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Dear Mr. Jason Meyers,

The Louisiana Department of Health (LDH)/Section of Environmental Epidemiology and Toxicology (SEET) has evaluated the ambient air quality data samples collected from the Irish Channel neighborhood in New Orleans, LA, in 2021 and 2022. The following letter provides the results of SEET's assessment of the ambient air-monitoring site sampling results.

**Background**

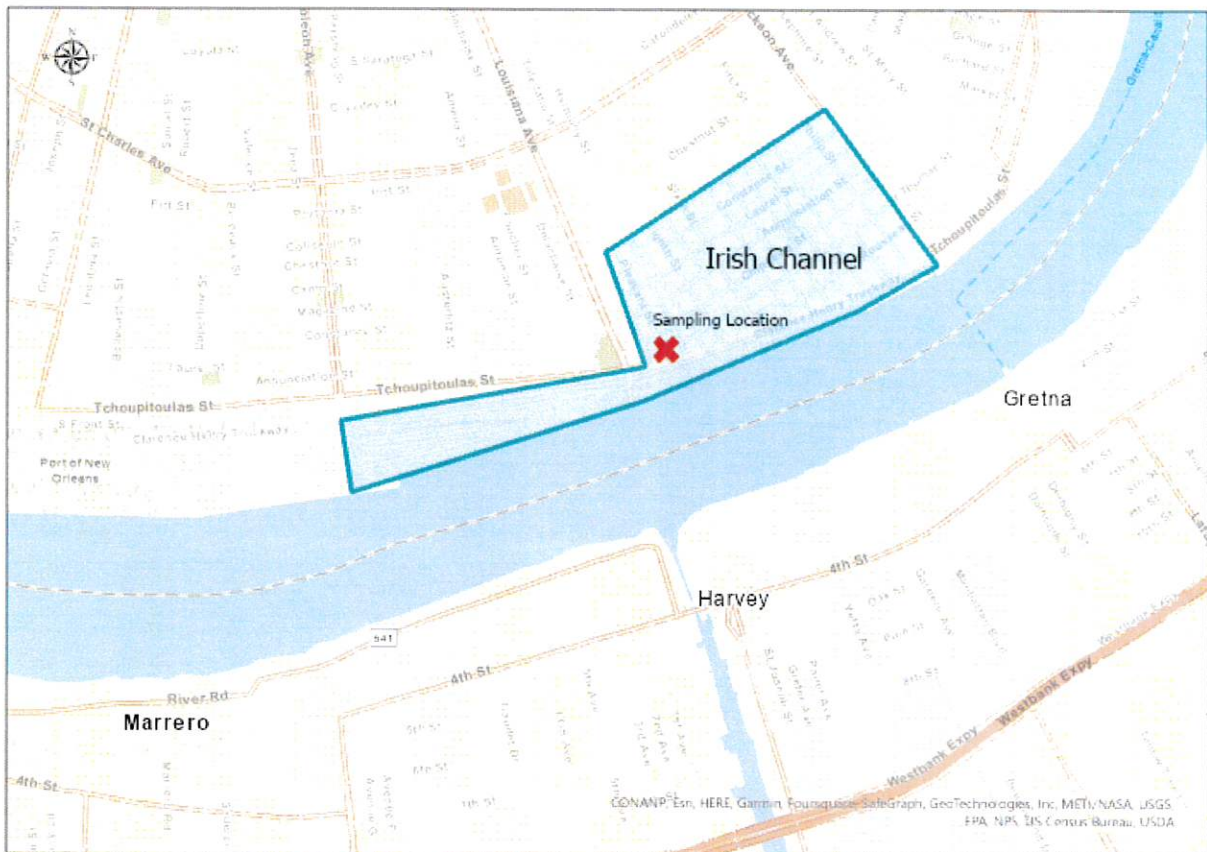
The Irish Channel is a neighborhood in New Orleans, LA. The neighborhood is residential and industrial, with many corner stores, bars, and restaurants [1]. The neighborhood consists of the city blocks bordered by Magazine Street to the North, Toledano Street to the West, Jackson Avenue to the East, and the Mississippi River to the south (**Figure 1**). The Port of Orleans is located to its southwest; has four business areas: cargo, rail, industrial real estate, and cruises [2]. Across the Mississippi River is a Kinder Morgan terminal in Marrero and a Blackwater Midstream terminal in Harvey. Kinder Morgan and Blackwater Midstream are both chemical storage and distribution facilities [3] [4] [5].

Residents from the Irish Channel requested the Louisiana Department of Environmental Quality (LDEQ) to conduct air sampling for polycyclic aromatic hydrocarbons (PAH). Complaints from residents in 2021 from the Irish Channel reported the smell of burning rubber and petroleum odors. The health effects residents reported were headaches, runny noses, nausea, and nosebleeds. Community members are concerned that industries on the West Bank in Harvey or Marrero were the cause of the odors. In response, a temporary monitoring site was placed by LDEQ near Tchoupitoulas and Pleasant Street in the Leo Benewell Playspot (**Figure 1**).

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**Figure 1.**

## Irish Channel Neighborhood in New Orleans, LA



### **Demographics**

The Irish Channel has a population of 2,977, with 54.4% female and 45.6% male. The largest ethnic group in the Irish Channel is White (65%), followed by Black or African American (23%), Hispanic (8%), followed by two or more races (2.2%), Native American (0.9%), then Asian (0.3%), and those identifying themselves as Other make up about 2% [6]. Income in the Irish Channel ranges from less than \$10,000 to \$200,000 or more, with the average household income of \$106,955. About eight percent of the Irish Channel residents are below the poverty line, and 91% of the residents of the Irish Channel live at or above the poverty line [6].

