

S-2. Screening Threshold Values Development

The Air Toxics Regulation Rule was developed to implement and govern regulation of facilities that emit air toxics. Facilities within the seven metropolitan counties: Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, or Washington county are subject to the rule.

The first step for an air toxics facility that is subject to this rule is to go through a screening threshold analysis to determine if the facility advances to the next step by either developing a compliance determination protocol (CDP) or completing an air emissions risk analysis (AERA). The screening threshold analysis is the first step of this process. In this screening threshold analysis step, an air toxics facility will compare its hourly and annual emissions against a screening threshold value to determine if the facility exceeds a screening threshold value for a given air toxic. The Minnesota Pollution Control Agency (MPCA) has developed a screening spreadsheet, screening threshold for regulated air toxics analysis (STRATA), for facilities to easily determine if the facility exceeds any screening threshold values for each individual air toxic. If an air toxics facility exceeds any screening threshold value, the facility will advance to the next step. The facility then has the choice to develop a compliance determination protocol (CDP) or complete an air emissions risk analysis (AERA).

The process of developing the screening threshold values by the MPCA is similar to how the New Jersey Department of Environmental Protections has developed their air pollutant reporting thresholds.¹ New Jersey uses their reporting thresholds to determine if a new or modified source operation is subject to a health risk assessment due to the potential for HAP emissions to cause significant health risk. MPCA used this documentation on how the reporting thresholds were created to calculate screening threshold values that would prompt an air toxics facility to either develop a CDP or complete an AERA.

The MPCA developed the screening threshold for regulated air toxics analysis (STRATA) spreadsheet to determine whether a facility exceeds screening threshold values. By creating an electronic spreadsheet with the screening threshold values, it allows the air toxics facility to easily see if they are at or below screening threshold values or above screening threshold values. An air toxics facility would input the stack height, stack distance to property line, and stack emissions in pounds/hour and tons/year. Given this information, the spreadsheet will compare the emissions provided by the facility for a given stack height and distance to property line and compare them to a calculated screening threshold value. The screening threshold value is calculated by taking the inhalation health benchmark (IHB) of an air toxic and dividing by the modeled dispersion value (Equation 1 through 6). Once the spreadsheet has compared the emissions to the screening threshold value it will display either "ABOVE" or "BELOW" for a given air toxics for each stack. Based on the results given in the STRATA spreadsheet, the air toxics facility can easily see if they exceed any screening thresholds values and will have to continue onto the next step in the process.

This technical document focuses on how the MPCA staff developed the screening threshold values and the screening spreadsheet (STRATA) used in the screening threshold analysis. This document explains how the MPCA developed the screening threshold values and details how the MPCA staff developed the modeling methodology, how the MPCA staff processed the modeling results, and how the MPCA staff evaluated the screening threshold values.

¹ *Technical Support Document: Updating Hazardous Air Pollutant Reporting Thresholds by New Jersey Department of Environmental Protection*. Retrieved from [technical-support-document-hap-reporting-thresholds.pdf](https://www.mn.gov/Portals/0/airtoxics/technical-support-document-hap-reporting-thresholds.pdf)

Modeling methodology

Dispersion modeling

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee’s (AERMIC) modeling system AERMOD (version 23132) was used for this evaluation. AERMOD is the Environmental Protection Agency’s (USEPA) preferred model for regulatory model applications. AERMOD is a steady-state model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including both surface and elevated sources, and both simple and complex terrain².

Model inputs

Location

To model the conditions in each of the seven counties that are subject to this rule, one stack was placed in each of the seven counties. The stack was placed by visually estimating the middle of the county, verifying that the stack is not located at a current facility. Additionally, each stack was verified to be placed on land and not on a lake, pond, or any other body of water.

Terrain data

Terrain data from the United States Geological Survey (USGS) 1/3rd arc-second Digital Elevation Models (DEMs) was used. This is a tiled collection of 3D Elevation Program (3DEP) and is 1/3 arc-second (approximately 10 m) resolution. The elevations in DEM represent the topographic bare-earth surface. These data are distributed in geographic coordinates in units of decimal degrees, and in conformance with the North American Datum of 1983 (NAD 83)³. Table 1 provides a list of the tile names used for each county, some counties used multiple tiles.

Table 1: List of tile names by county

County	Tile Name
Anoka	N46W094
Carver	N45W094
Dakota	N45W093 and N45W094
Hennepin	N45W094 and N46W094
Ramsey	N45W094 and N46W094
Scott	N45W094
Washington	N46W093

Meteorological data

Meteorological data was taken from the Minnesota Pollution Control Agency’s (MPCA) processed meteorological data. This data has already been processed with AERMET (version 22112), which includes the processors AERMINUTE (version 15272) and AERSURFACE (version 13016). The meteorological data used was for a 5-year period between 2020-2024.

² Air Quality Dispersion Modeling – Preferred and Recommended Models. Retrieved from <https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models>

³ Spatial Extent of Data. Retrieved from <https://data.usgs.gov/datacatalog/data/USGS:3a81321b-c153-416f-98b7-cc8e5f0e17c3>

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Surface stations were selected based on the proximity to the stack that was placed in each county. Table 2 is a list of the surface and upper air stations that were used for each county. Given that there are only 18 surface stations across the state of Minnesota, some counties used the same stations.

Table 2: Meteorological data

County	Surface station name	Upper air station name
Anoka	MIC – Crystal, MN	MPX – Chanhassen, MN
Carver	FCM – Flying Cloud Airport, MN	MPX – Chanhassen, MN
Dakota	MSP – Minneapolis/St. Paul International Airport, MN	MPX – Chanhassen, MN
Hennepin	MIC – Crystal, MN	MPX – Chanhassen, MN
Ramsey	STP – St. Paul Downtown Airport, MN	MPX – Chanhassen, MN
Scott	FCM – Flying Cloud Airport, MN	MPX – Chanhassen, MN
Washington	STP – St. Paul Downtown Airport, MN	MPX – Chanhassen, MN

Land use

AERMOD was run in only rural modes for all seven counties. The standard regulatory default for AERMOD is to use the rural option as this is considered the conservative approach. The rural option reduces turbulence assumption and leads to less atmospheric mixing and higher ground-level pollutant concentrations.

Stack parameters and emission rates

MPCA staff used hypothetical emission rates and stack parameters to represent a range of aerodynamic downwash scenarios for stacks. To understand the impact of different stack heights, the only parameter to change was stack height. Other parameters such as emission rate, stack diameter, exit velocity, and exit temperature were kept constant. Table 3 lists the stack parameters and values.

MPCA staff used stack parameters and emission rate to model and generate a modeled air dispersion value (micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)/gram per second of air toxics). These modeled dispersion values, along with inhalation health benchmarks IHBS, were used to calculate the screening threshold value for each air toxic.

MPCA staff selected stack heights by investigating the stack height information that MPCA has for facilities in the seven metropolitan counties. Figure 1 below shows the frequency of the stack heights. Figure 1 shows that the majority of the stacks range between 30 to 40 feet. For this reason, the MPCA staff split this group (30 to 40 feet) up further into 30 to less than 35 feet and 35 to less than 40 feet.

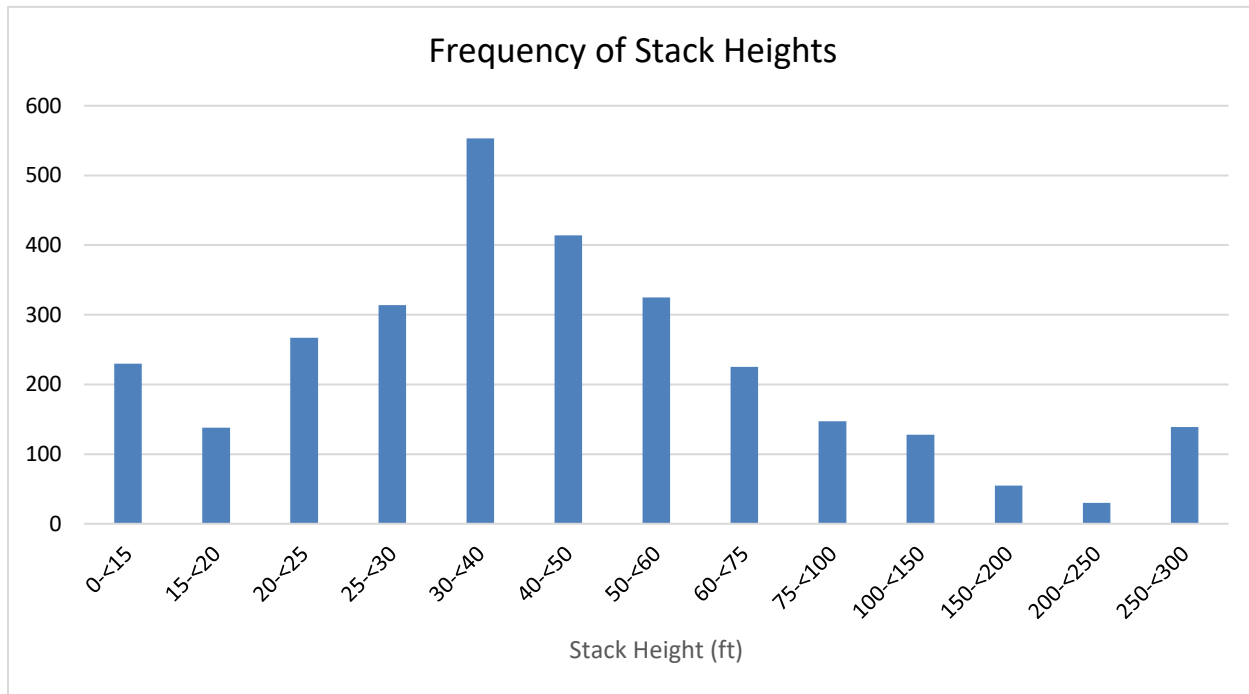
MPCA staff selected conservative numbers for parameters such as stack diameter, exit velocity, and gas exit temperature. MPCA staff selected these parameters to show the “worst case” for a given stack. MPCA staff used a smaller stack diameter of 0.305 meters (1 foot). The smaller the stack diameter, the less buoyancy and plume rise from a stack. This is a conservative approach as it assumes there is not much buoyancy from the stack. MPCA staff used an exit velocity of 0.001 m/s. The exit velocity promotes plume downwash; a lower velocity pulls the plume towards the ground and results in higher concentrations of pollutants at ground level. MPCA staff used ambient temperature selection in AERMOD which when modeled uses the ambient temperature for each hour. A lower stack temperature minimizes thermal buoyancy and can result in a higher ground-level concentrations. Table 3 displays the stack parameter values used in the modeling.

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Table 3: Stack parameters and emission rate

Parameter	Value(s)
Emission Rate (g/s)	1
Stack Diameter (ft)	1
Exit Velocity (m/s)	0.001
Exit Temperature (K)	Ambient Temperature
Stack height (ft)	10, 15, 20, 25, 30, 35, 40, 50, 60, 75, 100, 150, 200

Figure 1: Frequency of stack heights



Building downwash

MPCA staff investigated building downwash in developing the screening threshold values. In general, most, if not all, facilities have at least one building at their site. For the purposes of developing these screening threshold values, MPCA staff placed the stack in the center of the building. This allowed the model to show effects of building downwash from any wind direction.

The building height and dimensions were based on the stack height. Table 4 displays the building height and dimensions by stack height. MPCA staff selected the building heights based on Good Engineering Practice (GEP). For stack heights between 10 and 20 ft, the stack was assumed to be a factor of 1.25 times higher than the building height. For stack heights between 25 and 250 ft, the stack height was assumed to be 1.5 times higher than the building height.

