Letter Health Consultation

STACKYARD HOLLOW SITE

WHEELING, WEST VIRGINIA

JULY 27, 2015

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

STACKYARD HOLLOW SITE

WHEELING, WEST VIRGINIA

Prepared By:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Eastern Branch Headquarters

DEPARTMENT OF HEALTH & HUMAN SERVICES Public Health Service

Agency for Toxic Substances and
Disease Registry, Region 3
1650 Arch Street, 3HS00
Philadelphia, PA 19103

OSC Deborah Lindsey
U.S. Environmental Protection Agency Region 3
Wheeling Operations Office
303 Methodist Building
11th and Chapline Streets
Mail Code: 3HS32
Wheeling, WV 26003

July 27, 2015

Dear OSC Lindsey:

On January 5, 2015, you requested that the Agency for Toxic Substances and Disease Registry (ATSDR) complete a health consultation evaluating residential indoor air data collected after emergency response activities at the Stackyard Hollow site in Wheeling, WV (site). The site consists of a four-unit apartment building constructed "slab-on-grade" and situated atop an abandoned gas/oil production wellhead. The wellhead is located in the unoccupied first floor apartment unit. On June 5, 2015, ATSDR provided you with a letter assessing the public safety risk from the detection of flammable vapors inside the residential apartment building at the site and recommended taking immediate steps to eliminate this risk to the public. On June 8, 2015, local government officials ordered the property owner to evacuate the apartment building.

This letter health consult assesses the public health risk from past exposures to the volatile organic compounds (VOC) detected in the apartment building before actions were taken to evacuate the former tenants. The conclusions in this document are based on one round of 24-hour air sampling for VOCs collected on November 11, 2014 in the second floor occupied apartment. Additional air monitoring data for total (non-speciated) VOCs by photo-ionization detector (PID) collected between September 2014 and the May 2015 indicated VOCs have been continuously present inside the building since the discovery of the oil and gas well in September 2014. Air monitoring data for VOCs was primarily conducted in the unoccupied apartment room where the oil and gas wellhead is present. ATSDR appreciates and acknowledges the work the U.S. Environmental Protection Agency (EPA) and state and local agencies have already completed to date at this site, which have reduced apartment occupants' exposures to contaminants while they resided at this location.

Screening of the November 11, 2014, VOC sampling results indicated three chemicals (1,2,4-trimethylbenzene [TMB], benzene, and heptane) exceeded health-based comparison values (CV) and required further evaluation. *After further evaluation, ATSDR concludes breathing air inside the apartment building with these levels of chemicals in the past was not expected to harm people's health.* The reason for this is the levels of chemicals detected were below levels likely to cause non-cancer health effects, and the calculated cancer risk for the detected carcinogen falls within EPA's target cancer risk range. Limitations to our conclusion are that this is based on a single round of air

monitoring after mitigation actions at the site were already initiated, as well as that air monitoring data suggests variable emission rates from the source.

ATSDR supports EPA's ongoing efforts with state and local authorities to further mitigate exposures at this site. ATSDR understands that EPA will continue indoor air monitoring until a permanent remedy is in place at the site, and that post mitigation monitoring will be conducted to ensure that hazards are addressed prior to any reuse of the property.

Background and Statement of Issues

In June 2014, West Virginia Department of Environmental Protection (WVDEP) responded to a report of odors inside an apartment building and an oil sheen in a nearby culvert. In September 2014, the building owner drilled a hole in the building's slab to further explore the source of odors in the building. This caused the abandoned well to "bubble up liquids and vent gasses" into an unoccupied 1st floor apartment in the building. WVDEP requested EPA removal program assistance in evaluating and mitigating this concern. EPA and WVDEP confirmed the presence of strong odors and conducted field monitoring with handheld instruments that detected VOCs and flammable gasses (by Lower explosive limit, or LEL, meter) inside the first floor unit with the oil and gas wellhead. VOCs were also detected on the upper floor.

The environmental agencies worked with oil and gas field experts from the state and the building owner to install temporary engineering controls that exhaust oil/gas well vapors to outside the building above the roofline (via wellhead cap and vent pipe). The threat of explosion from the build-up of flammable gasses inside the apartment building was reduced, but not eliminated. Post-mitigation intermittent monitoring indicates vapors/gasses were still occasionally present inside the first floor unit in the area immediately adjacent to the wellhead that are at times at levels of safety concern. Since October 2014, flammable gases have only been monitored and detected in the unit with the wellhead.