About 25% of residents of the Irish Channel have a graduate or professional degree; 36% have a bachelor's degree, 16% have some college, or no degree, followed by 5% with an Associate's degree, and 13% with a high school diploma or GED. About 0.6 percent have some high school but no diploma, and about 4% have less than a 9th-grade level education [6]. The largest age group in the Irish Channel ranges from 18 – 34 years old, which make up about 32% of the neighborhood's population. The second largest age group is 35-49-year-olds, who make up about 25% of the Irish Channel population, followed by 50-64 year-olds who make up about 18% of the Irish Channel population [6].

### **PAHs and the Potential for Exposure**

PAHs (polycyclic aromatic hydrocarbon) are a family of compounds composed of multiple ring structures; there are over 10,000 different PAH compounds. They are formed from the incomplete combustion of plant or animal matter and carbon fuels, such as coal and petroleum. PAHs are widely distributed in the environment and are associated with the use of carbon fuels including coal, oil, natural gas, wood and motor vehicle exhaust; industrial emissions; creosote wood preservatives; smoking tobacco or being in a room with second-hand smoke and smoke from wood fires are common sources. PAHs may be present in household products such as mothballs or may be present in char-grilled meats. PAHs are common in the environment, particularly in urban areas; the general population is exposed to multiple sources of PAHs. [7] The primary health concern is related to the carcinogenic potential of some PAHs related to long-term chronic exposures.

Residents of the Irish Channel have complained about odors in their neighborhood and are concerned that they are being exposed to PAHs in the ambient air that are responsible for headaches, runny noses, nausea, and nosebleeds. There are many sources of PAHs in urban neighborhoods that contribute to an individual's exposure. Motor vehicle auto exhaust and tobacco smoking are the major contributors to exposure in the general public. Acute effects, such as headaches, runny noses, nausea, and nosebleeds are not associated with PAHs; it is possible that foul odors could give rise to nausea and headaches.

Unpleasant odors can arise from many environmental sources. The residents of the Irish Channel have reported the smell of burning rubber and petroleum odors. Odors can arise from many sources and it is possible that the odors could have arisen from activity on the Mississippi River or the west bank. Petroleum-like odors can arise from an array of many different types of compounds, which makes detection by air monitoring very difficult: there are many unidentified chemicals as well as those that are odiferous at very low concentrations. The human nose is sensitive to many odors and can often smell the odors at levels below that which can be measured.

### **Comparison of PAH Air Monitoring Results to Health Guidelines**

LDEQ collected fifty-nine ambient air samples; of these thirty-five samples were collected from August 2021 to December 2021, and twenty-four were collected from January 2022 to June 2022 and provided the results to SEET. SEET compared the PAH levels to the inhalation health-based comparison values (HBCVs) from the Agency for Toxic Substances and Disease Registry (ATSDR) (Table 3). An HBCV or health guideline helps identify environmental contaminants that require further evaluation. If ATSDR did not have a comparison value, the Environmental Protection Agency's (EPA) Residential Screening Levels (RSL) were used. If the maximum concentration of a contaminant exceeds a HBCV or screening level, it does not mean a health threat is present, but it does require further evaluation and is considered a Contaminant of Concern (COC). The focus of further evaluation of COCs is to determine the potential for the contaminant(s) to cause cancer and non-cancer health effects resulting from human exposure.

Once the maximum concentration of each contaminant per sample was screened against ATSDR's HBCVs, exposure point concentrations (EPCs) were calculated for each COC for each month sampled. An exposure point concentration is a representative concentration of a

contaminant exposure that could occur to an individual. These EPCs were compared to ATSDR's Minimum Risk Levels (MRL), and EPA's Reference Concentrations (RfC). An MRL is an estimate of the daily exposure of a human to a hazardous substance at or below a level that is unlikely to cause adverse health effects. The RfC is an estimate of daily inhalation exposure to a human population, including sensitive subgroups that is unlikely to cause negative health effects during a lifetime of exposure.

For concentrations higher than the RfC or MRL, hazard quotients were calculated to evaluate non-cancer risks. Cancer risks were estimated for the carcinogenic COCs. Hazard Quotients (HQ) and Cancer Risks were calculated using ATSDR's Public Health Assessment Site Tool (version 2.2.1.0). If the hazard quotient was above one, further toxicological evaluation was completed. If the cancer risks exceeded a risk of 1.0E-06 (1 in 1,000,000 people), further toxicological evaluation was completed.

The site-specific exposure scenario for a resident assumes exposure would occur for 24 hours per day, seven days per week, over 33 consecutive years (**Appendix A**) and includes all sources of exposure to PAHs. These assumptions are conservative because it assumes that a resident would not leave the neighborhood boundaries for 33 consecutive years. This offers a protective calculation for ambient air exposures to PAHs.

