Arkansas Department of Health

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Governor Sarah Huckabee Sanders

Renee Mallory, RN, BSN, Secretary of Health

Jennifer Dillaha, MD, Director

April 5, 2024

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

RE: Public Health Air Evaluation Near Eco Vista Landfill

Dear Secretary Khoury,

A round of air quality monitoring and sampling was conducted around the perimeter of the Eco Vista Landfill due to nearby residents' concerns about air quality issues and health effects. The Arkansas Department of Energy and Environment (ADEE) requested the Arkansas Department of Health's (ADH) Environmental Epidemiology Section to evaluate the air sampling results (February 2024) from an independent environmental consultant.

Background:
Eco Vista Landfill is located at 11979 Arbor Acres Road in Springdale, Arkansas. Eco Vista 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 storm water permits for this facility. Eco Vista Landfill has an Air Permit (1884-AOP-R6), Compost Permit (0013-SCYW), National Pollutant Discharge Elimination System (NPDES) Permit (ARG160045, ARR000231), Solid Waste Permit Class 1 (290-S1-R3), and Solid Waste Permit Class 4 (290-S4-R1) [1]. 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. The community contacted ADH with concerns of increased risk for cancer. The ADH Chronic Disease Cluster Investigation Team (CD-CIT) conducted a cancer cluster

investigation for this community. In January 2023, the ADH's CD-CIT team 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]. See Appendix 1 for the ADH CD-CIT report.

In December 2023, ADEE requested that the National Guard (61st Civil Support Team) monitor the air quality for 24-hours (December 21st to December 22nd) in four areas in the community surrounding the Eco Vista Landfill (outside perimeter of the landfill). The air quality test showed elevated results of sulfur dioxide above screening levels. However, levels of hydrogen sulfide and methane fell within normal limits. Hydrogen sulfide and methane gas are contaminants of concern that are typically associated with landfills. The National Guard recommended that ADEE hire an environmental consultant to conduct longer air quality studies during a 5-to-7-day continuous time-period using both monitors and summa canisters [4]. The ADH's Environmental Epidemiology Section reviewed the preliminary results as requested from ADEE. The ADH concurred with this recommendation and agreed to evaluate the next round of air sampling (an activity using summa canisters to get a volume or measure of something to analyze) and/or air monitoring (a process of analyzing multiple samples in real time).

As additional air sampling was recommended by the National Guard, ADEE requested the National Guard to conduct an additional five (5) days of 24-hours air monitoring and hired an independent environmental consultant, CTEH, LLC, to conduct a three (3) day time-period of air monitoring and air sampling. This air monitoring and sampling took place in February 2024 [5].

Demographics:

Residential areas are located around the Eco Vista Landfill, with the nearest home less than 50 feet from the landfill property boundary.

The 2022 U.S. Census Bureau estimated that Tontitown, Arkansas, has a population of 6,529 residents. Of the total population, approximately 76.4% are White, 1.2% are African American, and 17.0% are Hispanic or Latino. Approximately 22.0% of the population are under 18 years, while approximately 19.8% of the total population are over the age of 65. The median household income from 2018-2022 is listed as $83,705. In Tontitown, the population living below poverty level is approximately 3.0% [6].

Discussion:

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 around the perimeter of the Eco Vista Landfill. 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. [8: CTEH Arkansas Division of Environmental Quality Air Quality Assessment for Springdale, AR., February 26, 2024].

Location Number	Description
Area 1	By the second light pole on S Pianalto Rd., Tontitown, AR 72762
Area 2	On the fence across from 18769 Clear Water Rd, Fayetteville, AR 72704
Area 3	On a light pole across from 1497 Arbor Acres Ave, Springdale, AR 72762
Area 4	Corner of Arbor Acres Ave and Dowell Rd., Springdale, AR 72762
Background	On a light pole 100 yards west of 12104 Red Oak Drive, Fayetteville, AR 72704

Figure 1. Approximate Location of Air Sampling Areas. Air sampling locations (Areas 1-4) are on the outside perimeter north and northwest of the Eco Vista Landfill (Springdale, AR). A background sample (BG) was taken 100 yards west of 12104 Red Oak Drive, Fayetteville, AR 72704.

Evaluation:

Meteorological Data During Air Sampling and Monitoring

Air quality monitoring requires monitoring 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 monitoring or sampling 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 [7].

Meteorological parameters during air sampling and monitoring in February 2024 in the community near the Eco Visa Landfill were reported by the contractor at morning and nighttime intervals. Monday (02/05/2024) through Thursday (02/08/2024) temperatures ranged from 40 to 62 degrees Fahrenheit, and wind speeds ranged from 1.2 to 14 miles per hour (mph) [8].

February 2024 Air Testing

On February 5-8, 2024, CTEH conducted air quality monitoring and sampling near the Eco Vista Landfill on Arbor Acres Avenue in Springdale, Arkansas. Air sampling was conducted each day for volatile organic compounds (VOCs), hydrogen sulfide (H_2S), and sulfur dioxide (SO_2) at four locations selected by the ADEE. The same four locations were used by the National Guard air quality monitoring in December 2023. One air sample for VOCs was also collected upwind of the landfill on February 27th to evaluate background VOC concentrations. CTEH personnel also conducted air monitoring at each of the four locations for H_2S, oxygen (O_2), VOCs, SO_2, and atmospheric flammability as a percentage of the lower explosive limit (%LEL) [8].