For stack heights between 15 and 50 ft, the building's horizontal dimensions were assumed to be constant at 50 ft. As the stack heights increased above 50 ft, the building's horizontal dimensions also increased.

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Table 4: Building height and dimensions

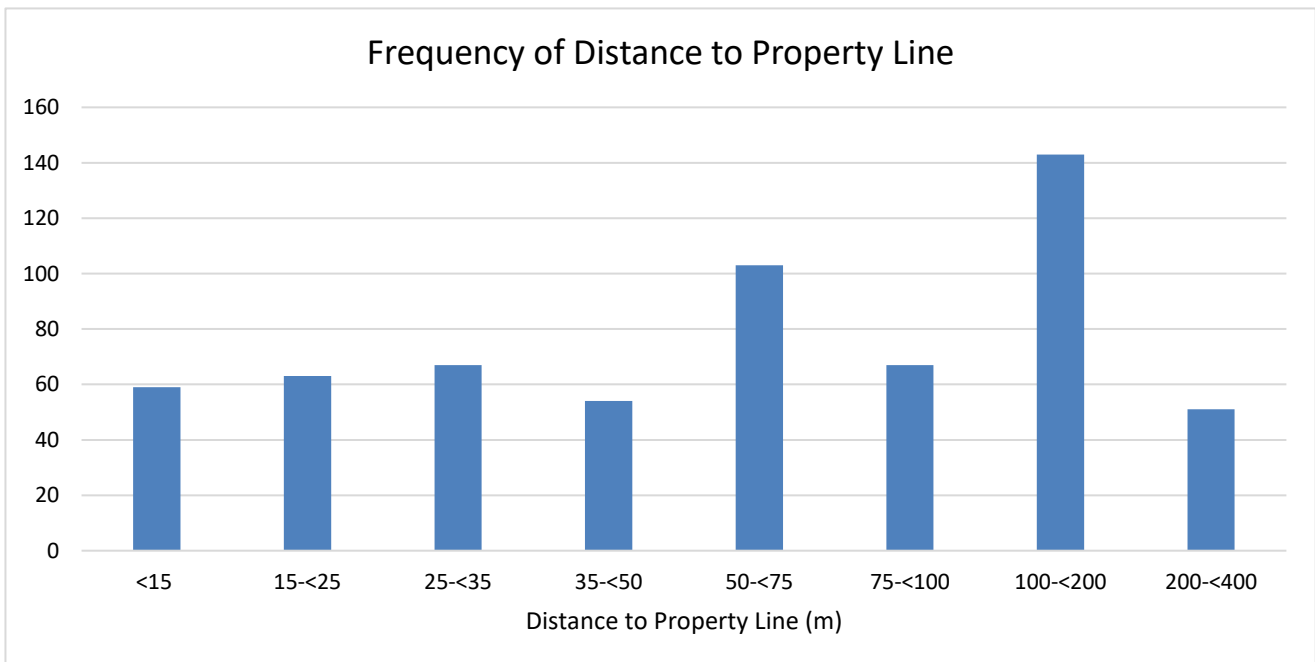
Stack height (ft)	Building height (ft)	Building width and length (ft)
10	8	50 x 50
15	12	50 x 50
20	16	50 x 50
25	16.7	50 x 50
30	20	50 x 50
35	23.3	50 x 50
40	26.7	50 x 50
50	33.4	50 x 50
60	40	60 x 60
75	50	75 x 75
100	66.7	100 x 100
150	100	150 x 150
200	133.4	200 x 200

Receptor grid

MPCA staff used an elevated terrain when modeling. Additionally, MPCA staff used a polar receptor grid of 1332 receptors that were centered on the stack with 36 radials spaced every 10 degrees. The spacing of the receptors along the radials were done every 5 m, 10 m, 15 m, 20 m, 25 m, 35 m, 50 m, 75 m, 100 m, 150 m, 200 m, 250 m, 300 m, 350 m, 400 m, 450 m, 500 m, 550 m, 600 m, 650 m, 700 m, 750 m, 800 m, 850 m, 900 m, 950 m, 1000 m, 1100 m, 1200 m, 1300 m, 1400 m, 1500 m, 1600 m, 1700 m, 1800 m, 1900 m, and 2000 m.

From previous modeling demonstrations, MPCA staff estimated the distance to property line for air toxics facilities in the seven metropolitan counties when this information was available. Figure 2 displays the frequency of the distance to property line. This helped to inform MPCA staff which receptor spacing should be used in the model.

Figure 2: Frequency of distance to property line



Processing modeled results

For each of the seven metropolitan counties, MPCA staff modeled the 13 stack heights for averaging times of 1-hr, 24-hr and annual. This resulted in 91 output (.PLT) files total.

The .PLT (output) files contained calculated pollutant concentrations at different receptor locations. MPCA staff used an R script to convert the .PLT files to a .CSV format. Each receptor distance (5m, 10m, 15m, etc.) had 36 modeled dispersion values associated with a given distance. MPCA staff used the output information to calculate an average for each receptor distance for each stack height. MPCA staff repeated this step for every stack height and averaging time for each of the seven metropolitan counties. Modeled dispersion values were in units of $\mu\text{g}/\text{m}^3$ per g/s. MPCA staff had to convert these dispersion values either $\mu\text{g}/\text{m}^3$ per lb/hr or $\mu\text{g}/\text{m}^3$ per ton/yr. The modeled dispersion value units depended on whether the screening threshold value under investigation was chronic (ton/yr) or acute (lb/hr).

MPCA staff summarized results in an Excel document by county. Table 5 shows an example of the results from Hennepin County. MPCA staff then calculated an average of all seven metropolitan counties for every stack height and distance to receptor.

Since the model was run for three different averaging times; 1-hr, 24-hr, and annually, this resulted in three different dispersion values for each given stack height and distance to receptor (property line). Tables 6 through 8 show the dispersion values (in either $\mu\text{g}/\text{m}^3$ per lb/hr or $\mu\text{g}/\text{m}^3$ per ton/yr) that MPCA staff averaged over all seven metropolitan counties.

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Table 5. 1 Hour dispersion results from Hennepin County ($\mu\text{g}/\text{m}^3$ per lb/hr)

Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
16.40	5	118627.7	60118.4	30942.4	18305.7	10778.4	7624.0	6103.8	4276.2	2846.2	1713.8	904.2	373.2	206.2
32.81	10	125862.1	70646.9	37750.8	22255.9	13241.1	9236.1	7266.4	5072.3	3391.7	2005.9	1029.8	408.6	218.6
49.21	15	112994.9	68513.2	36807.9	21675.9	12848.0	8800.3	6849.2	4726.8	3405.7	2221.1	1147.1	445.0	233.8
65.62	20	62305.8	57314.1	35067.2	20978.1	12526.3	8601.5	6656.7	4531.0	3254.4	2151.8	1240.2	481.5	249.6
82.02	25	42179.3	28072.2	22256.4	15187.3	11224.3	8030.6	6340.6	4433.1	3178.2	2091.5	1217.0	517.5	265.1
114.83	35	32409.1	22954.2	15039.2	10182.5	7143.3	5211.4	3851.4	2188.1	2596.6	1991.6	1160.1	535.7	294.5
164.04	50	23063.8	17202.7	11985.8	8353.1	5999.9	4547.9	3577.5	2176.5	1436.8	986.0	1081.1	497.6	292.1
246.06	75	15484.5	12077.6	8999.3	6425.5	4785.2	3666.1	2930.0	1963.4	1378.9	856.7	479.9	476.4	278.5
328.08	100	10820.9	9249.9	7170.1	5185.2	3992.0	3084.7	2451.7	1677.1	1229.7	803.1	474.6	235.4	269.6
492.13	150	4840.3	5004.8	4539.9	3419.2	2842.0	2297.1	1838.3	1262.7	961.5	679.1	413.0	205.4	113.6
656.17	200	2585.4	2697.4	2771.9	2188.7	1976.6	1698.9	1431.5	1029.7	772.6	564.0	363.5	187.9	107.8
820.21	250	1716.9	1635.6	1691.4	1405.1	1364.1	1249.6	1102.2	838.3	654.6	474.6	319.5	173.9	104.3
984.25	300	1309.7	1155.3	1135.8	975.4	955.2	918.1	849.3	689.6	556.2	409.8	282.5	161.4	99.8
1148.29	350	1060.7	899.2	843.7	743.0	718.1	688.3	660.1	569.7	478.4	365.0	251.7	149.1	95.4
1312.34	400	877.9	735.5	668.1	600.1	568.3	539.4	516.4	466.8	413.7	325.7	225.8	137.1	90.5
1476.38	450	733.9	615.1	552.1	504.2	467.5	436.2	414.1	381.5	358.1	290.0	205.6	125.9	85.0
1640.42	500	629.9	530.7	479.3	444.1	404.8	373.3	347.8	315.2	311.9	260.9	189.9	116.6	80.0
1804.46	550	535.1	452.7	410.7	386.3	354.2	323.2	296.3	261.5	265.6	231.2	172.4	105.8	73.5
1968.50	600	473.7	402.5	363.9	346.6	319.3	289.0	261.6	223.1	232.1	211.1	160.6	98.7	69.2
2132.55	650	435.3	370.9	337.1	323.5	300.7	271.4	243.5	201.0	209.4	198.1	154.4	95.7	67.2
2296.59	700	393.1	335.7	306.9	296.5	278.0	251.4	225.7	180.0	184.7	181.5	144.9	90.9	63.7
2460.63	750	356.4	304.7	279.7	270.9	255.5	232.9	206.8	163.0	162.6	165.4	136.0	86.4	60.4
2624.67	800	308.8	264.4	245.5	237.8	225.3	207.0	184.0	141.5	137.0	143.1	121.4	78.2	54.5
2788.71	850	303.1	260.1	240.4	234.4	223.2	206.7	184.9	141.8	131.2	139.0	121.6	79.3	55.4
2952.76	900	272.7	234.2	215.7	211.1	201.9	188.2	169.3	130.3	115.6	123.1	111.5	74.0	51.8

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Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
3116.80	950	259.6	223.0	205.4	201.5	193.6	181.4	164.1	127.0	106.9	115.1	107.9	72.9	51.3
3280.84	1000	241.6	207.7	191.3	188.1	181.4	170.9	155.6	121.5	99.2	104.7	101.8	70.0	49.5
3608.92	1100	209.5	180.1	165.6	163.2	158.3	150.7	139.1	110.7	88.6	85.3	89.8	64.5	46.0
3937.01	1200	187.1	161.7	148.2	146.2	142.4	136.5	127.0	102.5	82.0	70.6	79.6	60.2	43.2
4265.09	1300	166.3	143.6	133.2	131.9	129.1	124.8	117.4	95.9	77.2	61.8	70.6	56.4	40.8
4593.18	1400	151.7	131.3	121.0	120.0	117.8	114.3	108.4	89.8	72.7	55.7	62.5	53.1	38.7
4921.26	1500	137.5	118.8	109.8	109.0	107.4	104.7	99.9	83.7	68.4	50.6	54.8	49.9	36.8
5249.34	1600	121.7	105.4	97.5	97.2	96.1	94.2	90.6	77.2	63.3	46.7	46.6	45.6	34.2
5577.43	1700	114.8	99.2	91.9	91.8	91.1	89.7	86.8	74.8	61.8	46.0	42.9	44.1	33.7
5905.51	1800	106.9	92.7	85.7	85.8	85.4	84.4	82.1	71.6	59.4	44.6	39.2	41.7	32.4
6233.60	1900	98.6	85.4	79.5	79.6	79.2	78.5	76.7	67.6	56.5	42.7	35.5	39.1	31.1
6561.68	2000	92.0	79.8	74.4	74.5	74.4	74.0	72.6	64.6	54.3	41.3	32.9	36.8	29.9