Instantaneous air monitoring for total VOCs and flammable atmosphere

EPA conducted handheld monitoring for total VOCs and flammable atmosphere readings at two to five day intervals inside the unit with the wellhead and outside the subject building between September 2014 and May 2015. Over approximately 70 days of handheld monitoring (approximately 50 of which included monitoring at the wellhead), there were detectable levels of flammable gases on the LEL meter 21 times in the area immediately adjacent to the base of the wellhead. Following any LEL detections, EPA took immediate steps to reduce the presence of flammable gases until all readings returned to zero each time. There were no LEL detections in any of the other monitoring locations after September 29, 2014. Please refer to ATSDR's June 5, 2015, letter for a review of the public safety risk from the detection of flammable vapors inside the apartment building at this site.

24-hour Indoor Air Sampling

In the fall of 2014, EPA continued to work with oil and gas field experts from the state and the building owner to take actions to reduce the accumulation of vapors inside the building and mitigate exposures in occupied apartments, including installing a temporary wellhead cap and vent pipe from the wellhead in the first floor room to outside the building to exhaust vapors to the

outdoors. EPA then conducted air sampling on November 11, 2014, following EPA Method TO-15. A total of three indoor air samples were collected over a 24-hour time period, including sampling in the unoccupied room where the wellhead was discovered, and in the occupied apartment on the second floor of the building directly above the apartment with the wellhead.

Contaminants of Concern (COC)

Following ATSDR's public health assessment process, ATSDR screened the 24-hour indoor air sampling data against health-based comparison values, or CVs (ATSDR 2005). This process systematically determines which contaminants at the site require further public health evaluation and which are not expected to be of public health concern. Eleven VOCs were positively detected in indoor air from three samples collected at the site (see table 1). The highest concentrations of detected VOCs were identified in the sample collected from the first floor impacted unit, which is where the oil/gas wellhead is located.

- Three chemicals exceeded their respective CVs and were identified as potential COCs: 1,2,4-TMB, benzene, and heptane.
- In the 2nd floor occupied unit, 1,2,4-TMB was detected in one sample at 2.4 part per billion (ppb). In the first floor unoccupied unit, this chemical was detected at 4.4 ppb. Both these values exceed the health-based CV (EPA risk screening level, or RSL) for 1,2,4-TMB of 1.45 ppb.
- In the 2nd floor occupied unit, benzene was detected at 2.4 ppb in one sample and 2.5 ppb in the other sample from this unit. In the first floor unoccupied unit, benzene was detected at 3.3 ppb. All of three of these values exceed the health-based CV (ATSDR cancer risk evaluation guideline) for benzene of 0.04 ppb.
- In the 2nd floor occupied unit, heptane was detected at 43.3 and 85.5 ppb; it was detected at 94 ppb in the first floor unoccupied unit. The Texas Commission on Environmental Quality (TCEQ) identifies a long-term effect screening level (ESL) of 85 ppb for heptane.

Table 1
Summary of Compounds Detected in Indoor Air (24-hour samples)
Stackyard Hollow Site

	Indoor Air Samples			Health-based comparison values				
	SYA-01	SYA-02	SYA-03		ATSDR CV		Other CV	
	Unoccupied 1st floor unit	Occupied 2nd floor unit		Acute EMEG	Chron EMEG	CREG	CV	CV Source
Chemicals Detected	**ppb**	**ppb**	**ppb**	**ppb**	**ppb**	**ppb**	**ppb**	
1,2,4 TMB*	4.4	U	**2.4**	NA	NA		**1.45**	EPA Risk screening level (RSL)
1,3,5 TMB	1.5	U	U	NA	NA			
Acetone	U	10.8	10.0	26,000	13,000			
Benzene	3.3	**2.4**	**2.5**	9	3	**0.04**	9.4	EPA Reference concentration (RfC)
Cyclohexane	84.3	66.1	69.6	NA	NA		1700	EPA RSL