## Results

Over eleven months, fifty-nine ambient air samples were collected from the Irish Channel by the LDEQ. Thirty-five samples were collected from August 2021 to December 2021, and twenty-four were collected from January 2022 to June 2022. Each sample was collected over 24 hours and tested for PAHs. Fourteen of the twenty-three PAH congeners sampled were detected at least once. Detections included: 1-methylnaphthalene, 2-methylnaphthalene, 2-methyl phenol, acenaphthalene, acenaphthylene, biphenyl, cresols M&P, dibenzofuran, fluoranthene, fluorene, phenanthrene, phenol, pyrene, and naphthalene. Of the 14 congeners detected, only naphthalene and benzo(a)pyrene had available ATSDR or EPA inhalation screening levels (**Table 1**). After the initial screening, naphthalene remained as a COC and was selected for further evaluation. Though benzo (a) pyrene and its relative chemicals had no detections, they were also selected for further evaluation because the method detection limits (MDLs) for benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were above ATSDR's HBCVs (see MDLs with an asterisk in **Table 1** below).

**Table 1: Results from the Irish Channel Ambient Air Samples from August 2021 to June 2022**

Contaminants	No. of Samples	No. of Detects	Maximum Concentration (µg/m <sup>3</sup> )	Comparison Value (µg/m <sup>3</sup> )	No. above CV	Method Detection Limit <sup>§</sup>
2-Methylphenol	59	2	0.0054	NA	NA	0.0045
3&4-Methylphenol	59	8	0.01	NA	NA	0.0045
Phenol	59	39	0.076	NA	NA	0.007
Acenaphthene	59	49	0.03	NA	NA	0.0054
Acenaphthylene	59	1	0.0058	NA	NA	0.0051
Anthracene	59	0	0.0421	NA	NA	0.0054
1-Methylnaphthene	59	56	0.1	NA	NA	0.0051
2-Methylnaphthalene	59	57	0.103	NA	NA	0.0051
Naphthalene	59	58	0.254	0.029 (ATSDR CREG <sup>†</sup> )	56	0.0051
Phenanthrene	59	53	0.072	NA	NA	0.0054
1,1'-Biphenyl	59	31	0.015	NA	NA	0.0054
Dibenzofuran	59	51	0.026	NA	NA	0.0051
Fluoranthene	59	28	0.022	NA	NA	0.0067
Fluorene	59	46	0.023	NA	NA	0.0051
Benzo(g,h,i) perylene	59	0	0	NA	NA	0.0064
Pyrene	59	15	0.013	NA	NA	0.0061
Benzo(a)anthracene	59	0	0	0.017 (USEPA RSL <sup>‡</sup> )	0	0.0064
Benzo(a)pyrene	59	0	0	0.0017 (USEPA RSL <sup>‡</sup> )	0	0.0061*
Benzo(b)fluoranthene	59	0	0	0.017 (USEPA RSL <sup>‡</sup> )	0	0.0061
Benzo(k)fluoranthene	59	0	0	0.17 (USEPA RSL <sup>‡</sup> )	0	0.0064
Chrysene	59	0	0	1.7 (USEPA RSL <sup>‡</sup> )	0	0.0064
Dibenzo(a,h)anthracene	59	0	0	0.0017 (USEPA RSL <sup>‡</sup> )	0	0.0064*
Indeno(1,2,3-cd)pyrene	59	0	0	0.0017 (USEPA RSL <sup>‡</sup> )	0	0.0067*
Benzo(a)pyrene Equivalent Concentration (BEC)	59	0	0	0.00057 (ATSDR CREG <sup>†</sup> )	0	

<sup>†</sup> Cancer Risk Evaluation Guides (CREG) are estimated contaminant concentrations by ATSDR that would be expected to cause no more than one excess cancer in a million (1E-6) person exposed during their lifetime (78 years).

<sup>‡</sup>USEPA Regional Screening Levels (RSL) are developed using risk assessment guidance from the EPA Superfund program and are risk-based concentrations calculated from combining exposure information assumptions with EPA toxicity data.

\*Benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene have method detection limits higher than their respective comparison values.

<sup>§</sup>Method Detection Limit (MDL) – The minimum concentration of a substance that can be reported with 99% confidence.

NA – not available.

## *Toxicological Evaluation for Naphthalene*

### **Naphthalene**

Naphthalene is found in petroleum, coal, mothballs, mothball flakes, toilet deodorant blocks, polyvinyl chloride (PVC), car exhaust, cigarette smoke, and plastics and can be produced by burning tobacco or wood. It is made from crude oil or coal tar and produces a toxic gas.

Exposure to naphthalene can occur from inhaling vapors or smoke from any of the above sources. Symptoms of exposure to naphthalene above the 50 mg/m<sup>3</sup> range (LOAEL – 52 mg/m<sup>3</sup>; American Conference of Governmental Industrial Hygienists® (ACGIH®) Threshold Limit Values® (TLVs®) – 50 mg/m<sup>3</sup>) include headaches, dizziness, or vomiting. In addition, people exposed to a large amount of mothball vapor (naphthalene fumigant) or who have eaten a mothball have developed hemolytic anemia, which causes red blood cells to die faster than the body can replace them [8] [9].

The EPA's 1998 IRIS assessment classified naphthalene as a possible carcinogen based on inadequate human research and limited animal research on inhaled and oral naphthalene exposure [10]. There is no direct evidence that naphthalene exposure will cause cancer in humans; however, cancer has been seen in animal studies. The critically effected areas of exposure to naphthalene are the nervous and respiratory systems. The three available mice studies: a 2-year study (NTP, 1992), a 6-month study (Adkins et al., 1986), and a 4-hr study (Buckpitt, 1982), all identify the nasal pathway and lung injuries as critical non-cancer effects from long term exposure to the inhalation of naphthalene [10]. One of these studies, conducted by NTP in 1992, found nasal effects in mice exposed to naphthalene gas experienced hyperplasia and metaplasia in respiratory epithelium and olfactory epithelium. They extrapolated the study results to estimate the LOAEL in humans to be 9.3 mg/m<sup>3</sup> (or 9,300 µg/m<sup>3</sup>) [10]. The EPA is currently reassessing naphthalene's toxicity and plan to release an updated IRIS assessment in the next few years [11].

