Appendix J

Asbestos

Appendix J
Evaluation of Asbestos in Soil

To interpret measurements of asbestos in soils, it is necessary to establish the relationship between asbestos concentrations observed in soils and concentrations that could occur in air when such soil is disturbed by natural or anthropogenic forces. Asbestos is considered hazardous when inhaled, therefore it is necessary to estimate airborne concentrations. Asbestos in soil at this site was analyzed using the Modified Elutriator Method (Berman and Kolk 2000). This method was designed specifically to facilitate prediction of airborne asbestos exposures based on bulk measurements. Briefly, the Modified Elutriator Method incorporates a procedure for isolating and concentrating asbestos structures as part of the respirable dust fraction of a sample. Analytical measurements are reported as the number of asbestos structures per mass of respirable dust in the sample. These measurements are combined with dust emission factors to develop airborne asbestos concentrations. There are no default comparison levels to compare against the analytical measurements for asbestos in soil. Therefore, a risk-based approach was used to evaluate asbestos measurements in soil, and determine whether asbestos was adequately characterized.

Although U.S. Environmental Protection Agency (USEPA) has not issued final guidance on asbestos risk assessment methods, risks associated with asbestos in soil were evaluated using the most recent draft methodology proposed by USEPA (2003). A construction worker receptor was evaluated for outdoor air exposure. A construction worker is likely to have higher exposures than other receptors because of exposure to higher levels of dust that could be generated during construction activities.

1.1 Development of Exposure Point Concentrations

The first step involved developing asbestos concentrations to be included in the risk calculations. **Table J-1** shows the asbestos analytical results reported by the analytical laboratory. The laboratory reports concentrations as protocol structures per gram PM10 (s/gPM10). **Table J-1** shows all the information provided by the laboratory including total chrysotile and amphibole structures, long chrysotile and amphibole structures, total asbestos structures and analytical sensitivities. The samples are grouped according to Evaluation Areas, which are areas of discrete activities and land use at the site. Some of the Evaluation Areas showed asbestos results to be non-detect (reported as less than the analytical sensitivity). The non-detect results indicate that asbestos is not a problem in these Evaluation Areas.

In the risk assessment, only those asbestos protocol structures considered biologically active; i.e., longer than 5 um and thinner than 0.4 um), as defined by Berman and Crump (2001) were quantitatively evaluated. Therefore, the values for long chrysotile protocol structures and long amphibole protocol structures were evaluated. For each Evaluation Area, the sample representing the highest concentration of long chrysotile protocol structures and long amphibole protocol structures was evaluated in the risk assessment. This is a conservative screening level approach designed to evaluate the highest concentrations detected within an Evaluation Area. **Table J-2** summarizes the exposure point concentrations for long chrysotile and long amphibole protocol structures for each Evaluation Area. The exposure point concentrations for each Evaluation Area are the highest sample concentrations within that Area. Evaluation Areas EA01, EA02, EA03, EA04 and EA10 were non-detect for long amphibole and long chrysotile protocol structures.

1.2 Inhalation Unit Risk Factors

USEPA (2003) provides a method for calculating Unit Risk Factors (URFs) from epidemiological data. The calculated URFs are 5.69×10^{-2} per structure per cubic meter (s/m^3) for long chrysotile and 6.32 per s/m^3 for long amphibole structures. The calculation of these URFs is shown in **Table J-3**.

1.3 Exposure Assumptions

The assumptions for the construction worker were taken mainly from USEPA's Soil Screening Level guidance (USEPA, 2002).

Construction Worker – **Table J-4** lists exposure assumptions for the construction worker. It is assumed that the construction worker conducts an excavation activity for 90 days and that the exposure duration is 1 year. The construction worker works for 8 hours per 24-hour day (exposure fraction of 0.33). Since the asbestos results are expressed in s/gPM10 it is important to determine the concentration of gPM10 in volume of air that the construction worker could inhale (gPM10/m^3 air). This value was calculated using an equation provided in USEPA (2002) for construction workers (**Table J-5**).