CTEH Air Monitoring Results

Measurements for H_2S, VOCs, SO_2, %LEL, and O_2 were measured using a RAE Systems by Honeywell MultiRAE Pro with chemical-specific sensors, a photo-ionization detector (PID) for VOCs, and a combustible gas sensor for %LEL. A total of 120 real-time readings were collected during the assessment [8].

Hydrogen sulfide, or H_2S, is a contaminant of concern that is associated with landfills. Hydrogen sulfide is a flammable, colorless gas that smells like rotten eggs. Industrial sources of hydrogen sulfide include petroleum refineries, natural gas plants, petrochemicals plants, coke oven plants, food processing plants, and tanneries. Hydrogen sulfide occurs naturally in crude petroleum, natural gas, volcanic gases, and hot springs [9]. Results of CTEH air monitoring for hydrogen sulfide from February 5-8, 2024, for all sampling locations (Area 1-4) were below detection limits [detection limits for MultiRAE Pro <0.1 parts per million (ppm), Environmental Protection Agency (EPA) Regional Screening Level (RSL) 1.5 parts per billion (ppb)].

Sulfur dioxide, or SO_2, is a colorless gas with a pungent odor. It is a liquid when under pressure, and it dissolves in water very easily. Sulfur dioxide in the air comes mainly from activities such as the burning of coal and oil at power plants or from copper smelting [9]. Sulfur dioxide was the contaminant of concern from the December 2023 National Guard air monitoring results. Results for CTEH air monitoring for sulfur dioxide from February 5-7, 2024, for all sampling locations (Area 1-4) were below detection limits [detection limits for MultiRAE Pro <0.1 ppm, Agency for Toxic Substances and Disease Registry (ATSDR) Acute Minimal Risk Level (MRL) 0.01 ppm].

CTEH Air Sampling Results

Air samples for VOCs were collected using 6-liter evacuated canisters (SUMMA® canisters) with 24-hour flow control regulators to sample air over three 24-hour periods. Thus, there are

three sample points for each sampling location (Area 1-4). These 24-hour air samples were analyzed for VOCs by EPA method TO-15 plus tentatively identified compounds (TICs). A background air sample was collected for VOCs upwind of site on Red Oak Drive for comparison to downwind samples [8].

According to the CTEH report, air samples for H_2S were collected using passive Radiello® sampling badges, which were analyzed by the SGS Galson in-house method WET-SOP-13. H_2S samples were collected for three 24-hour periods. Air samples for SO_2 were collected using an SKC Touch sampling pump connected to the sampling media with flexible tubing. SO_2 samples were collected for six 12-hour periods. Field blanks for H_2S and SO_2 were collected as a quality control measure [8].

Air sampling indicated that two compounds, acrolein and benzene, were in exceedance of the EPA RSL for residential air but below industrial standards. The other VOCs were detected at concentrations below established RSLs and not evaluated further.

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 [10].

Maximum concentrations of acrolein reported at each location ranged from 0.11 ppb to 0.14 ppb in sampling locations (Area 1-4) with a background concentration of 0.094 ppb. Refer to Table 2. It was stated in the CTEH letter Appendix F "Assessment Field Notes" page 1, "Noted by Waste Management employees that household trash was seen being burned" on residential property along Arbor Acres Avenue the morning of February 6, 2024 [8]. This yard-waste burn pile could serve as a potential source of ambient air contamination, and it is unknown how close it was to one of the sampling locations.

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 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 [11].

Maximum reported concentrations of benzene ranged from 0.20 ppb to 0.32 ppb in sampling locations (Area 1-4) with the background concentration being 0.12 ppb. Refer to Table 2. 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 [12]. The off-site area benzene air sample concentrations ranged from 0.12 to 0.32 ppb, well within the background levels that would be expected in rural subdivisions.

ATSDR guidelines recommend to first screen ambient (outdoor) air analytical results against chemical-specific comparison values (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 MRLs 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 and benzene concentrations were above or equal to the recommended ATSDR CV; therefore, further public health risk evaluation was warranted.

Table 2. Maximum Concentrations of Acrolein and Benzene at Community Sampling Locations near Eco Vista Landfill Compared to Screening Values.

Location	Area 1	Area 2	Area 3	Area 4	Area 5 (Background)	ATSDR Comparison Value
Contaminant units in parts per billion (ppb)						
Acrolein	**0.11**	**0.14**	**0.13**	**0.12**	**0.09**	0.009
Benzene	**0.30**	**0.22**	**0.32**	**0.2**	**0.12**	0.04

To calculate air inhalation exposure risk, an adjusted exposure point concentration (EPC) was calculated by using 95% of the upper confidence level of the mean. Acrolein EPC was 0.11 ppb and benzene was 0.24 ppb. Acrolein exceeds the intermediate Environmental Media Evaluation Guide (EMEG)/ MRL,0.04 ppb and reference dose media evaluation guide (RMEG), 0.009 ppb. Benzene exceeds chronic EMEG, 0.04 ppb. EMEGs represent estimated contaminant concentrations below which humans exposed during a specific timeframe (acute, intermediate, or chronic) are not expected to experience noncarcinogenic health effects [13].

