-01	2.52E-03	5.00E-02
Benzo(a)pyrene	1.61E-02	3.00E-02	N/A	-	2.76E-04	3.00E-04
Benzene	6.60E+00	2.70E+01	4.94E+00	2.90E+01	1.61E+00	3.00E+01
Toluene	2.70E+01	1.50E+04	1.64E+01	3.75E+03	5.42E+00	5.00E+03
Ethylbenzene	6.50E+00	8.67E+04	5.06E+00	2.17E+04	1.34E+00	1.00E+03
Xylenes (Total)	2.36E+01	7.37E+03	1.15E+01	8.82E+03	2.64E+00	1.00E+02
Acenaphthylene	2.16E-02	1.00E+00	N/A	-	6.87E-03	1.00E-01
Acenaphthene	7.05E-02	1.00E+00	N/A	-	2.41E-02	1.00E-01
Fluorene	1.94E-02	1.00E+01	N/A	-	6.20E-03	1.00E+00
Chrysene	1.08E-02	3.60E-01	2.32E-03	2.40E-01	4.36E-04	5.00E-02
Benzo(a)anthracene	1.34E-02	5.00E-01	2.07E-03	3.60E-01	2.82E-04	5.00E-02
Benzo(b)fluoranthene	1.47E-02	3.60E-01	N/A	-	4.01E-04	5.00E-02
Benzo(k)fluoranthene	1.07E-02	5.00E-01	N/A	-	1.87E-04	5.00E-02
Dibenzo(a,h)anthracene	3.84E-03	5.00E-01	N/A	-	4.90E-05	5.00E-02
Indeno(1,2,3-cd)pyrene	7.82E-03	5.00E-01	N/A	-	2.99E-04	5.00E-02
Benzo(g,h,i)perylene	1.04E-02	5.00E-01	N/A	-	3.80E-04	5.00E-02

Heavy Metals ⁽³⁾						
	Hourly		Daily		Annual	
Tier 1	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria	ASR conc ⁽¹⁾	Criteria
Barium	1.25E-02*	5.00E+00	2.44E-03*	2.50E+00	1.51E-02	5.00E-01
Cobalt	4.65E-04*	2.00E-01	9.05E-05*	7.10E-02	3.35E-05*	1.00E-01
Chromium (III)	N/A	-	2.66E-04*	5.00E-01	2.38E-03	1.10E-01
Copper	1.60E-02*	1.00E+02	3.12E-03*	3.60E+00	4.62E-02	2.40E+00
Molybdenum	2.45E-04*	3.00E+01	4.76E-05*	1.10E+01	1.76E-05*	3.00E+00
Tin	4.41E-03*	2.00E+01	8.59E-04*	1.00E+01	3.18E-04*	2.00E+00
Zinc	6.16E-02*	2.00E+01	N/A	-	1.93E-01	2.00E+00
Mercury	6.66E-04*	6.00E-01	1.30E-04*	3.00E-01	2.64E-04	1.00E+00
Arsenic	1.53E-03*	2.00E-01	2.97E-04*	3.60E-02	4.39E-03	1.50E-02
Cadmium	2.57E-04*	1.00E-01	5.00E-05*	3.00E-02	1.03E-03	1.00E-02
Chromium (VI)	1.23E-03	8.50E-03	3.23E-04	3.00E-01	1.75E-04	1.00E-01
Nickel	9.41E-04*	2.00E-01	1.83E-04*	2.00E-01	6.25E-03	9.00E-02
Lead	N/A	-	6.87E-03*	1.50E-01	5.95E-02	5.00E-01

Notes:

- (1) Cumulative concentration of pollutants from project contribution plus background
- (2) For hydrocarbons, refer to Appendix 3.12 for the concentration details
- (3) For heavy metals, the concentrations are obtained from RSP results (refer to Appendix 3.11)
- (4) N/A means Not Assessed
- (5) Dash (-) means no relevant criteria identified
- (6) Asterisk (*) means no background data is available for the pollutant