Arkansas Department of Health

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July 18, 2024

Shane E. Khoury, Secretary
Arkansas Department of Energy and Environment (ADEE)
5301 Northshore Drive
North Little Rock, AR 72118

RE: Public Health Air Evaluation for the Eco Vista Landfill Perimeter

Dear Secretary Khoury,

An additional round of air quality sampling and monitoring was conducted around the Eco Vista Landfill perimeter to evaluate the potential for public health risk and further delineate the source of contaminants. The Arkansas Department of Energy and Environment (ADEE) requested the Arkansas Department of Health's (ADH) Environmental Epidemiology Section to evaluate the air sampling and monitoring results collected from Sunday, April 28 to Wednesday, May 1, 2024, by an independent environmental consultant, CTEH LLC. This letter is a follow-up to the letter sent to you on April 5, 2024.

Background and History:

Eco Vista Landfill is located at 11979 Arbor Acres Road in Springdale, Arkansas. The landfill was also known as the Tontitown landfill, before being bought by Waste Management. The landfill is a residential and commercial waste landfill located in Springdale on the border of Tontitown. The landfill has been in operation since 1979. Waste Management has operated the landfill since 2000 [1]. The ADEE oversees and enforces solid waste permits, air permits, and stormwater permits for this facility. According to online reports, the landfill has been operating within state regulations. The landfill is in the process of expanding on-site operations [2].

Residents in this community have been voicing concerns about air quality and health effects in recent years. In January 2023, the ADH's Chronic Disease Cluster Investigation Team (CD-CIT) concluded that there was no excess of any specific type of cancer in the area of concern than what was expected as compared to other Arkansas areas, the state, and the U.S. The ADH's CD-CIT staff has continued

to monitor this area for any excess of cancers [3]. Refer to the Letter Health Consultant (LHC) (April 5, 2024) addressed to the ADEE.

Two (2) previous rounds of air sampling and monitoring have been conducted at this site beginning in December 2023. The previous round of air sampling and monitoring (February 2024) conducted by CTEH, identified two contaminants (acrolein and benzene) that exceeded the public health comparison values (CVs), although reported benzene levels were in the ranges that would be expected for rural subdivisions. Residents near the perimeter of the sampling locations may have the potential to be at risk for exposure to levels of acrolein in the air. However, it was concluded that in order to better determine the human health risks for the general public and residents off-site in the adjacent neighborhood areas, more robust air sampling data were needed. Refer to the LHC (April 5, 2024) addressed to ADEE for more information on those findings.

Additional background and demographic information can also be found in the previous LHC (April 5, 2024).

Discussion:

Generally, when evaluating potential or existing hazards for an exposed population, all available (such as on-site and off-site) environmental data for media (e.g., air, soil, surface water, groundwater, biota) are reviewed. The validity of the conclusions in this evaluation depends on the accuracy and reliability of the data provided in the cited reports.

Exposure to a contaminant of concern (COC) is determined by examining human exposure pathways. An exposure pathway has five parts:

1. A source of contamination (e.g., release),
2. An environmental medium such as air, soil, or water that can hold or move the contamination,
3. A point at which people come in contact with a contaminated medium (e.g., ambient air),
4. An exposure route, such as inhalation, and
5. A population who could come in contact with the contaminants (e.g., people potentially or actually exposed).

An exposure pathway is eliminated if at least one of the five parts is missing and will not occur in the future. For a completed pathway, all five parts must exist and exposure to a contaminant must have occurred, is occurring, or will occur. For this evaluation, a potential past, current, and future exposure pathway exists for anyone breathing ambient air near and further away from the perimeter of the landfill (including residents near the four (4) background sampling locations). For evaluating potential air exposures from ambient air, ADH considered only breathing (inhalation) as the primary exposure route.

A completed exposure pathway does not necessarily mean that harmful health effects will occur. A chemical's ability to harm health depends on many factors, including how much of the chemical is

present, how long and how often a person is exposed to the chemical, and how toxic the chemical is. Further evaluation of the specific exposure occurring is needed to determine whether the exposure could cause harmful effects in an individual. Other considerations include additional chemical and environmental exposures, along with a person's age, gender, diet, family traits, lifestyle, and state of health.

Table 1. Air Sampling and Monitoring Locations. Sampling locations Area 1 (AS001) to Area 10 (AS0010) are considered to be near the perimeter of the Eco Vista Landfill while Area 11 (AS0011) to Area 14 (AS0014) are considered to be further away from the landfill. [3]

LOCATION NUMBER	DESCRIPTION
AS001	In front of 518 Kelly Ave
AS002	Corner of Arbor Acres Ave and Clear Water Rd
AS003	In front of 1447 Arbor Acres Ave
AS004	Corner of Arbor Acres Ave and Dowell Rd
AS005	Corner of Arbor Acres Ave and S Barrington Rd
AS006	In front of 18243 Clear Water Rd
AS007	Corner of Clear Water Rd and Wheeler Rd
AS008	Corner of S Barrington Rd and Reed Valley Rd
AS009	In front of 18595 Clear Water Rd
AS0010	In front of 12246 Red Oak Dr
AS0011	Corner of Morsani Ave and Klenc Rd
AS0012	Corner of Watkins and S 64th
AS0013	In front of 14601 White Oak Rd
AS0014	3034 Leirly Ln

Public Health Implications:

ADH and the Agency for Toxic Substances and Disease Registry (ATSDR) have a State Cooperative Agreement Program called ATSDR's Partnership to Promote Local Efforts to Reduce Environmental Exposure (APPLETREE). This program allows ADH's staff to evaluate and respond to environmental public health issues.

ADH addressed the likelihood that exposure to contaminants at the maximum (highest) concentrations detected would result in adverse health effects. Although the relative toxicity of a chemical is important, the response of the human body to a chemical exposure is determined by several additional factors, including concentration (how much), duration of exposure (how long), and the route of exposure (i.e., breathing, eating, drinking, or skin contact). Lifestyle factors (i.e., occupation and personal habits) may have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics, such as age, sex, nutritional status, overall health, and genetic constitution, affect the way a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of these factors determines a person's physiologic response to a chemical contaminant and any adverse health effects that could result from the exposure.

Based on scientific data cited in the ATSDR's toxicological profiles, ATSDR has determined levels of chemicals that can reasonably (and conservatively) be regarded as harmless. The resulting

comparison values (or CVs) and health guidelines are used to screen contaminant concentrations at a site and to select substances warranting closer scrutiny by agency health assessors and toxicologists. Of key importance is that ATSDR's and the U.S. Environmental Protection Agency's (EPA) CVs and health guidelines represent conservative levels of safety and not thresholds of toxicity. Thus, although concentrations at or below a CV are considered safe, it does not automatically follow that any concentration above a CV will necessarily produce toxic effects. To the contrary, ATSDR's (and EPA's) CVs are intentionally designed to be much lower than the corresponding no-effect levels (or lowest-effect levels) determined in laboratory studies. ATSDR uses CVs (regardless of the source) solely to screen individual contaminants. ATSDR considers that a compound warrants further evaluation if the highest single recorded concentration of that contaminant in the medium in question exceeds that compound's lowest available CV (e.g., cancer risk evaluation guides or other chronic exposure values) for potentially exposed people. This process results in the selection of many chemicals as "contaminants of concern (COCs)" that will not, upon closer scrutiny, be judged to pose any hazard to human health. Even COCs that ultimately are labeled in the toxicologic evaluation as potential public health hazards are identified solely on the basis of the maximum concentration detected. When considering the potential health implications of public health evaluations, one should keep in mind the protectiveness of this approach.

Evaluation:

A contaminant must first enter the body before it can affect the body. The toxicologic evaluation focuses primarily on completed pathways of exposure and potential pathways where a high probability exists that exposures have occurred or will occur.

The evaluation of health effects associated with inhalation involves comparing air concentrations from the sampling event to health-based guidelines developed by ATSDR and other agencies, such as EPA. People exposed for a specified length of time to COCs at levels greater than established guidelines are more likely to have an associated illness or disease. Accordingly, air monitoring samples of contaminant concentrations were compared with chemical-specific information about health effects that could occur at or below concentrations detected in the air monitoring samples.

To identify COCs, the maximum concentration of the chemical must exceed either an environmental or dose comparison value in at least one sample collected during the air monitoring. COCs were evaluated further to determine whether an increased likelihood existed that inhalation of the contaminant at the reported concentrations could adversely affect health. Although the air sampling and monitoring were limited to three (3) days, the evaluation of effects associated with chronic exposure assumed that the sampling and monitoring period captured typical ongoing exposures. Again, exceeding the CV does not necessarily mean a contaminant represents a public health threat; it does, however, suggest that the contaminant warrants further consideration.

Meteorological Data During Air Sampling and Monitoring

Air quality monitoring requires recording meteorology data (weather changes).
Meteorological measurements (temperatures, time of day, wind direction, and wind speed)

are essential for air quality data analysis as these measurements have a direct effect on air contaminant (pollutant) concentrations or travel.

The time of day or season when such conditions occur could be a possible indicator of air pollutants source. Identifying the time of the day ensures that representative data from time periods are observed. Wind speed affects the travel time from the air pollutants source to the receptor (air sampling and monitoring device). The dilution of air pollutants in the air will travel in the downwind direction. The concentrations of air pollutants are inversely proportional to the wind speed. Wind direction influences the general movements of air pollutants in the atmosphere. Temperature differentials may exist that could change the characteristics of the gases [4].

Based on the CTEH report, the air sampling and monitoring conducted from April 28 to May 1, 2024, recorded wind speed and direction from local weather stations, including the Springdale Municipal Airport and Fayetteville's Drake Public Airport. The prevailing wind direction at these stations during that period was north and north-northwest [4].

CTEH Air Testing

From April 28 to May 1, 2024, CTEH personnel carried out an air quality assessment near the landfill in Tontitown, Arkansas, as per the request of the ADEE. This assessment was conducted as a follow-up to a previous assessment done by CTEH from Monday, February 5 to Thursday, February 8, 2024, near the landfill. From April 28 to May 1, 2024, analytical air sampling for volatile organic compounds (VOCs) and hydrogen sulfide (H_2S) was conducted each day at ten (10) locations chosen by ADEE and CTEH near the landfill perimeter. Additionally, four (4) analytical air sampling locations were identified by ADEE further away from the landfill perimeter to assess potential background VOCs and H_2S concentrations. CTEH personnel also performed real-time air monitoring at each of the fourteen (14) air sampling locations and in various locations surrounding the landfill for benzene, H_2S, oxygen (O_2), VOCs, sulfur dioxide (SO_2), and lower explosive limit (%LEL) as stated in the CTEH report [4].