	Indoor Air Samples			Health-based comparison values				
	SYA-01	SYA-02	SYA-03		ATSDR CV		Other CV	
	Unoccupied 1st floor unit	Occupied 2nd floor unit		Acute EMEG	Chron EMEG	CREG	CV	CV Source
Chemicals Detected	**ppb**	**ppb**	**ppb**	**ppb**	**ppb**	**ppb**	**ppb**	
Ethanol	8.3	227	213.0	NA	NA		1000	TCEQ Effect Screening Level (ESL) long**
Ethylbenzene	1.2	U	U	5,000	60		230	EPA RfC
Heptane	94	43.3	**85.5**	NA	NA		850/85	TCEQ Effect Screening Level (ESL) short/long**
Hexane	286	172	173.0	NA	600			
m,p-Xylene	12.1	U	7.8	2,000	50			
o-Xylene	2.2	U	1.5	2,000	50			
Toluene	4.3	1.5	3.5	1,000	80			

* 1,2,4 TMB= Trimethylbenzene

** = ATSDR has not fully evaluated the toxicological basis for TCEQ effect screening levels; SYA-01 = sample identifier; CV = health based comparison value; Chron EMEG = chronic environmental media evaluation guideline; CREG = cancer risk evaluation guideline; ppb = parts per billion; TCEQ = Texas Commission on Environmental Quality; U = not detected; NA = not available

Discussion

Exposure to a COC is determined by examining human exposure pathways. An exposure pathway has five parts:

1. A source of contamination (e.g., venting oil and gas well),
2. An environmental medium such as water, soil, or air that can hold or move the contamination,
3. A point at which people come in contact with a contaminated medium (i.e. contaminated indoor air),
4. An exposure route, such as inhalation, and
5. A population who could come in contact with the contaminants (i.e. building residents).

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. The indoor air pathway is a completed past exposure pathway at the Stackyard Hollow Site. Residents are no longer occupying this apartment building.

As discussed in the previous section, the indoor air analytical results were first screened against health-based CVs. CVs are doses or substance concentrations set well below levels that are known or anticipated to result in adverse health effects. These values help health assessors make consistent decisions about what substance concentrations or dose levels require a closer look. Health-based CVs are non-site specific. They are based on health guidelines with uncertainty factors applied to ensure that they are adequately protective of public health (including sensitive populations).

None of the chemicals detected in the indoor air exceeded existing acute non-cancer CVs. Three chemicals exceeded chronic health-based CVs. 1,2,4-TMB exceeded its non-cancer CV; benzene exceeded its cancer CV; and heptane exceeded the TCEQ long-term ESL at this site. While 1,3,5-TMB was detected inside the building and there is no health-based screening value for comparison, this chemical was eliminated from further assessment because it was not detected in an occupied space in the apartment building. Exposures to the three COCs (1,2,4-TMB, benzene, and heptane) are further evaluated below to determine their potential to cause non-cancer and cancer health effects.

1,2,4-TMB

The TMB isomer, 1,2,4-TMB, is a clear, colorless liquid with a distinctive, aromatic odor. TMBs are released directly to the environment as components of gasoline and as emissions from gasoline-powered vehicles, municipal waste-treatment plants, and coal-fired power plants. TMBs are found in coal tar, occur in some mineral oils, and are formed during the refining of crude oil. The general population may be exposed to TMBs by breathing ambient air, particularly in areas with heavy traffic, eating food and drinking water contaminated with TMBs, or dermal exposure to products such as gasoline which contain TMBs. For example, 39% of the ambient air samples collected in Washington, DC, contained 1,2,4-TMB at an average concentration of 0.27 ppb (HSDB 2010). EPA determined the 50th percentile (or median) indoor air concentration of 1,2,4-TMB was 1.9 ppb (EPA 2011). This median indoor air concentration is below the maximum concentration in an occupied space at the subject property (2.4 ppb), and slightly above the EPA provisional peer-reviewed toxicity value (1.45 ppb), which is discussed in more detail below.

Collectively, the available carcinogenicity and genotoxicity data from human and animal studies do not adequately assess the carcinogenic potential of 1,2,4-TMB in humans or animals. Under the current U.S. EPA (2005) cancer guidelines, the toxicological database is considered inadequate for a determination of the human carcinogenic potential of 1,2,4-TMB. Therefore, this evaluation focuses on the noncancer health effects of exposure to this chemical.