Table 6. Annual dispersion values averaged over seven metropolitan counties ($\mu\text{g}/\text{m}^3$ per ton/yr)

Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
16.40	5	237.85	142.10	81.58	48.65	29.76	19.67	14.32	7.62	5.17	3.19	1.69	0.68	0.36
32.81	10	119.35	76.39	52.33	32.03	21.49	14.81	10.82	5.81	4.24	2.80	1.57	0.66	0.36
49.21	15	74.92	46.48	31.17	19.08	13.12	9.30	6.89	3.81	3.19	2.30	1.39	0.62	0.34
65.62	20	34.68	31.94	22.76	14.10	9.55	6.65	4.87	2.65	2.17	1.80	1.20	0.58	0.33
82.02	25	19.41	13.45	12.10	8.57	6.80	5.16	3.89	2.10	1.67	1.31	1.00	0.53	0.31
114.83	35	12.24	8.59	6.41	4.75	3.61	2.73	2.05	1.08	1.12	0.89	0.64	0.42	0.27
164.04	50	7.37	5.26	4.00	3.14	2.51	2.05	1.66	1.05	0.71	0.48	0.43	0.27	0.21
246.06	75	4.18	3.09	2.38	1.95	1.59	1.35	1.16	0.84	0.63	0.42	0.22	0.17	0.12
328.08	100	2.80	2.17	1.68	1.39	1.14	0.97	0.84	0.65	0.51	0.36	0.22	0.10	0.09

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492.13	150	1.36	1.19	0.98	0.83	0.69	0.58	0.50	0.40	0.33	0.26	0.17	0.09	0.05
656.17	200	0.80	0.76	0.67	0.58	0.48	0.41	0.35	0.28	0.23	0.19	0.13	0.08	0.05
820.21	250	0.53	0.52	0.48	0.42	0.36	0.31	0.27	0.21	0.17	0.14	0.10	0.06	0.04
984.25	300	0.39	0.38	0.36	0.32	0.28	0.25	0.21	0.16	0.14	0.11	0.08	0.05	0.04
1148.29	350	0.29	0.29	0.28	0.25	0.23	0.20	0.17	0.13	0.11	0.09	0.07	0.05	0.03
1312.34	400	0.24	0.23	0.22	0.21	0.19	0.17	0.15	0.11	0.09	0.07	0.06	0.04	0.03
1476.38	450	0.19	0.19	0.18	0.17	0.16	0.14	0.12	0.09	0.08	0.06	0.05	0.03	0.03
1640.42	500	0.16	0.16	0.15	0.14	0.13	0.12	0.11	0.08	0.07	0.05	0.04	0.03	0.02
1804.46	550	0.13	0.13	0.13	0.12	0.11	0.10	0.09	0.07	0.06	0.05	0.04	0.03	0.02
1968.50	600	0.11	0.11	0.11	0.10	0.10	0.09	0.08	0.06	0.05	0.04	0.03	0.02	0.02
2132.55	650	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.06	0.05	0.04	0.03	0.02	0.02
2296.59	700	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.05	0.04	0.03	0.03	0.02	0.01
2460.63	750	0.08	0.08	0.08	0.07	0.07	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01
2624.67	800	0.07	0.07	0.07	0.06	0.06	0.06	0.05	0.04	0.03	0.03	0.02	0.01	0.01
2788.71	850	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.04	0.03	0.03	0.02	0.01	0.01
2952.76	900	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.03	0.02	0.02	0.01	0.01
3116.80	950	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.03	0.02	0.02	0.01	0.01
3280.84	1000	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.03	0.02	0.02	0.01	0.01
3608.92	1100	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.02	0.01	0.01	0.01
3937.01	1200	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.01
4265.09	1300	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.01
4593.18	1400	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01
4921.26	1500	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
5249.34	1600	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	4.69E-03
5577.43	1700	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	4.44E-03
5905.51	1800	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	4.95E-03	4.11E-03
6233.60	1900	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	4.59E-03	3.80E-03
6561.68	2000	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	4.25E-03	3.52E-03

S-2. Screening Threshold Values Development

Table 7. 1 Hour dispersion values averaged over seven metropolitan counties ($\mu\text{g}/\text{m}^3$ per lb/hr)

Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
16.40	5	15265.97	7581.03	3800.91	2228.64	1300.90	887.76	673.47	451.02	296.57	178.43	94.21	39.04	21.45
32.81	10	16604.67	9133.37	4730.94	2787.88	1626.91	1091.66	765.73	546.88	360.76	212.83	108.72	43.03	22.90
49.21	15	14913.69	8807.10	4627.97	2724.69	1597.00	1060.93	722.20	522.42	369.48	237.12	122.54	47.22	24.63
65.62	20	7627.64	7243.62	4347.90	2608.41	1541.32	1029.68	690.91	500.57	353.73	231.37	131.60	51.36	26.39
82.02	25	4980.69	3198.96	2612.10	1794.60	1313.08	927.07	642.39	480.89	342.16	224.00	129.75	55.15	28.10
114.83	35	3835.28	2583.66	1693.61	1167.01	833.77	608.67	396.11	257.21	285.35	210.69	123.50	57.09	31.17
164.04	50	2752.64	1963.06	1330.53	941.02	689.77	530.87	366.99	254.08	167.88	116.53	114.18	53.47	31.32
246.06	75	1880.65	1420.57	1017.55	732.11	544.35	423.76	300.69	233.40	162.30	100.24	56.62	50.86	29.84
328.08	100	1315.34	1103.33	825.96	599.86	453.77	352.13	247.74	200.30	146.76	95.22	54.34	27.75	28.52
492.13	150	590.39	601.79	530.27	399.78	323.77	258.51	181.10	148.32	114.38	80.92	48.04	23.47	13.66
656.17	200	320.89	332.77	333.74	262.92	230.24	194.72	142.57	121.04	91.59	67.36	42.73	21.81	12.98
820.21	250	215.28	205.41	211.06	174.02	163.04	145.64	110.85	98.44	77.20	56.69	37.62	20.29	12.39
984.25	300	166.04	147.65	145.94	124.11	117.70	109.59	86.64	80.33	65.69	48.75	33.27	18.83	11.87
1148.29	350	134.77	115.50	110.30	96.44	90.18	84.24	68.50	65.95	56.06	43.44	29.55	17.36	11.33
1312.34	400	113.51	96.36	89.72	79.89	73.48	67.78	55.00	54.61	48.44	39.22	26.60	16.01	10.75
1476.38	450	96.24	81.75	75.61	68.39	62.19	56.41	45.24	45.33	41.88	35.31	24.41	14.76	10.13
1640.42	500	83.73	71.37	65.86	60.33	54.55	49.04	38.69	38.30	36.56	31.96	22.64	13.66	9.54
1804.46	550	71.71	61.38	56.65	52.43	47.58	42.66	33.22	32.19	31.13	28.28	20.55	12.34	8.75
1968.50	600	63.54	54.61	50.28	46.99	42.99	38.64	29.90	28.32	27.30	25.66	19.23	11.52	8.24
2132.55	650	58.27	50.21	46.24	43.52	40.06	36.10	27.90	26.11	24.81	24.01	18.55	11.18	7.99
2296.59	700	52.62	45.40	42.07	39.82	36.84	33.27	25.60	23.72	22.11	21.91	17.46	10.63	7.56
2460.63	750	48.19	41.71	38.72	36.78	34.20	31.02	23.82	21.72	19.90	20.03	16.47	10.13	7.17
2624.67	800	42.12	36.47	34.08	32.48	30.37	27.71	21.30	19.20	17.08	17.30	14.72	9.18	6.47
2788.71	850	41.15	35.74	33.60	32.13	30.17	27.68	21.36	19.15	16.48	16.71	14.69	9.29	6.55
2952.76	900	37.17	32.33	30.42	29.19	27.52	25.40	19.74	17.78	14.81	14.87	13.49	8.67	6.14
3116.80	950	35.65	31.03	29.13	28.01	26.53	24.62	19.28	17.58	14.10	14.01	13.08	8.57	6.08

S-2. Screening Threshold Values Development

Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
3280.84	1000	33.07	28.78	27.06	26.11	24.85	23.20	18.23	16.83	13.41	12.79	12.33	8.26	5.87
3608.92	1100	29.03	25.27	23.75	23.03	22.09	20.83	16.57	15.57	12.32	10.89	10.99	7.70	5.48
3937.01	1200	25.92	22.62	21.29	20.75	20.03	19.02	15.25	14.50	11.51	9.24	9.80	7.22	5.16
4265.09	1300	23.46	20.52	19.33	18.88	18.30	17.49	14.10	13.52	10.84	8.20	8.73	6.81	4.88
4593.18	1400	21.38	18.80	17.65	17.26	16.79	16.11	13.07	12.65	10.28	7.49	7.78	6.43	4.62
4921.26	1500	19.50	17.17	16.22	15.89	15.49	14.93	12.12	11.93	9.69	6.95	6.89	6.07	4.41
5249.34	1600	17.36	15.29	14.52	14.24	13.93	13.47	11.01	10.97	8.92	6.38	5.92	5.58	4.09
5577.43	1700	16.43	14.48	13.79	13.55	13.29	12.90	10.59	10.62	8.76	6.23	5.41	5.40	4.03
5905.51	1800	15.21	13.41	12.74	12.55	12.35	12.04	9.93	10.07	8.36	6.03	4.88	5.10	3.88
6233.60	1900	14.20	12.53	11.88	11.71	11.53	11.28	9.34	9.59	7.97	5.81	4.46	4.80	3.73
6561.68	2000	13.24	11.68	11.14	10.99	10.84	10.63	8.82	9.13	7.64	5.59	4.08	4.50	3.59

Table 8. 24 Hour dispersion values averaged over seven metropolitan counties ($\mu\text{g}/\text{m}^3$ per lb/hr)

Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
16.40	5	3470.53	2241.06	1244.39	737.63	444.36	291.12	210.37	112.83	73.46	43.76	22.71	9.29	5.16
32.81	10	3012.56	2030.31	1178.01	703.95	438.02	291.52	211.26	113.79	74.31	44.14	22.94	9.33	5.15
49.21	15	2349.13	1631.99	965.53	578.82	366.70	247.43	180.19	97.62	69.85	44.36	23.16	9.39	5.15
65.62	20	1107.15	1214.62	800.92	488.44	312.65	211.00	153.09	82.78	60.03	40.60	23.20	9.44	5.16
82.02	25	662.23	496.41	441.08	312.39	239.60	178.51	134.05	73.07	52.79	35.89	21.85	9.49	5.16
114.83	35	462.58	343.42	250.61	186.39	139.58	104.24	77.55	40.51	40.10	29.53	18.10	9.14	5.15
164.04	50	312.60	233.18	169.38	133.15	105.17	84.27	67.53	41.73	27.32	17.30	14.70	7.51	4.77
246.06	75	201.25	155.05	111.41	89.13	72.01	60.15	50.81	36.15	25.85	16.29	8.31	6.04	3.83
328.08	100	140.49	116.69	83.98	67.22	54.12	45.57	39.07	29.41	22.00	14.87	8.42	3.80	3.29
492.13	150	69.88	67.60	53.31	43.49	35.48	29.71	25.37	19.90	15.88	11.63	7.28	3.43	1.84
656.17	200	41.42	43.15	36.94	30.71	25.60	21.76	18.76	14.91	11.84	9.03	6.04	3.16	1.83