CTEH Air Monitoring Results

Measurements of VOCs, O_2, H_2S, SO_2, and %LEL were taken using a RAE System by Honeywell MultiRAE with chemical-specific sensors, a photo-ionization detector (PID) for VOCs, and a combustible gas sensor for %LEL. Additionally, the RAE System was equipped with a benzene-specific separator to monitor the presence of benzene directly. According to the CTEH report, a total of 696 real-time air monitoring readings were collected. There was no detection of benzene, H_2S, %LEL, SO_2, or VOCs. O_2 was detected at a concentration of 20.9%. According to ATSDR, the typical O_2 concentration is around 21% [6]. All handheld real-time air monitoring locations were near the landfill perimeter. Please refer to the appendix for CTEH air sampling and monitoring maps [4].

CTEH Air Sampling Results

Air samples for VOCs were collected using 6-liter evacuated canisters (SUMMAR® Cannisters) with twenty-four (24) hour flow control regulators to sample air over three (3) twenty-four (24) hour periods. Thus, there are three (3) sample points for each sampling location (Areas 1-14). Areas 1-10 are located near the perimeter of the landfill, while areas 11-14 are situated further away from the landfill. Furthermore, considering the placement of the sampling locations (Areas 11-14) relative to the landfill and the meteorological conditions, contaminant detections observed between April 28 and May 1, 2024, could be categorized as downwind, crosswind, and upwind of the landfill. Please refer to the appendix for CTEH air sampling and monitoring maps. These twenty-four (24) hour air samples were analyzed for VOCs by the EPA method TO-15 plus tentatively identified compounds (TICs) [4].

According to the CTEH report, air samples for H_2S were collected using Radiello ® sampling badges, which were analyzed by the SGS Galson in-house method WET-SOP-13. H_2S samples were collected over a seventy-two (72) hour period. A field blank for H_2S was collected as a quality control measure [4].

<u>Acrolein</u>

Acrolein is a colorless or yellow liquid with a disagreeable odor. It dissolves in water very easily and quickly changes to vapor when heated. Small amounts of acrolein can be formed and can enter the air when trees, tobacco, other plants, gasoline, and oil are burned. Also, acrolein is used as a pesticide to control algae, weeds, bacteria, and mollusks. Additionally, the U.S. Department of Health and Human Services (DHHS) has not classified acrolein as carcinogenic (a substance that causes cancer). The International Agency for Research on Cancer (IARC) has determined that acrolein is not classifiable as carcinogenic in humans. The EPA has stated that the potential carcinogenicity of acrolein cannot be determined based on an inadequate database [7].

Acrolein can cause irritation to the eyes, nose, throat, lungs, stomach, and skin. Children, especially those with asthma or other respiratory sensitivities, may be more susceptible to lung irritation from acrolein. In animal studies, high levels of acrolein ingestion during pregnancy led to reduced birth weights and skeletal deformities in newborns; although these effects were only observed at levels that were also toxic to the mother [8].

The maximum concentrations of acrolein ranged from 0.071 parts per billion (ppb) to 0.45 ppb near the landfill (Areas 1-10) and 0.1 ppb to 0.18 ppb at locations further away from the landfill (Areas 11-14). Refer to Table 2 for all area's maximum concentrations of acrolein. According to the ATSDR's Acrolein Public Health Statement, acrolein levels in the outside air are typically low, averaging around 0.20 ppb in urban areas and 0.12 ppb in rural areas. However, in some large cities, acrolein levels have been measured as high as 5.6 ppb. In a typical home, acrolein levels range between less than 0.02 and 12 ppb, but can be higher if tobacco is smoked indoors. Thus, the concentrations both near and further away from the landfill are within the typical ranges according to the ATSDR's Acrolein Public Health Statement [8].

Benzene

Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is highly flammable and is formed from both natural processes and human activities. Benzene is widely used in the U.S.; it ranks in the top twenty (20) chemicals for production volume. Some industries use benzene to make other chemicals, which are used to make plastics, resins, nylon, and other synthetic fibers. Also, benzene is used to make some types of rubbers, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include emissions from volcanoes and forest fires. Benzene is also a natural part of crude oil, gasoline, and cigarette smoke [9]. Additionally, U.S. DHHS has determined that benzene is a known carcinogen. The IARC and the EPA have determined that benzene is carcinogenic to humans [10].

Breathing at lower levels can cause drowsiness, dizziness, rapid heart rate, headaches, trembling, confusion, and loss of consciousness. While breathing in high levels of benzene can be fatal. Consuming or ingesting foods with high levels of benzene can lead to vomiting, stomach irritation, dizziness, drowsiness, seizures, rapid heart rate, and even death. Long-term exposure to benzene primarily affects the blood as it affects the bone marrow, leading to a decrease in red blood cells and causing anemia. Benzene can also lead to excessive bleeding and weaken the immune system, making the body more vulnerable to infections [9].

The maximum concentrations of benzene ranged from 0.12 ppb to 0.34 ppb near the landfill perimeter (Areas 1-10) and 0.096 ppb to 0.14 ppb at locations further away from the landfill (Areas 11-14). Refer to Table 2 for all area's maximum concentrations for benzene. Ambient air levels for benzene have been identified for remote/rural areas in the range of 0.16 ppb to 3.5 ppb and suburban residential-remote from traffic areas in the range of 1.8 ppb to 4.5 ppb [10]. The off-site area benzene air sample concentrations ranged well within the background levels that would be expected in rural subdivisions

Carbon Tetrachloride

Carbon tetrachloride is a clear liquid with a sweet smell that can be detected at low levels. It is often found in the air as a colorless gas. It is not flammable and does not dissolve in water very easily. It was used in the production of refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. However, several of these uses are now banned due to its harmful effects, and it can only be used in some industrial applications. Additionally, U.S. DHHS has determined that carbon tetrachloride may reasonably be anticipated to be a carcinogen. IARC has classified carbon tetrachloride as possibly carcinogenic to humans, while the EPA has determined that carbon tetrachloride is a probable human carcinogen [11].

Carbon tetrachloride can cause severe damage to the liver and kidneys, leading to a decrease in their function. However, if the injuries are not too severe, the organs can repair damaged cells and replace dead cells, and function usually returns to normal within a few days or weeks after exposure has stopped. High levels of exposure can also affect the nervous system, causing symptoms such as

headache, dizziness, and sleepiness, and in severe cases, it can lead to coma or permanent damage to nerve cells [12].

The maximum concentrations of carbon tetrachloride ranged from 0.068 ppb to 0.08 ppb near the landfill perimeter (Areas 1-10) and from 0.073 ppb to 0.078 ppb at locations further away from the landfill (Areas 11-14). Please see Table 2 for the maximum concentrations of carbon tetrachloride in each area. According to the ATSDR's Carbon Tetrachloride Public Health Statement, concentrations of 0.1 ppb are typical worldwide, while slightly higher levels (0.2 - 0.6 ppb) are often found in cities. Thus, the concentrations near and further away from the landfill are within typical ranges according to the ATSDR's Carbon Tetrachloride Public Health Statement [12].

Chloroform

Chloroform is a colorless and slightly sweet liquid. It occurs naturally in the environment, mainly in wet environments such as tropical oceans, forest soil, rice fields, swamplands, and peat moorlands. It can also be found in dry grasslands and is released during volcanic eruptions and when organic matter is burned. Small amounts of chloroform can also be formed when chlorine is added to water. Additionally, chloroform can be man-made. In the past, chloroform was used as an inhaled anesthetic during surgery, but it is no longer used for this purpose due to the availability of safer alternatives. Currently, chloroform is used as a solvent and to make other chemicals. The general population's exposure to chloroform is expected to be low. However, individuals who live near hazardous waste sites or work with chloroform or chlorinated water may be exposed to higher levels [13].

Chloroform has various effects on the human body. When inhaled or ingested in large amounts, it can affect the central nervous system (brain), liver, and kidneys. Short-term exposure to about 900 parts of chloroform per million parts of air (900 ppm or 900,000 ppb) can lead to fatigue, dizziness, and headaches. On the other hand, long-term exposure through breathing, and consuming contaminated food or water can result in liver and kidney damage. Additionally, direct contact with large amounts of chloroform can cause skin sores. Based on animal studies, U.S. DHHS has determined that chloroform may reasonably be anticipated to be a carcinogen. IARC has determined that chloroform is possibly carcinogenic to humans (2B). EPA has determined that chloroform is a probable human carcinogen [14].

The maximum concentration of chloroform was at Area 6 (near the landfill perimeter), 0.054 ppb. Chloroform was not detected at any other sample locations. The typical amounts of chloroform found in the air range from 0.02 to 0.05 ppb, while in treated drinking water, it ranges from 2 to 44 ppb. However, in some areas, chloroform concentrations may exceed 44 ppb. The concentration of chloroform in surface water, untreated groundwater, and soil is estimated to be 0.1 ppb. Higher concentrations of chloroform, such as 610 ppb in air at a municipal landfill, 88 ppb in treated municipal drinking water, and 1,900 ppb in well water and groundwater near hazardous waste sites, have also been reported. Additionally, chloroform has been detected in the air across the U.S. and in a majority of public drinking water supplies. Thus, Area 6 near the landfill is within typical ranges according to the ATSDR's Chloroform Public Health Statement. [14].

Naphthalene

Naphthalene is a white, easily evaporating solid. It also is referred to as mothballs, moth flakes, white tar, and tar camphor. When mixed with air, naphthalene vapors readily burn. Fossil fuels, such as petroleum and coal, naturally contain naphthalene. Burning tobacco or wood produces naphthalene. The major products made from naphthalene are moth repellents, in the form of mothballs or crystals, and toilet deodorant blocks. It also is used to make dyes, resins, leather tanning agents, and the insecticide carbaryl. Naphthalene has a strong smell, but the smell is generally not considered unpleasant [15].

A person's response to an unpleasant odor is not necessarily considered an adverse health effect. If concentrations of a chemical are below the level expected to produce a health effect, individual sensitivity to the chemical must be considered, as must the presence of an unpleasant odor that may interfere with quality of life. Studies suggest that odors may trigger respiratory effects among sensitive populations, such as people with asthma, children, elderly people, and immune-suppressed people. Odor triggers may be further confounded by other respiratory environmental triggers, such as dust mites, animal dander, tobacco smoke, and other types of outdoor air pollution [16].

Breathing in naphthalene can lead to irritation and inflammation in the nose, decreased lung function, headaches, confusion, fatigue, and dizziness. People exposed to naphthalene may also experience damage to their red blood cells. Based on the results of animal studies, U.S. DHHS has stated that naphthalene is reasonably anticipated to be a human carcinogen. IARC has concluded that naphthalene is possibly carcinogenic to humans due to evidence of its cancer-causing effects in animals, although there is not enough evidence regarding its impact on humans. According to the EPA 1986 cancer guidelines, naphthalene has been classified as a Group C possible human carcinogen. [17].