The equation provided in USEPA (2002) (Equation 5-5) for the derivation of the particulate emission factor for the construction worker is:

$$PEF_{sc} = Q/C_{sr} \times \frac{1}{F_D} \times \left[\frac{T \times A_R}{556 \times (W/3)^{0.4} \times \frac{(365d/yr - p)}{365d/yr} \times \sum VKT} \right]$$

Where:

PEF_{SC} = subchronic road particulate emission factor (m^3/kg)

Q/C_{sr} = inverse of the ratio of the 1-hr geometric mean air concentration to the emission flux along a straight road segment bisecting a square site (g/m^2-s per kg/m^3); calculated in equation shown below

F_D = dispersion correction factor (unitless); 0.185 (USEPA, 2002)

T = total time over which construction occurs (sec); (90 days x 24 hr/day x 3600 sec/hr = 7776000 sec)

A_R = surface area of contaminated road segment (m^2); 274.213 m^2 (USEPA, 2002)

W = mean vehicle weight (tons); example provided in USEPA 2002) – daily unpaved road traffic consists of 20 two-ton cars and 10 twenty-ton trucks, the mean vehicle weight is [(20 cars x 2 tons/car) + (10 trucks x 20 tons/truck]/30 vehicles = 8 tons

p = number of days with at least 0.01 inches of precipitation (days/yr); 27 days for this area

∑VKT = sum of fleet vehicle kilometers traveled during the exposure duration (km). This value was calculated following USEPA (2002). The area under excavation is assumed to be 10 acres (40,480 m^2). If this area is configured as a square and the unpaved road segment divides the square evenly, then the road length would be equal to the square root of 40,480 m^2, 201 m (0.201 km). Assuming that each vehicle travels the length of the road once per day, 5 days per week for a total of 3 months (90 days), the total vehicle kilometers traveled is: 30 vehicles x 0.201 km/day x (52 wks/yr ÷ 4) x 5 days/wk = 392 km.

The equation provided in USEPA (2002) (Equation 5-6) for the derivation of the dispersion factor for particulate emissions for the construction worker is:

$$Q / C_{sr} = A \times \exp\left[\frac{(\ln A_s - B)^2}{C}\right]$$

Where:

Q/C_{sr} = inverse of the ratio of the 1-hr geometric mean air concentration to the emission flux along a straight road segment bisecting a square site (g/m^2-s per kg/m^3)

A = constant (unitless); 12.9351 (USEPA, 2002)

A_s = areal extent of site surface soil contamination (acres); assumed to be 10 acres based on the likely size of an area that will be excavated for the purpose of building industrial structures. The sizes of the Evaluation Areas range from 12 to 73 acres; however, it is unlikely that a construction activity would occur throughout the extent of the Evaluation Area.

B = constant (unitless); 5.7383 (USEPA, 2002)

C = constant (unitless); 71.7711 (USEPA, 2002)

The calculated PEF using these equations is 5.88 x 10^5 m^3/kg. The calculated PM10 dust concentration is 1/PEF, or 1700 ug/m^3.

1.4 Risk Results

Cancer risk estimates were calculated using USEPA's standard equations. **Table J-6** shows the cancer risk estimates for the construction worker at each of the Evaluation Areas. The results show that EA05, EA06, EA07, EA08 and EA09 show potential cancer risks greater than 1x10^{-6}, and therefore will require additional asbestos characterization. Asbestos measurements from EA01, EA02, EA03, EA04 and EA11 show non-detect results, and therefore no cancer risks were calculated for those EAs.

References

Berman, D.W. and Kolk, A. 2000. Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material. May (Revision 1).

Berman, D.W. and Crump, K.S. 2001. Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Prepared for Mark Raney, Volpe Center, U.S. Department of Transportation, 55 Broadway, Kendall Square, Cambridge, MA 02142. Under EPA Review.