Table 3: Converted Concentration of Acrolein, Benzene, and ATSDR Comparison Values.

Contaminant Name	Exposure Point Concentration	Int EMEG/MRL	Acute EMEG/MRL	Chronic EMEG
Acrolein	0.11 ppb	0.040 ppb *	3.0 ppb	NA
Benzene	0.24 ppb	6.0 ppb	9.0 ppb	0.040 ppb *

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 and longer

EMEG: Environmental Media Evaluation Guide
MRL: Minimal Risk Level
CV: Comparison Value
NA: Not Applicable
* ATSDR CV met or exceeded
Source: Exported Wednesday, March 6, 2024, from PHAST version 2.3.0.0, database rev 8.3.7

The potential exposure from the EPC was further evaluated by comparing the estimated dose to the ATSDR MRL by calculating a hazard quotient (HQ). The HQ is the ratio of an exposure point concentration divided by the health guidelines (HG) 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 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 of Acrolein at Community Sampling Locations near Eco Vista Landfill.

Acrolein	
Chronic Hazard Quotient (HQ)	**13**
Intermediate Hazard Quotient (HQ)	**2.8**
Acute Hazard Quotient (HQ)	0.037
Lifetime Cancer Risk (LCR)	NA; Carcinogenicity not classified

All groups [child (birth to 21 years of age) and adult (33 years)] slightly exceeded the HQ of 1 based on this evaluation of the reported acrolein concentrations for the chronic and intermediate HQ values. No age groups [child (birth to 21 years of age) and adult (33 years)] exceeded the HQ of 1 based on this evaluation of the reported acrolein concentrations for the acute HQ values. The Department of Health and Human Services (DHHS) has not classified acrolein as carcinogenic. 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 [10].

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	13	-	1	13	-	1
1 to < 2 years	13	-	1	13	-	1
2 to < 6 years	13	-	4	13	-	4
6 to < 11 years	13	--	5	13	-	5
11 to < 16 years	13	-	1	13	-	5
16 < to 21 years	13	-	0	13	-	5
Total Child	-	-	12	-	-	21
Adult	13	-	12	13	-	33

The calculations in this table were generated using ATSDR's PHAST v2.3.0.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 0.02 µg/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	2.8
1 to < 2 years	2.8
2 to < 6 years	2.8
6 to < 11 years	2.8
11 to < 16 years	2.8
16 < to 21 years	2.8
Adult	2.8

The calculations in this table were generated using ATSDR's PHAST v2.3.0.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 0.092 µg/m^3.
BOLD VALUE: Exceedance of HQ of 1

No age groups exceeded the HQ of 1 based on this evaluation of the reported benzene concentrations. Refer to Table 7 and 8.

Table 7: 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	0.078	-	1	0.078	-	1
1 to < 2 years	0.078	-	1	0.078	-	1
2 to < 6 years	0.078	-	4	0.078	-	4
6 to < 11 years	0.078	--	5	0.078	-	5
11 to < 16 years	0.078	-	1	0.078	-	5
16 < to 21 years	0.078	-	0	0.078	-	5
Total Child	-	9.0×10^{-7}	12	-	1.6×10^{-6}	21
Adult	0.078	9.0×10^{-7}	12	0.078	2.5×10^{-6}	33
Birth to <21 years Plus 12 years during adulthood	-	-	-	0.078	2.5×10^{-6}	33

The calculations in this table were generated using ATSDR's PHAST v2.3.0.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 9.6 $\mu g/m^3$ and the cancer risks were calculated using the inhalation unit risk of 7.8E-06 $(\mu g/m^3)^{-1}$.
CTE: Central Tendency Exposure
RME: Reasonable Maximum Exposure
BOLD VALUE: Exceedance of HQ of 1

The DHHS has determined that benzene is a known carcinogen. The IARC and the EPA have determined that benzene is carcinogenic to humans [11]. ATSDR guidelines recommend conducting a separate evaluation to determine the potential risk from cancer-causing chemicals [14]. Reasonable maximum exposure (RME) and central tendency exposures (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 95^{th} percentile) but still within a realistic exposure range [13]. CTE refers to an individual who has an average or typical exposure to a contaminant [14]. Using risk calculations for the reported benzene values, age groups [child (birth to 21 years of age) and adult (33 years)] have a CTE cancer risk of 9.0×10^{-7}. Age groups [child (birth to 21 years of age)] have an RME cancer risk of 1.6×10^{-6} and age groups [adult (33 years)] have an RME cancer risk of 2.5×10^{-6}.

Table 8. Risk Assessment Values of Benzene at Community Sampling Locations near Eco Vista Landfill.