The maximum concentration of naphthalene was 0.17 ppb at Area 11 (a background sampling location further away from the landfill). Naphthalene was not detected at any other sample locations. Typical air concentrations for naphthalene are low, 0.2 ppb or less. Thus, the concentrations near and further away from the landfill are within typical ranges according to the ATSDR's Naphthalene Public Health Statement [17].

Table 2. Maximum Concentrations of Contaminants Detected at Sampling Locations, with the Associated ATSDR's Screening Values.

Air Sampling Location	Acrolein	Benzene	Carbon Tetrachloride	Chloroform	Naphthalene
Contaminant units in parts per billion (ppb)					
Area 1	**0.14**	**0.12**	**0.071**	ND	ND
Area 2	**0.45**	**0.34**	**0.068**	ND	ND
Area 3	**0.097**	**0.25**	**0.073**	ND	ND
Area 4	**0.15**	**0.12**	**0.07**	ND	ND
Area 5	**0.21**	**0.15**	**0.072**	ND	ND
Area 6	**0.071**	**0.25**	**0.075**	**0.054**	ND
Area 7	**0.095**	**0.19**	**0.076**	ND	ND
Area 8	**0.25**	**0.18**	**0.08**	ND	ND
Area 9	**0.14**	**0.19**	**0.073**	ND	ND
Area 10	**0.19**	**0.29**	**0.08**	ND	ND
Area 11	**0.1**	**0.14**	**0.076**	ND	**0.17**
Area 12	**0.15**	**0.13**	**0.077**	ND	ND
Area 13	**0.18**	**0.096**	**0.078**	ND	ND
Area 14	**0.17**	**0.12**	**0.073**	ND	ND
ATSDR's Comparison Values (CVs)					
	RMEG 0.009 ppb	CREG 0.040 ppb	CREG 0.026 ppb	CREG 0.0089 ppb	CREG 0.0056 ppb

Bolded values indicate that the ATSDR's CV has been met or exceeded.
ND: Not Detected
The maximum concentrations listed from each sampling area were from three (3) days or three (3) twenty-four (24) hour sampling periods. All maximum values listed are above the Agency for Toxic Substances and Disease Registry's (ATSDR) Comparison Values (CVs).

ATSDR's guidelines recommend to first screen ambient (outdoor) air analytical results against chemical-specific CVs. CVs are concentrations of chemicals in the air (or other media, like drinking water) below which no harmful health effects are expected to occur, even with continuous exposure. Concentrations higher than the corresponding CV do not necessarily result in harm but should be evaluated further. CVs may include values derived from ATSDR such as Minimum Risk Levels (MRL) and values developed by other state, federal, or international organizations. MRLs are derived for acute (1-14 days), intermediate (>14-364 days), and chronic (365 days and longer) exposure durations, and for the oral and inhalation routes of exposure. Acrolein, benzene, carbon tetrachloride, chloroform, and naphthalene concentrations were above or equal to the recommended ATSDR's CV; therefore, further public health risk evaluation was warranted.

Contaminants Detected near the Perimeter of the Eco Vista Landfill (Sampling Locations Areas 1 to 10)

An adjusted exposure point concentration (EPC) was calculated using the maximum concentrations in the sampling locations near the landfill perimeter (Areas 1-10) to assess air inhalation exposure risks. The maximum concentration was chosen to be the EPC out of extreme caution to provide a worst-case scenario for public health assessment. Acrolein's EPC was 0.45 ppb, benzene's EPC was 0.34 ppb, carbon tetrachloride's EPC was 0.08 ppb, chloroform's EPC was 0.054 ppb, and naphthalene was not detected in the sampling locations near the landfill.

Acrolein exceeds the chronic (365 days or longer) environmental media evaluation guide (EMEG), 0.40 ppb, intermediate (>14-364 days) EMEG, 0.40 ppb, and reference dose media evaluation guide (RMEG)/minimum risk level (MRL), 0.009 ppb. Benzene exceeds the cancer risk evaluation guides (CREG)/MRL, 0.040 ppb. Carbon tetrachloride exceeds the CREG/MRL, 0.026 ppb. Chloroform exceeds the CREG/MRL, 0.0089 ppb. EMEGs represent estimates of contaminant concentrations below which humans exposed during a specific timeframe (acute (1-14 days), intermediate, or chronic) are not expected to experience noncarcinogenic health effects [18]. CREGs represent estimates of contaminant concentrations that are expected to result in no more than one excess cancer in a million (written as E-6 or 10^{-6}) persons exposed during their lifetime (78 years) [18].

Table 3. Calculated Concentrations of Contaminants Detected Near the Perimeter of the Eco Vista Landfill (Sampling Locations Areas 1 to 10), and ATSDR's Screening Values.

Contaminant Name	Exposure Point Concentration	Acute EMEG	Int EMEG	Chronic EMEG
Units are in parts per billion (ppb)				
Acrolein	0.45	3.0	0.40*	0.40 *
Benzene	0.34	9.0	6.0	3.0
Carbon Tetrachloride	0.08	NA	30	30
Chloroform	0.054	1.0	0.80	0.40
Naphthalene	ND	0.060	NA	NA

ATSDR: Agency for Toxic Substances and Disease Registry Exported Thursday, July 11, 2024, from PHAST version 2.4.2.0, database rev 8.3.15
ppb: parts per billion
EPC: Exposure Point Concentration
Acute: 1-14 days
Int: Intermediate (>14-364 days)
Chronic: 365 days or longer
EMEG: Environmental Media Evaluation Guide
MRL: Minimal Risk Level
NA: Not Applicable
ND: Not Detected
**ATSDR CV met or exceeded*
Source: Exported Thursday, July 11, 2024, from PHAST version 2.4.2.0, database rev 8.3.15

The potential exposure from the EPC was further evaluated by comparing the estimated dose to the ATSDR's MRL by calculating a hazard quotient (HQ). The HQ is the ratio of an exposure point concentration divided by the health guidelines, such as the MRL. If the HQ for a chemical is equal to or less than one, it is believed that there is no appreciable risk that non-cancer health effects will occur. If the HQ exceeds one, further evaluation is necessary to understand the possibility that non-cancer effects may occur, although an HQ above one does not necessarily indicate an effect will occur. This is because of the margin of safety inherent in the derivation of all health-based toxicity values. The larger the HQ value, the more likely it is that a health effect may occur.

Table 4. Risk Assessment Values for Acrolein at Sampling Locations Near the Perimeter of the Eco Vista Landfill (Sampling Locations Areas 1 to 10).

Acrolein	
Chronic Hazard Quotient (HQ)	**1.1**
Intermediate Hazard Quotient (HQ)	**1.1**
Acute Hazard Quotient (HQ)	0.15
Lifetime Cancer Risk (LCR)	**NA; Carcinogenicity not classified**

All age groups [child and adult] had slightly exceeded the HQs of 1 based on this evaluation of the reported acrolein concentrations for the chronic and intermediate HQ values. No age groups [child and adult] had HQs above 1 based on this evaluation of the reported acrolein concentrations for the acute HQ values.

Table 5. Risk Calculations of Reported Acrolein Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	CTE Cancer Risk	CTE Exposure Duration (Years)	RME Noncancer HQ	RME Cancer Risk	RME Exposures (Years)
Birth to <1 year	**1.1**	-	1	**1.1**	-	1
1 to < 2 years	**1.1**	-	1	**1.1**	-	4
2 to < 6 years	**1.1**	-	4	**1.1**	-	5
6 to < 11 years	**1.1**	-	5	**1.1**	-	5
11 to < 16 years	**1.1**	-	1	**1.1**	-	5
16 < to 21 years	**1.1**	-	0	**1.1**	-	5
Total Child	**1.1**	-	12	**1.1**	-	21
Adult	**1.1**	-	12	**1.1**	-	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.92 micrograms per cubic meter ($\mu g/m^3$).
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Table 6. Risk Calculations of Reported Acrolein Values for Estimated Intermediate Exposures.

Exposure Age Group	Intermediate Hazard Quotient (HQ)
	Noncancer Quotient (HQ)
Birth to <1 year	1.1 †
1 to < 2 years	1.1 †
2 to < 6 years	1.1 †
6 to < 11 years	1.1 †
11 to < 16 years	1.1 †
16 < to 21 years	1.1 †
Adult	1.1 †

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 0.92 µg/m³.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Since benzene, carbon tetrachloride, and chloroform are known carcinogens, ATSDR's guidelines recommend conducting a separate evaluation to determine the potential risk from cancer-causing chemicals [19].

For a residential scenario, ATSDR recommends calculating lifetime cancer risk (LCR), central tendency exposure (CTE), and reasonable maximum exposure (RME). The lifetime cancer risk (LCR) is an estimated theoretical excess cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a specified time of exposure. The LCR uses an average lifetime expectancy of 78 years for adults (both males and females). The 95th percentile (RME) residential occupancy period (ROP: length of time a person resides in a specific property) is 33 years, and the 50th percentile (CTE) ROP is 12 years [18].

Risk values greater than one in 1,000,000 (or 1.0E-6), which likely represent no excess risk of cancer, but less than one in 10,000 (or 1.0E-4) are within the EPA's target risk range and considered an adequate level of health safety. If the additional LCR is greater than one in 10,000, it is generally considered an indicator that further evaluation may be warranted if the source of contamination is not removed. RME and CTE will be calculated for a noncancer HQ and cancer risk. RME refers to people who are at the high end of the exposure distribution (approximately the 95th percentile) but still within a realistic exposure range [20]. CTE refers to an individual who has an average or typical exposure to a contaminant [19].

Table 7. Risk Assessment Values for Benzene at Sampling Locations Near the Perimeter of the Eco Vista Landfill (Sampling Locations Areas 1 to 10).

Benzene	
Chronic Hazard Quotient (HQ)	0.11
Intermediate Hazard Quotient (HQ)	0.057
Acute Hazard Quotient (HQ)	0.037
Lifetime Cancer Risk (LCR)	**>1.0E-6**

No age groups [child and adult] had HQs above 1 based on this evaluation of the reported benzene for the intermediate, chronic, and acute HQ values. Refer to Tables 7 and 8.

To characterize potential cancer effects from benzene for a community member from inhalation exposure to the ambient air surrounding the landfill perimeter, CTE, RME, and theoretical LCR values were calculated.