USEPA. 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, Washington DC. OSWER 9355.4-24. December.

USEPA. 2003. Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft. Office of Solid Waste and Emergency Response, Washington, DC.

Table J-1
Asbestos (Amphibole and Chrysotile) Data (a)
Phase A Source Area Investigation Results
Tronox Facility - Henderson, Nevada

Evaluation Area	Client Sample ID	Lab Sample ID	Sample Collection Date	Regulated Asbestos Detected	Countable Asbestos Structures	Chrysotile Protocol Structures (s/g PM_{10})	Long Chrysotile Protocol Structures (s/g PM_{10})	Amphibole Protocol Structures (s/g PM_{10})	Long Amphibole Protocol Structures (s/g PM_{10})	Long Asbestos Protocol Structures (s/g PM_{10})	Total Asbestos Protocol Structures (Mean) (s/g PM_{10})	Analytical Sensitivity (Mean) (s/g PM_{10})	95% UCL (Mean)) (s/g PM_{10})
EA1	SA27	040626126-17	12/04/06	ND	ND	<2.968E+06	<2.968E+06	<2.968E+06	<2.968E+06	<2.968E+06	<2.968E+06	2.968E+06	1.095E+07
EA1	SA-25	040625818-11	12/05/06	Chrysotile	Chrysotile	2.940E+06	<2.940E+06	<2.940E+06	<2.940E+06	<2.940E+06	2.940E+06	2.940E+06	1.085E+07
EA2	SA24	040626126-22	12/01/06	ND	ND	<2.993E+06	<2.993E+06	<2.993E+06	<2.993E+06	<2.993E+06	<2.993E+06	2.993E+06	1.105E+07
EA2	SA26	040625818-9	12/05/06	Chrysotile	Chrysotile	2.947E+06	<2.947E+06	<2.947E+06	<2.947E+06	<2.947E+06	2.947E+06	2.947E+06	1.088E+07
EA2	SA26D	040625818-10	12/05/06	ND	ND	<2.916E+06	<2.916E+06	<2.916E+06	<2.916E+06	<2.916E+06	<2.916E+06	2.916E+06	1.076E+07
EA3	SA22	040626126-21	12/02/06	Chrysotile	ND	<2.883E+06	<2.883E+06	<2.883E+06	<2.883E+06	<2.883E+06	<2.883E+06	2.883E+06	1.064E+07
EA4	SA21	040625818-7	12/02/06	Chrysotile	ND	<2.935E+06	<2.935E+06	<2.935E+06	<2.935E+06	<2.935E+06	<2.935E+06	2.935E+06	1.083E+07
EA5	SA18	040626126-18	12/03/06	Chrysotile	Chrysotile	1.797E+07	5.990E+06	<2.995E+06	<2.995E+06	5.990E+06	1.797E+07	2.995E+06	1.105E+07
EA5	SA18D	040626126-19	12/02/06	Chrysotile	Chrysotile	2.391E+07	5.978E+06	<2.989E+06	<2.989E+06	5.978E+06	2.391E+07	2.989E+06	1.103E+07
EA5	SA20	040626126-03	12/07/06	ND	ND	<2.942E+06	<2.942E+06	<2.942E+06	<2.942E+06	<2.942E+06	<2.942E+06	2.942E+06	1.085E+07
EA5	SA19	040626126-04	12/07/06	Chrysotile, Amosite	Chrysotile, Amosite	5.033E+07	1.007E+07	3.020E+07	1.007E+07	2.013E+07	8.053E+07	3.355E+06	1.238E+07
EA5	SA23	040625818-6	12/02/06	Chrysotile	Chrysotile	2.939E+06	2.939E+06	<2.939E+06	<2.939E+06	2.939E+06	2.939E+06	2.939E+06	1.085E+07
EA6	SA16	040625818-8	12/02/06	Chrysotile, Amosite, Tremolite	Chrysotile, Amosite, Tremolite	2.949E+07	1.475E+07	8.847E+06	5.898E+06	2.064E+07	3.834E+07	2.949E+06	1.088E+07
