



BAY AREA  
AIR QUALITY  
MANAGEMENT  
DISTRICT

**BAAQMD**  
**Air Toxics NSR Program**  
**Health Risk Assessment Guidelines**

**December 2016**

**BAY AREA AIR QUALITY MANAGEMENT DISTRICT  
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**BAAQMD Air Toxics NSR Program  
Health Risk Assessment Guidelines**

## **1. INTRODUCTION**

This document describes the Bay Area Air Quality Management District's guidelines for conducting health risk assessments. Any health risk assessment (HRA) that is required pursuant to Regulation 2 Permits, Rule 1 General Requirements or Rule 5 New Source Review of Toxic Air Contaminants shall be conducted in accordance with these Air District HRA Guidelines.

In accordance with Regulation 2-5-402, the Air District HRA Guidelines generally conform to the Health Risk Assessment Guidelines adopted by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) for use in the Air Toxics Hot Spots Program for all types of facilities except gasoline dispensing facilities (GDFs). In addition, these guidelines are in accordance with State "Risk Management Guidance for Stationary Sources of Air Toxics" developed by the California Air Resources Board (ARB) and the California Air Pollution Control Officers Association (CAPCOA).

The Air District is delaying implementation of OEHHA's 2015 HRA Guidelines for gasoline dispensing facilities while further research is conducted on the potential impacts of OEHHA's 2015 HRA Guidelines on gasoline dispensing facilities. The Air District HRA Guidelines for gasoline dispensing facilities are described in Section 2.2.

The Air District will periodically update these Air District HRA Guidelines to clarify procedures or incorporate other revisions to regulatory guidelines.

## **2. PROCEDURES**

The procedures described below constitute the Regulation 2-5-603 Health Risk Assessment Procedures.

## **2.1 Procedures for All Facilities Other Than Gasoline Dispensing Facilities**

All HRAs for facilities other than gasoline dispensing facilities shall be completed by following the procedures described in the OEHHA Health Risk Assessment Guidelines for the Air Toxics Hot Spots Program adopted by OEHHA on March 6, 2015 and using the recommended breathing rates described in the ARB/CAPCOA Risk Management Guidance for Stationary Sources of Air Toxics adopted by ARB on July 23, 2015.

The OEHHA HRA Guidelines contain several sections which identify (a) the overall methodology, (b) the exposure assessment assumptions and procedures, and (c) the health effects data (cancer potency factors and reference exposure levels).

A summary of OEHHA's HRA Guidelines and an index of the relevant documents are located at:

**[http://www.oehha.ca.gov/air/hot\\_spots/index.html](http://www.oehha.ca.gov/air/hot_spots/index.html)**

OEHHA's risk assessment methodology (February 2015) is located at:

**[http://www.oehha.ca.gov/air/risk\\_assess/index.html](http://www.oehha.ca.gov/air/risk_assess/index.html)**

The exposure assessment and stochastic technical support document (August 2012) is located at:

**[http://www.oehha.ca.gov/air/exposure\\_assess/index.html](http://www.oehha.ca.gov/air/exposure_assess/index.html)**

The Technical Support Document for Cancer Potency Factors: Methodologies for Derivation, Listing of Available Values, and Adjustments to Allow for Early Life Stage Exposures (May 2009) is located at:

**[http://www.oehha.ca.gov/air/hot\\_spots/tsd052909.html](http://www.oehha.ca.gov/air/hot_spots/tsd052909.html)**

The Technical Support Document for the Derivation of Noncancer Reference Exposure Levels (June 2008) is located at:

**[http://www.oehha.ca.gov/air/hot\\_spots/rels\\_dec2008.html](http://www.oehha.ca.gov/air/hot_spots/rels_dec2008.html)**

The ARB/CAPCOA Risk Management Guidance for Stationary Sources of Air Toxics (July 23, 2015) provides guidance on managing potential health risks from sources subject to California air toxics programs and updates the Risk Management Policy for Inhalation Risk Assessments. It is located at:

**<http://www.arb.ca.gov/toxics/rma/rmaguideline.htm>**

Sections 2.1.1 through 2.1.6 below clarify and highlight some of the exposure assessment procedures including exposure assumptions (e.g., breathing rate and

exposure duration), health effect values, and calculation procedures to be used for conducting Air District HRAs.