Benzene	
Chronic Hazard Quotient (HQ)	0.078
Intermediate Hazard Quotient (HQ)	0.040
Acute Hazard Quotient (HQ)	0.026
Lifetime Cancer Risk (LCR)	9.0×10^{-7} (child) 9.0×10^{-7} (adult)

To characterize potential cancer effects from benzene for a community member from inhalation exposure to the ambient air surrounding the Eco Vista Landfill, a theoretical Lifetime Cancer Risk (LCR) value was calculated. The 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. This scenario represents total child (birth to 21 years of age) and adult (33 years). Risk values greater than one in 1,000,000 (or 1.0E-06), which likely represent no excess risk of cancer, but less than one in 10,000 (or 1.0E-04) are within the EPA's target risk range and considered an adequate level of health safety. If the additional lifetime cancer risk 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. The calculated theoretical LCR for a community member potentially exposed to benzene through ambient air inhalation was within EPA's target risk range.

Data Limitations:

Air samples provide a "snapshot" of conditions happening at a specific time. A short period of air sampling and/or monitoring provides 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 exists for residents living near the site. The off-site air data did identify levels of acrolein and benzene that exceed CVs; however reported benzene levels are in the ranges that would be expected for rural subdivisions. Odors near landfill emissions can sometimes trigger physical symptoms such as:

- Dizziness
- Watery eyes, stuffy nose, irritated throat
- Cough or wheeze, especially for those with allergies, asthma, and other chronic lung problems
- Sleep problems due to throat irritation and cough [15].

Based on the air sampling results collected off-site during February 5-8, 2024, residents near the perimeter of the sampling locations may have the potential to be at risk of exposure to acrolein in the air; however, in order to make a determination of human health risks for the general public and residents off-site in the adjacent neighborhood areas, more robust air sampling data are needed.

Recommendations:

For prudent public health safety, ADH recommends the following:

- Additional VOC air sampling and air monitoring in the surrounding community near the Eco Vista Landfill, to evaluate the potential for public health risks and further delineate the source. If resources are available, additional background samples may be collected. To ensure no outside sources interfere with sampling, testing should be conducted on days when no other outdoor burning is occurring.
- ADEE provides future air monitoring data 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 Rebecca.Davis@arkansas.gov, if you have any questions.

Sincerely,

Rebecca Davis, M.S.
ATSDR Health Assessor
Environmental Epidemiologist

cc: Lori Simmons, M.S., ADH Epidemiology Branch Chief
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Jeremy Courtney, MPH, ADH DHDA Director
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Attachment A

ADH CD-CIT Report

Suspected Cancer Cluster Investigation in a town in Northwest Arkansas

Outline

- Guidelines for Investigating Clusters of Chronic Diseases
- Suspected cancer cluster in a town in NW Arkansas
- Investigation steps and findings
- Summary of key findings and next steps

Guidelines for Investigating Clusters of Chronic Diseases

(Developed based on MMWR report, "Investigating Suspected Cancer Clusters and Responding to Community Concerns. Guidelines from CDC and the Council of State and Territorial Epidemiologists", published on September 27, 2013, Vol. 62, No. 8: Pages 1-24)

Four-Step Process of Evaluating Suspected Clusters

Step 1:

I. Suspect cluster is reported to ADH colleague

II. ADH colleague routes the report to CD-CIT member

III. CD-CIT member evaluates plausibility of concern and, if needed, collects additional information to initiate an investigation

IV. CD-CIT member decides whether to resolve the investigation and communicate the results to the caller, or if not resolved, to move to Step 2.

Four-Step Process of Evaluating Suspected Clusters

Step 2:

I. CD-CIT meets to begin to assess whether the cluster represents an excess of cases above that expected

II. CD-CIT defines the study population, conduct statistical analysis to calculate the Standardized Incidence Ratio (SIR) with 95% confidence intervals

III. CD-CIT reviews the literature on the risk factors and assesses possible associations between the risk factors and suspected excess

IV. CD-CIT decides whether to resolve the investigation and communicate the results to the caller, or if not resolved, to move to Step 3 (**An SIR >4 with CIs that do not overlap 1.0, and ≥10 cases that might be etiologically linked, should encourage advancing to Step 3**).

Four-Step Process of Evaluating Suspected Clusters

Step 3:

I. Expert advisory panel informed and participates in hypotheses generation and evaluation and potential study design

II. Expert advisory panel ascertains the plausibility of an association, and feasibility to conduct definitive study

III. Expert advisory panel decides whether to resolve the investigation and communicate the results to the caller, or if not resolved, to move to Step 4.

Four-Step Process of Evaluating Suspected Clusters

Step 4:

I. CD-CIT and Expert advisory panel engages relevant stakeholders, external partners and community members to conduct an epidemiologic study

II. Share the results of the investigation with relevant stakeholders, partners and community members. Recommend interventions to address the issue as appropriate.