S-2. Screening Threshold Values Development

Distance to receptor in feet	Distance to receptor in meters	Stack height at 10 ft (3.05 m)	Stack height at 15 ft (4.57 m)	Stack height at 20 ft (6.10 m)	Stack height at 25 ft (7.62 m)	Stack height at 30 ft (9.14 m)	Stack height at 35 ft (10.67 m)	Stack height at 40 ft (12.19 m)	Stack height at 50 ft (15.24 m)	Stack height at 60 ft (18.29 m)	Stack height at 75 ft (22.86 m)	Stack height at 100 ft (30.48 m)	Stack height at 150 ft (45.72 m)	Stack height at 200 ft (60.96 m)
820.21	250	28.38	29.70	26.89	22.94	19.53	16.64	14.38	11.52	9.36	7.19	5.00	2.80	1.73
984.25	300	21.39	22.19	20.47	18.00	15.58	13.37	11.54	9.14	7.66	5.94	4.19	2.47	1.59
1148.29	350	16.85	17.37	16.20	14.59	12.87	11.10	9.54	7.39	6.34	5.05	3.56	2.18	1.45
1312.34	400	13.90	14.31	13.38	12.25	10.93	9.49	8.13	6.17	5.32	4.37	3.10	1.94	1.33
1476.38	450	11.50	11.88	11.19	10.37	9.34	8.17	7.03	5.27	4.50	3.81	2.75	1.73	1.21
1640.42	500	9.79	10.13	9.57	8.96	8.16	7.22	6.25	4.61	3.89	3.35	2.46	1.55	1.10
1804.46	550	8.24	8.57	8.12	7.66	7.04	6.30	5.50	4.04	3.32	2.89	2.17	1.37	0.99
1968.50	600	7.15	7.44	7.06	6.70	6.22	5.64	4.98	3.70	2.94	2.57	1.97	1.25	0.91
2132.55	650	6.44	6.72	6.40	6.12	5.72	5.23	4.67	3.51	2.74	2.36	1.86	1.18	0.86
2296.59	700	5.75	6.00	5.73	5.50	5.17	4.76	4.28	3.26	2.52	2.13	1.71	1.10	0.80
2460.63	750	5.18	5.43	5.19	4.99	4.72	4.37	3.95	3.04	2.33	1.91	1.59	1.03	0.74
2624.67	800	4.46	4.67	4.49	4.34	4.12	3.83	3.49	2.71	2.07	1.66	1.40	0.91	0.66
2788.71	850	4.31	4.52	4.36	4.22	4.02	3.76	3.45	2.71	2.06	1.61	1.37	0.91	0.65
2952.76	900	3.86	4.04	3.90	3.79	3.62	3.40	3.14	2.50	1.90	1.45	1.25	0.84	0.60
3116.80	950	3.65	3.83	3.70	3.59	3.45	3.25	3.02	2.44	1.86	1.38	1.18	0.82	0.59
3280.84	1000	3.35	3.52	3.40	3.31	3.19	3.02	2.82	2.31	1.78	1.30	1.10	0.77	0.56
3608.92	1100	2.90	3.04	2.94	2.88	2.78	2.66	2.50	2.09	1.64	1.17	0.97	0.70	0.51
3937.01	1200	2.55	2.68	2.60	2.55	2.48	2.38	2.25	1.92	1.52	1.06	0.85	0.64	0.47
4265.09	1300	2.28	2.39	2.32	2.28	2.23	2.15	2.04	1.76	1.42	0.98	0.75	0.59	0.44
4593.18	1400	2.05	2.15	2.08	2.05	2.00	1.94	1.85	1.61	1.32	0.92	0.67	0.55	0.40
4921.26	1500	1.84	1.93	1.88	1.85	1.82	1.76	1.69	1.49	1.24	0.86	0.60	0.50	0.38
5249.34	1600	1.63	1.71	1.67	1.65	1.62	1.57	1.51	1.35	1.13	0.79	0.53	0.46	0.35
5577.43	1700	1.53	1.60	1.57	1.55	1.52	1.49	1.44	1.29	1.09	0.77	0.50	0.44	0.34
5905.51	1800	1.40	1.47	1.44	1.42	1.41	1.38	1.33	1.21	1.03	0.74	0.46	0.41	0.32
6233.60	1900	1.30	1.36	1.33	1.32	1.30	1.28	1.24	1.13	0.98	0.71	0.44	0.38	0.30
6561.68	2000	1.20	1.26	1.23	1.22	1.21	1.19	1.15	1.06	0.92	0.68	0.41	0.35	0.28

Screening threshold values

Once MPCA staff completed the modeling and averaged the model dispersion values, the next step was to evaluate the inhalation health benchmarks (IHBs) that the MPCA staff used to calculate the screening threshold values for each individual air toxic. IHBs have the correct units to result in a threshold value that is in units (lb/hr or ton/yr) that can then be compared to hourly and annual emission rates in the same units (lb/hr or ton/yr). Some air toxics do have an oral value, but for the purposes of this rule and screening threshold analysis only the inhalation values are used. The next sections discuss how the MPCA staff selected which IHBs to use, calculated the screening threshold values, and summarized the screening threshold values.

Inhalation Health Benchmarks

MPCA staff collected IHBs from various resources and MPCA staff used IHBs to calculate the screening threshold values for each air toxic. MPCA staff used IHBs that are cancer values based on inhalation unit risks (IURs) or noncancer reference concentrations (RfCs). RfCs are an estimate of the continuous inhalation exposure to the human population. The IUR is an estimate of the increased cancer risk from inhalation exposure for a lifetime. The documentation for the IHBs can be found in Sonar Exhibit 3.

MCPA staff used either cancer values or RfCs for the annual (or chronic) screening thresholds value, given the availability. If a chemical has both a cancer value and a reference concentration, then the MPCA staff used the lower value. RfCs used to calculate the annual screening threshold value are denoted with the subscript chronic (RfC_{chronic}).

Acute thresholds are based on 1-hr or 24-hr toxicity data. These are evaluated against the 1-hr or 24-hr dispersion values and are denoted with the subscript acute (RfC_{acute}).

MPCA staff used a variety of resources to collect IHB data, which included the Agency for Toxic Substances and Disease Registry (ATSDR), California Office of Environmental Health Hazard Assessment (CAL EPA), Integrated Risk Information System (IRIS), Minnesota Department of Health air guidance values, and Provisional Peer-Reviewed Toxicity Values (PPRTV).

Agency for Toxic Substances and Disease Registry

The Agency for Toxic Substances and Disease Registry (ATSDR) is an environmental public health agency overseen by the U.S. Department of Health and Human Services. ATSDR has developed Minimal Risk Levels (MRLs) which are a prediction of how much someone can be exposed to a chemical without detectable health risks⁴. MRLs are developed for health effects other than cancer and do not mean that health problems will occur if exposed to levels above the MRLs.

MRLs are derived for three different time periods: acute (about 1 to 14 days), intermediate (from 15-364 days), and chronic (exposure for more than 364 days). MPCA staff used the acute and chronic MRLs for the hourly and annual screening threshold values.

⁴ Minimal Risk Levels (MRLs). Retrieved from <https://www.atsdr.cdc.gov/minimal-risk-levels/about/index.html>

California Office of Environmental Health Hazard Assessment

The California Office of Environmental Health Hazard Assessment (CAL EPA) is the lead state agency for the assessment of health risks posed by environmental contaminants⁵. Part of CAL EPA's work is to develop reference exposure levels (RELs) and unit risk factors.

CAL EPA's RELs are also developed for different time durations; acute (hourly), intermediate, and chronic (continuous exposure over a lifetime). Unit risk factors look at the lifetime continuous exposure to a carcinogen. Acute RELs, chronic RELs, and unit risk factor were used to calculate screening threshold values.

Integrated Risk Information System

The U.S. EPA Integrated Risk Information System's (IRIS) mission is to identify and characterize the health hazards of chemicals found in the environment⁶. IRIS assessments can cover a chemical, a group of related chemicals, or a complex mixture.

IRIS assessments derive toxicity values including RfCs, and IURs. MPCA staff used RfCs to calculate hourly and annual screening threshold values, and IURs to calculate the annual screening thresholds values.

Minnesota Department of Health

The Minnesota Department of Health (MDH) develops air guidance values to evaluate the potential human health risks from exposures to chemicals in ambient air⁷. MDH has developed different air guidance values which include Health Based Values (HBVs), Risk Assessment Advice (RAA), and Volatile Organic Compounds (VOCs) toxicity values.

Air values from MDH are either a RfC or an IUR. RfCs are developed for different time durations: acute_{1h} (1 hour), acute_{24h} (24 hrs), intermediate (greater than 24 hours to 1 year), and chronic (greater than 1 year to lifetime). IURs cover a lifetime, which is between 0 to 70 years. MPCA staff used MDH's HBV, RAA, and VOC RfCs and IURs to calculate the hourly and annual screening threshold values.

Provisional Peer-Reviewed Toxicity Values

The Provisional Peer-Reviewed Toxicity Value (PPRTV) program's mission is to protect human health and the environment by identifying and characterizing health hazards and by providing toxicity information and toxicity values for chemicals of concern to the Superfund Program⁸.

PPRTV assessments develop toxicity values that include inhalation reference concentrations (p-RfCs), and provisional inhalation unit risks (p-IURs). MPCA staff used both p-RfCs and p-IURS to calculate annual screening threshold values.

⁵ OEHHA. Retrieved from <https://oehha.ca.gov/>

⁶ Basic Information About Integrated Risk Information System. Retrieved from <https://www.epa.gov/iris/basic-information-about-integrated-risk-information-system>.

⁷ Air Guidance Values. Retrieved from <https://www.health.state.mn.us/communities/environment/risk/guidance/air/table.html>

⁸ Basic Information About Provisional Peer-Reviewed Toxicity Values (PPRTVs). Retrieved from <https://www.epa.gov/pprtv/basic-information-about-provisional-peer-reviewed-toxicity-values-pprtvs>

Grouped compounds

Some air toxics that are required to be reported through emissions inventory do not have an IHB, but are a part of a compound group. For this reason, MPCA staff has developed a way for these air toxics to be grouped in the STRATA spreadsheet. For instance, antimony trichloride (CAS # 10025-91-9) does not have an IHB associated with it, but it is part of the Antimony Compounds. Since antimony trichloride is included in the Antimony Compounds, the emissions from antimony trichloride can be grouped along with other Antimony air toxics that don't have an IHB and then are evaluated as a group as Antimony Compounds. In the case of metal grouped compounds, there is a conversion factor applied to individual air toxics that do not have an IHB and are being grouped in a metal compound. For example, antimony trichloride has a conversion factor of 0.534 applied to any antimony trichloride emissions reported. The conversion factors are found by taking the molecular mass of the metal divided by the mass of the specific air toxics. For this example, antimony has a molecular mass of 121.76 g/mol and antimony trichloride has a molecular mass of 228.12 g/mol. Given this information $(121.76 \text{ g/mol} / 228.12 \text{ g/mol}) = 0.534$. For grouped compounds that are not metals, such as glycol ethers, polychlorinated biphenyls, and polycyclic organic matter (POM), the conversion factor is assumed to be 1. These air toxics that do not have an IHB are not listed in this document, but are included in the Screening Threshold for Regulated Air Toxics Analysis (STRATA) spreadsheet, along with the conversion factors.