The toxicological database for 1,2,4-TMB is limited, although several studies examining the inhalation toxicity of mixtures containing one or more TMB isomers, or pure 1,2,4-TMB, (both human and animal) have identified increases in the incidence of central nervous system (CNS) toxicity (Bättig et al., 1958; IBT, 1981; Gralewicz and Wiaderna, 2001; Gralewicz et al., 1997a, 1997b; Korsak and Rydzyński, 1996), and non-significant increases in the incidence of respiratory (Korsak et al., 1997, 2000) and hematological effects (Bernshtein, 1972; Korsak et al., 2000). In humans, CNS effects have included vertigo, dizziness, drowsiness and headaches. Respiratory and hematological (i.e. blood-related) effects have included bronchitis and hyperchromic anemia and blood clotting alterations (EPA 2007:13).

Based on this limited database and following a standardized process for deriving toxicity values, the EPA developed a provisional peer-reviewed toxicity value (PPRTV) of 1.45 ppb for chronic inhalation exposures to 1,2,4-TMB (EPA 2007). The PPRTV was derived from the Korsak et al. 2000 study, which determined the No Observed Adverse Effect Level (NOAEL) for hematological effects in rats was 123 mg/m^3 (24,561 ppb). The human equivalent concentration NOAEL, or NOAEL$_{HEC}$, of 4,353 ppb was derived from the Korsak et al. 2000 study and is used as the point of departure in deriving the PPRTV (EPA 2007). Confidence in the principal study (Korsak et al. 2000) is considered low (EPA

2007). In determining the PPRTV of 1.45 ppb, the $NOAEL_{HEC}$ was divided by a composite uncertainty factor of 3,000 to account for extrapolation from subchronic to chronic exposure (x10); for extrapolation from animal to human (x3); for inter-individual variability, such as for sensitive populations (x10), and for database deficiencies (x10).

The concentrations of 1,2,4-TMB detected in the occupied spaces of the subject building were less than two times the health-based CV, where no health effects are expected. The CV for 1,2,4-trimetylbenzene is an EPA provisional value representing the airborne concentration of the substance to which humans can be exposed without experiencing adverse health effects during a lifetime. PPRTVs (i.e. the CV used for this chemical) include uncertainty factors (in this case, the UF=3000) and are applicable for everyone, including sensitive subgroups (e.g. children, the elderly). While two of the three indoor air samples had 1,2,4-TMB concentrations exceeded the PPRTV, the exposure assumptions used to develop the PPRTV are conservative with respect to protecting public health. The concentrations detected inside the building suggest the well is emitting 1,2,4-TMB, although the detected concentrations in the occupied units (non-detect and 2.4 ppb) are consistent with EPA's assessment of average or typical indoor air concentrations for this chemical (1.9 ppb). Although there is limited toxicological data for this chemical, the exposure assumptions and uncertainty factors used in deriving the PPRTV of 1.45 ppb are very conservative, resulting in a screening level (i.e. PPRTV) that is 3,000 times below the exposure concentration identified in studies as the NOAEL. This information suggests the exposure to low ppb levels of TMBs would not be expected to result in adverse health effects, especially given that the duration of exposure for former residents was considerably less than 78 years (i.e. lifetime). However, the environmental sampling data is limited to one round of sampling in the building, and it is not clear how long the wellhead has been venting into the apartment building. Intermittent hand-held monitoring for total VOCs, while not sufficient for public health assessment, indicates source emissions, at least since the wellhead was discovered, have been variable. Breathing zone monitoring for total VOCs has been consistently lower than at the wellhead.

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 United States; 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, and nylon and other synthetic fibers. Benzene is also 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 (ATSDR 2007).

The benzene concentrations detected in occupied units at the site are below the non-cancer CV of 3 ppb. Therefore, based on one round of samples collected on November 11, 2014, the residents living in this building are not expected to experience non-cancer health effects from exposure to the detected level of benzene.

This single round of sampling, however, does indicate that a low estimated increased cancer risk can be calculated for individuals if they are or will be continuously exposed over their lifetime (i.e. 78 years) to the benzene levels detected. The excess cancer risk from 78 years of exposure is

approximately 6 additional cancers per 100,000 exposed individuals. This falls within EPA's target cancer risk range (see formula box below). While we do not have indoor air data or more information about length of residency at the subject property, the duration of exposure for each resident is likely much lower than 78 year; therefore, the actual lifetime excess cancer risk may also be lower.