Suspected cancer cluster in a town in NW Arkansas

Investigation steps and findings

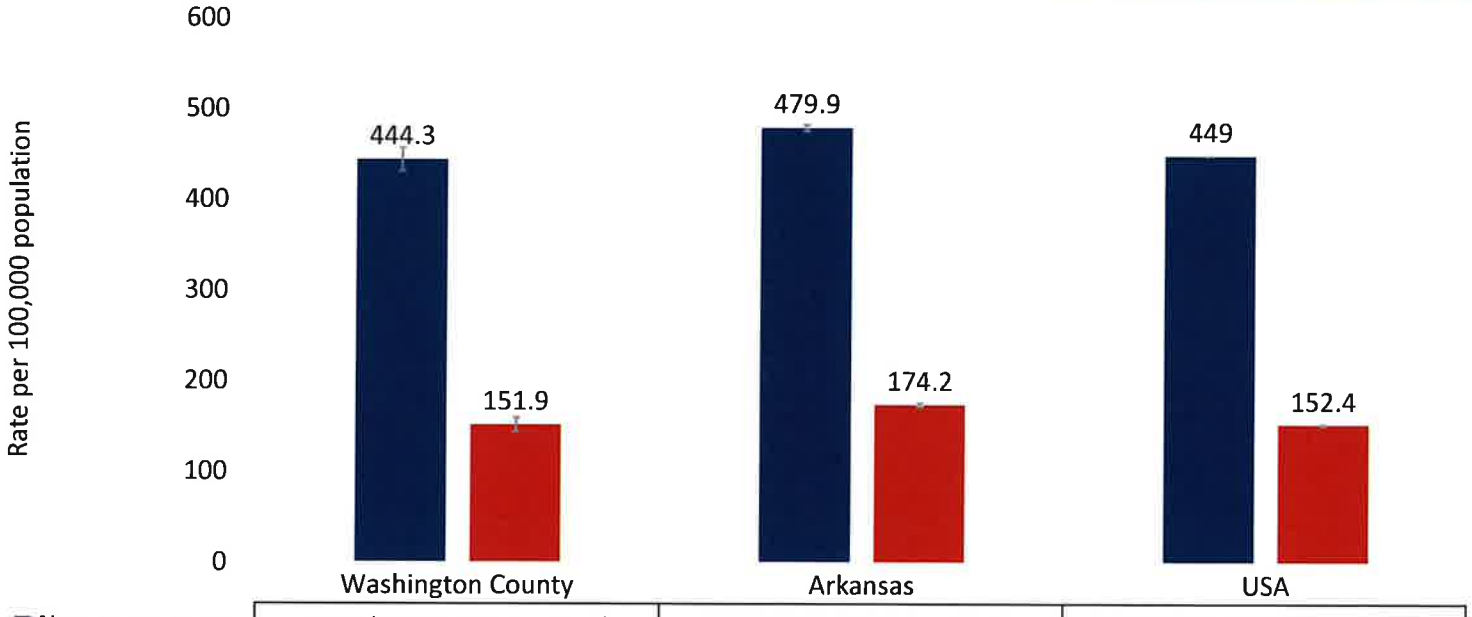
Step 1

Profile of Washington County in AR

Population (as of July 1, 2021) *Estimates are not comparable to other geographic levels due to methodology differences that may exist between different data sources.*	250,057 **Ranked 3rd highest population density in Arkansas as of 2020**
Population per square mile (as of 2020)	261.2 persons
Age groups	Age < 18 years: 23.9% Age 18-64 years: 63.8% Age 65+ years: 12.3%
Sex	Females: 49.8% Males: 50.2%
Race	White: 64.5% Black or African American: 3.1% Other: 67.6%

Source: US Census, (source: https://www.census.gov/library/stories/state-by-state/arkansas-population-change-between-census-decade.html)

Age-Adjusted Incidence Rate of new cancer cases and deaths by regions, 2015-2019



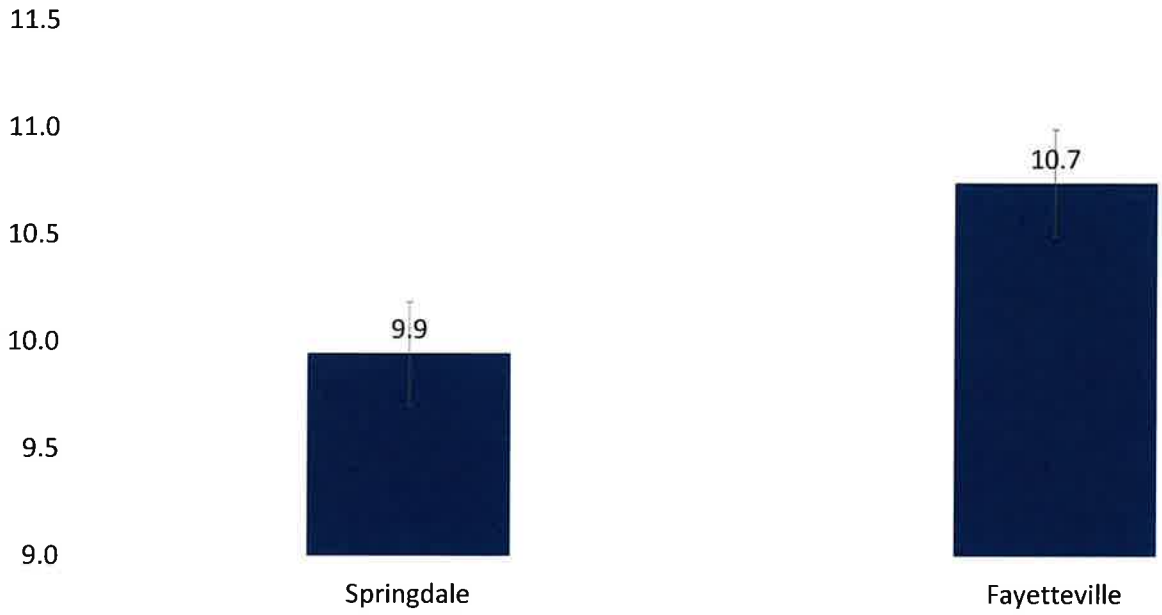
	Washington County	Arkansas	USA
New cancers rate	**444.3** (95% CI: 431.7 – 457.2)	**479.9** (95% CI: 476.7 – 483.2)	**449** (95% CI not readily available)
Cancer death rate	**151.9** (95% CI: 144.4 – 159.6)	**174.2** (95% CI: 172.3-176.1)	**152.4** (95% CI: 152.3-152.6)