Table 8. Risk Calculations of Reported Benzene Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	CTE Cancer Risk	CTE Exposure Duration (Years)	RME Noncancer HQ	RME Cancer Risk	RME Exposures (Years)
Birth to <1 year	0.11	-	1	0.11	-	1
1 to < 2 years	0.11	-	1	0.11	-	1
2 to < 6 years	0.11	-	4	0.11	-	4
6 to < 11 years	0.11	-	5	0.11	-	5
11 to < 16 years	0.11	-	1	0.11	-	5
16 < to 21 years	0.11	-	0	0.11	-	5
Total Child	-	1.3E-6 ‡	12	-	2.3E-6 ‡	21
Adult	0.11	1.3E-6 ‡	12	0.11	3.6E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood	**-**	-	-	**-**	3.6E-6 ‡	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 9.6 µg/m^3 and the cancer risks were calculated using the inhalation unit risk of 7.8E-6 (µg/m^3)$^{-1}$.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Using risk calculations for the reported benzene values, age groups [child (12 years) and adult (12 years)] have a CTE cancer risk of 1.3E-6. Age groups [child (birth to 21 years of age)] have an RME cancer risk of 2.3E-6 and age groups [adult (33 years) and adult {33 years (21 years as childhood exposure plus 12 additional adult years}] have an RME cancer risk of 3.6E-6.

Table 9. Risk Assessment Values for Carbon Tetrachloride at Sampling Locations Near the Perimeter of the Eco Vista Landfill (Sampling Locations Areas 1 to 10).

Carbon Tetrachloride	
Chronic Hazard Quotient (HQ)	0.0050
Intermediate Hazard Quotient (HQ)	0.0026
Acute Hazard Quotient (HQ)	NA
Lifetime Cancer Risk (LCR)	**>1.0E-6**

No age groups [child and adult] had HQs above 1 based on this evaluation of the reported carbon tetrachloride concentrations for the intermediate and chronic HQ values. Refer to Table 10.

To characterize potential cancer effects from carbon tetrachloride for a community member from inhalation exposure to the ambient air surrounding the landfill perimeter, CTE, RME, and theoretical LCR values were calculated.

Table 10. Risk Calculations of Reported Carbon Tetrachloride Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	**CTE Cancer Risk**	**CTE Exposure Duration (Years)**	**RME Noncancer HQ**	**RME Cancer Risk**	**RME Exposures (Years)**
Birth to <1 year	0.0050	-	1	0.0050	-	1
1 to < 2 years	0.0050	-	1	0.0050	-	1
2 to < 6 years	0.0050	-	4	0.0050	-	4
6 to < 11 years	0.0050	-	5	0.0050	-	5
11 to < 16 years	0.0050	-	1	0.0050	-	5
16 < to 21 years	0.0050	-	0	0.0050	-	5
Total Child	-	4.6E-7	12	-	8.1E-7	21
Adult	0.0050	4.6E-7	12	0.0050	1.3E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood	-	-	-	-	1.3E-6 ‡	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 100 µg/m^3 and the cancer risks were calculated using the inhalation unit risk of 6.0E-6 (µg/m^3)$^{-1}$.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Using risk calculations for the reported carbon tetrachloride values, [child (12 years) and adult (12 years)] have a CTE cancer risk of 4.6E-7. Age groups [child (birth to 21 years of age)] have an RME

cancer risk of 8.1E-7 and [adult (33 years) and adult {33 years (21 years as childhood exposure plus 12 additional adult years)}] have an RME cancer risk of 1.3E-6.

Table 11. Risk Assessment Values for Chloroform at Sampling Locations Near the Perimeter of the Eco Vista Landfill (Sampling Locations Areas 1 to 10).

Chloroform	
Chronic Hazard Quotient (HQ)	0.13
Intermediate Hazard Quotient (HQ)	0.068
Acute Hazard Quotient (HQ)	0.054
Lifetime Cancer Risk (LCR)	**>1.0E-6**

No age groups [child and adult] had HQs above 1 based on this evaluation of the reported chloroform concentrations for the intermediate, chronic, and acute HQ values. Refer to Table 12.

To characterize potential cancer effects from chloroform for a community member from inhalation exposure to the ambient air surrounding the landfill perimeter, CTE, RME, and theoretical LCR values were calculated.

Table 12. Risk Calculations of Reported Chloroform Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	CTE Cancer Risk	CTE Exposure Duration (Years)	RME Noncancer HQ	RME Cancer Risk	RME Exposures (Years)
Birth to <1 year	0.13	-	1	0.13	-	1
1 to < 2 years	0.13	-	1	0.13	-	1
2 to < 6 years	0.13	-	4	0.13	-	4
6 to < 11 years	0.13	-	5	0.13	-	5
11 to < 16 years	0.13	-	1	0.13	-	5
16 < to 21 years	0.13	-	0	0.13	-	5
Total Child	-	9.3E-7	12	-	1.6E-6 ‡	21
Adult	0.13	9.3E-7	12	0.13	2.6E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood	-	-	-	-	2.6E-6 ‡	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 2 µg/m^3 and the cancer risks were calculated using the inhalation unit risk of 2.3E-5 (µg/m^3)$^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

CTE: Central Tendency Exposure

RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Using risk calculations for the reported chloroform values, age groups [child (years) and adult (12 years)] have a CTE cancer risk of 9.3E-7. Age groups [child (birth to 21 years of age)] have an RME cancer risk of 1.6E-6., and [adult (33 years) and adult {33 years (21 years as childhood exposure plus 12 additional adult years)}] have an RME cancer risk of 2.6E-6.

Contaminants Detected Further Away from Eco Vista Landfill
(Sampling Locations Areas 11 to 14)

To ensure high-quality data, CTEH and ADEE selected four background sampling locations (Areas 11 to 14). The sample locations were positioned in four (4) quadrants and placed farther away from the landfill. This was done to determine if any other sources could be contributing to the air contamination and to help pinpoint the source of the pollutants. Since the sampling locations (Areas 11 to 14) had similar concentration ranges for the following contaminants: acrolein, benzene, and carbon tetrachloride. These samples were grouped for this analysis. Additionally, chloroform was not detected at locations further away from the landfill, and naphthalene was only found at Area 11.

An adjusted exposure point concentration (EPC) was calculated using the maximum concentrations in the sampling locations further away from the landfill (Areas 11-14) to assess air inhalation exposure risk. The maximum concentration was chosen to be EPC out of extreme caution to provide a worst-case scenario for public health assessment. Acrolein EPC was 0.18 ppb, benzene was 0.14 ppb, carbon tetrachloride was 0.078 ppb, naphthalene was 0.17 ppb, and chloroform was not detected in sampling locations further away from the landfill. Acrolein exceeds the reference dose media evaluation guide (RMEG)/MRL, 0.009 ppb. Benzene exceeds the cancer risk evaluation guides (CREG)/MRL, 0.040 ppb. Carbon tetrachloride exceeds the CREG/MRL, 0.026 ppb. Naphthalene exceeds the Acute EMEG, 0.060 ppb, and CREG/MRL, 0.0089 ppb. EMEGs represent estimates of contaminant concentrations below which humans exposed during a specific timeframe (acute, intermediate, or chronic) are not expected to experience noncarcinogenic health effects [18]. CREGs represent estimates of contaminant concentrations that are expected to result in no more than one excess cancer in a million (written as E-6 or 10^{-6}) persons exposed during their lifetime (78 years) [18].

Table 13. Converted Concentrations of Contaminants Detected Further Away from Eco Vista Landfill (Sampling Locations Areas 11 to 14) and ATSDR's Comparison Values.

Contaminant Name	Exposure Point Concentration	Acute EMEG	Int EMEG	Chronic EMEG
Units are in parts per billion (ppb)				
Acrolein	0.18	3.0	0.40	0.40
Benzene	0.14	9.0	6.0	3.0
Carbon Tetrachloride	0.078	NA	30	3.0
Chloroform	ND	1.0	0.80	0.40
Naphthalene	0.17	0.060*	NA	NA

ATSDR: Agency for Toxic Substances and Disease Registry
ppb: parts per billion
EPC: Exposure Point Concentration
Acute: 1-14 days
Int: Intermediate (>14-364 days)
Chronic: 365 days or longer
EMEG: Environmental Media Evaluation Guide
MRL: Minimal Risk Level
NA: Not Applicable
ND: Not Detected
**ATSDR CV met or exceeded*
Source: Exported Thursday, July 11, 2024, from PHAST version 2.4.2.0, database rev 8.3.15

The potential exposure from the EPC was further evaluated by comparing the estimated dose to the ATSDR's MRL by calculating a hazard quotient (HQ). The HQ is the ratio of an exposure point concentration divided by the health guidelines, such as the MRL. If the HQ for a chemical is equal to or less than one, it is believed that there is no appreciable risk that non-cancer health effects will occur. If the HQ exceeds one, further evaluation is necessary to understand the possibility that non-cancer effects may occur, although an HQ above one does not necessarily indicate an effect will occur. This is because of the margin of safety inherent in the derivation of all health-based toxicity values. The larger the HQ value, the more likely it is that a health effect may occur.

No age groups [child and adult] had HQs above 1 based on this evaluation of the reported acrolein concentrations for the intermediate, chronic, and acute HQ values.

Since benzene, carbon tetrachloride, and naphthalene are known to be carcinogenic, ATSDR's guidelines recommend conducting a separate evaluation to determine the potential risk from cancer-causing chemicals [19].

For a residential scenario, ATSDR recommends calculating lifetime cancer risk (LCR), central tendency exposure (CTE), and reasonable maximum exposure (RME). The lifetime cancer risk (LCR) is an estimated theoretical excess cancer risk expressed as the proportion of a population that may be affected by a carcinogen during a specified time of exposure. The LCR uses an average

lifetime expectancy of 78 years for adults (both males and females). The 95th percentile (RME) residential occupancy period (ROP: length of time a person resides in a specific property) is 33 years, and the 50th percentile (CTE) ROP is 12 years [18].

Risk values greater than one in 1,000,000 (or 1.0E-6), which likely represent no excess risk of cancer, but less than one in 10,000 (or 1.0E-4) are within the EPA's target risk range and considered an adequate level of health safety. If the additional LCR is greater than one in 10,000, it is generally considered an indicator that further evaluation may be warranted if the source of contamination is not removed. RME and CTE will be calculated for a noncancer HQ and cancer risk. RME refers to people who are at the high end of the exposure distribution (approximately the 95th percentile) but still within a realistic exposure range [20]. CTE refers to an individual who has an average or typical exposure to a contaminant [19].

Table 14. Risk Assessment Values for Benzene at Sampling Locations (Areas 11 to 14) Further Away from Eco Vista Landfill.