### **2.1.1 Clarifications of Exposure Assessment Procedures**

This section clarifies and highlights some of the exposure assessment procedures that should be followed when conducting an Air District HRA.

#### **2.1.1.1 Breathing Rate**

On July 23, 2015, ARB adopted "Risk Management Guidance for Stationary Sources of Air Toxics", which includes an updated Risk Management Policy for Inhalation Risk Assessments. For the HRA methodology used in the Air Toxics NSR Program, the Air District has conformed with these State guidelines and adopted the exposure assessment recommendations made by ARB and CAPCOA. The policy considers the new science while providing a reasonable estimate of potential cancer risk for use in risk assessments for risk management decisions. This policy recommends using a combination of the 95<sup>th</sup> percentile and 80<sup>th</sup> percentile daily breathing rates as the minimum exposure inputs for risk management decisions. Specifically, the policy recommends using the 95<sup>th</sup> percentile rate for age groups less than 2 years old and the 80<sup>th</sup> percentile rate for age groups that are greater than or equal to 2 years old.

To assess potential inhalation exposure to offsite workers, OEHHA recommends assuming a breathing rate of 230 L/kg-8 hours. This value represents the 95<sup>th</sup> percentile 8-hour breathing rate based on moderate activity of 16-70 years-old age range.

To assess exposure to children at schools and daycare facilities, OEHHA recommends using the 95<sup>th</sup> percentile moderate intensity breathing rates from Table 5.8 of OEHHA's HRA Guidelines. As a default, the Air District recommends using the breathing rate for 2<16 years (520 L/kg-8 hours) for children at schools. For a more refined analysis, the Air District will allow the use of breathing rates for other age ranges that are tailored to the ages of the children in the specific school under evaluation.

#### **2.1.1.2 Exposure Frequency**

Based on OEHHA recommendations, the Air District will estimate cancer risk to residential receptors assuming exposure occurs 24 hours per day for 350 days per year. For a worker receptor, exposure is assumed to occur 250 days per year. However, for some professions (e.g., teachers) a different schedule may be more appropriate. For children at school sites, exposure is assumed to occur 180 days (or 36 weeks) per year.

#### **2.1.1.3 Exposure Duration**

Based on OEHHA recommendations, the Air District will estimate cancer risk to residential receptors based on a 30-year exposure duration. Although 9-year and 70-

year exposure scenarios may be presented for information purposes, risk management decisions will be made based on 30-year exposure duration for residential receptors.

For worker receptors, risk management decisions will be made based on OEHHA's recommended exposure duration of 25 years.

As a default, cancer risk estimates for children at school sites will be calculated based on a 9-year exposure duration, such as for a K-8 school. However, this exposure duration may be refined based on the specific school under evaluation (i.e. 6 years for a K-5 elementary school, 4 years for a 9-12 high school, or 3 years for a 6-8 middle school). For any analyses using an alternative to the 9-year default duration for school children, the breathing rate assumptions must also be adjusted in accordance with the ages of the children in the school.

### **2.1.2 Health Effects Values**

Chemical-specific health effects values have been consolidated and are presented in Regulation 2, Rule 5, Table 2-5-1 Toxic Air Contaminant Trigger Levels for use in conducting HRAs. The Air District has added the 8-hour reference exposure levels (RELs) adopted by OEHHA to this table. The Air District will periodically update this table to include OEHHA's revisions to health effects values.

### **2.1.3 Cancer Risk Calculations**

In accordance with OEHHA's 2015 HRA Guidelines, cancer risk estimates should incorporate age sensitivity factors (ASFs) and fraction of time at home (FAH) adjustment factors. Air District HRAs should follow OEHHA's recommended cancer risk calculation procedures as presented in Section 8.2 of OEHHA's 2015 HRA Guidelines.

For residential exposures, the cancer risk calculations should include the most sensitive age groups: from third trimester of pregnancy to 30 years of age for a 30-year exposure duration. For worker receptors, assume working begins at age 16 years.

#### **2.1.3.1 Fraction of Time at Home (FAH)**

For the initial cancer risk estimate, assume the fraction of time at home factors are equal to one (FAH = 1.0) for the following age groups: 3<sup>rd</sup> trimester to < 2 years and 2 to < 16 years. Use this initial analysis to assess if there are any schools within cancer risk isopleths of one in a million or greater. If there are no schools within one in a million or greater cancer risk isopleths, the cancer risk analysis may be refined by using the appropriate age-specific FAH factors as identified in Table 8.4 of the 2015 OEHHA Guidelines:

- FAH = 0.85 for age group: 3<sup>rd</sup> trimester to < 2 years;
- FAH = 0.72 for age group: 2 to < 16 years;

- FAH = 0.73 for age group: 16 to 70 years.