Population demographic comparison between Springdale (city of concern) and Fayetteville

	Springdale, AR	Fayetteville, AR
Population (as of 2020)	87,255	95,230
Age groups	Age < 18 years: 27.6% Age 18-64 years: 60.0% Age 65+ years: 12.4%	Age < 18 years: 18.1% Age 18-64 years: 72.8% Age 65+ years: 9.1%
Sex	Females: 49.5% Males: 50.5%	Females: 50.0% Males: 50.0%
Race	White: 61.2% African American: 4.6% Other: 34.2%	White: 79.1% African American: 5.9% Other: 15.0%

Source: US Census, (source: https://www.census.gov/library/stories/state-by-state/arkansas-population-change-between-census-decade.html)

Age-Adjusted Incidence Rate Comparison between Springdale and Fayetteville, Arkansas 2015-2019

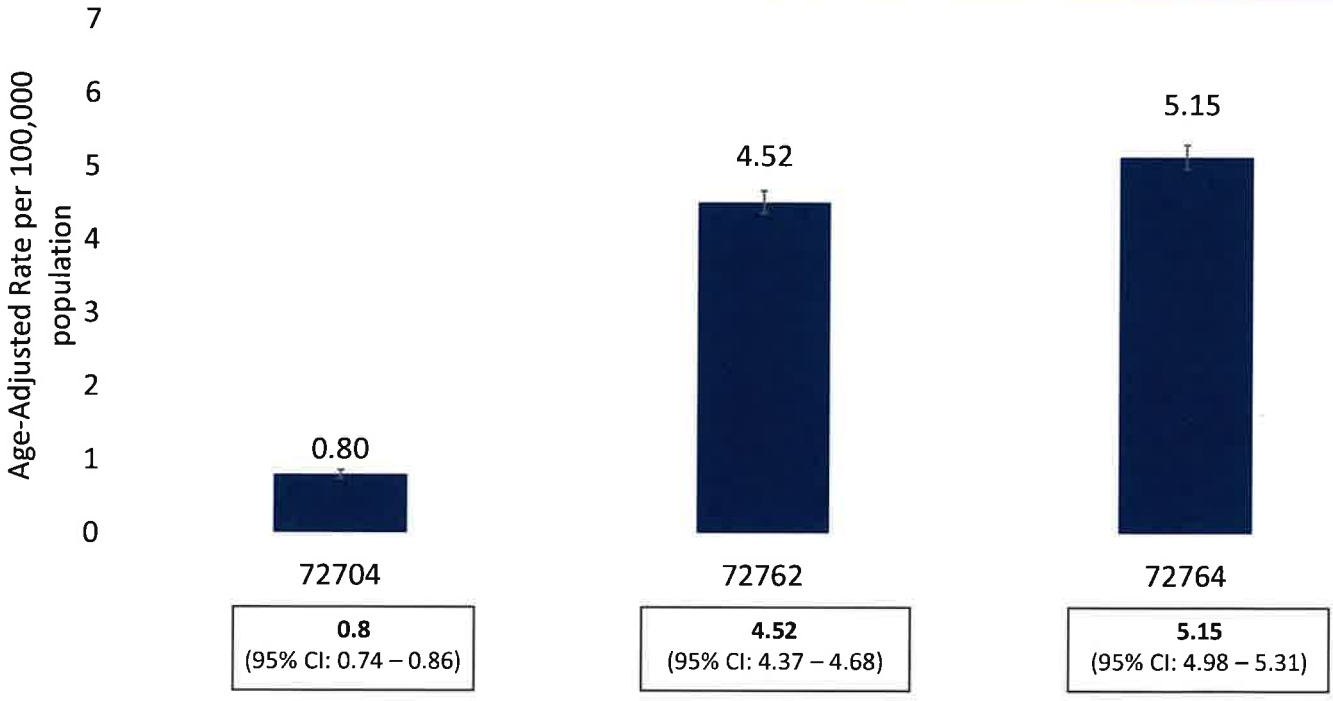


Population demographic comparison between areas of concern (72704, 72762) and 72764

