

# Health Consultation

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SHERRILL MINI MART/HEALTH CLINIC

ANNAPOLIS, IRON COUNTY, MISSOURI

EPA FACILITY ID: MOP000514265

SEPTEMBER 30, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry

Division of Health Assessment and Consultation

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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HEALTH CONSULTATION

SHERRILL MINI MART/HEALTH CLINIC

ANNAPOLIS, IRON COUNTY, MISSOURI

EPA FACILITY ID: MOP000514265

Prepared by:

Missouri Department of Health and Senior Services  
Division of Community and Public Health  
Bureau of Environmental Epidemiology  
under Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

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## STATEMENT OF ISSUES AND BACKGROUND

### Statement of Issues

The Missouri Department of Natural Resources (MDNR) has requested that the Missouri Department of Health and Senior Services (DHSS), in conjunction with the federal Agency for Toxic Substances and Disease Registry (ATSDR), complete a health consultation for the Sherrill Mini Mart/Health Clinic in Annapolis, Missouri. This health consultation focuses on exposure to the indoor air in the building that serves as a convenience store and health clinic.

### Background

The Sherrill Mini-Mart opened in 1992; it is located in Annapolis, Iron County, Missouri on State Highway 49. The building is approximately 60 feet by 60 feet, of which the Mini-Mart occupies approximately 70%. It is the local gasoline station and convenience store, which stocks a few grocery items. The Sherrill Mini-Mart employs 11 people who collectively work three shifts, seven days a week, from 6:00 a.m. until 10:00 p.m.

Since 1993, a family health clinic has leased the remaining 30% of the building (see Appendix A., Figure 1). There is a separate entrance and lobby for clinic employees and patients. Three employees staff the clinic (a receptionist, nurse, and nurse practitioner) five days a week. On Tuesdays, a doctor is available for appointments. The clinic is open from 8:00 a.m. until 5:00 p.m., with appointments generally beginning at 9:00 a.m.

In late January 2005, gas and diesel pumps were knocked over causing a fuel spill at the Mini-Mart pump island, which is approximately 15 feet from the front of the building (Appendix A., Figure 1). The pumps were replaced in early February.

In August, clinic staff began complaining of unpleasant odors in the clinic and experiencing headaches that they believed were caused by the odors. The clinic closed for business on August 23, 2005 while the odors were investigated. The owner of Sherrill Mini-Mart contacted a consultant (The Kiesel Company) and the Missouri Department of Natural Resources (MDNR).

In September, MDNR staff visited the site and spoke to clinic staff as well as to Mini-Mart employees and patrons. MDNR staff observed odors in the clinic but neither the nature of the odor nor the source of the odor was immediately identifiable. None of the Mini-Mart staff or patrons complained of odors in the Mini-Mart portion of the building. MDNR discovered that gasoline and diesel product from the pump spill had permeated the ground under the driveway and traveled under the building. Contaminated soil was removed from under the driveway in front of the Mini-Mart portion of the building on September 19 and 20, 2005.

Because of concern that employees and patrons may be inhaling vapors emanating from the contaminated soil, MDNR staff collected an air sample from inside the clinic during the site visit on September 17, 2005. MDNR sent the sample results to DHSS for review. Concentrations of benzene and toluene, common ingredients of gasoline and diesel fuel, exceeded ATSDR's

comparison values for acute (exposure that occurs for less than 14 days) inhalation exposure (Appendix B., Table 1). Several chemicals in the air sample were at levels that exceeded health-based comparison values for longer-term exposure.

Based on the sampling results, DHSS recommended that actions be taken to reduce or prevent exposure for those working in the Mini-Mart or clinic (Appendix C., Letter 1). As a result, a vapor extraction and air filtration system was installed in the building to decrease the concentration of contaminants in the building air. The vapor extraction system pulls contaminated vapors from the soil beneath the clinic and pumps them to the outside to prevent them from entering the clinic through the building floor. The vapor is treated before being released to the outside air. Additionally, carbon filters were placed in the interior heating/cooling system to remove contaminants from circulating indoor air.

MDNR collected a second air sample approximately two and a half days after the system began operating. It is evident from the second sample collected on October 17, 2005 that air quality in the clinic had improved (Appendix B., Table 2). DHSS reviewed this sample and did not find any chemicals that exceeded comparison values for acute or intermediate exposure; however, several chemicals (benzene, hexane, xylenes, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and tetrahydrofuran) were detected at levels that exceed values for long-term exposure (Appendix C., Letter 2). Also, one chemical that was not detected in the first sampling, tetrahydrofuran, was detected in this second sampling at an elevated level. DHSS recommended that another sample be collected for further evaluation after the systems had been operating for a longer duration.