Estimated Benzene Excess Cancer Risk*

Benzene concentration x EPA inhalation unit risk = excess lifetime cancer risk

$8.1\ \mu g/m^3 \times 0.0000078\ (\mu g/m^3)^{-1} = 0.000063 = 6.3 \times 10^{-5}$

Note: *assumes 78 years of daily exposure for 24 hours per day using the upper end of EPA inhalation unit risk value of 7.8x10-6 (µg/m3)-1; µg/m3 = micrograms per cubic meter

Heptane

Heptane is produced and used as a solvent in organic synthesis and as a standard for octane-rating determinations. Heptane is found in raw natural gas, gasoline and petroleum-based products and has a gasoline-like odor.

ATSDR does not have any CVs for heptane. The TCEQ long-term ESL is 85 ppb, slightly lower than the level detected in one of two samples collected in the previously occupied second-floor apartment. TCEQ ESLs are used to evaluate the potential for effects to occur as a result of exposure to concentrations of particular constituents in the air. ESLs are based on data concerning health effects, the potential for odors to be a nuisance, and effects on vegetation. They are not ambient air standards. If predicted airborne levels of a constituent do not exceed the screening level, adverse health or welfare effects are not expected. If predicted ambient levels of constituents in air exceed the ESL, it does not necessarily indicate a problem but rather triggers a review in more depth. ATSDR has not fully evaluated the toxicological basis for TCEQ ESLs.

The mean concentration of the two samples within the second-floor residential unit is below the TCEQ ESL of 85 ppb. Based on one round of sampling from November 11, 2014, ATSDR concludes that the detected levels of heptane are not expected to produce harmful health effects in exposed residents in the apartment building.

Air monitoring for total VOCs and lower explosive limit (LEL)

Intermittent air monitoring by EPA for LEL and total VOCs indicates toxic and flammable gasses have been and continue to be released into the building, even with the presence of a cap venting the gasses from the wellhead to outdoor air. The public health (toxic chemical exposures) and safety (flammable atmospheres) risks have been temporarily mitigated by the installation of a wellhead vent pipe and by the local government's decision to order the property owner to vacate the premises. The June 5, 2015 ATSDR letter health consultation discussed the safety hazard in more detail. ATSDR concurs with EPA efforts to achieve a permanent solution that both eliminates exposures to the gasses being produced by the well and the explosion risk from vapor accumulation inside this building.

Data Limitations

An important limitation for consideration is that the indoor air sampling data analyzed further in this health consultation is limited to one 24-hour time period in November 2014 while temporary

mitigation controls were in place. ATSDR notes here that there remains uncertainty about the indoor air quality at the site due to the limited quantity of data it assessed in this document, including limited sampling locations within the building (2 units) and only a single round of air sampling for public health evaluation. Therefore, this information may not be representative of current or future conditions. Residents are no longer occupying this building, and EPA is currently working with state and local authorities to plan additional remedial actions at this site.

Conclusion

Based on the available air toxics monitoring information from November 11, 2014, ATSDR concludes breathing air inside the apartment building with these levels of chemicals in the past was not expected to harm people's health. The reason for this is the levels of chemicals detected were below levels likely to cause non-cancer health effects, and the calculated cancer risk for the detected carcinogen falls within EPA's target cancer risk range. Limitations to our conclusion are that this is based on a single round of air monitoring after mitigation actions at the site were already initiated, as well as that air monitoring data suggests variable emission rates from the source.

Recommendation

ATSDR supports EPA's ongoing efforts with state and local authorities to further mitigate exposures to well emissions and the safety risks at this site. ATSDR understands that EPA will continue indoor air monitoring until a permanent remedy is in place at the site, and that post mitigation monitoring will be conducted to ensure that hazards are addressed prior to any reuse of the property.

Sincerely,

Robert Helverson
Environmental Health Scientist
ATSDR Region 3 Representative

cc: Fran Burns, EPA R3 Western Branch Chief, Hazardous Site Cleanup Division
Michael Towle, EPA R3 On-Scene Coordinator, Hazardous Site Cleanup Division
Howard Gamble, Wheeling-Ohio County Health Department
Lock Johnson, Wheeling-Ohio County Health Department
Tony Turner, WV Bureau for Public Health
Dr. Sharon Williams-Fleetwood, ATSDR DCHI Eastern Branch Chief

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Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

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LCDR Donna K. Chaney, MBAHCM
U.S. Public Health Service
4770 Buford Highway N.E. MS-F59
Atlanta, GA 30341-3717
(W) 770.488.0713
(F) 770.488.1542