	72704	72762	72764
Population (as of 2020)	**27,740**	41,669	57,561
Age groups	Age < 18 years: 21.3% Age 18-64 years: 69.6% Age 65+ years: 9.1%	Age < 18 years: 26.8% Age 18-64 years: 58.8% Age 65+ years: 14.4%	Age < 18 years: 30.7% Age 18-64 years: 40.4% Age 65+ years: 9.7%
Sex	Females: 50.9% Males: 49.1%	Females: 51.0% Males: 49.0%	Females: 47.7% Males: 52.3%
Race	White: 82.5% African American: 3.8% Other: 13.7%	White: 72.6% African American: 2.0% Other: 25.4%	White: 54.1% African American: 3.7% Other: 42.2%

Source: US Census, (source: https://www.census.gov/library/stories/state-by-state/arkansas-population-change-between-census-decade.html)

Age-adjusted rate of new cancer cases by major zip codes in Springdale, 2015-2019



Step 2

SIR Comparison, 1996-2022

	Washington County, AR	Springdale, AR	72704	72762	72764
Standardized Incidence Ratio, 1996-2020	0.93	1.00 (95% CI: 0.98 – 1.02)	1.00 (95% CI: 0.92 – 1.08)	1.00 (95% CI: 0.97 – 1.03)	1.00 (95% CI: 0.97-1.03)
Standardized Incidence Ratio, 2015-2019	0.90 (95% CI: 0.90-0.90)	1.00 (95% CI: 0.95 – 1.05)	1.00 (95% CI: 0.89 – 1.05)	1.00 (95% CI: 0.94-1.06)	1.00 (95% CI: 0.94-1.06)

Number of cases of primary tumors within 2-miles of Eco-Vista (from community members), 1996-2022

Type of tumor, 1999-2022 (from list)	Number of cases (N = 17)	SIR (95% CI) for zip code 72762	SIR (95% CI) for zip code 72704
Urinary System (Bladder & Kidney and Renal Pelvis)	2	1.00 (95% CI: 0.89 – 1.11)	1.00 (95% CI: 0.70 – 1.34)
Breast	1	1.00 (95% CI: 0.91 – 1.09)	1.00 (95% CI: 0.83 – 1.19)
Leukemia	1	1.00 (95% CI: 0.83 – 1.18)	1.00 (95% CI: 0.67 – 1.39)
Colorectal (Colon)	3	1.00 (95% CI: 0.89 – 1.11)	1.00 (95% CI: 0.68 – 1.38)
Lung and Bronchus	3	1.00 (95% CI: 0.91 – 1.09)	1.00 (95% CI: 0.91 – 1.09)
Skin* (Melanoma) *excluding basal and squamous cell	4	1.00 (95% CI: 0.84 – 1.18)	1.00 (95% CI: 0.72 – 1.33)
Lymphoma (Non-Hodgkin Lymphoma)	1	1.00 (95% CI: 0.83 – 1.18)	1.00 (95% CI: 0.62 – 1.39)
Pancreas & Appendix	1	1.00 (95% CI: 0.85 – 1.17)	1.00 (95% CI: 0.53 – 1.62)
Prostate	1	1.00 (95% CI: 0.91 – 1.10)	1.00 (95% CI: 0.87 – 1.14)
Unknown	4	N/a	N/a

Note:
2 cases are excluded since they were not found in ACCR DBMS or death certificates
4 ACCR-confirmed cases had at least a second primary tumor

Summary of Key Findings

Based on our analysis and the data shared from the community members, we found the following:

1. There were **19 individuals** with a type of cancer **since 1999** as reported from community members through **2022**
   - Of the 19 in the list, 17 of these individuals were identified through our registry
   - There were 10 different types of cancer identified among the 17 individuals (4 cases had an unknown/unspecified cancer tumor)
2. The most frequent tumor was **melanoma in 4 individuals** followed by **colon & rectum in 3 individuals from 1999 to 2022**

Conclusion:

1. While cancer is an umbrella term used to define over 100 different cancers, every cancer has different risk factors, either exposure or genetics
2. At this time, we did not find any specific type of cancer to be of excess in the area of concern than what was expected. However, ACCR and CD-CIT will continue to monitor the area for any excess of cancers.

Attachment B

PHAST Calculations and Equations

PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL

Contents

Default Parameters Table
PHAST Report, v2.3.0.0, March 6, 2024

Equations

Air Inhalation Exposure Equation

$$\textbf{Adjusted EPC} = \textbf{EPC} \times \textbf{EF}_{\textbf{noncancer}} \qquad \textbf{Equation 1}$$

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

Hazard Quotient

$$\textbf{HQ} = \textbf{Adjusted EPC} \div \textbf{HG} \qquad \textbf{Equation 2}$$

HQ = hazard quotient, EPC = exposure point concentration (µg/m³ or ppb), HG = health guideline (e.g., inhalation MRL, RfC)

Cancer Risk Equations

$$\textbf{CR} = \textbf{Adjusted EPC} \times \textbf{IUR} \times (\textbf{ED} \div \textbf{LY}) \qquad \textbf{Equation 3}$$

$$\textbf{ADAF-adjusted CR} = (\textbf{Adjusted EPC} \times \textbf{IUR}) \times (\textbf{ED} \div \textbf{LY}) \times \textbf{ADAF} \qquad \textbf{Equation 4}$$

$$\textbf{Total CR} = \textbf{Sum of the CR for all exposure groups} \qquad \textbf{Equation 5}$$