The Kiesel Company collected an indoor air sample on October 27, 2005 to further evaluate the effectiveness of the vapor recovery and air filtration systems. The values in Table 1 illustrate the significant decrease in the chemical levels over time. Although the levels are lower than in the previous samples, several chemicals were detected in the October 27 sample. Five chemicals were detected above recommended values for long-term residential exposure.

**Table 1. Decrease in Contaminant Concentrations from the Sampling Events at the Sherrill Mini Mart/Health Clinic**

Contaminant	Sampling Date			Acute MRL <sup>†</sup>	Residential Comparison Values
	9/17/05	10/17/05	10/27/05		
Benzene	<b>1400</b>	<b>11</b>	<b>9.3</b>	160	0.1 <sup>‡</sup>
Hexane	<b>6700</b>	<b>340</b>	110	NA	210 nc <sup>§</sup>
Methylene Chloride*	ND	ND	<b>14</b>	2084	3 <sup>‡</sup>
m,p - Xylene	<b>4100</b>	<b>460</b>	47	4342	110 nc <sup>§</sup>
o - Xylene	<b>1400</b>	<b>280</b>	26	4342	110 nc <sup>§</sup>
1,3,5 - Trimethylbenzene	<b>220</b>	<b>97</b>	<b>7.1</b>	NA	6.2 nc <sup>§</sup>
1,2,4- Trimethylbenzene	<b>730</b>	<b>290</b>	<b>21</b>	NA	6.2 nc <sup>§</sup>
Tetrahydrofuran	ND	<b>1800</b>	<b>16</b>	NA	0.99 ca <sup>§</sup>

All values are in micrograms per meter cubed ( $\mu\text{g}/\text{m}^3$ ).

Values in boldface type exceed residential comparison values.

Shaded values exceed occupational comparison values.

ND = Values were non-detect.

NA= Not available.

\*Methylene Chloride is a common laboratory contaminant.

<sup>†</sup>MRL – ATSDR Minimal Risk Level for exposure occurring for less than 14 days.

<sup>‡</sup>ATSDR Cancer Risk Evaluation Guides indicate that long-term exposure could cause an increased excess cancer risk to exposed populations.

<sup>§</sup>U.S. Environmental Protection Agency Region 9 Preliminary Remediation Goal values designated “ca” are equal to the carcinogenic ambient air preliminary remediation goal (corresponding to a target cancer risk of  $1 \times 10^{-6}$ ). Values designated “nc” are equal to the non-carcinogenic ambient air preliminary remediation goal (corresponding to an Hazard Quotient of 1).

## DISCUSSION

Once indoor air samples were collected, MDNR contacted DHSS for assistance with evaluating the indoor air quality in the building. DHSS received the sampling results and compared them to ATSDR health based comparison values. The comparison values (CVs) are media specific and specify acute, intermediate, and chronic duration exposures by the inhalation and oral routes. Acute exposure is defined as exposure that occurs for less than 14 days. Intermediate exposure occurs for more than 14 days but less than 364. Chronic exposure occurs for more than 365 days. ATSDR’s Cancer Risk Evaluation Guides (CREG) are media specific CVs that can indicate if long-term exposure could cause an increased excess cancer risk to exposed populations.

U.S. Environmental Protection Agency Region 9 Preliminary Remediation Goal (PRG) values were also used to compare the sampling results to acceptable levels. Region 9 PRGs are risk-based concentrations that are considered to be health protective for long-term human exposures and correspond to fixed levels of risk for cancer or non-cancer health effects.

The maximum time that employees and patrons could have been exposed to contaminants inside the clinic is from January, when the spill occurred, until August when the clinic closed. However, odors were not observed or reported until August. The levels of benzene and toluene detected in the first sampling event did exceed the acute MRL. Once the vapor extraction and air filtration systems were installed, the air quality inside the building began to improve. Table 1. illustrates the significant decrease in the chemical levels over time as a result of the installation of the air filtration and vapor extraction systems. In the second sample collected on October 17, the levels are less than in the previous samples; however, there were still several chemicals present. Five chemicals are above recommended values for long-term residential exposure. The contaminant concentrations decreased further in the October 27, 2005 sample. As the systems operate in the building, the contaminant concentrations should continue to decrease, thus reducing potential exposures to staff in the clinic and Mini-Mart.

Because the contaminant levels detected in the last sampling are significantly decreasing and residential exposures are not expected to occur, the employees should not experience any adverse health effects. Community members who visit the mini mart or health clinic spend very limited time in the building. Although some of the community members may be very old or young, or have compromised immune systems, the limited exposure time should not result in adverse health affects.

### **Pathway Analysis**

To determine whether residents of the area have been or are being exposed to contaminants inside the Sherrill Mini Mart/Health Clinic, DHSS evaluated the environmental and human components that lead to an exposure pathway. Completed exposure pathways exist when all five elements of a pathway link the contaminant source to a receptor population. Potential exposure pathways exist if at least one of the five elements is missing or uncertain, but could exist. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. Completed and potential exposure pathways could have been present in the past, could be present currently, or could be present in the future.