The naphthalene samples were screened using ATSDR's cancer risk evaluation guides (CREGs); an estimated concentration of a contaminant that is unlikely to result in not more than one excess cancer in a million persons exposed in their lifetime (78 years) [12]. Inhalation Unit Risks (IURs) are used to derive CREGs for inhalation exposures to a suspected carcinogenic contaminant. IURs are determined through EPA quantitative evaluations of inhalation exposures [13].

Naphthalene exceeded ATSDR's Cancer Risk Evaluation Guideline (CREG) of 0.029 micrograms per cubic meter (µg/m<sup>3</sup>) in 56 samples out of a total 59 samples (**Table 1**). The maximum naphthalene concentration of 0.254 µg/m<sup>3</sup> was collected on November 30, 2021. The minimum naphthalene concentration was 0.014 µg/m<sup>3</sup> and was collected on March 12, 2022. The 56 exceedances of the CREG prompted further toxicological evaluation and the calculation of exposure point concentrations.

### ***Naphthalene Non-Cancer Health Effects Evaluation***

The concentrations of naphthalene detected are far below the odor threshold and below the levels likely to cause non-cancer health effects. One EPC per month was calculated to represent an individual's estimated exposure to naphthalene (see **Table 2** below). The exposure point concentrations (or exposure doses for air) ranged from a minimum of 0.043  $\mu\text{g}/\text{m}^3$  to 0.421  $\mu\text{g}/\text{m}^3$  across the eleven months sampled. These exposure point concentrations were below ATSDR's chronic exposure MRL of 3.7  $\mu\text{g}/\text{m}^3$  for all eleven months sampled, indicating that these exposure levels are unlikely to cause adverse health effects (see **Table 2**). SEET used ATSDR's Public Health Assessment Site Tool (PHAST) version v2.2.1.0 to calculate hazard quotients (refer to **Appendix A** for hazard quotient calculations). All naphthalene exposures based on a residential exposure scenario had a hazard quotient of less than one for adults (21 and up) and children (birth to 21). No non-cancer health effects are expected to occur from naphthalene.

**Table 2. Naphthalene Non-cancer Assessment**

Month - Year	Exposure Point Concentration* ( $\mu\text{g}/\text{m}^3$ )	Hazard Quotient <sup>†</sup> (unitless)	ATSDR Chronic MRL <sup>‡</sup> ( $\mu\text{g}/\text{m}^3$ )	EPA Chronic RfC <sup>§</sup> ( $\mu\text{g}/\text{m}^3$ )
August 2021	0.136	0.038	3.7	3
September 2021	0.170	0.046	3.7	3
October 2021	0.121	0.032	3.7	3
November 2021	0.421	0.11	3.7	3
December 2021	0.140	0.038	3.7	3
January 2022	0.089	0.024	3.7	3
February 2022	0.190	0.051	3.7	3
March 2022	0.163	0.043	3.7	3
April 2022	0.113	0.03	3.7	3
May 2022	0.090	0.024	3.7	3
June 2022	0.043	0.012	3.7	3

\*EPC = Exposure Point Concentrations are a representative estimate of a contaminant concentration that an individual may be exposed to. These concentrations are representative of what an individual would be exposed to outdoors in each month/year above sampled in the Irish Channel near the sampling site.

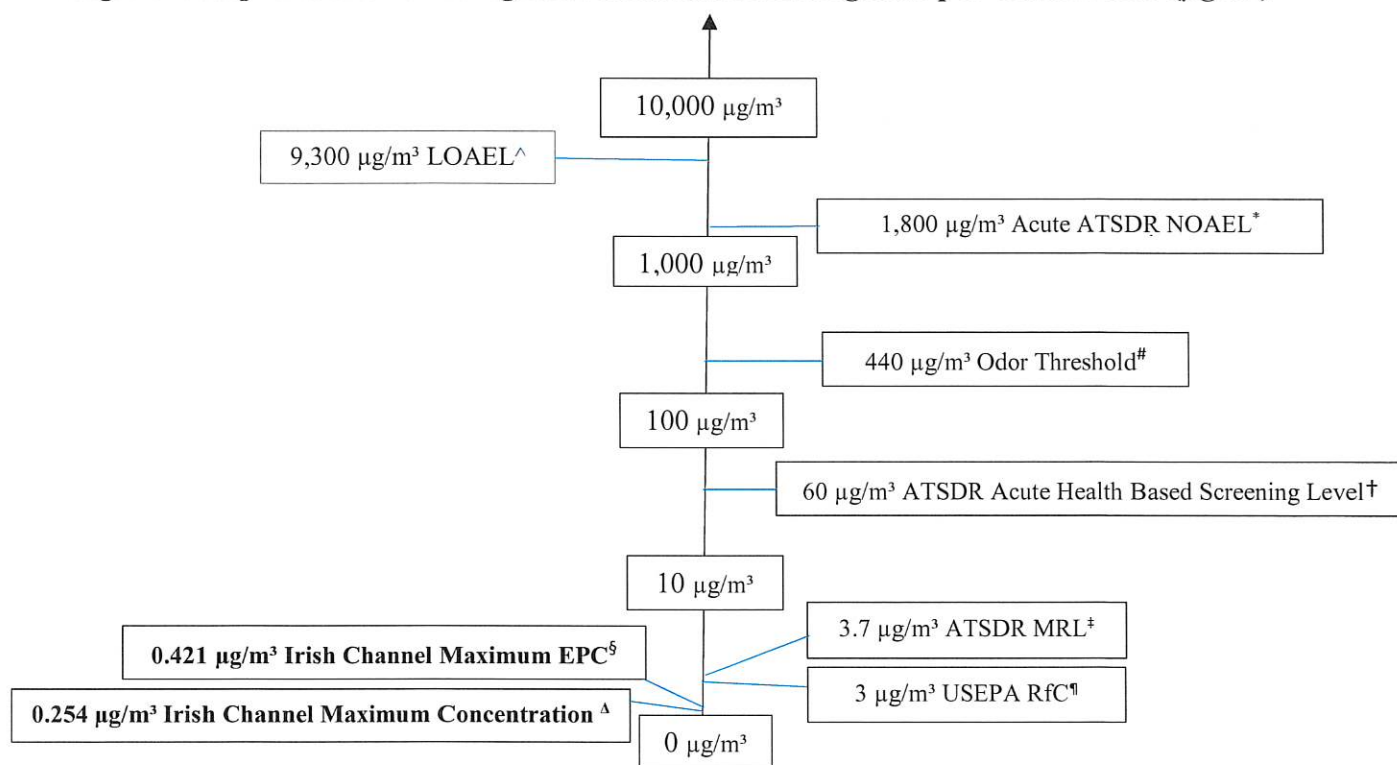
<sup>†</sup> A hazard quotient less than one, indicates the potential for non-cancer health hazards to occur from exposure to a contaminant is very unlikely. A hazard quotient greater than one, indicates non-cancer adverse health effects could occur.