Benzene	
Chronic Hazard Quotient (HQ)	0.047
Intermediate Hazard Quotient (HQ)	0.024
Acute Hazard Quotient (HQ)	0.015
Lifetime Cancer Risk (LCR)	**>1.0E-6**

No age groups [child and adult] had HQs above 1 based on this evaluation of the reported benzene concentrations for the intermediate, chronic, and acute HQ values. Refer to Table 15.

To characterize potential cancer effects from benzene for a community member from inhalation exposure to the ambient air further away from the landfill, a theoretical Lifetime Cancer Risk (LCR) value was calculated.

Table 15. Risk Calculations of Reported Benzene Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	CTE Cancer Risk	CTE Exposure Duration (Years)	RME Noncancer HQ	RME Cancer Risk	RME Exposures (Years)
Birth to <1 year	0.047	-	1	0.047	-	1
1 to < 2 years	0.047	-	1	0.047	-	1
2 to < 6 years	0.047		4	0.047	-	4
6 to < 11 years	0.047	-	5	0.047	-	5
11 to < 16 years	0.047	-	1	0.047	-	5
16 < to 21 years	0.047	-	0	0.047	-	5
Total Child	-	5.4E-7	12	-	9.4E-7	21
Adult	0.047	5.4E-7	12	0.047	1.5E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood	-	-	-	-	1.5E-6 ‡	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 9.6 µg/m^3 and the cancer risks were calculated using the inhalation unit risk of 7.8E-6 (µg/m^3)$^{-1}$.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Using risk calculations for the reported benzene values, age groups [child (12 years) and adult (12 years)] have a CTE cancer risk of 5.4E-7. Using risk calculations for the reported benzene values, age groups [adults (33 years) and adult {33 years (21 years as childhood exposure plus 12 additional adult years)}] have an RME cancer risk of 1.5E-6 and age groups [child (birth to 21 years)] have an RME cancer risk of 9.4E-7.

Table 16. Risk Assessment Values for Carbon Tetrachloride at Sampling Locations (Areas 11 to 14) Further Away from Eco Vista Landfill.

Carbon Tetrachloride	
Chronic Hazard Quotient (HQ)	0.0049
Intermediate Hazard Quotient (HQ)	0.0026
Acute Hazard Quotient (HQ)	NA
Lifetime Cancer Risk (LCR)	**>1.0E-6**

No age groups [child and adult] had HQs above 1 based on this evaluation of the reported carbon tetrachloride concentrations for the chronic, intermediate, and acute HQ values. Refer to Table 17.

To characterize potential cancer effects from carbon tetrachloride for a community member from inhalation exposure to the ambient air further away from landfill, CTE, RME, and theoretical LCR values were calculated.

Table 17. Risk Calculations of Reported Carbon Tetrachloride Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	CTE Cancer Risk	CTE Exposure Duration (Years)	RME Noncancer HQ	RME Cancer Risk	RME Exposures (Years)
Birth to <1 year	0.0049	-	1	0.0049	-	1
1 to < 2 years	0.0049	-	1	0.0049	-	1
2 to < 6 years	0.0049	-	4	0.0049	-	4
6 to < 11 years	0.0049	-	5	0.0049	-	5
11 to < 16 years	0.0049	-	1	0.0049		5
16 < to 21 years	0.0049	-	0	0.0049	-	5
Total Child	-	4.5E-7	12	-	7.9E-7	21
Adult	0.0049	4.5E-7	12	0.0049	1.2E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood	-	-	-	-	1.2E-6 ‡	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 100 µg/m^3 and the cancer risks were calculated using the inhalation unit risk of 6.0E-6 (µg/m^3)$^{-1}$.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.
§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Using risk calculations for the reported carbon tetrachloride values, age groups [child (12 years) and adult (12 years)] have a CTE cancer risk of 4.5E-7. Age groups [adult (33 years) and adult {33 years (21 years as childhood exposure plus 12 additional adult years)}] have an RME cancer risk of 1.2E-6 and age groups [child (birth to 21 years)] have an RME cancer risk of 7.9E-7.

Table 18. Risk Assessment Values for Naphthalene at Sampling Locations (Areas 11 to 14) Further Away from Eco Vista Landfill.

Naphthalene	
Chronic Hazard Quotient (HQ)	0.30
Intermediate Hazard Quotient (HQ)	NA
Acute Hazard Quotient (HQ)	**2.9**
Cancer Risk (LCR)	**>1.0E-6**

Table 19. Risk Calculations of Reported Naphthalene Values for Estimated Acute Exposures.

Exposure Age Group	Intermediate Hazard Quotient (HQ)
	Noncancer Quotient (HQ)
Birth to <1 year	2.9 †
1 to < 2 years	2.9 †
2 to < 6 years	2.9 †
6 to < 11 years	2.9 †
11 to < 16 years	2.9 †
16 < to 21 years	2.9 †
Adult	2.9 †

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.31 µg/m^3.
† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

All age groups [child and adult] exceeded the intermediate HQs of 1 based on this evaluation of the reported naphthalene concentrations for the acute HQ values. No age groups [child and adult] had HQs above 1 based on this evaluation of the reported naphthalene concentrations for the chronic HQ values. Refer to Tables 18 and 20.

To characterize potential cancer effects from naphthalene for a community member from inhalation exposure to the ambient air further away from the landfill, CTE, RME, and theoretical LCR values were calculated.

Table 20. Risk Calculations of Reported Naphthalene Values for Estimated Chronic Exposures.

Exposure Age Group	Chronic Hazard Quotient (HQ)					
	CTE Noncancer HQ	CTE Cancer Risk	CTE Exposure Duration (Years)	RME Noncancer HQ	RME Cancer Risk	RME Exposures (Years)
Birth to <1 year	0.30	-	1	0.30	-	1
1 to < 2 years	0.30	-	1	0.30	-	1
2 to < 6 years	0.30	-	4	0.30	-	4
6 to < 11 years	0.30	-	5	0.30	-	5
11 to < 16 years	0.30	-	1	0.30	-	5
16 < to 21 years	0.30	-	0	0.30	-	5
Total Child	-	4.7E-6 ‡	12	-	8.2E-6 ‡	21
Adult	0.30	4.7E-6 ‡	12	0.30	1.3E-5 ‡	33
Birth to < 21 years plus 12 years during adulthood	-	-	-	-	1.3E-5 ‡	33

The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 3 µg/m^3 and the cancer risks were calculated using the inhalation unit risk of 3.4E-5 (µg/m^3)$^{-1}$.
‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

Using risk calculations for the reported naphthalene values, age groups [child (years) and adult (12 years)] have a CTE cancer risk of 4.7E-6. Age groups [adult (33 years) and adult {33 years (21 years as childhood exposure plus 12 additional adult years)}] have an RME cancer risk of 1.3E-5 and age groups [child (birth to 21 years)] have an RME cancer risk of 8.2E-6.

The Influence of Non-Work Day on Data

Since the data for the air samples and monitoring were collected on Sunday, April 28, 2024, which was a non-work day for the landfill, it is needed to determine if the data were influenced by normal activities from the landfill (normal operation schedule is Monday through Friday [1]), local business, and traffic.

Acrolein was not detected in several areas (Areas 1, 3, 4, 5, and 14) on the non-work day, April 28. It can be concluded that vehicle traffic from normal activities during a business week could significantly contribute to the ambient concentration of acrolein. However, the concentrations of other COCs were not significantly impacted by the testing days. There was not a significant influence on other COC concentrations between the non-work day and work day.

Child Health Considerations:

In communities faced with potential contamination, the many physical differences between children and adults may require special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than adults; this means they breathe dust, soil, and vapors closer to the ground. A child's lower body weight and higher intake rate result in a greater dose of hazardous substances per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Additionally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Therefore, adults need as much information as possible to make informed decisions regarding their children's health. This health consultation evaluates children's exposure (from birth to 21 years of age) to airborne contaminants that are of concern in a specific area, assessing potential cancer risk scenarios. The assessment considered children are likely to live in their childhood home to adulthood.

Data Limitations:

Air samples provide a "snapshot" of conditions happening at a specific time. A short period of air sampling and/or monitoring provides a limited representation of year-round conditions.

Variable atmospheric conditions such as temperatures, barometric pressure, wind speed, and direction fluctuate regularly and can potentially affect gas concentrations detected in the ambient (outdoor) air and may change over time with no predictable pattern.

Conclusions:

Based on the data evaluated, a completed pathway for inhalation exposure does exist for residents living near and further away (including residents near the background sampling locations) from the site.

The data collected near the Eco Vista Landfill perimeter did identify levels of acrolein, benzene, carbon tetrachloride, and chloroform in the air that exceed health CVs. However, reported benzene levels are in the ranges that would be expected for rural subdivisions. The air data results near the site perimeter did indicate that acrolein exceeds the chronic (exposure over 1 year) EMEG, 0.40 parts per billion (ppb); intermediate (exposure 15 – 365 days) EMEG, 0.40 ppb; and RMEG/ MRL, 0.009 ppb.

The off-site data collected at locations further from the site did identify levels of acrolein, benzene, carbon tetrachloride, and naphthalene that exceed health CVs. However, reported benzene levels are in the ranges that would be expected for rural subdivisions. The data further away from the Eco Vista Landfill perimeter did indicate that naphthalene exceeds the acute (exposure 1-14 days) EMEG, 0.060 ppb; and CREG/MRL, 0.0056 ppb.

The EPA considers a cancer risk of less than 1E-6 (which translates to one additional cancer in 1,000,000 individuals) as generally not concerning. On the other hand, risk levels exceeding 1E-4 (one additional cancer in 10,000 individuals) are typically considered unacceptable. The highest cancer risk was associated with naphthalene from an area located farther away from the landfill. However, even this level of cancer risk falls within an acceptable range as defined by the EPA [21].

Since the analyses demonstrate that the maximum contamination levels for acrolein, benzene, and carbon tetrachloride near the landfill perimeter (Areas 1-10) are consistent with background concentrations [further away from the landfill, (Areas 11-14)] a determination cannot be made on if or how much the other local sources are impacting the ambient air.

Currently, ADH cannot conclusively determine the source of these contaminants. However, it is possible that local businesses or other activities not associated with the Eco Vista Landfill site are contributing to these levels. As a result, we recommend obtaining more comprehensive air quality data.