1. **Contaminant source** – contaminated soil and indoor air.
2. **Environmental medium and transport** – contaminated air.
3. **Point of exposure** – indoor air
4. **Route of exposure** –inhalation.
5. **Receptor population** – employees and patrons of the mini mart and health clinic.



## **Completed Exposure Pathways:**

### **Past:**

Prior to the remediation of the contaminated soil and the installation of the air filtration and vapor extraction system, the air in the Sherrill Mini Mart/Health Clinic may have posed a risk to employee who experienced short-term daily exposure. Visitors or clients are not expected to have experienced adverse health effects because of short exposure duration.

### **Present:**

The contaminant levels detected in the last sampling are significantly lower than previous sampling events. Because of the type of exposure, the employees should not experience any adverse health effects. Community members who visit the mini mart or health clinic spend very limited time in the building and should not experience any adverse health effects.

## **TOXICOLOGICAL EVALUATION**

This section will discuss the potential adverse health effects of exposure to benzene and toluene. Non-cancerous health effects and the likelihood of the contaminants causing cancer are evaluated.

### **Benzene**

Benzene is a clear, colorless liquid with a sweet odor typically found in gasoline, paints, cigarette smoke, glues and pesticides. It has a fairly low odor threshold that provides adequate warning of acutely hazardous concentrations (odor threshold 1.5-5 ppm). Benzene vapor is heavier than air and may cause asphyxiation in enclosed, poorly ventilated, or low-lying areas.

Breathing benzene vapor in small amounts can cause headache, dizziness, drowsiness, or nausea. At higher levels of exposure, benzene may cause sleepiness, stumbling, irregular heartbeats, fainting, or even death (4). Benzene vapors are mildly irritating to the skin, eyes, and lungs. In most cases, people will stop feeling these effects when they stop being exposed and begin to breathe fresh air. The primary long-term (365 days or longer) effect of benzene exposure is blood-related. People who breathe benzene for long periods may experience harmful effects in the tissues that form blood cells. Benzene may cause harmful effects to bone marrow and can cause a decrease in red blood cells leading to anemia. Excessive exposure can also be harmful to the immune system, increasing the chance for infection.

Benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia (cancer of the blood-forming organs). Exposure to benzene has been associated with development of a specific type of leukemia called acute myeloid leukemia (4).

The levels of benzene found in the health clinic were originally high enough to potentially cause short-term health effects. However, actions were taken that decreased the benzene concentration and adverse health effects are not expected to occur.

## **Toluene**

Toluene is a clear, colorless liquid with a distinctive smell. It is a solvent, which is produced during the refining of crude oil into gasoline and other fuels. Toluene is a major component of gasoline and is used in making paints, paint thinners, fingernail polish, lacquers, adhesives, and rubber and in some printing and leather tanning processes.

Studies have shown that exposure to toluene may affect the nervous system. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and hearing and color-vision loss (5). These symptoms usually disappear when exposure is stopped. Inhaling high levels of toluene in a short time can cause light-headed-ness, dizziness, or sleepiness. It can also cause unconsciousness, and even death. Studies in humans and animals generally indicate that toluene does not cause cancer (5).

Levels of toluene detected in the clinic were initially high enough to potentially cause short-term health effects. However, actions were taken that decreased the toluene concentration and adverse health effects are not expected to occur.

## **Children's Health**

Children exposed to similar levels of benzene vapors as adults could receive a larger dose because they have greater lung surface area to body weight ratios and higher breathing rates. In addition, because benzene vapors are found nearer to the ground, children may be exposed to higher concentrations than adults in the same location because of their short stature. Children are likely to experience similar health affects as adults when exposed to benzene. In addition, benzene exposure via inhalation has been associated with hematological effects in children (6).

Children are likely to experience similar health effects as adults who are exposed to toluene. Some animal studies indicate that babies may be more sensitive than adults. Breathing high levels of toluene during pregnancy can cause birth defects and slow developing mental abilities, and growth. It is not known if exposure to low levels of toluene during pregnancy harms the unborn child.

In this case, children's exposure time is limited to an hour or less (doctor appointment or visit to mini mart) and is not expected to cause health problems.

## **CONCLUSIONS**

Prior to the remediation of the contaminated soil and the installation of the air filtration and vapor extraction system, the air in the Sherrill Mini Mart/Health Clinic may have posed a risk to

individuals who experienced short-term daily exposure. The potential for harmful exposure existed from the time of the spill in January until August, when the clinic closed. The Sherrill Mini Mart/Health Clinic is considered to be a *Public Health Hazard for past exposures* for employees. This category is used for sites where exposures to hazardous substances or conditions could result in adverse health affects. Visitors or clients are not expected to experience adverse health effects because of short exposure duration.