### 2.1.3.2 Short Term Projects

In the 2015 HRA Guidelines, OEHHA recommends using actual project duration for short term projects, but cautions that the risk manager should consider a lower cancer risk threshold for very short term projects, because a higher exposure over a short period of time may pose a greater risk than the same total exposure spread over a much longer period of time. To ensure that short-term projects do not result in unanticipated higher cancer impacts due to short-duration high-exposure rates, the Air District recommends that the cancer risk be evaluated assuming that the average daily dose for short-term exposure lasts a minimum of three years for projects lasting three years or less. For residential exposures, the cancer risk calculations should include the most sensitive age groups (beginning with the third trimester of pregnancy) and should use the 95<sup>th</sup> percentile breathing rates. The Air District recommends following OEHHA guidelines for other aspects of short term projects. In summary, the Air District recommends:

- use of actual emission rates over a minimum 3-year duration for cancer risk assessments involving projects lasting 3 years or less, and
- use of actual project duration for cancer risk assessments on projects lasting longer than 3 years.

### 2.1.4 Noncancer Health Impacts

In accordance with OEHHA's 2015 HRA Guidelines, noncancer health impacts should be calculated using the hazard index approach. Air District HRAs should follow OEHHA's recommended calculation procedures for noncancer health impacts, as presented in Section 8.3 of OEHHA's 2015 HRA Guidelines.

Regarding Section 8.3.5 of OEHHA's 2015 HRA Guidelines, the Air District does not require inclusion of the contribution of background criteria pollutants to respiratory health effects for Air District HRAs.

### 2.1.5 Spatial Averaging

Typically, HRA results for an individual receptor have been based on air dispersion modeling results at a single point or location. In the 2015 OEHHA Guidelines (Section 4.7.3), OEHHA provides a refinement option that takes into account that people move around within their property or workplace and do not normally remain at a single fixed point for the entire exposure duration. This spatial averaging refinement may be used for any chronic analysis in an Air District HRA. Spatial averaging is not appropriate for an acute analysis.

After the points of interest have been identified by the air dispersion modeling analysis, the ground level air concentration for each maximum impact point may be refined by using the arithmetic mean of the receptor concentrations identified within a spatial average grid instead of the single maximum impact point concentration. The modeler shall generally center the spatial average grid around the maximum impact point, but the modeler shall also consider facility boundaries, possible receptor locations, and predominant wind direction. This grid shall be of an appropriate shape, shall be no larger than 400 square meters, and shall have a receptor spacing within the grid of no less than 5 meters. Grid shape, size, and location are subject to Air District approval.

### **2.1.6 Stochastic Risk Assessment**

For a stochastic, multipathway risk assessment, the potential cancer risk should be reported for the full distribution of exposure from all exposure pathways included in the risk assessment. For risk management decisions, the potential cancer risk from a stochastic, multipathway risk assessment should be based on the 95<sup>th</sup> percentile cancer risk.

## **2.2 Procedures for Gasoline Dispensing Facilities**

Any HRA for a gasoline dispensing facility shall be completed by following the procedures described in the OEHHA Health Risk Assessment Guidelines for the Air Toxics Hot Spots Program that were adopted by OEHHA on October 3, 2003 and any State risk assessment and risk management policies and guidelines in effect as of June 1, 2009.

The 2003 OEHHA Health Risk Assessment Guidelines contain several sections which identify (a) the overall methodology, (b) the exposure assessment assumptions and procedures, and (c) the health effects data (cancer potency factors, chronic reference exposure levels, and acute reference exposure levels).