List of values

Tables 9 and 10 below show the values the MPCA staff used to calculate the hourly and annual screening threshold values and their sources. Table 9 includes values (RfC_{acute}) that the MPCA used to calculate the hourly screening threshold values. Table 10 includes the RfC_{chronic} and cancer values that the MPCA staff used to calculate the annual screening threshold values. Additionally, Table 10 includes information on whether the chemical needs an age dependent adjustment factor (ADAF) applied to it. The ADAFs are only applied to cancer values. MPCA staff applied ADAFs when there is an increased susceptibility to cancer from early-life exposures to linear carcinogens in the absence of chemical-specific data. The equations in the next section will show how the MPCA staff calculated these screening threshold values given the different IHBs and modeled dispersion values.

Table 9. List of RfC_{acute} values

CAS number	Air toxic	HAP	RfC_{acute} value ($\mu\text{g}/\text{m}^3$)	Source	Using 1-hr or 24-hr dispersion value
75-07-0	Acetaldehyde	x	470	CAL EPA	1-hr
67-64-1	Acetone		19000	ATSDR	24-hr
107-02-8	Acrolein	x	5	MDH HBV	1-hr
79-10-7	Acrylic acid	x	6000	CAL EPA	1-hr
---	Aldehydes		50	MDH HBV	1-hr
7664-41-7	Ammonia		11800	ATSDR	24-hr
7440-36-0	Antimony	x	1	ATSDR	24-hr
ANTIMONY- COMPS	Antimony Compounds	x	1	ATSDR	24-hr
7440-38-2	Arsenic	x	0.2	CAL EPA	1-hr
ARSENIC-COMPS	Arsenic Compounds	x	0.2	CAL EPA	1-hr
1327-53-3	Arsenic (V) oxide	x	0.2	CAL EPA	1-hr

CAS number	Air toxic	HAP	RfC _{acute} value (ug/m ³)	Source	Using 1-hr or 24-hr dispersion value
1327-53-3	Arsenic Trioxide	x	0.2	CAL EPA	1-hr
7784-42-1	Arsine	x	0.2	CAL EPA	1-hr
71-43-2	Benzene	x	30	MDH HBV	24-hr
100-44-7	Benzyl chloride	x	240	CAL EPA	1-hr
74-83-9	Bromomethane	x	3900	CAL EPA	1-hr
106-94-5	Bromopropane, 1-	x	100	MDH HBV	24-hr
106-99-0	Butadiene, 1,3-	x	660	CAL EPA	1-hr
111-76-2	Butyl Cellosolve (ethylene glycol monobutyl ether)		29000	ATSDR	24-hr
7440-43-9	Cadmium	x	0.03	ATSDR	24-hr
CADMIUM-COMPS	Cadmium Compounds	x	0.03	ATSDR	24-hr
1306-19-0	Cadmium oxide	x	0.03	ATSDR	24-hr
105-60-2	Caprolactam		50	CAL EPA	1-hr
75-15-0	Carbon disulfide	x	600	ATSDR	24-hr
56-23-5	Carbon tetrachloride	x	1900	CAL EPA	1-hr
463-58-1	Carbonyl sulfide	x	660	CAL EPA	1-hr
111-15-9	Cellosolve Acetate (ethylene glycol monoethyl ether acetate)	x	140	CAL EPA	1-hr
7782-50-5	Chlorine	x	170	ATSDR	24-hr
67-66-3	Chloroform	x	5	ATSDR	24-hr
7440-48-4	Cobalt	x	0.3	ATSDR	24-hr
COBALT-COMPS	Cobalt Compounds	x	0.3	ATSDR	24-hr
7440-50-8	Copper		100	CAL EPA	1-hr
COPPER-COMPS	Copper Compounds		100	CAL EPA	1-hr
57-12-5	Cyanide (Cyanide ion, Inorganic cyanides, Isocyanide)	x	340	CAL EPA	1-hr
CYANIDE-COMPS	Cyanide Compounds	x	340	CAL EPA	1-hr
106-46-7	Dichlorobenzene(p), 1,4-	x	12000	ATSDR	24-hr
25321-22-6	Dichlorobenzenes		12000	ATSDR	24-hr
156-60-5	Dichloroethylene, trans-1,2-		12000	ATSDR	24-hr
62-73-7	Dichlorvos	x	18	ATSDR	24-hr
123-91-1	Dioxane, 1,4- (1,4-Diethylene dioxide)	x	7200	ATSDR	24-hr
106-89-8	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	x	1300	CAL EPA	1-hr
110-80-5	Ethoxyethanol, 2- (ethylene glycol monoethyl ether)	x	370	CAL EPA	1-hr
100-41-4	Ethylbenzene	x	21700	ATSDR	24-hr
75-00-3	Ethyl chloride (Chloroethane)	x	34000	ATSDR	24-hr
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	x	400	ATSDR	24-hr

CAS number	Air toxic	HAP	RfC _{acute} value (ug/m ³)	Source	Using 1-hr or 24-hr dispersion value
107-21-1	Ethylene glycol	x	2000	ATSDR	24-hr
75-21-8	Ethylene oxide	x	50	MDH HBV	24-hr
50-00-0	Formaldehyde	x	50	MDH HBV	1-hr
GLYCOL ETHERS-COMPS	Glycol ethers	x	93	CAL EPA	1-hr
67-72-1	Hexachloroethane	x	58000	ATSDR	24-hr
822-06-0	Hexamethylene-1,6-diisocyanate	x	0.3	CAL EPA	1-hr
110-54-3	Hexane	x	21000	ATSDR	24-hr
7647-01-0	Hydrochloric acid (hydrogen chloride)	x	2100	CAL EPA	1-hr
74-90-8	Hydrogen cyanide	x	340	CAL EPA	1-hr
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)	x	16	ATSDR	24-hr
7783-07-5	Hydrogen selenide	x	5	CAL EPA	1-hr
7783-06-4	Hydrogen sulfide		98	ATSDR	24-hr
7439-97-6	Mercury (elemental)	x	0.6	CAL EPA	1-hr
MERCURY-COMPS	Mercury Compounds	x	0.6	CAL EPA	1-hr
67-56-1	Methanol	x	28000	CAL EPA	1-hr
109-86-4	Methoxyethanol, 2- (ethylene glycol monomethyl ether EGME)	x	93	CAL EPA	1-hr
74-87-3	Methyl chloride (Chloromethane)	x	1000	ATSDR	24-hr
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	x	9000	IRIS	1-hr
78-93-3	Methyl ethyl ketone (2-Butanone)		2950	ATSDR	24-hr
1634-04-4	Methyl tert butyl ether	x	7200	ATSDR	24-hr
75-09-2	Methylene chloride (Dichloromethane)	x	2000	ATSDR	24-hr
101-68-8	Methylene diphenyl diisocyanate (MDI)	x	12	CAL EPA	1-hr
91-20-3	Naphthalene	x	200	MDH HBV	1-hr
7440-02-0	Nickel	x	0.2	CAL EPA	1-hr
373-02-4	Nickel Acetate	x	0.2	CAL EPA	1-hr
3333-67-3	Nickel Carbonate	x	0.2	CAL EPA	1-hr
13463-39-3	Nickel Carbonyl	x	0.2	CAL EPA	1-hr
NICKEL-COMPS	Nickel Compounds	x	0.2	CAL EPA	1-hr
12054-48-7	Nickel Hydroxide	x	0.2	CAL EPA	1-hr
1313-99-1	Nickel oxide	x	0.2	CAL EPA	1-hr
---	Nickel refinery dust	x	0.2	CAL EPA	1-hr
12035-72-2	Nickel Subsulfide (Ni3S2)	x	0.2	CAL EPA	1-hr
1271-28-9	Nickelocene	x	0.2	CAL EPA	1-hr
7697-37-2	Nitric acid		86	CAL EPA	1-hr
98-95-3	Nitrobenzene	x	500	ATSDR	24-hr
108-95-2	Phenol	x	5800	CAL EPA	1-hr

CAS number	Air toxic	HAP	RfC _{acute} value (ug/m ³)	Source	Using 1-hr or 24-hr dispersion value
75-44-5	Phosgene	x	4	CAL EPA	1-hr
9016-87-9	Polymeric diphenylmethane diisocyanate		12	CAL EPA	1-hr
151-50-8	Potassium cyanide	x	340	CAL EPA	1-hr
78-87-5	Propylene dichloride (1,2-Dichloropropane)	x	92	ATSDR	24-hr
75-56-9	Propylene oxide	x	3100	CAL EPA	1-hr
143-33-9	Sodium cyanide	x	340	CAL EPA	1-hr
100-42-5	Styrene	x	21000	ATSDR	24-hr
7664-93-9	Sulfuric acid (aerosol forms only)		120	CAL EPA	1-hr
127-18-4	Tetrachloroethylene (perchloroethylene)	x	41	ATSDR	24-hr
108-88-3	Toluene	x	7600	ATSDR	24-hr
584-84-9	Toluene-2,4-diisocyanate	x	2	CAL EPA	1-hr
26471-62-5	Toluenediisocyanate (mixed isomers)	x	0.07	ATSDR	24-hr
79-00-5	Trichloroethane, 1,1,2-	x	160	ATSDR	24-hr
79-01-6	Trichloroethylene (TCE)	x	2	MDH HBV	24-hr
96-18-4	Trichloropropane, 1,2,3-		6	ATSDR	24-hr
121-44-8	Triethylamine	x	2800	CAL EPA	1-hr
526-73-8	Trimethylbenzene, 1,2,3-		2400	CAL EPA	1-hr
95-63-6	Trimethylbenzene, 1,2,4-		2400	CAL EPA	1-hr
108-67-8	Trimethylbenzene, 1,3,5-		2400	CAL EPA	1-hr
7440-62-2	Vanadium		0.8	ATSDR	24-hr
VANADIUM-COMPS	Vanadium Compounds		0.8	ATSDR	24-hr
1314-62-1	Vanadium Pentoxide, (V2O5)		30	CAL EPA	1-hr
108-05-4	Vinyl acetate	x	3500	ATSDR	24-hr
75-01-4	Vinyl chloride	x	1300	ATSDR	24-hr
1330-20-7	Xylenes	x	8700	ATSDR	24-hr
108-38-3	Xylenes, m-	x	8700	ATSDR	24-hr
95-47-6	Xylenes, o-	x	8700	ATSDR	24-hr
106-42-3	Xylenes, p-	x	8700	ATSDR	24-hr

Table 10. List of RfC_{chronic} and cancer values (C)