EA6	SA15	040626126-13	12/08/06	Chrysotile, Crocidilite, Actinolite	Chrysotile, Crocidilite, Actinolite	2.696E+07	5.991E+06	5.991E+06	5.991E+06	1.198E+07	3.295E+07	2.996E+06	1.105E+07
EA6	SA12	040625818-2	12/02/06	Chrysotile	Chrysotile	5.850E+06	<2.925E+06	<2.925E+06	<2.925E+06	<2.925E+06	5.850E+06	2.925E+06	1.079E+07
EA6	SA12D	040625818-3	12/02/06	Chrysotile, Actinolite	Chrysotile, Actinolite	2.962E+06	2.962E+06	<2.962E+06	<2.962E+06	2.962E+06	2.962E+06	2.962E+06	1.093E+07
EA6	SA11	040625818-4	12/02/06	Chrysotile, Anthophyllite	Chrysotile, Anthophyllite	8.827E+06	5.885E+06	5.885E+06	2.942E+06	8.827E+06	1.471E+07	2.942E+06	1.086E+07
EA6	SA11D	040625818-5	12/02/06	Chrysotile	Chrysotile	8.766E+06	5.844E+06	<2.922E+06	<2.922E+06	5.844E+06	8.766E+06	2.922E+06	1.078E+07
EA7	SA10	040626126-02	12/05/06	Chrysotile	ND	<2.951E+06	<2.951E+06	<2.951E+06	<2.951E+06	<2.951E+06	<2.951E+06	2.951E+06	1.089E+07
EA7	SA9	040626126-20	12/02/06	Chrysotile, Amosite	Chrysotile, Amosite	1.493E+07	5.974E+06	2.987E+06	2.987E+06	8.961E+06	1.792E+07	2.987E+06	1.102E+07
EA7	SA14	040626126-12	12/08/06	Chrysotile	Chrysotile	4.793E+07	1.198E+07	<2.996E+06	<2.996E+06	1.198E+07	4.793E+07	2.996E+06	1.105E+07
EA8	SA07	040626126-08	12/07/06	Chrysotile	Chrysotile	1.195E+07	2.988E+06	<2.988E+06	<2.988E+06	2.988E+06	1.195E+07	2.988E+06	1.103E+07
EA8	SA08	040626126-09	12/07/06	Chrysotile	Chrysotile	1.498E+07	5.993E+06	<2.997E+06	<2.997E+06	5.993E+06	1.498E+07	2.997E+06	1.106E+07
EA8	SA13	040626126-10	12/07/06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EA8	SA13	040626126-14	12/08/06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
EA8	SA13	040626126-15	12/08/06	Chrysotile, Crocidilite	Chrysotile, Crocidilite	2.996E+06	<2.996E+06	2.996E+06	2.996E+06	2.996E+06	5.992E+06	2.996E+06	1.106E+07
EA8	SA17	040626126-16	12/07/06	ND	ND	<2.995E+06	<2.995E+06	<2.995E+06	<2.995E+06	<2.995E+06	<2.995E+06	2.995E+06	1.105E+07
EA9	SA03	040625818-1	12/02/06	Chrysotile, Actinolite	Chrysotile, Actinolite	2.391E+07	7.971E+06	5.580E+07	7.971E+06	7.971E+06	7.971E+07	7.971E+06	2.941E+07
EA9	SA04	040626126-05	12/07/06	Chrysotile, Crocidilite, Amosite	Chrysotile, Crocidilite	1.090E+08	3.830E+07	2.946E+06	<2.946E+06	3.830E+07	1.120E+08	2.946E+06	1.087E+07
EA9	SA05	040626126-06	12/07/06	Chrysotile	Chrysotile	5.365E+07	3.577E+07	<2.980E+06	<2.980E+06	3.577E+07	5.365E+07	2.980E+06	1.100E+07
EA9	SA06	040626126-07	12/07/06	Chrysotile	Chrysotile	2.846E+06	<2.846E+06	<2.846E+06	<2.846E+06	<2.846E+06	2.846E+06	2.846E+06	1.050E+07
EA10	SA02	040626126-11	12/07/06	ND	ND	<2.989E+06	<2.989E+06	<2.989E+06	<2.989E+06	<2.989E+06	<2.989E+06	2.989E+06	1.103E+07