A summary of OEHHA's 2003 Health Risk Assessment Guidelines and an index of the relevant documents are located at:

**<http://oehha.ca.gov/air/crnrr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk>**

OEHHA's 2003 risk assessment methodology is located at:

**<http://oehha.ca.gov/media/downloads/crnrr/hraguidefinal.pdf>**

The exposure assessment and stochastic technical support document (Part IV of OEHHA's Risk Assessment Guidelines) is located at:

<http://oehha.ca.gov/media/downloads/crrn/stoch4f.pdf>

The Technical Support Document for Cancer Potency Factors: Methodologies for Derivation, Listing of Available Values, and Adjustments to Allow for Early Life Stage Exposures (June 2009) is located at:

<http://oehha.ca.gov/media/downloads/crrn/tsdcancerpotency.pdf>

The Technical Support Document for the Derivation of Noncancer Reference Exposure Levels (June 2008) is located at:

<http://oehha.ca.gov/media/downloads/crrn/noncancertsdfinal.pdf>

Sections 2.2.1 through 2.2.4 below clarify and highlight some of the exposure assessment procedures including exposure assumptions (e.g., breathing rate and exposure duration) and health effect values to be used for conducting HRAs for gasoline dispensing facilities.

### **2.2.1 Clarifications of Exposure Assessment Procedures**

This section clarifies and highlights some of the exposure assessment procedures that should be followed when conducting an HRA for a gasoline dispensing facility.

#### **2.2.1.1 Breathing Rate**

On October 9, 2003, a statewide interim Risk Management Policy for inhalation-based residential cancer risk was adopted by the California Air Resources Board (ARB) and Cal/EPA's OEHHA (<http://www.arb.ca.gov/toxics/rmpolicy.pdf>). For the HRA methodology used in the Air Toxics NSR Program for gasoline dispensing facilities, the Air District has conformed with these State guidelines and adopted the interim exposure assessment recommendations made by ARB and OEHHA. The Air District will continue to use this interim recommendation for gasoline dispensing facilities even though newer guidance has been adopted by ARB and OEHHA. The interim policy recommended, where a single cancer risk value for a residential receptor is needed or prudent for risk management decision-making, the potential cancer risk estimate for the inhalation exposure pathway be based on the breathing rate representing the 80<sup>th</sup> percentile value of the breathing rate range of values (302 L/kg-day).

To assess potential inhalation exposure to offsite workers, OEHHA recommended assuming a breathing rate of 149 L/kg-day. This value corresponds to a 70 kg worker breathing 1.3 m<sup>3</sup>/hour (breathing rate recommended by USEPA as an hourly average for outdoor workers) for an eight-hour day.

For children, OEHHA recommended assuming a breathing rate of 581 L/kg-day to assess potential risk via the inhalation exposure pathway. This value represents the upper 95% percentile of daily breathing rates for children.

#### **2.2.1.2 Exposure Time and Frequency**

Based on OEHHA's 2003 HRA Guidelines, the Air District will estimate cancer risk to residential receptors for gasoline dispensing facilities assuming exposure occurs 24 hours per day for 350 days per year. For a worker receptor, exposure is assumed to occur 8 hours per day for 245 days per year. However, for some professions (e.g., teachers) a different schedule may be more appropriate. For children at school sites, exposure is assumed to occur 10 hours per day for 180 days (or 36 weeks) per year.

#### **2.2.1.3 Exposure Duration**

Based on OEHHA's 2003 HRA Guidelines, the Air District will estimate cancer risk to residential receptors for gasoline dispensing facilities based on a 70-year lifetime exposure. Although 9-year and 30-year exposure scenarios may be presented for information purposes, risk management decisions will be made based on 70-year exposure duration for residential receptors. For worker receptors for gasoline dispensing facilities, risk management decisions will be made based on OEHHA's 2003 recommended exposure duration of 40 years. Cancer risk estimates for children at school sites will be calculated based on a 9-year exposure duration.

### **2.2.2 Health Effects Values**

Chemical-specific health effects values have been consolidated and are presented in Regulation 2, Rule 5, Table 2-5-1 Toxic Air Contaminant Trigger Levels for use in conducting HRAs. Toxicity criteria summarized in Table 2-5-1 represent health effects values that were adopted by OEHHA/ARB as of March 31, 2016.

### **2.2.3 Cancer Risk Calculations**

In accordance with OEHHA's revised health risk assessment guidelines (specifically, OEHHA's Technical Support Document (TSD) for Cancer Potency Factors, adopted June 1, 2009), calculation of cancer risk estimates for gasoline dispensing facilities should incorporate age sensitivity factors (ASFs).