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
75-07-0	Acetaldehyde	x	4.55	C	IRIS	N
60-35-5	Acetamide	x	5.00E-01	C	CAL EPA	Y
67-64-1	Acetone		2.00E+04	RfC _{chronic}	MDH VOC	
75-05-8	Acetonitrile	x	6.00E+01	RfC _{chronic}	IRIS	
53-96-3	Acetylaminofluorene, 2-	x	7.70E-03	C	CAL EPA	Y
107-02-8	Acrolein	x	0.4	RfC _{chronic}	MDH HBV	
79-06-1	Acrylamide	x	1.00E-01	C	IRIS	Y
79-10-7	Acrylic acid	x	1	RfC _{chronic}	IRIS	
107-13-1	Acrylonitrile	x	1.50E-01	C	IRIS	Y
---	Aldehydes	x	4.55	C	IRIS	N
309-00-2	Aldrin		2.04E-03	C	IRIS	Y
107-05-1	Allyl chloride	x	1	RfC _{chronic}	IRIS	
7429-90-5	Aluminum		5	RfC _{chronic}	PPRTV	
ALUMINUM-COMPOUNDS	Aluminum Compounds		5	RfC _{chronic}	PPRTV	
82-28-0	Amino-2-methylantraquinone, 1-	x	2.30E-01	C	CAL EPA	Y
117-79-3	Aminoanthraquinone, 2-	x	1.1	C	CAL EPA	Y
97-56-3	Aminoazotoluene, o- (C.I. Solvent Yellow 3)	x	9.00E-03	C	CAL EPA	Y
92-67-1	Aminobiphenyl, 4-	x	1.70E-03	C	CAL EPA	Y
7664-41-7	Ammonia		500	RfC _{chronic}	ATSDR	
62-53-3	Aniline	x	1	RfC _{chronic}	IRIS	
90-04-0	Anisidine, o-	x	2.50E-01	C	CAL EPA	Y
7440-36-0	Antimony	x	0.3	RfC _{chronic}	ATSDR	
ANTIMONY-COMPS	Antimony Compounds	x	0.3	RfC _{chronic}	ATSDR	
1309-64-4	Antimony trioxide	x	0.2	RfC _{chronic}	IRIS	
140-57-8	Aramite		1.4	C	IRIS	Y
7440-38-2	Arsenic	x	2.33E-03	C	IRIS	Y
ARSENIC-COMPS	Arsenic Compounds	x	2.33E-03	C	IRIS	Y
1303-28-2	Arsenic (V) oxide	x	2.33E-03	C	IRIS	Y
1327-53-3	Arsenic Trioxide	x	2.33E-03	C	IRIS	Y
7784-42-1	Arsine	x	2.33E-03	C	IRIS	Y
1332-21-4	Asbestos (units in fibers)	x	43	C	IRIS	Y
492-80-8	Auramine (C.I. Solvent Yellow 34)	x	4.00E-02	C	CAL EPA	Y
103-33-3	Azobenzene		3.23E-01	C	IRIS	Y
10294-40-3	Barium Chromate	x	9.01E-04	C	IRIS	Y
56-55-3	Benz[a]anthracene	x	9.09E-02	C	CAL EPA	Y

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
71-43-2	Benzene	x	0.8	C	MDH HBV	N
92-87-5	Benzidine	x	1.49E-04	C	IRIS	Y
205-82-3	Benzo(j)fluoranthene	x	9.09E-02	C	CAL EPA	Y
207-08-9	Benzo(k)fluoranthene	x	9.09E-02	C	CAL EPA	Y
50-32-8	Benzo[a]pyrene	x	2.00E-04	RfC _{chronic}	IRIS	
205-99-2	Benzo[b]fluoranthene	x	9.09E-02	C	CAL EPA	Y
100-44-7	Benzyl chloride	x	2.00E-01	C	MDH VOC	Y
7440-41-7	Beryllium	x	4.17E-03	C	IRIS	Y
BERYLLIUM-COMPS	Beryllium Compounds	x	4.17E-03	C	IRIS	Y
1304-56-9	Beryllium Oxide	x	4.17E-03	C	CAL EPA	Y
13510-49-1	Beryllium sulfate	x	1.20E-05	C	CAL EPA	Y
111-44-4	Bis(2-chloroethyl)ether	x	3.00E-02	C	IRIS	Y
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	x	4.2	C	CAL EPA	Y
542-88-1	Bis(chloromethyl)ether	x	1.61E-04	C	IRIS	Y
108-86-1	Bromobenzene		60	RfC _{chronic}	IRIS	
75-25-2	Bromoform	x	9.1	C	IRIS	Y
74-83-9	Bromomethane	x	4	RfC _{chronic}	MDH VOC	
106-94-5	Bromopropane, 1-	x	2	RfC _{chronic}	MDH HBV	
106-99-0	Butadiene, 1,3-	x	2.78E-01	C	MDH VOC	N
111-76-2	Butyl Cellosolve (ethylene glycol monobutyl ether)		1600	RfC _{chronic}	IRIS	
7440-43-9	Cadmium	x	5.56E-03	C	IRIS	Y
CADMIUM-COMPS	Cadmium Compounds	x	5.56E-03	C	IRIS	Y
1306-19-0	Cadmium Oxide	x	5.56E-03	C	IRIS	Y
13765-19-0	Calcium Chromate	x	9.01E-04	C	IRIS	Y
105-60-2	Caprolactam		2.2	RfC _{chronic}	CAL EPA	
133-06-2	Captan	x	15.2	C	CAL EPA	Y
75-15-0	Carbon disulfide	x	800	RfC _{chronic}	MDH VOC	
56-23-5	Carbon tetrachloride	x	1.7	C	MDH VOC	Y
463-58-1	Carbonyl sulfide	x	100	RfC _{chronic}	PPRTV	
111-15-9	Cellosolve Acetate (ethylene glycol monoethyl ether acetate)		60	RfC _{chronic}	PPRTV	
1306-38-3	Cerium Oxide		0.9	RfC _{chronic}	IRIS	
57-74-9	Chlordane	x	2.94E-02	C	CAL EPA	Y
12789-03-6	Chlordane, technical		1.00E-01	C	IRIS	Y
7782-50-5	Chlorine	x	0.15	RfC _{chronic}	ATSDR	
10049-04-4	Chlorine Dioxide (CLO2)		0.2	RfC _{chronic}	IRIS	

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
75-68-3	Chloro-1,1-difluoroethane, 1- (HCFC-142b)		50000	RfC _{chronic}	IRIS	
563-47-3	Chloro-2-methylpropene, 3-		2.50E-01	C	CAL EPA	Y
532-27-4	Chloroacetophenone, 2-	x	0.03	RfC _{chronic}	IRIS	
108-90-7	Chlorobenzene	x	50	RfC _{chronic}	MDH VOC	
510-15-6	Chlorobenzilate	x	3.17E-01	C	CAL EPA	Y
75-45-6	Chlorodifluoromethane (HCFC-22)		50000	RfC _{chronic}	IRIS	
67-66-3	Chloroform	x	4.30E-01	C	IRIS	Y
107-30-2	Chloromethyl Methyl Ether	x	1.45E-02	C	CAL EPA	Y
126-99-8	Chloroprene	x	3.30E-02	C	IRIS	Y
7738-94-5	Chromic acid	x	8.00E-04	C	IRIS	Y
1333-82-0	Chromic Trioxide	x	9.01E-04	C	IRIS	Y
7440-47-3	Chromium	x	9.01E-04	C	IRIS	Y
18540-29-9	Chromium (Hexavalent)	x	9.01E-04	C	IRIS	Y
CHROMVI-COMPS	Chromium VI Compounds	x	9.01E-04	C	IRIS	Y
218-01-9	Chrysene (Benzo(a)phenanthrene)	x	9.09E-01	C	CAL EPA	Y
10061-01-5	cis-1,3-Dichloropropene		2.5	C	MDH VOC	Y
8007-45-2	Coal Tar		1.61E-02	C	IRIS	Y
7440-48-4	Cobalt	x	1.10E-03	C	PPRTV	N
COBALT-COMPS	Cobalt Compounds	x	1.10E-03	C	PPRTV	N
1307-96-6	Cobalt (II) oxide	x	1.30E-03	C	CAL EPA	N
10124-43-3	Cobalt sulfate	x	1.00E-03	C	CAL EPA	N
---	Coke Oven Emissions	x	1.61E-02	C	IRIS	Y
108-39-4	Cresol, m-	x	600	RfC _{chronic}	CAL EPA	
95-48-7	Cresol, o-	x	600	RfC _{chronic}	CAL EPA	
106-44-5	Cresol, p-	x	600	RfC _{chronic}	CAL EPA	
1319-77-3	Cresols/Cresylic acid (isomers and mixture)	x	600	RfC _{chronic}	CAL EPA	
98-82-8	Cumene	x	400	RfC _{chronic}	IRIS	
57-12-5	Cyanide (Cyanide ion, Inorganic cyanides, Isocyanide)	x	0.8	RfC _{chronic}	IRIS	
CYANIDE-COMPS	Cyanide Compounds	x	0.8	RfC _{chronic}	IRIS	
110-82-7	Cyclohexane		6000	RfC _{chronic}	PPRTV	
101-80-4	Diaminodiphenyl ether, 4,4-	x	2.50E-01	C	CAL EPA	Y
226-36-8	Dibenz(a,h)acridine	x	9.09E-02	C	CAL EPA	Y
224-42-0	Dibenz(a,j)acridine	x	9.09E-02	C	CAL EPA	Y
53-70-3	Dibenz[a,h]anthracene	x	8.33E-03	C	CAL EPA	Y

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
192-65-4	Dibenzo(a,e)pyrene	x	9.09E-03	C	CAL EPA	Y
189-64-0	Dibenzo(a,h)pyrene	x	9.09E-04	C	CAL EPA	Y
191-30-0	Dibenzo(a,l)pyrene	x	9.09E-04	C	CAL EPA	Y
194-59-2	Dibenzo(c,g)carbazole, 7H-	x	9.09E-03	C	CAL EPA	Y
189-55-9	Dibenzo[a,i]pyrene	x	9.09E-04	C	CAL EPA	Y
96-12-8	Dibromo-3-chloropropane, 1,2-	x	1.67E-09	C	PPRTV	N
106-46-7	Dichlorobenzene(p), 1,4-	x	0.91	C	CAL EPA	Y
25321-22-6	Dichlorobenzenes		0.91	C	CAL EPA	Y
91-94-1	Dichlorobenzidene, 3,3-	x	2.90E-02	C	CAL EPA	Y
72-55-9	Dichlorodiphenyldichloroethylene (DDE)	x	0.10	C	CAL EPA	Y
50-29-3	Dichlorodiphenyltrichloroethane, p, p'- (DDT)		0.10	C	IRIS	Y
75-35-4	Dichloroethylene (1,1-) (Vinylidene chloride)	x	200	RfC _{chronic}	MDH VOC	
156-59-2	Dichloroethylene, cis-1,2-		40	RfC _{chronic}	PPRTV	
156-60-5	Dichloroethylene, trans-1,2-		20	RfC _{chronic}	MDH RAA	
542-75-6	Dichloropropene, 1,3-	x	2.5	C	IRIS	Y
62-73-7	Dichlorvos	x	0.12	C	CAL EPA	Y
111-42-2	Diethanolamine	x	0.2	RfC _{chronic}	PPRTV	
112-34-5	Diethylene Glycol Monobutyl Ether	x	0.1	RfC _{chronic}	MDH HBV	
111-90-0	Diethylene Glycol Monoethyl Ether	x	2	RfC _{chronic}	MDH HBV	
60-11-7	Dimethyl aminoazobenzene	x	7.70E-03	C	CAL EPA	Y
68-12-2	Dimethyl formamide	x	30	RfC _{chronic}	IRIS	
57-97-6	Dimethylbenz[a]anthracene, 7,12-	x	1.41E-04	C	CAL EPA	Y
79-44-7	Dimethylcarbamoyl Chloride	x	2.70E-03	C	CAL EPA	Y
42397-64-8	Dinitropyrene, 1,6- (BaP)	x	9.09E-04	C	CAL EPA	Y
42397-65-9	Dinitropyrene, 1,8- (BaP)	x	9.09E-03	C	CAL EPA	Y
121-14-2	Dinitrotoluene, 2,4-	x	0.11	C	CAL EPA	Y
123-91-1	Dioxane, 1,4- (1,4-Diethylene dioxide)	x	2	C	IRIS	Y
122-66-7	Diphenylhydrazine, 1,2-	x	4.55E-02	C	IRIS	Y
1937-37-7	Direct Black 38	x	4.76E-03	C	CAL EPA	Y
2602-46-2	Direct Blue 6	x	4.76E-03	C	CAL EPA	Y
16071-86-6	Direct Brown 95	x	5.26E-03	C	CAL EPA	Y
106-89-8	Epichlorohydrin (1-Chloro-2,3-epoxypropane)	x	1	RfC _{chronic}	IRIS	
106-88-7	Epoxybutane, 1,2-	x	20	RfC _{chronic}	IRIS	
110-80-5	Ethoxyethanol, 2- (ethylene glycol monoethyl ether)	x	200	RfC _{chronic}	IRIS	
140-88-5	Ethyl Acrylate	x	8	RfC _{chronic}	PPRTV	