Notes:
EA - Evaluation Area.
N/A - Not Available.
ND - Not Detected.
s/g PM_{10} - Protocol structures per gram of PM_{10}.
(a) Values obtained from EMSL analytical asbestos results summary table. Samples collected from 12/02/2006 - 12/08/2006.

Table J-2

Exposure Point Concentrations for Long Amphibole and Chrysotile Protocol Structures

Phase A Source Area Investigation Results

Tronox Facility - Henderson, Nevada

Evaluation Area	Maximum Detected Long Amphibole Protocol Structures (s/g PM_{10}) (a)	Maximum Detected Long Chrysotile Protocol Structures (s/g PM_{10}) (a)
EA01	ND	ND
EA02	ND	ND
EA03	ND	ND
EA04	ND	ND
EA05	1.01E+07	1.01E+07
EA06	5.99E+06	1.48E+07
EA07	2.99E+06	1.20E+07
EA08	3.00E+06	5.99E+06
EA09	7.97E+06	3.83E+07
EA10	ND	ND

Notes:

ND - Not Detected. Concentrations listed as less than analytical sensitivity.

s/g PM_{10} - Protocol structures per gram PM_{10}.

(a) Values obtained from EMSL analytical asbestos results summary table. Samples collected from 12/02/2006 - 12/08/2006. Maximum detected concentrations in samples within respective evaluation areas. See Table J-1 for analytical data.

Table J-3
Asbestos $URF_{Chysotile}$ and $URF_{Amphibole}$ Calculations Using Expected Values (a)
Phase A Source Area Investigation Results
Tronox Facility - Henderson, Nevada

Asbestos URF Equation:

$$URF_{2003} = \left(\frac{1}{10}\right) R_{Avg}$$

Where:

R_{Avg} = 0.5(0.786(NSM+NSF)+0.214(SM+SF)).
NSM = Non-Smoker Male Combined Values (Chysotile/Amphibole).
NSF = Non-Smoker Female Combined Values (Chrysotile/Amphibole).
SM = Smoker Male Combined Values (Chrysotile/Amphibole).
SF = Smoker Female Combined Values (Chrysotile/Amphibole).

1) Table 8-2. Estimated Additional Deaths from Lung Cancer or Mesothelioma per 100,000 Persons from Constant Lifetime Exposure to 0.0001 TEM f/cc Longer than 10 um and Thinner than 0.4 um - Based on Optimum Risk Coefficients. Combined Lung Cancer and Mesothelioma values. (a)

A) $URF_{Chrysotile}$

$$URF_{Chrysotile} = \frac{(0.5(0.786(0.269+0.303)+0.214(1.65+1.57))}{10}$$

$$URF_{Chrysotile} = 5.69E-02$$

B) $URF_{Amphibole}$

$$URF_{Amphibole} = \frac{(0.5(0.786(62.9+72.5)+0.214(38.3+55.1))}{10}$$

$$URF_{Amphibole} = 6.32E+00$$

Notes:
UCL - Upper Confidence Limit.
URF - Unit Risk Factor.
USEPA - United States Environmental Protection Agency.
(a) USEPA, 2003. Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft. Office of Solid Waste and Emergency Response. EPA# 9345.4-06. October, 2003. Tables 8-2 and 8-3.