The revised TSD for Cancer Potency Factors provides updated calculation procedures used to consider the increased susceptibility of infants and children to carcinogens, as compared to adults. The calculation procedure below includes the use of age-specific weighting factors in calculating cancer risks from exposures of infants, children and adolescents, to reflect their anticipated special sensitivity to carcinogens. OEHHA recommended weighting cancer risk by a factor of 10 for exposures that occur from the third trimester of pregnancy to 2 years of age, and by a factor of 3 for exposures that occur from 2 years through 15 years of age. These weighting factors should be applied to all carcinogens emitted from gasoline dispensing facilities. For estimating cancer risk

for residential receptors, the incorporation of the ASFs results in a cancer risk adjustment factor of 1.7. For estimating cancer risk for student receptors, an ASF of 3 should be applied. For estimating cancer risk for worker receptors, an ASF of 1 should be applied.

The cancer risk adjustment factors for gasoline dispensing facilities were developed based on the following:

Receptor	Age Groups	ASF	Duration	Cancer Risk Adjustment Factor
Resident	Third trimester to age 2 years	10	2.25/70	0.32
	Age 2 to age 16 years	3	14/70	0.6
	Age 16 to 70 years	1	54/70	0.77
				<b>1.7</b>
Student	Age 2 to age 16 years	3	9 years	<b>3</b>
Worker	Age 16 to 70 years	1	40 years	<b>1</b>

Since the exposure duration for a student receptor (9 years), and worker receptor (40 years), falls within a single age group, the student cancer risk adjustment factor is 3 and the worker cancer risk adjustment factor is 1.

Cancer risk adjustment factors should be used to calculate all cancer risk estimates for gasoline dispensing facilities.

Below is the equation for calculating cancer risk estimates for gasoline dispensing facilities:

$$\text{Cancer Risk} = \text{Dose} * \text{Cancer Risk Adjustment Factor} * \text{Cancer Potency Factor}$$

#### 2.2.4 Noncancer Health Impacts

In accordance with OEHHA's 2003 HRA Guidelines, noncancer health impacts should be calculated using the hazard index approach. Air District HRAs should follow OEHHA's recommended calculation procedures for noncancer health impacts, as presented in Section 8.3 of OEHHA's 2003 HRA Guidelines, using the RELs identified in Table 2-5-1.

Regarding Section 8.3.A of OEHHA's 2003 HRA Guidelines, the Air District does not require inclusion of the contribution of background criteria pollutants to respiratory health effects for Air District HRAs.

### **3. Assessment of Acrolein Emissions**

CARB has issued advisories regarding acrolein emissions data determined using CARB Method 430 (M430): <http://www.arb.ca.gov/ei/acrolein.htm>. The CARB advisories state that acrolein emissions data determined using CARB Method 430 are suspect and should be flagged as non-quantitative. Although acrolein emission factor data is available for several types of stationary combustion sources, this data was developed based on source tests that utilized CARB Method 430 or equally inaccurate test methods; therefore, the validity of this acrolein emission factor data is suspect. In addition, the tools the Air District needs to implement and enforce acrolein emission limits are not available due to the lack of an ARB approved acrolein test method for stationary sources.

In consideration of this information, the Air District has determined that acrolein emissions may be included in Air District HRAs for screening or informational purposes, but the Air District will exclude acrolein emissions from the final HRA results on which risk management decisions will be based.

## **References**

- 1 *“Air Toxics “Hot Spots” Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments,” OEHHA, August, 2003*
- 2 *“Air Toxics “Hot Spots” Program Risk Assessment Guidelines, Part IV. Technical Support Document for Exposure Assessment and Stochastic Analysis”, OEHHA, September, 2000*
- 3 *“Air Toxics Hot Spots Program Risk Assessment Guideline; Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures”, OEHHA, May, 2009*
- 4 *“Air Toxics Hot Spots Program Risk Assessment Guidelines; Technical Support Document for the Derivation of Noncancer Reference Exposure Levels”, OEHHA, June, 2008*
- 5 *“Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values”, California Air Resources Board, updated March 28, 2016*
- 6 *“Air Toxics Hot Spots Program Risk Assessment Guidelines; Guidance Manual for Preparation of Health Risk Assessments”, OEHHA, February, 2015*
- 7 *“Air Toxics Hot Spots Program Risk Assessment Guidelines; Technical Support Document for Exposure Assessment and Stochastic Analysis”, OEHHA, August, 2012*
- 8 *“Risk Management Guidance for Stationary Sources of Air Toxics”, Air Resources Board and California Air Pollution Control Officers Association, July 23, 2015*