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
100-41-4	Ethylbenzene	x	4	C	MDH VOC	N
51-79-6	Ethyl carbamate (Urethane)	x	3.40E-02	C	CAL EPA	Y
75-00-3	Ethyl chloride (Chloroethane)	x	4000	RfC _{chronic}	MDH VOC	
637-92-3	Ethyl tertiary-butyl ether (ETBE)		125	C	IRIS	Y
106-93-4	Ethylene dibromide (Dibromoethane)	x	1.70E-02	C	MDH VOC	Y
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	x	0.38	C	MDH VOC	Y
107-21-1	Ethylene glycol	x	400	RfC _{chronic}	CAL EPA	
75-21-8	Ethylene oxide	x	2.00E-03	C	MDH HBV	N
96-45-7	Ethylene thiourea	x	0.77	C	CAL EPA	Y
151-56-4	Ethyleneimine	x	5.26E-04	C	CAL EPA	Y
75-34-3	Ethylidene dichloride (1,1-Dichloroethane)	x	6.3	C	CAL EPA	Y
50-00-0	Formaldehyde	x	7	RfC _{chronic}	MDH HBV	
GLYCOL ETHERS-COMP	Glycol ethers	x	0.1	RfC _{chronic}	PPRTV	
76-44-8	Heptachlor	x	7.69E-03	C	IRIS	Y
35822-46-9	Heptachlorodibenzo-p-dioxin, 1,2,3,4,6,7,8-	x	2.50E-06	C	MDH RAA	N
67562-39-4	Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	x	2.50E-06	C	MDH RAA	N
55673-89-7	Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	x	2.50E-06	C	MDH RAA	N
118-74-1	Hexachlorobenzene	x	2.20E-02	C	IRIS	Y
87-68-3	Hexachlorobutadiene	x	0.45	C	IRIS	Y
608-73-1	Hexachlorocyclohexane (technical grade)	x	2.00E-02	C	IRIS	Y
319-84-6	Hexachlorocyclohexane, alpha-	x	5.60E-03	C	IRIS	Y
319-85-7	Hexachlorocyclohexane, beta-1,2,3,4,5,6-	x	1.90E-02	C	IRIS	Y
58-89-9	Hexachlorocyclohexane- Gamma Isomer	x	3.23E-02	C	CAL EPA	N
77-47-4	Hexachlorocyclopentadiene	x	0.20	RfC _{chronic}	IRIS	
39227-28-6	Hexachlorodibenzo-p-dioxin, 1,2,3,4,7,8-	x	2.50E-07	C	MDH RAA	N
57653-85-7	Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	x	7.69E-06	C	MDH RAA	N
19408-74-3	Hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-	x	7.69E-06	C	MDH RAA	N
70648-26-9	Hexachlorodibenzofuran, 1,2,3,4,7,8-	x	2.50E-07	C	MDH RAA	N
57117-44-9	Hexachlorodibenzofuran, 1,2,3,6,7,8-	x	2.50E-07	C	MDH RAA	N

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
72918-21-9	Hexachlorodibenzofuran, 1,2,3,7,8,9-	x	2.50E-07	C	MDH RAA	N
60851-34-5	Hexachlorodibenzofuran, 2,3,4,6,7,8-	x	2.50E-07	C	MDH RAA	N
67-72-1	Hexachloroethane	x	0.91	C	CAL EPA	Y
822-06-0	Hexamethylene-1,6-diisocyanate	x	0.01	RfC _{chronic}	IRIS	
110-54-3	Hexane	x	700	RfC _{chronic}	MDH VOC	
591-78-6	Hexanone-2		30	RfC _{chronic}	MDH VOC	
302-01-2	Hydrazine	x	2.04E-03	C	IRIS	Y
7647-01-0	Hydrochloric acid (hydrogen chloride)	x	20	RfC _{chronic}	IRIS	
74-90-8	Hydrogen cyanide	x	0.8	RfC _{chronic}	IRIS	
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)	x	14	RfC _{chronic}	CAL EPA	
7783-06-4	Hydrogen sulfide		2	RfC _{chronic}	IRIS	
193-39-5	Indeno(1,2,3-cd)pyrene	x	9.09E-02	C	CAL EPA	Y
78-59-1	Isophorone	x	2000	RfC _{chronic}	CAL EPA	
7439-92-1	Lead	x	0.83	C	CAL EPA	Y
301-04-2	Lead Acetate	x	0.13	C	CAL EPA	Y
7758-97-6	Lead Chromate	x	9.01E-04	C	IRIS	Y
LEAD-COMPS	Lead Compounds	x	0.83	C	IRIS	Y
7446-27-7	Lead Phosphate	x	0.83	C	CAL EPA	Y
1335-32-6	Lead Subacetate	x	0.91	C	CAL EPA	Y
108-31-6	Maleic anhydride	x	0.7	RfC _{chronic}	CAL EPA	
7439-96-5	Manganese	x	0.1	RfC _{chronic}	MDH RAA	
MANGANESE-COMPS	Manganese Compounds	x	0.1	RfC _{chronic}	MDH RAA	
7439-97-6	Mercury (elemental)	x	0.3	RfC _{chronic}	IRIS	
MERCURY-COMPS	Mercury Compounds	x	0.3	RfC _{chronic}	IRIS	
67-56-1	Methanol	x	20000	RfC _{chronic}	IRIS	
109-86-4	Methoxyethanol, 2- (ethylene glycol monomethyl ether EGME)	x	20	RfC _{chronic}	IRIS	
110-49-6	Methyl Cellosolve Acetate	x	1	RfC _{chronic}	PPRTV	
74-87-3	Methyl chloride (Chloromethane)	x	90	RfC _{chronic}	MDH VOC	
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	x	5000	RfC _{chronic}	MDH VOC	
78-93-3	Methyl ethyl ketone (2-Butanone)		3000	RfC _{chronic}	MDH VOC	
108-10-1	Methyl isobutyl ketone (Hexone)	x	3000	RfC _{chronic}	MDH VOC	
624-83-9	Methyl isocyanate	x	1	RfC _{chronic}	CAL EPA	
80-62-6	Methyl methacrylate	x	700	RfC _{chronic}	IRIS	
1634-04-4	Methyl tert butyl ether	x	38	C	IRIS	Y
56-49-5	Methylcholanthrene, 3-	x	1.59E-03	C	CAL EPA	Y
3697-24-3	Methylchrysene, 5-	x	9.09E-03	C	CAL EPA	Y

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
101-14-4	Methylene bis(2-chloroaniline), 4,4-	x	2.30E-02	C	CAL EPA	Y
75-09-2	Methylene chloride (Dichloromethane)	x	600	RfC _{chronic}	MDH VOC	
101-68-8	Methylene diphenyl diisocyanate (MDI)	x	0.6	RfC _{chronic}	IRIS	
101-77-9	Methylenedianiline, 4,4-	x	2.20E-02	C	CAL EPA	Y
90-12-0	Methylnaphthalene, 1-	x	3.00E-03	RfC _{chronic}	PPRTV	
90-94-8	Michler's ketone	x	4.00E-02	C	CAL EPA	Y
2385-85-5	Mirex		1.96E-03	C	CAL EPA	Y
684-93-5	N-Nitroso-N-methylurea	x	2.94E-04	C	CAL EPA	Y
924-16-3	N-Nitrosodi-n-butylamine		6.20E-03	C	IRIS	Y
55-18-5	N-Nitrosodiethylamine		2.30E-04	C	IRIS	Y
62-75-9	N-Nitrosodimethylamine	x	7.10E-04	C	IRIS	Y
86-30-6	N-Nitrosodiphenylamine	x	3.8	C	CAL EPA	Y
59-89-2	N-Nitrosomorpholine	x	5.30E-03	C	CAL EPA	Y
91-20-3	Naphthalene	x	9	RfC _{chronic}	MDH HBV	
7440-02-0	Nickel	x	1.40E-02	RfC _{chronic}	CAL EPA	
373-02-4	Nickel Acetate	x	1.40E-02	RfC _{chronic}	CAL EPA	
3333-67-3	Nickel Carbonate	x	1.40E-02	RfC _{chronic}	CAL EPA	
13463-39-3	Nickel Carbonyl	x	1.40E-02	RfC _{chronic}	CAL EPA	
NICKEL-COMPS	Nickel Compounds	x	1.40E-02	RfC _{chronic}	CAL EPA	
12054-48-7	Nickel Hydroxide	x	1.40E-02	RfC _{chronic}	CAL EPA	
1313-99-1	Nickel oxide	x	2.00E-02	RfC _{chronic}	CAL EPA	
---	Nickel refinery dust from the pyrometallurgical process	x	1.40E-02	RfC _{chronic}	CAL EPA	
12035-72-2	Nickel Subsulfide (Ni ₃ S ₂)	x	1.40E-02	RfC _{chronic}	CAL EPA	
1271-28-9	Nickelocene	x	1.40E-02	RfC _{chronic}	CAL EPA	
602-87-9	Nitroacenaphthene, 5-	x	2.70E-01	C	CAL EPA	Y
98-95-3	Nitrobenzene	x	0.25	C	IRIS	N
7496-02-8	Nitrochrysene, 6-	x	9.09E-04	C	CAL EPA	Y
1836-75-5	Nitrofen		0.44	C	CAL EPA	Y
607-57-8	Nitrofluorene, 2-	x	9.09E-01	C	CAL EPA	Y
79-46-9	Nitropropane, 2-	x	20	RfC _{chronic}	IRIS	
5522-43-0	Nitropyrene, 1-	x	9.09E-02	C	CAL EPA	Y
57835-92-4	Nitropyrene, 4-	x	9.09E-02	C	CAL EPA	Y
156-10-5	Nitrosodiphenylamine, p-		1.6	C	MDH RAA	Y
3268-87-9	Octachlorodibenzo-p-dioxin, 1,2,3,4,6,7,8,9-	x	8.33E-05	C	MDH RAA	N