Table J-4

Asbestos Risk Calulations for Construction Worker

Phase A Source Area Investigation Results

Tronox Facility - Henderson, Nevada

Receptors Evaluated:	
Receptor 1:	Construction Worker

CARCINOGENIC ASSUMPTIONS FOR CONSTRUCTION WORKER INHALATION OF ASBESTOS DUST FROM SOIL		**Assumed Value**	**Units**	**Calculated Value**
ED Fraction (b)	Construction Worker	3.33E-01	(unitless)	3.33E-01
Dust Level (a)	Construction Worker	1.70E+03	ug/m^3	1.70E+03
Exposure Frequency	Construction Worker	90	(days)/(year) =	9.00E+01
Exposure Duration (cancer)	Construction Worker	1	(years)/(year) =	1.00E+00
Exposure Duration (noncancer)	Construction Worker	1	(yrs)/1(yrs) =	1.00E+00
Lifetime		70	(years)	
Conversion Factor		1.00E-06	g/ug	1.00E-06

Notes:

PEF - Particulate Emission Factor.

USEPA - United States Environmental Protection Agency.

(a) Equal to 1/PEF, which was calculated from PEF equation for construction workers provided in USEPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002). See Table J-5.

(b) A factor applied to the expsoure duration to account for an 8 hour work day (8hr/24hr).

Table J-5a

Derivation of the Particulate Emission Factor for the Construction Worker (a)

Phase A Source Area Investigation Results

Tronox Facility- Henderson, Nevada

$$PEF_{sc} = Q/C_{sr} \times \frac{1}{F_D} \times \left[\frac{T \times A_R}{556 \times (W/3)^{0.4} \times \frac{(365d/yr - p)}{365d/yr} \times \sum VKT} \right]$$

Parameter	Definition	Units	Values	Notes
Q/C_{sr}	inverse of the ratio of the 1-hr geometric mean air concentration to the emission flux along a straight road segment bisecting a square site	g/m^2-s per kg/m^3	15.24747	(b)
F_D	dispersion correction factor	unitless	0.185	USEPA (2002)
T	total time over which construction occurs	sec	7,776,000	(c)
A_R	surface area of contaminated road segment	m^2	274.213	USEPA (2002)
W	mean vehicle weight	tons	8	(d)
p	number of days with at least 0.01 inches of precipitation	days/yr	27	(e)
∑VKT	sum of fleet vehicle kilometers traveled during the exposure duration	km	392	(f)
PEF_{SC}	**subchronic road particulate emission factor**	**m^3/kg**	**5.88E+05**	**(a)**
1/PEF	**calculated dust concentration**	**ug/m^3**	**1700**	**(g)**

Notes:

(a) USEPA, 2002 (Equation 5-5)

(b) Calculated from Equation 5-6 (USEPA, 2002), see table J-5b

(c) Value calculated with the equation: total construction time = 90 days x 24 hr/day x 3600 sec/hr

(d) Example provided by USEPA (2002): daily unpaved road traffic consists of 20 two-ton cars and 10 twenty-ton trucks and the mean vehicle weght is [(20 cars x 2 tons/car) + (10 trucks x 20 tons/truck)]/30 vehicles = 8 tons

(e) USEPA, 2002 (Exhibit 5-2)

(f) This value was calculated based on USEPA (2002): The area under excavation was assumed to be 10 acres (48,480 m^2). If this area is configured as a square and the unpaved road segment divides the square evenly, then the road length would be equal to the square root of 40,480 m^2, 210 m (0.201 km). Assuming that each vehicle travels the length of the road once per day, 5 days per week for a total of 3 months (90 days) the total vehicle kilometers traveled is: 30 vehicles x 0.201 km/day x (52 wks/yr /4) x 5 days/wk = 392 km.