At this time, it appears that the air quality in the Sherrill Mini-Mart building is improving as the vapor recovery and air filtration systems operate. The levels are still above what is recommended for long-term residential exposure. However, because this is not a residential setting, it appears that the levels do not pose a health risk for this type of exposure. The exposure time for community members who visit the mini mart and the health clinic is very short and not considered to be a health hazard. The Sherrill Mini Mart/Health Clinic site is currently considered to be a *No Apparent Public Health Hazard*. This category is used for sites where exposure to contaminated media may be occurring but the exposure is not expected to cause adverse health affects. These past and present categories are based on the following conclusions:

1. A gasoline spill at the pump island resulted in contaminated subsurface soil and unacceptable air concentrations in the past. Actions have been taken to remedy the situation.
2. The air quality in the building is improving as a result of the vapor recovery and air filtration systems recently installed.

### **RECOMMENDATIONS**

1. The building should only be used as a commercial facility, residential use should not be allowed.
2. Regular maintenance, such as changing of the carbon filter, should be performed by certified professionals on the air filtration and vapor recovery system to ensure appropriate air quality in the building.
3. Air sampling should be conducted inside the health clinic to ensure clean air before and after soil vapor extraction ceases and carbon filters are removed.

### **PUBLIC HEALTH ACTION PLAN**

This Public Health Action Plan (PHAP) for the Sherrill Mini-Mart/Health Clinic site contains an explanation of the actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR), and other stakeholders. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse

human health effects resulting from past, present, and future exposures to hazardous substances at or near the site. Below is a list of commitments of public health actions to be implemented by DHSS, ATSDR, or other stakeholders at the site:

1. DHSS/ATSDR will address employee and community health concerns and questions as they arise.
2. DHSS/ATSDR will review additional sampling data as it becomes available and provide guidance regarding possible health risk if necessary.

**Preparers of the Report:**

Kristi Campbell, Cherri Baysinger, Missouri Department of Health and Senior Services

**Attachments:**

**Appendix A. Figures**

**Figure 1. Photo of Sherrill Mini-Mart and Annapolis Family Clinic, Annapolis, MO**

**Appendix B. Tables:**

**Table 1. Contaminants of Concern from September 17, 2005 Sampling of the Sherrill Mini Mart/Health Clinic**

**Table 2. Contaminants of Concern from October 17, 2005 Sampling of the Sherrill Mini Mart/Health Clinic**

**Table 3. Decrease in Contaminant Concentrations from the Sampling Events at the Sherrill Mini Mart/Health Clinic**

**Appendix C. Letters:**

**Letter 1. October 6, 2005**

**Letter 2. October 25, 2005**

**Letter 3. November 7, 2005**

## CERTIFICATION

This Sherrill Mini-Mart/Health Clinic, Annapolis, Missouri, Public Health Consultation was prepared by the Missouri Department of Health and Senior Services (DHSS) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with the approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.



Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.



Team Lead, CAT, SPAB, DHAC, ATSDR

for Alan Yardbrough

## References

1. Air Toxics, LTD. Results of air sampling analysis via modified EPA Method TO-15. Summary of Detected Compounds, Work order #0509603. Folsom, California. October 3, 2005.
2. Air Toxics, LTD. Results of air sampling analysis via modified EPA Method TO-15. Summary of Detected Compounds, Work order #0510321. Folsom, California. October 21, 2005.
3. Air Toxics, LTD. Results of air sampling analysis via modified EPA Method TO-15. Summary of Detected Compounds, Work order #0510539. Folsom, California. November 2, 2005.
4. Agency for Toxic Substances and Disease Registry. Toxicological profile for benzene, update. Atlanta: U.S. Department of Health and Human Services; 1997 September.
5. Agency for Toxic Substances and Disease Registry. Toxicological profile for toluene, update. Atlanta: U.S. Department of Health and Human Services; 2000 September.
6. U.S. Environmental Protection Agency, Toxicity and Exposure Assessments for Children's Health. Benzene, Chemical Summary Form. Special Concerns for Children from Benzene.

## Appendix A. Figures

**Figure 1. Photo of Sherrill Mini-Mart and Annapolis Family Clinic,  
Annapolis, MO**





## Appendix B. Tables

**Table 1. Contaminants of Concern from September 17, 2005 Sampling of the Sherrill Mini Mart/Health Clinic**

<b>Contaminant</b>	<b>Sampling Result (ppb*)</b>	<b>Acute MRL† (ppb)</b>	<b>Chronic MRL† (ppb)</b>	<b>Occupational Comparison Values‡</b>
Benzene	440	50	Not available	100
Toluene	1200	1000	80	100,000

All values are in part per billion (ppb).