Recommendations:

For prudent public health safety, ADH recommends the following:

- If resources are available, additional VOC air sampling and monitoring should be conducted:
    - Near Area 2 and the four (4) selected background sampling locations (Areas 11-14) indicated on CTEH's Analytical Air Sampling Location map. (COCs were detected

above ATSDR's CVs further away from the landfill and the highest concentrations of acrolein and benzene were detected at Area 2, near the landfill perimeter. If requested, ADH staff can assist in developing a sampling scheme.)
    - On the Eco Vista Landfill site to better determine if it is contributing to the elevated contaminant levels. (There is a possibility that an evaluation of the on-site testing data could assist in better determining or verifying if the landfill is contributing to the COC concentrations, even if the on-site results indicate that the levels are within ADEE air permit limits.)
    - In a comparison community that does not have a landfill nearby. (Conducting this sampling would require substantial resources; however, it may identify possible community sources not associated with landfill operations.)
- ADEE continue to provide any air monitoring and/or air sampling results to ADH for evaluation of public health exposures.
- Community members contact a physician or health care professional if they feel they are experiencing possible health effects related to strong odors.

Please feel free to contact me at 501-661-2232 or ADH.TS@arkansas.gov, if you have any questions.

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Appendix A: CTEH Maps

Figure 1. CTEH Air Sampling Locations. Area 1 to Area 10 was located around the Eco Vista Landfill perimeter. Area 11 to Area 14 was located further away from the Eco Vista Landfill [5].

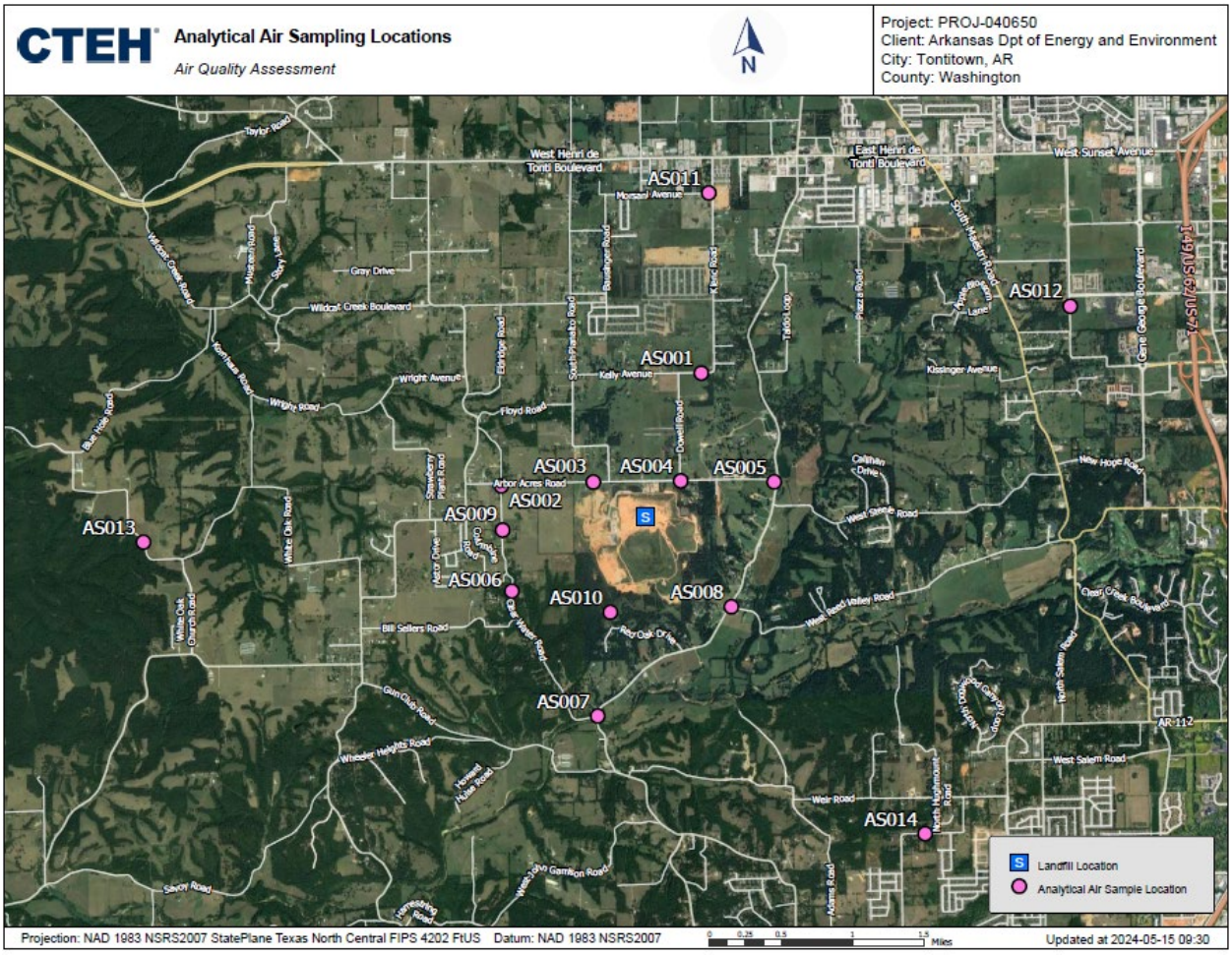
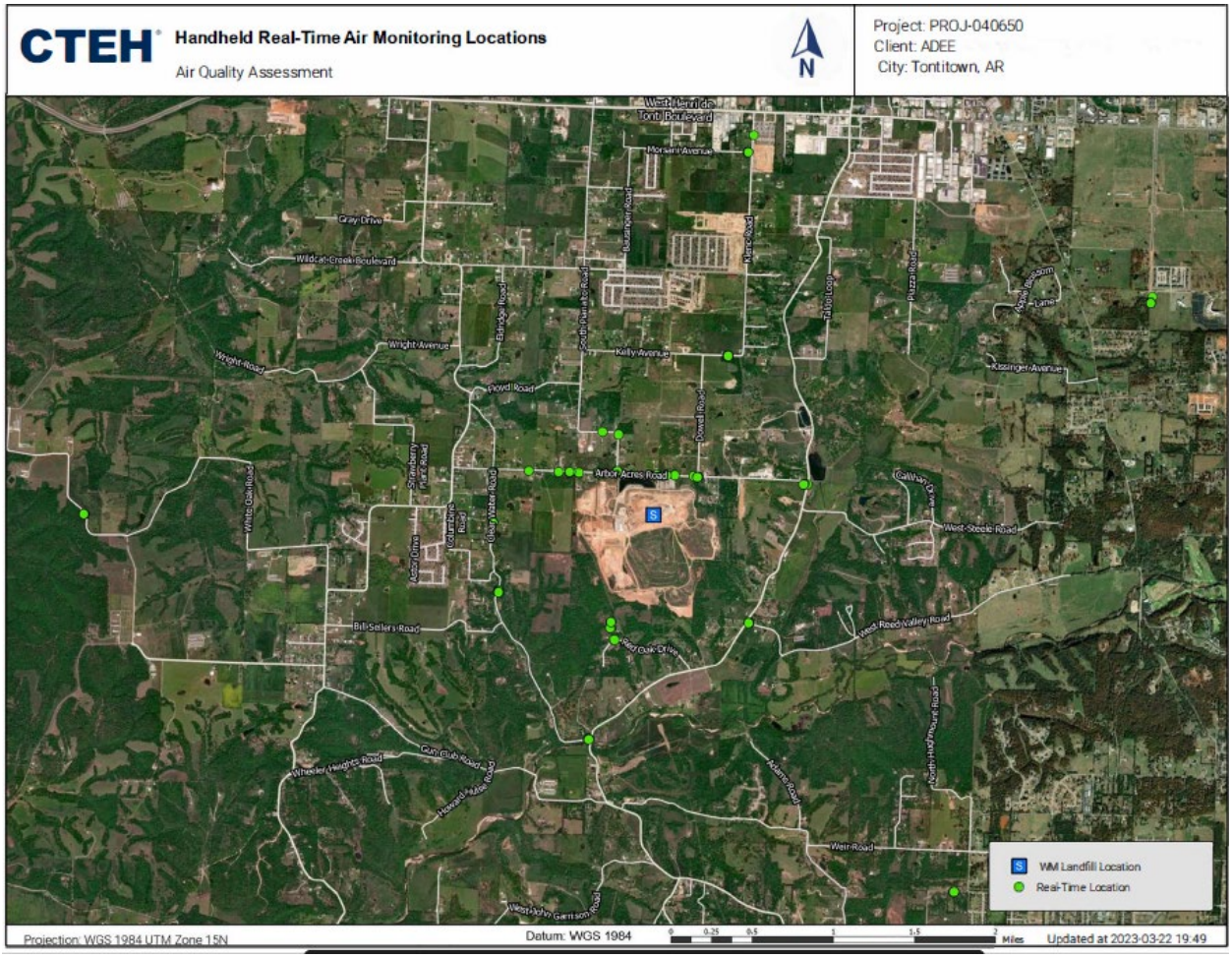


Figure 2. CTEH Air Monitoring Locations. All handheld real-time air monitoring locations were around and further away from the Eco Vista Landfill perimeter [5].



Appendix B: Public Health Risk Assessment Calculations

PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL

Contents

Default Parameters Table
PHAST Report, v2.4.2.0, July 11, 2024

Equations

Air Inhalation Exposure Equation

Adjusted EPC = EPC x $EF_{noncancer}$ **Equation 1**

EPC = exposure point concentration, $EF_{noncancer}$ = exposure factor (unitless)

Hazard Quotient

HQ = Adjusted EPC ÷ HG **Equation 2**

HQ = hazard quotient, EPC = exposure point concentration (µg/m^3 or ppb), HG = health guideline (e.g., inhalation MRL, RfC)

Cancer Risk Equations

CR = Adjusted EPC x IUR x (ED ÷ LY) **Equation 3**

ADAF-adjusted CR = (Adjusted EPC x IUR) x (ED ÷ LY) x ADAF **Equation 4**

Total CR = Sum of the CR for all exposure groups **Equation 5**

CR = cancer risk (unitless), EPC = exposure point concentration (µg/m^3 or ppb), IUR = inhalation unit risk ((µg/m^3 or ppb)$^{-1}$),
ED = exposure duration (years), LY = lifetime years (78 years), ADAF = age-dependent adjustment factor (unitless),
EF (cancer) = exposure factor (cancer) calculated as follows: EF (noncancer; unitless) x exposure group specific exposure duration (years) ÷ lifetime of 78 years

Default Exposure Factors

Duration Category	Hours per Day	Days per Week	Weeks per Year	Years	Exposure Group Specific $EF_{noncancer}$	Exposure Group Specific* EF_{cancer}
Acute	24	-	-	-	1	-
Intermediate	24	7	-	-	1	-
Chronic	24	7	52.14	See exposure group specific exposure durations	1	= $EF_{noncancer}$ x Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years

Abbreviations: EF = exposure factor; NC = not calculated

Cancer EFs are not shown in the table because they are calculated using age-specific durations. The general formula is $EF_{cancer} = EF_{noncancer} \times$ Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years.