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
39001-02-0	Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	x	8.33E-05	C	MDH RAA	N
74472-37-0	PCB 114 (2,3,4,4,5 Pentachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
31508-00-6	PCB 118 (2,3,4,4,5 Pentachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
65510-44-3	PCB 123 (2,3,4,4,5 Pentachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
57465-28-8	PCB 126 (3,3,4,4,5 Pentachlorobiphenyl)	x	2.60E-06	C	CAL EPA	Y
38380-08-4	PCB 156 (2,3,3,4,4,5 Hexachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
69782-90-7	PCB 157 (2,3,3,4,4,5 Hexachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
52663-72-6	PCB 167 (2,3,4,4,5,5 Hexachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
32774-16-6	PCB 169 (3,3,4,4,5,5 Hexachlorobiphenyl)	x	9.09E-06	C	CAL EPA	Y
39635-31-9	PCB 189 (2,3,3,4,4,5,5 Heptachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
32598-13-3	PCB 77 (3,3,4,4-Tetrachlorobiphenyl)	x	2.60E-03	C	CAL EPA	Y
70362-50-4	PCB 81 (3,4,4,5 Tetrachlorobiphenyl)	x	9.09E-04	C	CAL EPA	Y
32598-14-4	PCB 105 (2,3,3,4,4 Pentachlorobiphenyl)	x	9.00E-03	C	CAL EPA	Y
40321-76-4	Pentachlorodibenzo-p-dioxin, 1,2,3,7,8-	x	2.50E-08	C	CAL EPA	N
57117-41-6	Pentachlorodibenzofuran, 1,2,3,7,8-	x	8.33E-07	C	MDH RAA	N
57117-31-4	Pentachlorodibenzofuran, 2,3,4,7,8-	x	8.33E-08	C	MDH RAA	N
87-86-5	Pentachlorophenol	x	1.96	C	CAL EPA	Y
375-73-5	Perfluorobutane sulfonic acid (PFBS)		0.30	RfC _{chronic}	MDH RAA	
375-22-4	Perfluorobutanoic acid (PFBA)		10	RfC _{chronic}	MDH RAA	
355-46-4	Perfluorohexanesulfonic acid (PFHxS)		0.034	RfC _{chronic}	MDH RAA	
307-24-4	Perfluorohexanoic acid (PFHxA)		0.5	RfC _{chronic}	MDH RAA	
335-67-1	Perfluorooctanoic acid (PFOA)		0.063	RfC _{chronic}	MDH RAA	
1763-23-1	Perfluorooctane sulfonic acid (PFOS)		0.011	RfC _{chronic}	MDH RAA	
198-55-0	Perylene	x	2.00E-03	RfC _{chronic}	PPRTV	
108-95-2	Phenol	x	200	RfC _{chronic}	CAL EPA	
132-27-4	Phenylphenate, Sodium, o-	x	11.6	C	CAL EPA	Y
75-44-5	Phosgene	x	0.3	RfC _{chronic}	IRIS	
7803-51-2	Phosphine	x	0.3	RfC _{chronic}	IRIS	
7664-38-2	Phosphoric acid		10	RfC _{chronic}	IRIS	

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
85-44-9	Phthalic anhydride	x	20	RfC _{chronic}	CAL EPA	
36355-01-8	Polybrominated Biphenyls	x	1.20E-03	C	CAL EPA	Y
1336-36-3	Polychlorinated biphenyls (Aroclors unspciated)	x	0.1	C	IRIS	Y
POM-COMPS	Polycyclic Organic Matter (POM)	x	0.33	C	MDH RAA	Y
9016-87-9	Polymeric diphenylmethane diisocyanate		0.60	RfC _{chronic}	IRIS	
3761-53-3	Ponceau MX (C.I. Food Red 5)	x	7.69	C	CAL EPA	Y
151-50-9	Potassium cyanide	x	0.8	RfC _{chronic}	IRIS	
1120-71-4	Propane sultone, 1,3-	x	1.40E-02	C	CAL EPA	Y
57-57-8	Propiolactone, beta-	x	2.50E-03	C	CAL EPA	Y
123-38-6	Propionaldehyde	x	8	RfC _{chronic}	IRIS	
115-07-1	Propylene		3000	RfC _{chronic}	MDH ISV	
78-87-5	Propylene dichloride (1,2-Dichloropropane)	x	2.7	C	PPRTV	Y
107-98-2	Propylene Glycol Monomethyl Ether		2000	RfC _{chronic}	MDH VOC	
75-56-9	Propylene oxide	x	2.7	C	IRIS	Y
930-55-2	Pyrrolidine, 1-Nitroso-		1.64E-02	C	IRIS	Y
7782-49-2	Selenium	x	20	RfC _{chronic}	CAL EPA	
SELENIUM-COMPS	Selenium Compounds	x	20	RfC _{chronic}	CAL EPA	
7446-34-6	Selenium Sulfide	x	20	RfC _{chronic}	CAL EPA	
7631-86-9	Silica (crystalline, respirable, PM4)		3	RfC _{chronic}	MDH HBV	
143-33-9	Sodium cyanide	x	0.8	RfC _{chronic}	IRIS	
10588-01-9	Sodium Dichromate	x	9.01E-04	C	IRIS	Y
7789-06-2	Strontium chromate	x	9.01E-04	C	IRIS	Y
100-42-5	Styrene	x	9.00E+02	RfC _{chronic}	MDH VOC	
96-09-3	Styrene oxide	x	0.22	C	CAL EPA	Y
7664-93-9	Sulfuric acid (aerosol forms only)		1	RfC _{chronic}	CAL EPA	
540-88-5	Tert-Butyl Acetate		7.7	C	CAL EPA	N
75-65-0	tert-Butyl Alcohol (tBA)		5000	RfC _{chronic}	IRIS	
1746-01-6	Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	x	2.50E-08	C	MDH RAA	N
51207-31-9	Tetrachlorodibenzofuran, 2,3,7,8-	x	2.50E-07	C	MDH RAA	N
79-34-5	Tetrachloroethane, 1,1,2,2-	x	0.17	C	CAL EPA	Y
127-18-4	Tetrachloroethylene (Perchloroethylene)	x	2	C	MDH RAA	N
811-97-2	Tetrafluoroethane, 1,1,2,2-		8.00E+04	RfC _{chronic}	IRIS	
109-99-9	Tetrahydrofuran		2000	RfC _{chronic}	MDH VOC	
101-61-1	Tetramethyldiaminodiphenylmethane	x	0.77	C	CAL EPA	Y
139-65-1	Thiodianiline, 4,4'-	x	2.33E-03	C	CAL EPA	Y

CAS number	Air toxic	HAP	RfC _{chronic} or cancer value (ug/m ³)	RfC _{chronic} or C	Source	ADAF applied?
62-56-6	Thiourea		0.48	C	CAL EPA	Y
7550-45-0	Titanium Tetrachloride	x	0.1	RfC _{chronic}	ATSDR	
108-88-3	Toluene	x	4000	RfC _{chronic}	MDH VOC	
584-84-9	Toluene-2,4-diisocyanate	x	7.00E-02	RfC _{chronic}	IRIS	
26471-62-5	Toluenediisocyanate (mixed isomers)		7.00E-02	RfC _{chronic}	IRIS	
95-80-7	Toluene diamine, 2,4-	x	9.1E-03	C	CAL EPA	Y
95-53-4	Toluidine, o- (Methylaniline, 2-)	x	0.2	C	CAL EPA	Y
8001-35-2	Toxaphene (chlorinated camphene)	x	3.10E-02	C	IRIS	Y
10061-02-6	trans-1,3-Dichloropropene		2.5	C	MDH VOC	Y
120-82-1	Trichlorobenzene, 1,2,4-	x	2	RfC _{chronic}	MDH VOC	
79-00-5	Trichloroethane, 1,1,2-	x	0.2	RfC _{chronic}	MDH VOC	
79-01-6	Trichloroethylene (TCE)	x	2	C	MDH HBV	N
75-69-4	Trichlorofluoromethane (CFC-11)		1000	RfC _{chronic}	MDH VOC	
88-06-2	Trichlorophenol, 2,4,6-	x	3.2	C	IRIS	Y
96-18-4	Trichloropropane, 1,2,3-		0.3	RfC _{chronic}	IRIS	
121-44-8	Triethylamine	x	7	RfC _{chronic}	IRIS	
420-46-2	Trifluoroethane, 1,1,1-		20000	RfC _{chronic}	PPRTV	
526-73-8	Trimethylbenzene, 1,2,3-		60	RfC _{chronic}	IRIS	
95-63-6	Trimethylbenzene, 1,2,4-		60	RfC _{chronic}	MDH VOC	
108-67-8	Trimethylbenzene, 1,3,5-		60	RfC _{chronic}	MDH VOC	
7440-62-2	Vanadium		0.1	RfC _{chronic}	ATSDR	
VANADIUM-COMPS	Vanadium Compounds		0.1	RfC _{chronic}	ATSDR	
1314-62-1	Vanadium Pentoxide, (V2O5)		1.20E-03	C	PPRTV	Y
108-05-4	Vinyl acetate	x	200	RfC _{chronic}	MDH VOC	
593-60-2	Vinyl bromide	x	0.67	C	PPRTV	Y
75-01-4	Vinyl chloride	x	1.14	C	IRIS	N
1330-20-7	Xylenes	x	100	RfC _{chronic}	MDH VOC	
108-38-3	Xylenes, m-	x	100	RfC _{chronic}	MDH VOC	
95-47-6	Xylenes, o-	x	100	RfC _{chronic}	MDH VOC	
106-42-3	Xylenes, p-	x	100	RfC _{chronic}	MDH VOC	
13530-65-9	Zinc chromate	x	9.01E-04	C	IRIS	Y

Calculating screening threshold values

With the dispersion values modeled and the inhalation health benchmarks defined, the next step was for the MPCA staff to calculate the screening threshold values.

MPCA staff calculated hourly screening threshold values with one of the following equations (Equation 1 and 2). MPCA staff calculated the hourly screening threshold value by using either the 1-hr or 24-hr modeled dispersion value and the RfC_{acute} . Table 9 lists which pollutants use the 1-hr versus the 24-hr modeled dispersion value.

Equation 1.

$$HSTV = \frac{RfC_{acute}}{MDV_{1hr}}$$

where:

HSTV = hourly screening threshold value, lb/hr

RfC_{acute} = reference concentration, $\mu\text{g}/\text{m}^3$

MDV_{1hr} = 1-hr modeled dispersion value, $\mu\text{g}/\text{m}^3$ per lb/hr

The other option to calculate the hourly screening threshold value is:

Equation 2.

$$HSTV = \frac{RfC_{acute}}{MDV_{24hr}}$$

where:

HSTV = hourly screening threshold value, lb/hr

RfC_{acute} = reference concentration, $\mu\text{g}/\text{m}^3$

MDV_{24hr} = 24-hr modeled dispersion value, $\mu\text{g}/\text{m}^3$ per lb/hr

MPCA staff calculated annual screening threshold values slightly different than acute screening threshold values. In this case, MPCA staff used the annual modeled dispersion value and either the $RfC_{chronic}$ or cancer value to calculate the annual screening threshold value. The following equations (Equations 3 through 6) show how the MPCA staff calculated the annual screening threshold values.

Equation 3.

$$ASTV = \frac{RfC_{chronic}}{MDV_{annual}}$$

where:

ASTV = annual screening threshold value, ton/yr

$RfC_{chronic}$ = reference concentration, $\mu\text{g}/\text{m}^3$

MDV_{annual} = annual modeled dispersion value, $\mu\text{g}/\text{m}^3$ per ton/yr

Another option to calculate the annual screening threshold value is:

Equation 4.

$$C = \frac{0.00001}{IUR}$$

where:

C = Cancer value, $\mu\text{g}/\text{m}^3$

IUR= inhalation unit risk factor, $(\mu\text{g}/\text{m}^3)^{-1}$

0.00001 = 1×10^{-5} (risk of 1 in 100,000)

Equation 5.

$$ASTV = \frac{C}{MDV_{annual}}$$

where:

ASTV = annual screening threshold value, ton/yr

C = Cancer value, $\mu\text{g}/\text{m}^3$

MDV_{annual} = annual modeled dispersion value, $\mu\text{g}/\text{m}^3$ per ton/yr

The last option to calculate the annual threshold value accounts for the ADAF:

Equation 6.

$$ASTV = \frac{C}{MDV_{annual} * ADAF}$$

where:

ASTV = annual screening threshold value, ton/yr

C = Cancer value, $\mu\text{g}/\text{m}^3$

MDV_{annual} = annual modeled dispersion value, $\mu\text{g}/\text{m}^3$ per ton/yr

ADAF= age dependent adjustment factor, 1.6, unitless