†MRL = Minimal Risk Level.

Acute exposure occurs for less than 14 days.

Chronic exposure occurs for more than 365 days.

‡National Institute for Occupation Safety and Health Recommended Exposure Limit.

(Ca = potential occupational carcinogen.)

**Table 2. Contaminants of Concern from October 17, 2005 Sampling of the Sherrill Mini Mart/Health Clinic**

<b>Contaminant</b>	<b>Sampling Result (µg/m<sup>3</sup>)</b>	<b>Chronic ATSDR CV (µg/m<sup>3</sup>)</b>	<b>Region 9 PRGs* for Chronic Exposure (µg/m<sup>3</sup>)</b>
Benzene	11	0.1 (CREG)	0.25 ca
Hexane	340		210 nc
m,p - Xylene	460	435 (chronic EMEG)	110 nc
o - Xylene	280	435 (chronic EMEG)	110 nc
1,3,5 - Trimethylbenzene	97		6.2 nc
1,2,4- Trimethylbenzene	290		6.2 nc
Tetrahydrofuran	1800		0.99 ca

All values are in micrograms per meter cubed (µg/m<sup>3</sup>).

\*U.S. Environmental Protection Agency Region 9 PRG values designated “ca” are equal to the carcinogenic ambient air PRG (corresponding to a target cancer risk of 1 x 10<sup>-6</sup>). Values designated “nc” are equal to the non-carcinogenic ambient air PRG (corresponding to an HQ of 1).

**Table 3. Contaminants of Concern from October 27, 2005 Sampling  
of the Sherrill Mini Mart/Health Clinic**

<b>Contaminant</b>	<b>10/27/05 Sampling (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>Residential Comparison Values</b>	<b>Occupational Comparison Values</b>
Benzene	<b>9.3</b>	0.1 <sup>†</sup>	320 Ca <sup>§</sup>
Hexane	110	210 nc <sup>‡</sup>	180,000 <sup>§</sup>
Methylene Chloride*	<b>14</b>	3 <sup>†</sup>	87,000 <sup>¶</sup>
m,p - Xylene	47	110 nc <sup>‡</sup>	440,000 <sup>§,¶</sup>
o - Xylene	26	110 nc <sup>‡</sup>	440,000 <sup>§,¶</sup>
1,3,5 - Trimethylbenzene	<b>7.1</b>	6.2 nc <sup>‡</sup>	120,000 <sup>§</sup>
1,2,4- Trimethylbenzene	<b>21</b>	6.2 nc <sup>‡</sup>	120,000 <sup>§</sup>
Tetrahydrofuran	<b>16</b>	0.99 ca <sup>‡</sup>	590,000 <sup>§,¶</sup>

All values are in micrograms per meter cubed ( $\mu\text{g}/\text{m}^3$ ).

Values in boldface type exceed residential comparison values.

Shaded values exceed occupational comparison values.

ND = Values were non-detect.

\*Methylene Chloride is a common laboratory contaminant.

<sup>†</sup>ATSDR Cancer Risk Evaluation Guides indicate that long-term exposure could cause an increased excess cancer risk to exposed populations.

<sup>‡</sup>U.S. Environmental Protection Agency Region 9 PRG values designated "ca" are equal to the carcinogenic ambient air PRG (corresponding to a target cancer risk of  $1 \times 10^{-6}$ ). Values designated "nc" are equal to the non-carcinogenic ambient air PRG (corresponding to an HQ of 1).

<sup>§</sup>National Institute for Occupational Safety and Health values. Values designated with "Ca" are potential occupational carcinogens. Values designated "C" are ceiling value that should not be exceeded at any time.

<sup>¶</sup>Occupational Safety and Health Administration value.

## Appendix C. Letters



**Missouri Department of Health and Senior Services**

P.O. Box 570, Jefferson City, MO 65102-0570 Phone: 573-751-6400 FAX: 573-751-6010  
RELAY MISSOURI for Hearing and Speech Impaired 1-800-735-2966 VOICE 1-800-735-2466

Julia M. Eckstein  
Director



**Matt Blunt**  
Governor

October 6, 2005

Larry Lehman  
Environmental Services Program  
Missouri Department of Natural Resources  
P.O. Box 176  
Jefferson City, MO 65102

Dear Mr. Lehman:

This letter is in response to your request for review of an ambient air sample collected on September 27, 2005. It is our understanding that this sample was taken from the health clinic adjacent to the gasoline station/convenience store in Annapolis, Missouri

Several chemicals detected in the air sample were at levels that exceeded health based comparison values. The sampling results were compared to Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRLs) when available. An MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. MRLs are media specific and can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes. Acute exposure is defined as exposure that occurs for less than 14 days. Intermediate exposure occurs for more than 14 days but less than 364. Chronic exposure occurs for more than 365 days.