<sup>‡</sup>ATSDR Chronic Minimum Risk Level (MRL) is the estimate of a daily exposure to a hazardous substance at or below which an adverse, non-cancer health effect is unlikely to occur.

<sup>§</sup> EPA Chronic Reference Concentration (RfC) is the air concentration of a contaminant that can be continuously inhaled (including sensitive subpopulations) that is unlikely to cause any negative health effects over a lifetime.

**Figure 2** shows the maximum naphthalene concentration of 0.254  $\mu\text{g}/\text{m}^3$  and the maximum naphthalene EPC of 0.421  $\mu\text{g}/\text{m}^3$  relative to the MRL, USEPA's RfC, No Observable Adverse Effect Level (NOAEL), and Lowest Observable Adverse Effect Level (LOAEL). A NOAEL is the highest tested dose of a substance that does not result in adverse health effects in people or animals. The LOAEL is the lowest tested dose of a substance that has been reported to result in harmful health effects in people or animals.

**Figure 2. Naphthalene Toxicological Evaluation in Micrograms per Cubic Meter ( $\mu\text{g}/\text{m}^3$ )**



\*NOAEL: No Observed Adverse Effect Level

<sup>^</sup>LOAEL: Lowest Observable Adverse Effect Level [14]

<sup>†</sup> ATSDR Acute Health Based Screening Level – An acute exposure lasts between 0 – 14 days.

<sup>‡</sup>ATSDR MRL: Agency for Toxic Substances and Disease Registry's Minimal Risk Level

<sup>§</sup> EPC: Exposure Point Concentration

<sup>¶</sup> EPA RfC: Environmental Protection Agency Reference Concentration

<sup>#</sup> Odor Threshold – The lowest threshold of an odor that can be detected by the human nose.

<sup>Δ</sup> Maximum Concentration – The maximum detection of naphthalene collected from the Irish Channel from August 2021 to June 2022.

The maximum naphthalene concentration and the maximum EPC are much lower than ATSDR's human equivalent based MRL, NOAEL, LOAEL, and RfC, as shown in **Figure 2**.

### ***Naphthalene Cancer Risks Toxicological Evaluation***

According to the National Toxicology Program (NTP), naphthalene is reasonably considered to be a carcinogen and by the International Agency for Research on Cancer (IARC) to be possibly carcinogenic [15]. The EPA's Integrated Risk Information System (IRIS), classifies naphthalene in Group C, as a possible human carcinogen [14]. There is limited human evidence and less than sufficient inhalation evidence in animals to classify it as carcinogenic [14]. SEET used ATSDR's Public Health Assessment Site Tool (PHAST) version v2.2.1.0 to calculate cancer risks. Estimated cancer risks higher than one excess cancer case out of one million people ( $1\text{E}-06$ ) require further toxicological evaluation. Estimated cancer risks for exposure to naphthalene in Irish Channel ambient air samples for adults and children from August 2021 to June 2022 are listed below in **Table 3**.

**Table 3. Naphthalene Cancer Risk Assessment**

Month - Year	Exposure Point Concentration <sup>†</sup> (µg/m <sup>3</sup> )	Total Child Cancer Risk	Adult Cancer Risk
August 2021	0.136	<b>1E-06</b>	<b>2E-06</b>
September 2021	0.170	<b>2E-06</b>	<b>2E-06</b>
October 2021	0.121	<b>1E-06</b>	<b>2E-06</b>
November 2021	0.421	<b>4E-06*</b>	<b>6E-06*</b>
December 2021	0.140	<b>1E-06</b>	<b>2E-06</b>
January 2022	0.089	8E-07	<b>1E-06</b>
February 2022	0.190	<b>2E-06</b>	<b>3E-06</b>
March 2022	0.163	<b>2E-06</b>	<b>2E-06</b>
April 2022	0.113	1E-06	<b>2E-06</b>
May 2022	0.090	8E-07	<b>1E-06</b>
June 2022	0.043	4E-07	6E-07

<sup>†</sup>EPC = Exposure Point Concentrations are a representative estimate of a contaminant concentration that an individual may be exposed to based on the samples collected for the exposure unit. In this case, each month is an exposure unit, and each month has its own EPC.