Contaminant Information

Contaminant Name	Entered Concentration	EPC Type	Converted Concentration (µg/m^3)	Converted Concentration (ppb)
Acrolein	0.45 ppb	Maximum	1	0.45
Benzene	0.34 ppb	Maximum	1.1	0.34
Carbon tetrachloride	0.08 ppb	Maximum	0.5	0.08
Chloroform	0.054 ppb	Maximum	0.26	0.054

Abbreviations: EPC = exposure point concentration; ppb = parts per billion

PUBLIC HEALTH ASSESSMENT SITE TOOL

Default Air Residential Results for Chronic, Intermediate, and Acute Duration Exposures
PHAST Report, v2.4.2.0, July 11, 2024

Instructions to Health Assessors

1. Because you have used the "Run Quick Summary" feature in PHAST, this report contains default results in the tables that follow. The default results for chronic, intermediate, and acute durations are based on ATSDR's standard age ranges and are generated using standard default assumptions detailed in the ATSDR Exposure Dose Guidance documents (EDGs). Site-specific information has not been incorporated into these results.

2. You should decide which of these tables should be presented in your public health document to support your conclusions and recommendations. It may not be necessary to include all of them.

Air Inhalation Chronic (Default)

Acrolein

Table 1. Residential: Default exposure point concentrations for chronic exposure to acrolein in air at 1 µg/m³ (0.45 ppb) along with noncancer hazard quotients*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	1.0	0.45	1.1 †	-	1	1.0	0.45	1.1 †	-	1
1 to < 2 years	1.0	0.45	1.1 †	-	1	1.0	0.45	1.1 †	-	1
2 to < 6 years	1.0	0.45	1.1 †	-	4	1.0	0.45	1.1 †	-	4
6 to < 11 years	1.0	0.45	1.1 †	-	5	1.0	0.45	1.1 †	-	5
11 to < 16 years	1.0	0.45	1.1 †	-	1	1.0	0.45	1.1 †	-	5
16 to < 21 years	1.0	0.45	1.1 †	-	0	1.0	0.45	1.1 †	-	5
Total Child	-	-	-	-	12	-	-	-	-	21
Adult	1.0	0.45	1.1 †	-	12	1.0	0.45	1.1 †	-	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.92 µg/m³.

† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table 2. Residential: Default exposure point concentrations for chronic exposure to benzene in air at 1.1 µg/m³ (0.34 ppb) along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	1.1	0.34	0.11	-	1	1.1	0.34	0.11	-	1
1 to < 2 years	1.1	0.34	0.11	-	1	1.1	0.34	0.11	-	1
2 to < 6 years	1.1	0.34	0.11	-	4	1.1	0.34	0.11	-	4
6 to < 11 years	1.1	0.34	0.11	-	5	1.1	0.34	0.11	-	5
11 to < 16 years	1.1	0.34	0.11	-	1	1.1	0.34	0.11	-	5
16 to < 21 years	1.1	0.34	0.11	-	0	1.1	0.34	0.11	-	5
Total Child	-	-	-	1.3E-6 ‡	12	-	-	-	2.3E-6 ‡	21
Adult	1.1	0.34	0.11	1.3E-6 ‡	12	1.1	0.34	0.11	3.6E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	3.6E-6 ‡	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 9.6 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 7.8E-06 $(\mu g/m^3)^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table 3. Residential: Default exposure point concentrations for chronic exposure to carbon tetrachloride in air at 0.5 µg/m³ (0.08 ppb) along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.50	0.080	0.0050	-	1	0.50	0.080	0.0050	-	1
1 to < 2 years	0.50	0.080	0.0050	-	1	0.50	0.080	0.0050	-	1
2 to < 6 years	0.50	0.080	0.0050	-	4	0.50	0.080	0.0050	-	4
6 to < 11 years	0.50	0.080	0.0050	-	5	0.50	0.080	0.0050	-	5
11 to < 16 years	0.50	0.080	0.0050	-	1	0.50	0.080	0.0050	-	5
16 to < 21 years	0.50	0.080	0.0050	-	0	0.50	0.080	0.0050	-	5
Total Child	-	-	-	4.6E-7	12	-	-	-	8.1E-7	21
Adult	0.50	0.080	0.0050	4.6E-7	12	0.50	0.080	0.0050	1.3E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	1.3E-6 ‡	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 100 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 6.0E-06 $(\mu g/m^3)^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table 4. Residential: Default exposure point concentrations for chronic exposure to chloroform in air at 0.26 µg/m³ (0.054 ppb) along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.26	0.054	0.13	-	1	0.26	0.054	0.13	-	1
1 to < 2 years	0.26	0.054	0.13	-	1	0.26	0.054	0.13	-	1
2 to < 6 years	0.26	0.054	0.13	-	4	0.26	0.054	0.13	-	4
6 to < 11 years	0.26	0.054	0.13	-	5	0.26	0.054	0.13	-	5
11 to < 16 years	0.26	0.054	0.13	-	1	0.26	0.054	0.13	-	5
16 to < 21 years	0.26	0.054	0.13	-	0	0.26	0.054	0.13	-	5
Total Child	-	-	-	9.3E-7	12	-	-	-	1.6E-6 ‡	21
Adult	0.26	0.054	0.13	9.3E-7	12	0.26	0.054	0.13	2.6E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	2.6E-6 ‡	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 2 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 2.3E-05 $(\mu g/m^3)^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Air Inhalation Intermediate (Default)

Acrolein

Table 5. Residential: Default exposure point concentrations for intermediate exposure to acrolein in air at 1 µg/m³ (0.45 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	1.0	0.45	1.1 †
1 to < 2 years	1.0	0.45	1.1 †
2 to < 6 years	1.0	0.45	1.1 †
6 to < 11 years	1.0	0.45	1.1 †
11 to < 16 years	1.0	0.45	1.1 †
16 to < 21 years	1.0	0.45	1.1 †
Adult	1.0	0.45	1.1 †

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 0.92 µg/m³.

† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.

Table 6. Residential: Default exposure point concentrations for intermediate exposure to benzene in air at 1.1 µg/m³ (0.34 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	1.1	0.34	0.057
1 to < 2 years	1.1	0.34	0.057
2 to < 6 years	1.1	0.34	0.057
6 to < 11 years	1.1	0.34	0.057
11 to < 16 years	1.1	0.34	0.057
16 to < 21 years	1.1	0.34	0.057
Adult	1.1	0.34	0.057

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 19 µg/m^3.

Table 7. Residential: Default exposure point concentrations for intermediate exposure to carbon tetrachloride in air at 0.5 µg/m³ (0.08 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.50	0.080	0.0026
1 to < 2 years	0.50	0.080	0.0026
2 to < 6 years	0.50	0.080	0.0026
6 to < 11 years	0.50	0.080	0.0026
11 to < 16 years	0.50	0.080	0.0026
16 to < 21 years	0.50	0.080	0.0026
Adult	0.50	0.080	0.0026

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 190 µg/m^3.

Table 8. Residential: Default exposure point concentrations for intermediate exposure to chloroform in air at 0.26 µg/m³ (0.054 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.26	0.054	0.068
1 to < 2 years	0.26	0.054	0.068
2 to < 6 years	0.26	0.054	0.068
6 to < 11 years	0.26	0.054	0.068
11 to < 16 years	0.26	0.054	0.068
16 to < 21 years	0.26	0.054	0.068
Adult	0.26	0.054	0.068

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 3.9 µg/m³.

Air Inhalation Acute (Default)

Acrolein

Table 9. Residential: Default exposure point concentrations for acute exposure to acrolein in air at 1 µg/m³ (0.45 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	1.0	0.45	0.15
1 to < 2 years	1.0	0.45	0.15
2 to < 6 years	1.0	0.45	0.15
6 to < 11 years	1.0	0.45	0.15
11 to < 16 years	1.0	0.45	0.15
16 to < 21 years	1.0	0.45	0.15
Adult	1.0	0.45	0.15

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 6.9 µg/m³ . The standard exposure factor rule does not apply to this chemical.

Table 10. Residential: Default exposure point concentrations for acute exposure to benzene in air at 1.1 µg/m³ (0.34 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	1.1	0.34	0.037
1 to < 2 years	1.1	0.34	0.037
2 to < 6 years	1.1	0.34	0.037
6 to < 11 years	1.1	0.34	0.037
11 to < 16 years	1.1	0.34	0.037
16 to < 21 years	1.1	0.34	0.037
Adult	1.1	0.34	0.037

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 29 µg/m^3.

Carbon tetrachloride

Table 11. Residential: Default exposure point concentrations for acute exposure to carbon tetrachloride in air at 0.5 µg/m³ (0.08 ppb)*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.50	0.080	-
1 to < 2 years	0.50	0.080	-
2 to < 6 years	0.50	0.080	-
6 to < 11 years	0.50	0.080	-
11 to < 16 years	0.50	0.080	-
16 to < 21 years	0.50	0.080	-
Adult	0.50	0.080	-

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0.

Table 12. Residential: Default exposure point concentrations for acute exposure to chloroform in air at 0.26 µg/m³ (0.054 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.26	0.054	0.054
1 to < 2 years	0.26	0.054	0.054
2 to < 6 years	0.26	0.054	0.054
6 to < 11 years	0.26	0.054	0.054
11 to < 16 years	0.26	0.054	0.054
16 to < 21 years	0.26	0.054	0.054
Adult	0.26	0.054	0.054

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 4.9 µg/m³.

PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL

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EPC = exposure point concentration, $EF_{noncancer}$ = exposure factor (unitless)

Hazard Quotient

HQ = Adjusted EPC ÷ HG **Equation 2**

HQ = hazard quotient, EPC = exposure point concentration (µg/m^3 or ppb), HG = health guideline (e.g., inhalation MRL, RfC)

Cancer Risk Equations

CR = Adjusted EPC x IUR x (ED ÷ LY) **Equation 3**

ADAF-adjusted CR = (Adjusted EPC x IUR) x (ED ÷ LY) x ADAF **Equation 4**

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CR = cancer risk (unitless), EPC = exposure point concentration (µg/m^3 or ppb), IUR = inhalation unit risk ((µg/m^3 or ppb)$^{-1}$),
ED = exposure duration (years), LY = lifetime years (78 years), ADAF = age-dependent adjustment factor (unitless),
EF (cancer) = exposure factor (cancer) calculated as follows: EF (noncancer; unitless) x exposure group specific exposure duration (years) ÷ lifetime of 78 years

Default Exposure Factors

Duration Category	Hours per Day	Days per Week	Weeks per Year	Years	Exposure Group Specific $EF_{noncancer}$	Exposure Group Specific* EF_{cancer}
Acute	24	-	-	-	1	-
Intermediate	24	7	-	-	1	-
Chronic	24	7	52.14	See exposure group specific exposure durations	1	= $EF_{noncancer}$ x Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years

Abbreviations: EF = exposure factor; NC = not calculated

Cancer EFs are not shown in the table because they are calculated using age-specific durations. The general formula is $EF_{cancer} = EF_{noncancer} \times$ Exposure Duration for $Cancer_{Exposure\ Group}$ (years) ÷ 78 years.