The contaminants listed in the table below exceeded ATSDR's acute MRL for inhalation exposure.

<b>Contaminant</b>	<b>Sampling Result (ppb*)</b>	<b>Acute MRL (ppb)</b>	<b>Chronic MRL (ppb)</b>
Benzene	440	50	Not available
Toluene	1200	1000	80

\*part per billion

Since the measured concentrations for benzene exceeded the MRL for acute exposure, short-term exposure may cause adverse health effects. Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. The primary long-term (365 days or longer) effect of benzene exposure is blood-related. Benzene may cause harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. Benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia (cancer of the blood-forming organs).

[www.dhss.mo.gov](http://www.dhss.mo.gov)

The Missouri Department of Health and Senior Services protects and promotes quality of life and health for all Missourians by developing and implementing programs and systems that provide: information and education, effective regulation and oversight, quality services, and surveillance of diseases and conditions.

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER: Services provided on a nondiscriminatory basis.

The levels of toluene detected were slightly higher than the acute MRL and significantly higher than the MRL for intermediate exposure. Studies have shown that exposure to toluene may affect the nervous system. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite, and hearing and color-vision loss. These symptoms usually disappear when exposure is stopped. Inhaling high levels of toluene in a short time can make you feel light-headed, dizzy, or sleepy. It can also cause unconsciousness, and even death.

Several other chemicals exceeded long-term health based levels: hexane, 2,2,4 – trimethylpentane, 1,3,5- trimethylbenzene, and 1,2,4 – trimethylbenzene. The level of hexane (1900 ppb) detected in the sample exceeded ATSDR's MRL for chronic exposure of 600 ppb. The only known data from human exposure to hexane was in a work environment. The studies showed that breathing large amounts of hexane caused numbness in the feet and hands, followed by muscle weakness in the feet and lower legs. Continued exposure led to paralysis of the arms and legs. If removed from the exposure, the workers recovered in 6 months to a year.

The levels of 2,2,4 – trimethylpentane detected in the sample were at a level of concern since 2,2,4 – trimethylpentane is considered to be a Hazardous Air Pollutant by the U.S. Environmental Protection Agency (EPA). However, information about the safe exposure levels or potential health effects is not available.

Because ATSDR MRLs were not available for 1,3,5 – trimethylbenzene and 1,2,4 – trimethylbenzene, the detected levels were compared to preliminary remediation goals (PRGs) established by EPA's Region 9. EPA Region 9 PRGs are risk-based concentrations that are considered to be protective for humans over a lifetime of exposure. The Region 9 PRG for 1,3,5 - trimethylbenzene is 1.26 ppb, the detected amount was 45 ppb. For 1,2,4 –trimethylbenzene, the Region 9 PRG is also 1.26 ppb, the detected amount was 150 ppb. Because the detected amounts significantly exceed the lifetime exposure concentrations, long-term exposure to these contaminants may result in adverse health affects.

Based on our analysis of the sampling data, it appears that exposure to indoor air in the health clinic may pose a risk. The reported concentrations of benzene and toluene are of particular concern. We recommend that actions be taken to reduce or prevent exposure to these chemicals in the building.

If you have any questions or would like more information, please contact Kristi Campbell at (573) 751-6160.

Sincerely,



Gale Carlson, Chief  
Environmental Health Assessment and Surveillance Unit

GC/KC/jd



**Missouri Department of Health and Senior Services**

P.O. Box 570, Jefferson City, MO 65102-0570 Phone: 573-751-6400 FAX: 573-751-6010  
RELAY MISSOURI for Hearing and Speech Impaired 1-800-735-2966 VOICE 1-800-735-2466

**Julia M. Eckstein**  
Director



**Matt Blunt**  
Governor

October 25, 2005

Randy Carter  
Missouri Department of Natural Resources  
Environmental Emergency Response Section  
Southeast Regional Office  
2155 N Westwood Blvd.  
Poplar Bluff, MO 63901

Dear Mr. Carter:

This letter is in response to your request for review of an ambient air sample collected on October 17, 2005. This is the second sample that staff from the Missouri Department of Natural Resources (MDNR) has collected at the health clinic adjacent to the gasoline station/convenience store in Annapolis, Missouri. The Department of Health and Senior Services provided an assessment of the first sample results to Mr. Larry Lehman of the Environmental Services Program on October 6, 2005.