**Bold print** indicates that there is a cancer risk greater than 1 in one-million individuals.


\*The maximum cancer risk out of all eleven months sampled is denoted with an asterisk.

The maximum cancer risk for adults was six excess cancer cases among 1,000,000 (one-million) people exposed (6E-06). The maximum total child cancer risk was four excess cancer cases among 1,000,000 children exposed (4E-06). These cancer risks are significantly lower than the national lifetime risk of cancer in the United States. According to the Centers for Disease Control and Prevention (CDC), the lifetime risk of cancer in the United States is 1 in 3 or 33% of the population [16].

#### **Benzo(a)pyrene Equivalent Concentrations**

Benzo(a)pyrene and related congeners were assessed using ATSDR guidelines for PAH data with more than 80% non-detects [17]. Benzo(a)pyrene and related congeners were not detected in any of the samples. Three of the congeners: benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3 cd)pyrene could not be screened out (see **Table 1**) since their Method Detection Limits were higher than the ATSDR HBCVs. Because these contaminants were not detected in any of the samples and had a comparison value less than the method detection limit, cancer risks and hazard quotients could not be calculated (see **Table 4**).

**Table 4. Residential: Site-specific exposure point concentrations for chronic air inhalation exposure to BaP equivalent concentration upper bound in air at 0.024 µg/m<sup>3</sup> (0.0023 ppb)\***

	Adjusted EPC (µg/m <sup>3</sup> )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
<b>Exposure Group</b>					
Birth to < 1 year	0.024	0.0023	-	-	1
1 to < 2 years	0.024	0.0023	-	-	1
2 to < 6 years	0.024	0.0023	-	-	4
6 to < 11 years	0.024	0.0023	-	-	5
11 to < 16 years	0.024	0.0023	-	-	5
16 to < 21 years	0.024	0.0023	-	-	5
Total Child	-	-	-	-	21
Adult	0.024	0.0023	-	-	33

Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m<sup>3</sup> = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years

\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0.

## Conclusions

Ambient air quality data samples collected from the Irish Channel neighborhood in New Orleans, LA, in 2021 and 2022 were evaluated by the Louisiana Department of Health (LDH)/Section of Environmental Epidemiology and Toxicology (SEET). This evaluation was performed using conservative assumptions to be protective of Irish Channel residents.

**Conclusion 1:** At the levels detected in ambient air samples collected from the Irish Channel, naphthalene is not expected to cause health effects in community members. The air samples include all sources of naphthalene in ambient air including industrial emissions, motor vehicle exhaust and other sources.

### Basis for Conclusion:

- Non-cancer risks including headache and nausea are not expected to occur as the maximum naphthalene concentration and the maximum EPC are much lower than ATSDR's human equivalent based inhalation Minimal Risk Level, Reference Concentration, No Observable Adverse Effect Level and Lowest Observable Adverse Effect Level.
- Naphthalene cancer risks exceeded the level of no concern for increase in cancer risk (one excess case in one-million people). However, naphthalene is not a known human carcinogen; it is classified as a possible human carcinogen according to the IRIS [18]. Based on limited human evidence and less than sufficient research for naphthalene's carcinogenicity in humans, the levels of naphthalene detected in the Irish Channel are not expected to pose an increase in the risk of developing cancer.

**Conclusion 2:** The remaining PAHs (other than naphthalene) were not detected in ambient air samples at levels that would pose health concerns.

Basis for Conclusion:

- Benzo(a)pyrene and its relative toxicity contaminants were not detected in any of the samples collected. Benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3 cd)pyrene had a HBCV less than the method detection limit, therefore cancer risks and hazard quotients could not be calculated.
- Thirteen PAHs with detections did not have available HBCVs or EPA RSLs and could not be assessed (see **Table 1**).

**Conclusion 3:** While the assessments did not show health risks to naphthalene (PAH), the odors reported by residents could have contributed to headaches and nausea.

Basis for Conclusion:

- These are common health effects with a wide variety of causes; odors could have contributed if they reached noxious levels.
- It is not generally possible to measure odors with air sampling, but symptoms may be present.
- Health effects from odors such as headaches and nausea are generally reversible with the removal or mitigation of the odors.

## **Recommendations**

Steps to identify sources of odors in the Irish Channel may focus on activities on the Mississippi River or chemical storage and fuel handling facilities along the River and West Bank. When odors arise from these facilities, actions to mitigate or control odors can then be taken.

LDH encourages anyone with concerns or questions to contact the Section of Environmental Epidemiology and Toxicology at 1-(888)-293-7020 or online at <http://ldh.la.gov/index.cfm/subhome/22>.