Contaminant Information

Contaminant Name	Entered Concentration	EPC Type	Converted Concentration (µg/m^3)	Converted Concentration (ppb)
Acrolein	0.18 ppb	Maximum	0.41	0.18
Benzene	0.14 ppb	Maximum	0.45	0.14
Carbon tetrachloride	0.078 ppb	Maximum	0.49	0.078
Naphthalene	0.17 ppb	Maximum	0.89	0.17

Abbreviations: EPC = exposure point concentration; ppb = parts per billion

PUBLIC HEALTH ASSESSMENT SITE TOOL

Default Air Residential Results for Chronic, Intermediate, and Acute Duration Exposures
PHAST Report, v2.4.2.0, July 11, 2024

Instructions to Health Assessors

1. Because you have used the "Run Quick Summary" feature in PHAST, this report contains default results in the tables that follow. The default results for chronic, intermediate, and acute durations are based on ATSDR's standard age ranges and are generated using standard default assumptions detailed in the ATSDR Exposure Dose Guidance documents (EDGs). Site-specific information has not been incorporated into these results.

2. You should decide which of these tables should be presented in your public health document to support your conclusions and recommendations. It may not be necessary to include all of them.

Air Inhalation Chronic (Default)

Acrolein

Table 1. Residential: Default exposure point concentrations for chronic exposure to acrolein in air at 0.41 µg/m³ (0.18 ppb) along with noncancer hazard quotients*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.41	0.18	0.45	-	1	0.41	0.18	0.45	-	1
1 to < 2 years	0.41	0.18	0.45	-	1	0.41	0.18	0.45	-	1
2 to < 6 years	0.41	0.18	0.45	-	4	0.41	0.18	0.45	-	4
6 to < 11 years	0.41	0.18	0.45	-	5	0.41	0.18	0.45	-	5
11 to < 16 years	0.41	0.18	0.45	-	1	0.41	0.18	0.45	-	5
16 to < 21 years	0.41	0.18	0.45	-	0	0.41	0.18	0.45	-	5
Total Child	-	-	-	-	12	-	-	-	-	21
Adult	0.41	0.18	0.45	-	12	0.41	0.18	0.45	-	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.92 µg/m³.

Table 2. Residential: Default exposure point concentrations for chronic exposure to benzene in air at 0.45 µg/m³ (0.14 ppb) along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.45	0.14	0.047	-	1	0.45	0.14	0.047	-	1
1 to < 2 years	0.45	0.14	0.047	-	1	0.45	0.14	0.047	-	1
2 to < 6 years	0.45	0.14	0.047	-	4	0.45	0.14	0.047	-	4
6 to < 11 years	0.45	0.14	0.047	-	5	0.45	0.14	0.047	-	5
11 to < 16 years	0.45	0.14	0.047	-	1	0.45	0.14	0.047	-	5
16 to < 21 years	0.45	0.14	0.047	-	0	0.45	0.14	0.047	-	5
Total Child	-	-	-	5.4E-7	12	-	-	-	9.4E-7	21
Adult	0.45	0.14	0.047	5.4E-7	12	0.45	0.14	0.047	1.5E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	1.5E-6 ‡	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 9.6 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 7.8E-06 $(\mu g/m^3)^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table 3. Residential: Default exposure point concentrations for chronic exposure to carbon tetrachloride in air at 0.49 µg/m³ (0.078 ppb) along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.49	0.078	0.0049	-	1	0.49	0.078	0.0049	-	1
1 to < 2 years	0.49	0.078	0.0049	-	1	0.49	0.078	0.0049	-	1
2 to < 6 years	0.49	0.078	0.0049	-	4	0.49	0.078	0.0049	-	4
6 to < 11 years	0.49	0.078	0.0049	-	5	0.49	0.078	0.0049	-	5
11 to < 16 years	0.49	0.078	0.0049	-	1	0.49	0.078	0.0049	-	5
16 to < 21 years	0.49	0.078	0.0049	-	0	0.49	0.078	0.0049	-	5
Total Child	-	-	-	4.5E-7	12	-	-	-	7.9E-7	21
Adult	0.49	0.078	0.0049	4.5E-7	12	0.49	0.078	0.0049	1.2E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	1.2E-6 ‡	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 100 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 6.0E-06 $(\mu g/m^3)^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Table 4. Residential: Default exposure point concentrations for chronic exposure to naphthalene in air at 0.89 µg/m³ (0.17 ppb) along with noncancer hazard quotients and cancer risk estimates*

Exposure Group	CTE Adjusted EPC (µg/m³)	CTE Adjusted EPC (ppb)	CTE Noncancer Hazard Quotient	CTE Cancer Risk	CTE Exposure Duration (yrs)	RME Adjusted EPC (µg/m³)	RME Adjusted EPC (ppb)	RME Noncancer Hazard Quotient	RME Cancer Risk	RME Exposure Duration (yrs)
Birth to < 1 year	0.89	0.17	0.30	-	1	0.89	0.17	0.30	-	1
1 to < 2 years	0.89	0.17	0.30	-	1	0.89	0.17	0.30	-	1
2 to < 6 years	0.89	0.17	0.30	-	4	0.89	0.17	0.30	-	4
6 to < 11 years	0.89	0.17	0.30	-	5	0.89	0.17	0.30	-	5
11 to < 16 years	0.89	0.17	0.30	-	1	0.89	0.17	0.30	-	5
16 to < 21 years	0.89	0.17	0.30	-	0	0.89	0.17	0.30	-	5
Total Child	-	-	-	4.7E-6 ‡	12	-	-	-	8.2E-6 ‡	21
Adult	0.89	0.17	0.30	4.7E-6 ‡	12	0.89	0.17	0.30	1.3E-5 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	1.3E-5 ‡	33

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; CTE = central tendency exposure (typical); RME = reasonable maximum exposure (higher); yrs = years

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 3 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 $(\mu g/m^3)^{-1}$.

‡ Indicates that the cancer risk exceeds one extra case in a million people similarly exposed, which ATSDR evaluates further.

§ This cancer risk represents a scenario where children are likely to continue to live in their childhood home as adults.

Air Inhalation Intermediate (Default)

Acrolein

Table 5. Residential: Default exposure point concentrations for intermediate exposure to acrolein in air at 0.41 µg/m³ (0.18 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.41	0.18	0.45
1 to < 2 years	0.41	0.18	0.45
2 to < 6 years	0.41	0.18	0.45
6 to < 11 years	0.41	0.18	0.45
11 to < 16 years	0.41	0.18	0.45
16 to < 21 years	0.41	0.18	0.45
Adult	0.41	0.18	0.45

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 0.92 µg/m³.

Table 6. Residential: Default exposure point concentrations for intermediate exposure to benzene in air at 0.45 µg/m³ (0.14 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.45	0.14	0.024
1 to < 2 years	0.45	0.14	0.024
2 to < 6 years	0.45	0.14	0.024
6 to < 11 years	0.45	0.14	0.024
11 to < 16 years	0.45	0.14	0.024
16 to < 21 years	0.45	0.14	0.024
Adult	0.45	0.14	0.024

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 19 µg/m^3.

Table 7. Residential: Default exposure point concentrations for intermediate exposure to carbon tetrachloride in air at 0.49 µg/m³ (0.078 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.49	0.078	0.0026
1 to < 2 years	0.49	0.078	0.0026
2 to < 6 years	0.49	0.078	0.0026
6 to < 11 years	0.49	0.078	0.0026
11 to < 16 years	0.49	0.078	0.0026
16 to < 21 years	0.49	0.078	0.0026
Adult	0.49	0.078	0.0026

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 190 µg/m³.

Table 8. Residential: Default exposure point concentrations for intermediate exposure to naphthalene in air at 0.89 µg/m³ (0.17 ppb)*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.89	0.17	-
1 to < 2 years	0.89	0.17	-
2 to < 6 years	0.89	0.17	-
6 to < 11 years	0.89	0.17	-
11 to < 16 years	0.89	0.17	-
16 to < 21 years	0.89	0.17	-
Adult	0.89	0.17	-

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0.

Air Inhalation Acute (Default)

Acrolein

Table 9. Residential: Default exposure point concentrations for acute exposure to acrolein in air at 0.41 µg/m³ (0.18 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.41	0.18	0.060
1 to < 2 years	0.41	0.18	0.060
2 to < 6 years	0.41	0.18	0.060
6 to < 11 years	0.41	0.18	0.060
11 to < 16 years	0.41	0.18	0.060
16 to < 21 years	0.41	0.18	0.060
Adult	0.41	0.18	0.060

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 6.9 µg/m^3 . The standard exposure factor rule does not apply to this chemical.

Table 10. Residential: Default exposure point concentrations for acute exposure to benzene in air at 0.45 µg/m³ (0.14 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.45	0.14	0.015
1 to < 2 years	0.45	0.14	0.015
2 to < 6 years	0.45	0.14	0.015
6 to < 11 years	0.45	0.14	0.015
11 to < 16 years	0.45	0.14	0.015
16 to < 21 years	0.45	0.14	0.015
Adult	0.45	0.14	0.015

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 29 µg/m³.

Carbon tetrachloride

Table 11. Residential: Default exposure point concentrations for acute exposure to carbon tetrachloride in air at 0.49 µg/m³ (0.078 ppb)*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.49	0.078	-
1 to < 2 years	0.49	0.078	-
2 to < 6 years	0.49	0.078	-
6 to < 11 years	0.49	0.078	-
11 to < 16 years	0.49	0.078	-
16 to < 21 years	0.49	0.078	-
Adult	0.49	0.078	-

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m^3 = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0.

Table 12. Residential: Default exposure point concentrations for acute exposure to naphthalene in air at 0.89 µg/m³ (0.17 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.89	0.17	2.9 †
1 to < 2 years	0.89	0.17	2.9 †
2 to < 6 years	0.89	0.17	2.9 †
6 to < 11 years	0.89	0.17	2.9 †
11 to < 16 years	0.89	0.17	2.9 †
16 to < 21 years	0.89	0.17	2.9 †
Adult	0.89	0.17	2.9 †

Source: [list reference of environmental data]

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion

* The calculations in this table were generated using ATSDR's PHAST v2.4.2.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 0.31 µg/m³.

† Indicates the hazard quotient is greater than 1, which ATSDR evaluates further.