CR = cancer risk (unitless), EPC = exposure point concentration (µg/m³ or ppb), IUR = inhalation unit risk ((µg/m³ 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/m³)	Converted Concentration (ppb)
Acrolein	0.112102 ppb	95% UCL of the mean	0.26	0.11
Benzene	0.23544 ppb	95% UCL of the mean	0.75	0.24

Abbreviations: EPC = exposure point concentration; ppb = parts per billion; UCL = upper confidence limit

PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL

Default Air Residential Results for Chronic, Intermediate, and Acute Duration Exposures
PHAST Report, v2.3.0.0, March 6, 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 0.26 µg/m³ (0.11 ppb) along with noncancer hazard quotients*

PHAST Public Health Assessment Site Tool 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	0.11	**13** †	-	1	0.26	0.11	**13** †	-	1
1 to < 2 years	0.26	0.11	**13** †	-	1	0.26	0.11	**13** †	-	1
2 to < 6 years	0.26	0.11	**13** †	-	4	0.26	0.11	**13** †	-	4
6 to < 11 years	0.26	0.11	**13** †	-	5	0.26	0.11	**13** †	-	5
11 to < 16 years	0.26	0.11	**13** †	-	1	0.26	0.11	**13** †	-	5
16 to < 21 years	0.26	0.11	**13** †	-	0	0.26	0.11	**13** †	-	5
Total Child	-	-	-	-	12	-	-	-	-	21
Adult	0.26	0.11	**13** †	-	12	0.26	0.11	**13** †	-	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 v2.3.0.0. The noncancer hazard quotients were calculated using the chronic (greater than 1 year) reference concentration of 0.02 µg/m³.

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

Benzene

Table 2. Residential: Default exposure point concentrations for chronic exposure to benzene in air at 0.75 µg/m³ (0.24 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	0.75	0.24	0.078	-	1	0.75	0.24	0.078	-	1
1 to < 2 years	0.75	0.24	0.078	-	1	0.75	0.24	0.078	-	1
2 to < 6 years	0.75	0.24	0.078	-	4	0.75	0.24	0.078	-	4
6 to < 11 years	0.75	0.24	0.078	-	5	0.75	0.24	0.078	-	5
11 to < 16 years	0.75	0.24	0.078	-	1	0.75	0.24	0.078	-	5
16 to < 21 years	0.75	0.24	0.078	-	0	0.75	0.24	0.078	-	5
Total Child	-	-	-	9.0E-7	12	-	-	-	1.6E-6 ‡	21
Adult	0.75	0.24	0.078	9.0E-7	12	0.75	0.24	0.078	2.5E-6 ‡	33
Birth to < 21 years plus 12 years during adulthood §	-	-	-	-	-	-	-	-	2.5E-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 v2.3.0.0. 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.

Air Inhalation Intermediate (Default)

Acrolein

Table 3. Residential: Default exposure point concentrations for intermediate exposure to acrolein in air at 0.26 µg/m³ (0.11 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.26	0.11	**2.8** †
1 to < 2 years	0.26	0.11	**2.8** †
2 to < 6 years	0.26	0.11	**2.8** †
6 to < 11 years	0.26	0.11	**2.8** †
11 to < 16 years	0.26	0.11	**2.8** †
16 to < 21 years	0.26	0.11	**2.8** †
Adult	0.26	0.11	**2.8** †

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 v2.3.0.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 0.092 µg/m³.

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

Benzene

Table 4. Residential: Default exposure point concentrations for intermediate exposure to benzene in air at 0.75 µg/m³ (0.24 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.75	0.24	0.040
1 to < 2 years	0.75	0.24	0.040
2 to < 6 years	0.75	0.24	0.040
6 to < 11 years	0.75	0.24	0.040
11 to < 16 years	0.75	0.24	0.040
16 to < 21 years	0.75	0.24	0.040
Adult	0.75	0.24	0.040

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 v2.3.0.0. The noncancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 19 µg/m³.

Air Inhalation Acute (Default)

Acrolein

Table 5. Residential: Default exposure point concentrations for acute exposure to acrolein in air at 0.26 µg/m³ (0.11 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.26	0.11	0.037
1 to < 2 years	0.26	0.11	0.037
2 to < 6 years	0.26	0.11	0.037
6 to < 11 years	0.26	0.11	0.037
11 to < 16 years	0.26	0.11	0.037
16 to < 21 years	0.26	0.11	0.037
Adult	0.26	0.11	0.037

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 v2.3.0.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 6.9 µg/m³.

Benzene

Table 6. Residential: Default exposure point concentrations for acute exposure to benzene in air at 0.75 µg/m³ (0.24 ppb) along with noncancer hazard quotients*

Exposure Group	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Noncancer Hazard Quotient
Birth to < 1 year	0.75	0.24	0.026
1 to < 2 years	0.75	0.24	0.026
2 to < 6 years	0.75	0.24	0.026
6 to < 11 years	0.75	0.24	0.026
11 to < 16 years	0.75	0.24	0.026
16 to < 21 years	0.75	0.24	0.026
Adult	0.75	0.24	0.026

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 v2.3.0.0. The noncancer hazard quotients were calculated using the acute (less than two weeks) minimal risk level of 29 µg/m³.