The sampling results from both sampling events were compared to the federal Agency for Toxic Substances and Disease Registry (ATSDR) comparison values (CVs). ATSDR has developed CVs that are media-specific concentrations used by health assessors to select environmental contaminants of concern. Contaminant concentrations that are less than the CV are unlikely to pose a health threat. Contaminant levels above the CV do not necessarily indicate that a health threat is present, but that further evaluation of the chemical and pathways is needed. CVs have been derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes. Acute exposure is defined as exposure that occurs for up to 14 days. Intermediate exposure occurs for more than 14 days but less than 364. Chronic exposure occurs for 365 days or more. Environmental media evaluation guides (EMEGs) are CVs that have been derived for a variety of chemicals in various media. EMEGs represent concentrations of substances to which humans can be exposed without experiencing adverse health affects. ATSDR's Cancer Risk Evaluation Guides (CREG) are media specific CVs that can indicate if long-term exposure could cause an increased cancer risk to exposed populations. If ATSDR CVs are not available, sampling results are compared to preliminary remediation goals (PRGs) that are established by the US Environmental Protection Agency's (EPA) Region 9. EPA Region 9 PRGs are risk-based concentrations that are considered to be health protective for long-

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term human exposures and correspond to fixed levels of risk for cancer or non-cancer health effects.

In the first air sample collected on September 17, 2005 by MDNR, several chemicals were detected at levels above CVs. Benzene and toluene were of immediate concern, because they were detected at levels that exceeded CVs for acute exposure. Since that time, it is our understanding that vapor extraction and air filtration systems have been installed in the building and the second air sample was taken approximately two and a half days after the systems began operating.

Upon analysis of the second sample collected on October 17, 2005, it is evident that the air quality in the clinic has improved. The levels of the detected chemicals did not exceed comparison values for acute or intermediate exposure. However, several of the same chemicals were detected at levels that exceed values for long-term exposure. Also, one chemical that was not detected in the first sampling, tetrahydrofuran, was detected in this sampling at an elevated level.

Contaminant	Sampling Result ( $\mu\text{g}/\text{m}^3$ *)	Chronic ATSDR CV ( $\mu\text{g}/\text{m}^3$ *)	Region 9 PRGs <sup>1</sup> for Chronic Exposure ( $\mu\text{g}/\text{m}^3$ *)
Benzene	11	0.1 (CREG)	0.25 ca
Hexane	340		210 nc
m,p - Xylene	460	435 (chronic EMEG)	110 nc
o - Xylene	280	435 (chronic EMEG)	110 nc
1,3,5 - Trimethylbenzene	97		6.2 nc
1,2,4- Trimethylbenzene	290		6.2 nc
Tetrahydrofuran	1800		0.99 ca

\*micrograms per meter cubed

<sup>1</sup>U.S. Environmental Protection Agency Region 9 PRG values designated "ca" are equal to the carcinogenic ambient air PRG (corresponding to a target cancer risk of  $1 \times 10^{-6}$ ). Values designated "nc" are equal to the non-carcinogenic ambient air PRG (corresponding to an HQ of 1).

Based on our analysis of the sampling data, it appears that at the time the sample was collected, long-term exposure to the air in the health clinic may pose a risk to exposed individuals. Both carcinogenic and non-carcinogenic health affects could potentially be expected. However, because the vapor extraction and air filtration systems have now been operating for a longer period, the sample taken on October 17, 2005, does not reflect the current air quality in the building. The sampling results show that the vapor recovery and air filtration systems decreased the levels of chemicals in the air after only operating for two and a half days. It is possible that the air quality has improved further since the last sample was collected. We would recommend that another sample be taken in the building for further evaluation.

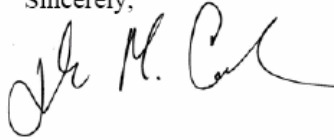
We appreciate the opportunity to collaborate with MDNR on this matter. Please let us know if we can be of further assistance or if MDNR would like DHSS to provide health



Carter, Randy  
October 25, 2005  
Page 3

information to the health clinic staff. If you have any questions or would like more information, please contact Kristi Campbell at (573) 751-6160.

Sincerely,

A handwritten signature in black ink, appearing to read "Gale M. Carlson". The signature is fluid and cursive, with the first name "Gale" being the most prominent.

Gale Carlson  
Missouri Department of Health  
and Senior Services

GC/CB/KC/rb

cc: Larry Lehman, MDNR, ESP



**Missouri Department of Health and Senior Services**

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**Julia M. Eckstein**  
Director



**Matt Blunt**  
Governor

November 7, 2005

Randy Carter  
Missouri Department of Natural Resources  
Environmental Emergency Response Section  
Southeast Regional Office  
2155 N Westwood Blvd.  
Poplar Bluff, MO 63901

Dear Mr. Carter:

This letter is in response to your request for review of an ambient air sample collected at the health clinic adjacent to the gasoline station/convenience store in Annapolis, Missouri.