Sincerely,



**Chelsea Bourgeois, MPH**

Health Risk Assessor

Louisiana Department of Health/Office of Public Health

Section of Environmental Epidemiology and Toxicology

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## **Appendices**

# Appendix A



## Site-specific Parameters Table PHAST Report, v2.2.1.0, February 27, 2023

### Equations

#### Air Inhalation Exposure Equation

$$\text{Adjusted EPC} = \text{EPC} \times \text{EF}_{\text{noncancer}} \quad \text{Equation 1}$$

EPC = exposure point concentration,  $\text{EF}_{\text{noncancer}}$  = exposure factor (unitless)

#### Hazard Quotient

$$\text{HQ} = \text{Adjusted EPC} \div \text{HG} \quad \text{Equation 2}$$

HQ = hazard quotient, EPC = exposure point concentration ( $\mu\text{g}/\text{m}^3$  or ppb), HG = health guideline (e.g., inhalation MRL, RfC)

#### Cancer Risk Equations

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

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

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

CR = cancer risk (unitless), EPC = exposure point concentration ( $\mu\text{g}/\text{m}^3$  or ppb), IUR = inhalation unit risk ( $(\mu\text{g}/\text{m}^3 \text{ or ppb})^{-1}$ ),

ED = exposure duration (years), LY = lifetime years (78 years), ADAF = age-dependent adjustment factor (unitless),

EF (cancer) = exposure factor (cancer) calculated as follows:  $\text{EF (non-cancer; unitless)} \times \text{exposure group specific exposure duration (years)} \div \text{lifetime of 78 years}$

## Site-specific Exposure Factors

Duration Category	Hours per Day	Days per Week	Weeks per Year	Years	Exposure Group Specific EF <sub>noncancer</sub>	Exposure Group Specific* EF <sub>cancer</sub>
Acute	24	-	-	-	1	-
Intermediate	24	7	-	-	1	-
Chronic	24	7	52.14	33	1	= EF <sub>noncancer</sub> x Exposure Duration for Cancer <sub>Exposure Group</sub> (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  $EF_{cancer} = EF_{noncancer} \times \text{Exposure Duration for Cancer}_{\text{Exposure Group}} (\text{years}) \div 78 \text{ years}$ .

## Appendix B

August 2021

### Naphthalene

**Table 1. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.14  $\mu\text{g}/\text{m}^3$  (0.027 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.14	0.027	0.038	-	1
1 to < 2 years	0.14	0.027	0.038	-	1
2 to < 6 years	0.14	0.027	0.038	-	4
6 to < 11 years	0.14	0.027	0.038	-	5
11 to < 16 years	0.14	0.027	0.038	-	5
16 to < 21 years	0.14	0.027	0.038	-	5
Total Child	-	-	-	1E-6 ‡	21
Adult	0.14	0.027	0.038	2E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of  $3.4\text{E}-05$  ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

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

September 2021

## Naphthalene

**Table 2. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.17  $\mu\text{g}/\text{m}^3$  (0.032 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.17	0.032	0.046	-	1
1 to < 2 years	0.17	0.032	0.046	-	1
2 to < 6 years	0.17	0.032	0.046	-	4
6 to < 11 years	0.17	0.032	0.046	-	5
11 to < 16 years	0.17	0.032	0.046	-	5
16 to < 21 years	0.17	0.032	0.046	-	5
Total Child	-	-	-	2E-6 ‡	21
Adult	0.17	0.032	0.046	2E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of  $3.4\text{E-}05$  ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

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

October 2021

## Naphthalene

**Table 3. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.12  $\mu\text{g}/\text{m}^3$  (0.023 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

 Exposure Group	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Birth to < 1 year	0.12	0.023	0.032	-	1
1 to < 2 years	0.12	0.023	0.032	-	1
2 to < 6 years	0.12	0.023	0.032	-	4
6 to < 11 years	0.12	0.023	0.032	-	5
11 to < 16 years	0.12	0.023	0.032	-	5
16 to < 21 years	0.12	0.023	0.032	-	5
Total Child	-	-	-	1E-6 ‡	21
Adult	0.12	0.023	0.032	2E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

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

November 2021

## Naphthalene

**Table 4. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.42  $\mu\text{g}/\text{m}^3$  (0.08 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.42	0.080	0.11	-	1
1 to < 2 years	0.42	0.080	0.11	-	1
2 to < 6 years	0.42	0.080	0.11	-	4
6 to < 11 years	0.42	0.080	0.11	-	5
11 to < 16 years	0.42	0.080	0.11	-	5
16 to < 21 years	0.42	0.080	0.11	-	5
Total Child	-	-	-	4E-6 ‡	21
Adult	0.42	0.080	0.11	6E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

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

December 2021

## Naphthalene

**Table 5. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.14 µg/m<sup>3</sup> (0.027 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC (µg/m <sup>3</sup> )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.14	0.027	0.038	-	1
1 to < 2 years	0.14	0.027	0.038	-	1
2 to < 6 years	0.14	0.027	0.038	-	4
6 to < 11 years	0.14	0.027	0.038	-	5
11 to < 16 years	0.14	0.027	0.038	-	5
16 to < 21 years	0.14	0.027	0.038	-	5
Total Child	-	-	-	1E-6 ‡	21
Adult	0.14	0.027	0.038	2E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m<sup>3</sup> = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7 µg/m<sup>3</sup> and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 (µg/m<sup>3</sup>)<sup>-1</sup>.