(g) In order to convert PEFsc (m^3/kg) to 1/PEF (ug/m^3), 1/PEF was multiplied by 10^9

Table J-5b

Derivation of the Dispersion Factor for Particulate Emissions for the Construction Worker (a)

Phase A Source Area Investigation Results

Tronox Facility - Henderson, Nevada

$$Q / C_{sr} = A \times \exp\left[\frac{(\ln A_s - B)^2}{C}\right]$$

Parameter	Definition	Units	Values	Notes
A	constant	unitless	12.9351	USEPA (2002)
A_s	areal extent of site surface soil contamination	acres	10	(b)
B	constant	unitless	5.7383	USEPA (2002)
C	constant	unitless	71.7711	USEPA (2002)
Q/C_{sr}	**inverse of the ratio of the 1-hr geometric mean air concentration to the emission flux along a straight road segment bisecting a square site**	**(g/m^2 -s per kg/m^3)**	**15.24747**	**(a)**

Notes:

(a) USEPA, 2002 (Equation 5-6)

(b) Assumed to be 10 acres based on the likely size of an area that will be excavated for the purpose of building industrial structures.

Table J-6
Asbestos Risk Calulations for Construction Worker
Phase A Source Area Investigation Results
Tronox Facility - Henderson, Nevada

Compound	Asbestos Concentration (b) (s/gPM_{10})	Inhalation Unit Risk Factor (a) (per s/m^3)	Excess Lifetime Cancer Risk - Inhalation (c)
Amphibole - Long Structures			
EA-1	ND	6.32E-06	NA
EA-2	ND	6.32E-06	NA
EA-3	ND	6.32E-06	NA
EA-4	ND	6.32E-06	NA
EA-5	1.01E+07	6.32E-06	1.27E-04
EA-6	5.99E+06	6.32E-06	7.56E-05
EA-7	2.99E+06	6.32E-06	3.77E-05
EA-8	3.00E+06	6.32E-06	3.78E-05
EA-9	7.97E+06	6.32E-06	1.01E-04
EA-10	ND	6.32E-06	NA
Chrysotile - Long Structures			
EA-1	ND	5.69E-08	NA
EA-2	ND	5.69E-08	NA
EA-3	ND	5.69E-08	NA
EA-4	ND	5.69E-08	NA
EA-5	1.01E+07	5.69E-08	1.14E-06
EA-6	1.48E+07	5.69E-08	1.68E-06
EA-7	1.20E+07	5.69E-08	1.36E-06
EA-8	5.99E+06	5.69E-08	6.81E-07
EA-9	3.83E+07	5.69E-08	4.35E-06
EA-10	ND	5.69E-08	NA

Notes:
NA - Not Applicable.
ND - Not Detected.
s/gPM_{10} - protocol structures per gram PM_{10}
s/m^3 - protocol structures per m^3 of air
USEPA - United States Environmental Protection Agency.
USEPA, 2003. Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft. Office of Solid Waste and Emergency Response. EPA# 9345.4-06. October, 2003.
(a) USEPA, 2003. Chrysotile and Amphibole inhalation unit risk factors calculated using the following formula:
$URF_{2003} = (1/10)(R_{Avg})$
Where:
R Avg = 0.5(0.786(NSM+NSF)+0.214(SM+SF)).
NSM = Non-Smoker Male. Equal to the expected values (Table 8-2).
NSF = Non-Smoker Female. Equal to the expected values (Table 8-2).
SM = Smoker Male. Equal to the expected values (Table 8-2).
SF = Smoker Female. Equal to the expected values (Table 8-2).
(b) Maximum concentration for Long Chrysotile and Long Amphibole Protocol Structures (structures/gram PM_{10}) in each evaluation area.
(c) USEPA, 2003. Asbestos risk calculated using the following equation:
AsbRisk = (Asbestos Concentration x Dust Level x Inhalation Unit Risk x EF x ED x ED Fraction x CF)/(365 x AT)
Where:
CF = Conversion Factor.
EF = Exposure Frequency.
ED = Exposure Duration.
AT = Averaging Time (Lifetime).