The first sample taken by Missouri Department of Natural Resources (MDNR) on September 17, 2005, contained two chemicals that exceeded recommended short-term exposure values. There were also several chemicals detected that exceeded long-term values. A vapor recovery system was installed beneath the building in addition to an air filtration system inside the building. MDNR collected another sample on October 17, 2005. Although the systems had only been operating for approximately two and a half days, this sample indicated a significant decrease in the chemical levels in the air. The Department of Health and Senior Services (DHSS) provided an assessment of the previous sampling results to MDNR on October 6, and October 25, 2005. It is our understanding that The Kiesel Company collected the most recent indoor air sample on October 27, 2005 to further evaluate the effectiveness of the vapor recovery and air filtration systems.

The table below illustrates the significant decrease in the chemical levels over time. Although the levels are less than in the previous samples, there were several chemicals detected in the October 27 sample. Five chemicals are above recommended values for long-term residential exposure; however, the levels are below recommended occupational exposure values. The National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA) established the occupational values. The values are generally a time weighted average concentration for up to a 10-hour workday during a 40-hour workweek.

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**Contaminant Concentrations from the Sampling Events**

Contaminant	Sampling Date			Residential Comparison Values	Occupational Comparison Values
	9/17/05 ( $\mu\text{g}/\text{m}^3$ *)	10/17/05 ( $\mu\text{g}/\text{m}^3$ *)	10/27/05 ( $\mu\text{g}/\text{m}^3$ *)		
Benzene	<b>1400</b>	<b>11</b>	<b>9.3</b>	0.1 <sup>1</sup>	320 Ca <sup>3</sup>
Hexane	<b>6700</b>	<b>340</b>	110	210 nc <sup>2</sup>	180,000 <sup>3</sup>
Methylene Chloride†	ND	ND	<b>14</b>	3 <sup>1</sup>	87,000 <sup>4</sup>
m,p - Xylene	<b>4100</b>	<b>460</b>	47	110 nc <sup>2</sup>	440,000 <sup>3,4</sup>
o - Xylene	<b>1400</b>	<b>280</b>	26	110 nc <sup>2</sup>	440,000 <sup>3,4</sup>
1,3,5 - Trimethylbenzene	<b>220</b>	<b>97</b>	<b>7.1</b>	6.2 nc <sup>2</sup>	120,000 <sup>3</sup>
1,2,4- Trimethylbenzene	<b>730</b>	<b>290</b>	<b>21</b>	6.2 nc <sup>2</sup>	120,000 <sup>3</sup>
Tetrahydrofuran	ND	<b>1800</b>	<b>16</b>	0.99 ca <sup>2</sup>	590,000 <sup>3,4</sup>

Values in boldface type exceed residential comparison values.

Shaded values exceed occupational comparison values.

\*micrograms per meter cubed.

ND = Values were non-detect.

<sup>1</sup>ATSDR Cancer Risk Evaluation Guides indicate that long-term exposure could cause an increased excess cancer risk to exposed populations.

<sup>2</sup>U.S. Environmental Protection Agency Region 9 PRG values designated "ca" are equal to the carcinogenic ambient air PRG (corresponding to a target cancer risk of  $1 \times 10^{-6}$ ). Values designated "nc" are equal to the non-carcinogenic ambient air PRG (corresponding to an HQ of 1).

<sup>3</sup>National Institute for Occupational Safety and Health values. Values designated with "Ca" are potential occupational carcinogens. Values designated "C" are ceiling value that should not be exceeded at any time.

<sup>4</sup>Occupational Safety and Health Administration value.

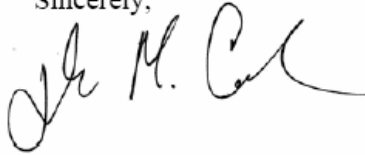
† Methylene Chloride is a common laboratory contaminant.

At this time, it appears that the air quality in the building is improving as the vapor recovery and air filtration systems operate. The levels are still above what is recommended for long-term residential exposure. However, because this is an occupational setting, the National Institute for Occupational Safety and Health (NIOSH) and Occupational Safety and Health Association (OSHA) values were consulted and it appears that the levels do not pose a health risk for an occupational type of exposure. It is important to keep in mind that the occupational values are set for healthy white males in workplace settings. Because clinic patients may have compromised immune systems or be children with developing bodies, we recommend that air quality in the building be improved to levels closer to the residential values.

Carter, Randy  
11/7/05  
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We appreciate the opportunity to collaborate with MDNR on this matter. Please let us know if we can be of further assistance or if MDNR would like DHSS to provide health information to the health clinic staff. If you have any questions or would like more information, please contact Kristi Campbell at (573) 751-6160.

Sincerely,

A handwritten signature in black ink, appearing to read "Gale M. Carlson". The signature is fluid and cursive, with the first name "Gale" being the most prominent.

Gale Carlson, Chief  
Bureau of Environmental Epidemiology  
Missouri Department of Health and Senior Services

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cc: Larry Lehman, MDNR, ESP  
cc: file