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

January 2022

## Naphthalene

**Table 6. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.089  $\mu\text{g}/\text{m}^3$  (0.017 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.089	0.017	0.024	-	1
1 to < 2 years	0.089	0.017	0.024	-	1
2 to < 6 years	0.089	0.017	0.024	-	4
6 to < 11 years	0.089	0.017	0.024	-	5
11 to < 16 years	0.089	0.017	0.024	-	5
16 to < 21 years	0.089	0.017	0.024	-	5
Total Child	-	-	-	8E-7	21
Adult	0.089	0.017	0.024	1E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

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

February 2022

## Naphthalene

**Table 7. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.19 µg/m<sup>3</sup> (0.036 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC (µg/m <sup>3</sup> )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.19	0.036	0.051	-	1
1 to < 2 years	0.19	0.036	0.051	-	1
2 to < 6 years	0.19	0.036	0.051	-	4
6 to < 11 years	0.19	0.036	0.051	-	5
11 to < 16 years	0.19	0.036	0.051	-	5
16 to < 21 years	0.19	0.036	0.051	-	5
Total Child	-	-	-	2E-6 ‡	21
Adult	0.19	0.036	0.051	3E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m<sup>3</sup> = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7 µg/m<sup>3</sup> and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 (µg/m<sup>3</sup>)<sup>-1</sup>.

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

March 2022

## Naphthalene

**Table 8. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.16  $\mu\text{g}/\text{m}^3$  (0.031 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

 PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.16	0.031	0.043	-	1
1 to < 2 years	0.16	0.031	0.043	-	1
2 to < 6 years	0.16	0.031	0.043	-	4
6 to < 11 years	0.16	0.031	0.043	-	5
11 to < 16 years	0.16	0.031	0.043	-	5
16 to < 21 years	0.16	0.031	0.043	-	5
Total Child	-	-	-	2E-6 ‡	21
Adult	0.16	0.031	0.043	2E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

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

April 2022

## Naphthalene

**Table 9. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.11 µg/m<sup>3</sup> (0.021 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC (µg/m <sup>3</sup> )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.11	0.021	0.030	-	1
1 to < 2 years	0.11	0.021	0.030	-	1
2 to < 6 years	0.11	0.021	0.030	-	4
6 to < 11 years	0.11	0.021	0.030	-	5
11 to < 16 years	0.11	0.021	0.030	-	5
16 to < 21 years	0.11	0.021	0.030	-	5
Total Child	-	-	-	1E-6 ‡	21
Adult	0.11	0.021	0.030	2E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m<sup>3</sup> = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7 µg/m<sup>3</sup> and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 (µg/m<sup>3</sup>)<sup>-1</sup>.

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

May 2022

## Naphthalene

**Table 10. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.09 µg/m³ (0.017 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC (µg/m³)	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.090	0.017	0.024	-	1
1 to < 2 years	0.090	0.017	0.024	-	1
2 to < 6 years	0.090	0.017	0.024	-	4
6 to < 11 years	0.090	0.017	0.024	-	5
11 to < 16 years	0.090	0.017	0.024	-	5
16 to < 21 years	0.090	0.017	0.024	-	5
Total Child	-	-	-	8E-7	21
Adult	0.090	0.017	0.024	1E-6 ‡	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors; µg/m³ = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years


\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7 µg/m³ and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 (µg/m³)⁻¹.

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

June 2022

## Naphthalene

**Table 11. Residential: Site-specific exposure point concentrations for chronic exposure to naphthalene in air at 0.043  $\mu\text{g}/\text{m}^3$  (0.0082 ppb) along with non-cancer hazard quotients and cancer risk estimates\***

	Adjusted EPC ( $\mu\text{g}/\text{m}^3$ )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.043	0.0082	0.012	-	1
1 to < 2 years	0.043	0.0082	0.012	-	1
2 to < 6 years	0.043	0.0082	0.012	-	4
6 to < 11 years	0.043	0.0082	0.012	-	5
11 to < 16 years	0.043	0.0082	0.012	-	5
16 to < 21 years	0.043	0.0082	0.012	-	5
Total Child	-	-	-	4E-7	21
Adult	0.043	0.0082	0.012	6E-7	33


Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  $\mu\text{g}/\text{m}^3$  = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years

\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 3.7  $\mu\text{g}/\text{m}^3$  and the cancer risks were calculated using the inhalation unit risk of 3.4E-05 ( $\mu\text{g}/\text{m}^3$ )<sup>-1</sup>.

## Air Inhalation Chronic Benzo(a)pyrene Equivalent Concentration

**Table 12. Residential: Site-specific exposure point concentrations for chronic exposure to BaP equivalent upper bound in air at 0.024 µg/m<sup>3</sup> (0.0023 ppb)\***

	Adjusted EPC (µg/m <sup>3</sup> )	Adjusted EPC (ppb)	Non-cancer Hazard Quotient	Cancer Risk	Exposure Duration (yrs)
Exposure Group					
Birth to < 1 year	0.024	0.0023	-	-	1
1 to < 2 years	0.024	0.0023	-	-	1
2 to < 6 years	0.024	0.0023	-	-	4
6 to < 11 years	0.024	0.0023	-	-	5
11 to < 16 years	0.024	0.0023	-	-	5
16 to < 21 years	0.024	0.0023	-	-	5
Total Child	-	-	-	-	21
Adult	0.024	0.0023	-	-	33

Data Source: LDEQ, Ambient Air Monitoring Program

Abbreviations: adjusted EPC = the exposure point concentration (EPC) times the appropriate exposure factors;  
 µg/m<sup>3</sup> = micrograms per meter cubed; ppb = parts per billion; mg/kg/day = milligram chemical per kilogram body weight per day; yrs = years

\* The calculations in this table were generated using ATSDR's PHAST v2.2.1.0.